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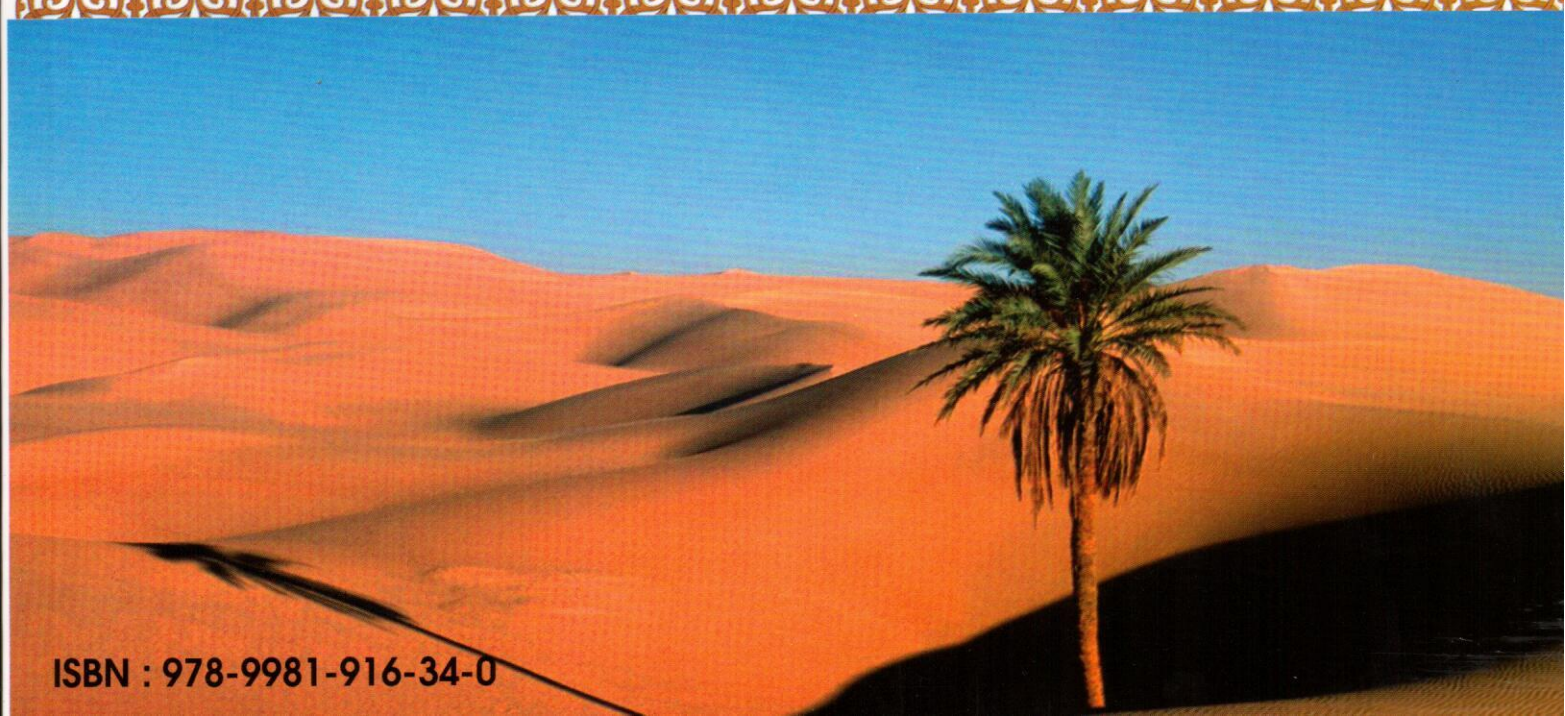
Book of Abstracts

26 - 29 October, 2011
Marrakech, Morocco



ISBN : 978-9981-916-34-0

PLENARY LECTURES

OBSERVING AND PREDICTING THE EFFECTS OF ENVIRONMENTAL CHANGE IN WATER RESOURCES IN SEMI ARID REGIONS: CURRENT STATUS AND FUTURE CHALLENGES

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ABSTRACT

Southern and Easter Mediterranean countries are considered to be either water-scarce or water-stressed because their growing populations require more water than the hydrological system can provide on a sustainable basis. Even as the demand for water grows in these countries, the supply is being diminished by human activities that degrade watersheds and threaten natural ecosystems. Additionally the prospect of global climate change greatly increases the risks and challenges already faced by these countries. Under current assumptions of global warming, climate models predict major shifts in world precipitation and evaporation patterns over the next century. The Mediterranean countries, many of which are already drought-prone, may suffer longer and more severe dry periods, as well as more destructive flooding and erosion caused by higher-intensity rainfall events. The combined effect of these stresses could permanently alter the water balance, further reducing water availability to human and natural ecosystems.

The adverse effects of natural and human-induced environmental change have already manifested themselves in many Mediterranean countries. The failure of communities in these regions to protect their natural resource is due, in part, to an incomplete understanding of the physical and biological processes operating in such ecosystems, and the inability to monitor these processes over a broad range of time and space scales. Policy-makers and resource managers often lack the information and tools needed to detect, predict, and mitigate widespread, incremental, long-term change on water and biotic resources. These inadequacies will be greatly magnified in the event of major shifts in global climate patterns. There is a need to better understand the key ecological processes operating in semi-arid environments, and to develop observation, monitoring, and modeling technologies that can be applied to global change problems in these environments.

In this context, several large scale experiments/programs have been taken place in semi-arid regions for the past two decades (Monsoon '90, Hapex-Sahel 92, SALSA 96, SUDMED 2002, AMMA 2004; SICMED 2010) to investigate the critical question of the impact and the feedback between climate change, water availability , and ecosystem structure and use. These programs federate the expertise of multiple disciplines and have led to substantial improvement of our capabilities to understand the functioning of the earth system.

The objective of this contribution is to provide an overview of

a- The lesson learned from these different programs in terms of advancing state-of-the art knowledge and techniques from multiple fields related to hydro-ecological science.
b- To synthesize the current status of hydrologic remote sensing and determine what are the necessary next steps for the study of the water cycle.
c- To identify the remaining critical stakeholder-relevant knowledge gaps and the way to fill them to improve water management and policy.

ARAB REGION STRATEGY FOR WATER SECURITY (ASWS) TO FACE THE CHALLENGES AND REQUIREMENTS FOR FUTURE SUSTAINABLE DEVELOPMENT 2010 – 2030

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ABSTRACT

Arab Economic Summit in Kuwait 2009 commissioned the Arab Center for Studies of Arid Zones and Dry Lands (ACSAD) to develop a draft for the Arab strategy of water security and to revise and coordinate the comments made by the Arab States, regional and international organizations following its dissemination by the Council Technical Secretary. Several meetings were held by selected experts from the Arab region to prepare the draft of this strategy.
The ASWS is endorsed by the Arab Water Ministers and latter adopted by Arab Socio-economic Council of the League of Arab States. It is expected to be submitted to the Heads of Arab States Summit soon.
The Arab Strategy for Water Security aims to achieve sustainable development that meets future Arab demands and to fulfill the major goals that can be categorized in the following:-

1- ECONOMIC AND DEVELOPMENT ISSUES

To provide services in the water sector for:-
- Potable water and Sanitation
- Agriculture

This includes: Finance, Investment, Technology, The implementation of IWRM principles and Development of non-conventional water.

2-POLITICAL ISSUE

It concerns with the protection and preservation of the Arab rights in water in the occupied lands and the Transboundary waters. Furthermore, it is to strengthen the collaboration amongst Arab countries in managing their water resources, and to meet the commitments of the 3rd Millennium Development Goals.

3-INSTITUTIONAL DEVELOPMENT ISSUE

This is concerned with the following:
- Capacity Building
- Awareness Raising
- Stakeholders Participation

The main challenges facing the Arab strategy for water security are that:-
- Two third of its water resources originates outside the region, and
- How to deal with the water stress issue resulting from population growth and climate change.

4- EXPECTED OUTPUTS

a. Make available all water related information
b. Achieve sustainable development considering climate change impacts on water resources.
c. Raise water and environment Awareness.
d. Institutional and human resources capacity building
e. Increase available finance for water projects investment
f. Put in effect the current agreements in IWRM
g. Arab Region Strategy for Water Security (2010 – 2030) Document.

5- INDICATORS

a. Database and Water Status
b. Sustainable Development and Impacts of Climate Change
c. Environment and Water Awareness in IWRM
d. Capacity Building in Water Management and International Laws
e. Water Sector, Finance, and Technology
f. Collaboration among Arab Countries in Water Resources Management.

PUBLICATIONS AS FORERUNNERS OF TECHNOLOGY DEVELOPMENT

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ABSTRACT

Research in the field of desalination and water treatment began to grow in the nineteen fifties. This led to serious development and innovation. Water purification studies have been applied and have now blown into a booming field to provide water to a growing world population. The technology has developed to embrace sophisticated reuse and water treatment processes.

Research long precedes application and perfection of technology. Some examples will be presented based on publication of research in the early reports of the US Department of the Interior and the journals *Desalination* and *Desalination and Water Treatment*.
Growth of the number of publications by regions will be presented.

PROCESSING TECHNOLOGIES AND WASTEWATER RECLAMATION

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ABSTRACT

Wastewater reclamation and reuse is becoming an important tool for the integrated management of water resources in arid and semiarid climates, like the Mediterranean basin. Nevertheless, the need to control the hazards and limit the risks associated to the practice requires the implementation of specific technologies for the adequate treatment of wastewater up to determined levels of quality.

At present, there are several tendencies in which respects to treatment and reclamation, which depend on the reuse schools. For establishing the treatment level and the acceptable risk for every society is paramount to know the scenarios under which treatment, reclamation and reuse will happen and obviously the economic capacity of the society in which the systems will operate. In relation to the economy is necessary to consider not only the cost of the treatments and distribution of water but also the amount of water not needed when the initial resources are substituted by reclaimed water. The savings obtained from the no-transportation and treatment of new resources and in the case of agriculture the reduced need for fertilizers are to be considered. Apart from the costs easily evaluated, other features not so easily valuable, the intangibles, are to be considered. Under the intangibles are to mention the reduction of extractions, the improvement of the landscape and the reduction of negative impacts derived from the disposal of treated or untreated wastewater in natural systems.

In any case, the technologies available are capable to generate water of excellent quality from wastewater. The panel of technologies departs from the simple filters to reach the more sophisticated membranes. Technologies can be initially divided into extensive and intensive ones. The study of the available techniques leads to define the best available technologies for every case, considering implementation inversions, operation and management costs and the desired final quality of treated or reclaimed water. Analytical tasks related to the treatment as well as evaluation of data must also be accounted for in the cost-benefit calculations.

Taking as a starting point treated wastewater up to a secondary level; a collection of existing reclamation technologies is examined with their expected results and their range of application. It is to consider that the final reclaimed water must have a quality enough for reuse and this is generally obtained with two treatment steps: the first one is usually eliminating the mineral or organic pollutants still remaining after the secondary treatment and the second is mainly devoted to the reduction or nearly fully elimination of pathogenic microorganisms.

For the case of extensive treatments, lagooning, constructed wetlands and infiltration-percolation are the techniques examined, while for the intensive technologies coagulation-flocculation, membrane-based and other filtration procedures are studied. In terms of disinfection hypochlorite, chlorine dioxide, ozone and ultraviolet radiation are the technologies compared. It should be considered that some technologies are capable to exert both activities in a single step. Finally, the most used treatment trains are examined and its results are compared with the regulation demands.

SICMED, A COOPERATIVE LONG -TERM RESEARCH PROGRAMME STUDYING THE IMPACT OF GLOBAL CHANGE ON MEDITERRANEAN ANTHROPO-ECOSYSTEMS

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ABSTRACT

SICMED (Surfaces and Interfaces of the Continental Mediterranean, www.sicmed.net) is part of the French initiative MISTRALS (Mediterranean Integrated Studies at Local and Regional Scales). It aims at developing a regional cooperation process for long-term research on the present and future states of rural and peri-urban Mediterranean anthropo-ecosystems under climatic and man-induced pressures. This includes biophysical processes governing biochemical and hydrological cycles, and also social, economical, technical and institutional processes driving human activities. Because of these multiple dimensions, the most important determinants of present variability and potential future changes must be identified. The simultaneous consideration of biophysical and socio-economic components and their interactions will lead to both cognitive and operational results, with elaboration of tools and methodologies for a better management of natural resources and territories.

As a preliminary attempt to identify this complexity, a matrix was designed that crosses the main bio-physical, bio-technical and socio-economical mechanisms on one side and the main Mediterranean anthropo-ecosystems on the other side. A state of the art on major issues and research activities was elaborated for most cells of this matrix by multiple groups of Mediterranean experts. This double approach highlights the most important components of the Mediterranean changes.

SICMED field operations consist in two distinct types of actions. The first type is the implementation of comprehensive research in a limited number of major sites typical of the Mediterranean physical and social environment. Selection criteria are the preexistence of representative series of information in a large range of disciplines and the efficient cooperation between several research teams that will facilitate future works. Some major sites are defined yet in France, Morocco and Tunisia; others are still to be identified. Major sites are complemented by a series of thematic networks, more scattered in geography and much more focused in their scientific definition: they allow considering social or environmental components insufficiently accessible in the major sites.

The SICMED programme aims to extend part of its co-operative activities by associating new regional and international parties, for a better identification of major challenges of the 21th century, and their possible solutions.

ORAL PRESENTATIONS

TOPIC 1

Rational and Efficient Use of Water Resources

WATER ALLOCATION MODEL (WAM)

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ABSTRACT

This paper presented a decision support model namely Water Allocation Model (WAM), where it can be used as a decision support system for irrigated agriculture. WAM has two main goals, first, to provide district and national level planners with a decision support tool for planning agricultural production under various water amounts, qualities, and prices; and second to provide the main model with a soundly based analysis of agricultural water demand and it optimal allocation. WAM is an optimizing model of agriculture. It uses data on available land, water requirements per unit land area for different crops, and net revenues per unit of land area generated by the growing of those crops. WAM is characterized by the following: (1) application of WAM to actual data suggests that the model closely approximates the actual response of farmers to water prices. (2) WAM results can serve planners as an approximation. (3) A departure of actual behavior from the optima generated by WAM can serve as a signal to planners that further study should be done. (4) WAM provides a quantitative post-optimal sensitivity analysis that can be used to analyze uncertainty, stability of plans and risks. (5) WAM can serve as a decision-support device suggesting to planners what crop patterns are likely to prove optimal under various conditions and relating these to different water policies.

WAM is formulated at the district level. Its objective function is the net agricultural income of the district, which is maximized by selecting the optimal mix of water-consuming activities (Vegetables, fruits and field crops). The constraints in WAM involve two factors: water and land area. The user can impose constraints on the availability of water by quality and by season and on land quality represented by it class level. For Jordan Valley (JV), as an example, the categories of activities subject to land-area constraints are all activities; crops of the same group (vegetables, fruit trees and field crops); crops irrigated by the same water quality and crops grown during the same season; One of the main results of WAM is the use of this program generate the allocation of irrigation water. But WAM has its own, independent interest. That interest stems partly from the ability of WAM to produce results about specific crops or groups and partly from the fact that water prices and policies are not the only inputs that affect crop choice and water demand.

KEYWORDS: Water Allocation Model, Decision Support System

HYDROLOGICAL MODELING OF BOUREGREG WATERSHED USING THE SOIL AND WATER ASSESSMENT TOOL (SWAT)

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ABSTRACT

In order to ensure a rational and efficient management of water resources it is necessary to study and understand the various issues influencing the cycle of water and particularly in the arid or semi-arid areas where the pressure on this resource is increasing.
Modeling the Bouregreg watershed, located in north-central of Morocco, aims to represent the hydrological system of the basin, analyze its response to the various hazards to which it is exposed (erosion, drought, pollution, nutrients…) and study the impacts of the climate and urban changes on this watershed.
The subject of this study focuses on the analysis of the hydrological modeling of Bouregreg basin through the use of Soil and Water Assessment Tool (SWAT) that is never tested in large basins of Morocco.
The big problem to implement such model in the Moroccan areas is the unavailability of data because the calibration and the validation of continuous hydrological models require space-time data for many years. It was then question to prepare and gather all the data necessary to run the model taking into account the very large size of the study area (9600 km²) and the combination of data coming from various sources and scales (data collected from local organizations, data delivered by international agencies and data generated from satellite images or by using GIS) in order to fill the different parameters required by SWAT model.
The first results of hydrological simulation got by SWAT are very satisfactory and show that this model can be used to represent the hydrological system of semi-arid areas such the Bouregreg watershed especially if we take into account the different approximations made in the context of this work due to the unavailability of more accurate and more spatial data.

KEYWORDS: Hydrological Modeling, Bouregreg, SWAT, GIS

ESTIMATION OF SPATIAL WATER BALANCE DISTRIBUTION OF OUEM ERRBIA RIVER BASIN, MOROCCO

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ABSTRACT

Fresh water is a scarce resource in many parts of the world, particularly in the Mediterranean region like Morocco. In this region, the pressure on water resources is high and large quantities of water are required to satisfy the need for environment and socio-economic activities— like phosphate mining, agriculture, and tourism. Understanding the regional hydrological water balance and their spatial distribution is a prerequisite to implement appropriate water management options to ensure sustainable environment and socio-economic development.

In this study, a spatially distributed hydrological water balance model (WetSpass) is employed in Oum Er Rbia River basin in Morocco with the objective to understand and estimate the long-term mean annual evapotranspiration, surface runoff, and groundwater recharge based on land cover, soil texture, topography, and hydrometeorological parameters. The study area, Ouem Er Rbia River basin is located in the western part of the country, and it is the longest river in Morocco covering a drainage area of 37,588 km^2.
The model estimated basin evapotranspiration, surface runoff, and groundwater recharge to be 232.3, 58.2, and 32.8 mm per annum, respectively, accounting for 72.5, 18.1, and 10% of the long-term average precipitation (320.5 mm). Additional evaluation was carried out to verify the measured and simulated mean annual flows for selected gauging stations in the basin. The comparison shows good agreement except at the sites where the natural flow is disturbed or regulated by manmade hydraulic structures, as dams and reservoirs. Furthermore, GIS analysis shows how strongly evapotranspiration, surface runoff, and groundwater recharge vary for various land cover and soil texture classes.
The model outputs also provide good information to the stakeholders and decision makers regarding the state of the basin water resources, availability and distribution—particularly the surface runoff and groundwater recharge which in turn help to improve the management of water resources by implementing appropriate water conservation or hydraulic structures at the suitable locations. The model can be used further to analyse the effect of climate and land cover changes under different management scenarios.

KEYWORDS: Wetspass, Evapotranspiration, Recharge, Runoff, Ouem Er Rbia, Spatial Water Balance

ARTIFICIAL NEURAL NETWORK FOR ESTIMATING DESIGN FLOODS OF UPPER MOULOUYA WATERSHEDS BASED ON HYDROLOGIC AND HYDROGRAPHIC PARAMETERS

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ABSTRACT

The Upper Moulouya watershed covers about 5600 km^2; it was divided into 29 sub basins with areas greater than 20 km^2. The watersheds are similar in terms of geographic location, climate and physical characteristics. The climate is arid to semi-arid, the annual rainfall is less than 200 mm for Midelt station, but summer rainfall is characterized by heavy showers which makes the area prone to flooding. The area is characterized by economic activities along the rivers, so forecasting of frequency stream flow is essential to assist policymakers in forecasting extreme events to warn public of potential flood risks and call for necessary precautions.

The estimated flow of different returns period requires knowledge of several hydrologic and hydrographic parameters. Indeed the formulas for calculating the peak flow takes into account these parameters for better estimation. Runoff generation highly depends on catchment topography, river network, soil characteristics and antecedent moisture. On the other hand all these parameters are not always available. In this case the estimation of flows is done by conventional methods like Gradex method, which takes in count just hydrologic and hydrographic parameters.

Accurate flood quantile estimates are required for the design of hydraulic structures and for floodplain management. The 29 watersheds of upper Moulouya were subject of a previous frequency analysis to obtain the design floods from rainfall using the Gradex method.

A simple neural network (ANN) model is developed for determination of design flood of upper Moulouya watersheds. It has a multiple inputs, relative to hydrologic and hydrographic parameters, and a single output. Different learning algorithm and learning rate are used to determine the optimum simulation network. The proposed network uses Levenberg-Marquardt training algorithm, instead of gradient descent, which gives good results, and it was tested with different numbers of neurons in hidden layer. The results of simulation prove that ANN models developed are reliable to forecast design flood with a higher accuracy.

KEYWORDS: Artificial Neural Networks, Design Floods

IMPLEMENTATION OF A WEAP-MODFLOW MODEL BASED ON WATER DEMAND DERIVED BY REMOTE SENSING IN A SEMI-ARID CLIMATE: THE CASE OF THE HAOUZ MEJJATE PLAIN IN MOROCCO

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ABSTRACT

Arid and semi-arid regions are characterized by high sensitivity to climatic hazards. Their water resources hardly satisfy growing water demands driven by population growth, improved living conditions and economic development. At the foot of the Atlas ranges in Morocco, the Haouz basin is a 6000 square kilometers alluvial plain containing the Haouz aquifer and its western spread, the Mejjat aquifer. Irrigated agriculture represents about 85% of water demand (olive and orange orchards, winter wheat mainly). While urban water demand is increasing, mainly driven by Marrakech outburst, agriculture is also densifying and thus relying more than ever on groundwater. A Decision Support System (DSS) for integrated management of water resources in the Haouz basin is under development. The DSS aims, firstly to assess spatial and temporal comparison of the various sectoral demands in relation to surface and groundwater resources, and secondly to develop management scenarios and development. The implementation of the DSS required the conceptualization of the functioning patterns of the water systems, reconstruction of hydrological change and compilation of water resources and uses. The DSS implemented at a monthly time step for the 2001-2008 period is setup above four components. A GIS gathers spatial and temporal information, SAMIR (Satellite Monitoring of Irrigation) is in charge of water demand estimates by Remote Sensing imagery, WEAP21 (Water Evaluation and Planning system) is the integrator tool based on a simplified water budget, while MODFLOW is the linked model of groundwater flow. The SAMIR tool spatializes an estimation of evapotranspiration (ET_{sat}) following the FAO56 method from ground meteorological stations, and Remote sensing (RS) imagery. Freely available MODIS 16 day's synthetical NDVI (Normalized Difference of Vegetation Index) images were used. The first stage is to spatialize reference Evapotranspiration (ET0) above the whole area at a daily step. The second stage involves the mapping of Land Cover for each simulation year. The third stage is to derive daily Kc coefficients from RS imagery, so that ET_{sat} could be computed. Special care was taken on validation at each step either by ground survey (LC) or field measurements (Eddy-correlation of ET). Finally, a discretization into functional areas determines the level of aggregation of evapotranspiration estimated by SAMIR and the definition of demand sites in WEAP. The purpose of zoning is to distinguish a limited number of areas, homogeneous in terms of water management, where surface water intakes are known. Here, the yearly LC was used to separate usually irrigated area from non irrigated area. After calibration of groundwater parameters, the model output reasonable results on gauging station and control piezometers. Specific Scenarii like irrigation reconversion, artificial recharge, and higher dam control are being studied.

KEYWORDS: Surface Water, Groundwater, DSS, Remote Sensing,

RELATION BETWEEN EXCESSIVE EXPLOITATION OF RIVER'S SAND AND DAMAGE ON ITS ALLUVIAL AQUIFER: CASE STUDY OUED SEBAOU VALLEY (ALGERIA)

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ABSTRACT EL Mandour

The Sebaou valley is full of quaternary fluvial sediments made of alluvial deposits (Pebbles, sands, gravels…) out-cropping on the banks of the river. Geomorphologic ally, this valley is an incision in a heterogeneous basement, filled up with alluvial deposits organized into fill in fill terraces showing the alternate periods of erosion and sedimentation.
This is a braided sand river characterized by fining upward cycles with bars and channels filled with gravels topped with bed load sands. In the beds of the deep channels (3m) there are winding crest dunes. The detrital material brought by this river build up at its month a stock of sediments that interacts with the shore's dynamic and permits to maintain the coastal equilibrium (erosion-sedimentation), so, any inconvenience of this equilibrium due to an excessive exploitation of sands produces inexorably an increase of the marine erosion and an on lap of the sea over the coastal plain which has a very low slope.
A wide part of the lower Sebaou valley is occupied by the first terrace that contains the main aquifer. This aquifer is made of coarse sands, pebbles and gravels; the thickness varies from 2 to 20m.
The lower aquifer is located at 20 to 30m depth, it is made of coarse sands-gravels and pebbles. The first aquifer is directly linked with the climate variations. The piezometric measurements show fluctuation between 2 and 4m according to the rainfall. The flow is done from the banks to axis of the valley. The drain axis fit with the flow at the surface of Oued Sebaou.
All of that show that the alluvial deposit is the body of the aquifer and any excessive taking of sand and gravel damages the aquifer reservoirs and therefore the loss of the water resource.
At present time, the intensive and anarchic exploitation of nine sites along the Lower Sebaou has already damaged the aquifer; in fact, in some sites the exploitation is not limited to the sand bars and dunes, but the taking reached the floor of the reservoir it self and now the water out crops.
The consequences are:

- A formation of lagunes.
- The water resources are exposed to pollution.
- A proliferation of bugs.
- A mixture between waste in channel and the water of the aquifer.
- The running water of agricultural lands, with chemical products is directly in contact with the water of the aquifer.
- An extension of the sea inside the coastal plain.
- Salty levels are invading the aquifer.
- A loss of agricultural lands.

Since, this region is for agriculture and tourism, the need of water is very high, and it is imperative to protect this resource. To remedy and mitigate the damages some solutions are proposed.

A SUSTAINABLE SYSTEM OF HARVESTING WATER FOR RURAL COMMUNITIES IN MOROCCO

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ABSTRACT

Since June 2006, the University of La Laguna in partnership with the Dar Si Hmad (www.darsihmad.org, Morocco) have been working on a study about the viability of providing drinking water from the clouds to rural communities living in the Anti-Atlas Mountains, in region of Morocco, using a sustainable system.

The population suffers from serious shortage of drinking water which not only compromises their domestic tasks, but also their livestock activity. The region has a hostile environment (droughts, poor quality soils, lack of water, degradation of the vegetation cover due to the absence of livestock management, poverty, etc.). Our objective through his research is to install Large Fog Collectors (LFC) in order to collect fog water for use to the local population; the beneficiaries are three villages and one traditional school, supporting the water needs of approximately 400 residents and 500 livestock, as well as some reforestation activities. The availability of water for the communities will come with strong benefits, especially for the women and children (they walk 3.5hrs/daily for fetching water, when the conditions are rather and during dry season walking to wells starts at 4a.m.). This is in addition to improving the health of the population given the reduction of the impact of water-borne diseases. Finally, the livestock will have available water to drink particularly during dry seasons.

The selected experimental site is Mont Boutmezguida, at 1,225 m a.s.l. and 30 km from the Atlantic coast (29°12'30''N). During the experimental phase, we have used instruments used of different sized screens, 1 m^2 (Standard Fog Collector, designed by Schemenauer and Cereceda in 1994) and ¼ m^2 (Quarter Fog Collector, designed by Marzol, 2002), connected a meteorological station. The meteorological station allows us to establish the relationship between the collected water, wind speed and direction, and humidity and temperature. The analysis scale for the amounts of collected water is daily. The average of water collected is around 10litres/m^2 per day although there are important monthly variations (14.5 L/m^2/day in the seven months from December to June and 3.2 L/m^2/day from July to September).

KEYWORDS: Water, Fog Water, Sustainable System, Rural Communities

WATER SECTOR RESPONSIVENESS TOWARDS LONG DROUGHT PERIODS AND THE ANTICIPATED ECONOMICAL IMPACTS IN JORDAN

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ABSTRACT

Most of the world's arid countries in the world are exposed to natural disasters such as drought. These disasters may extend for years and disturb all sorts of human activities including agriculture and industry. As there is a growing demand for all available resources, it has become a challenging task for decision makers to manage available resources in a way that satisfies the basic needs of consumers. One of the most crucial sectors is the agriculture. Most of the agricultural crops are sensitive to any decrease in water supply which result in damaging the plantation cover especially for the trees and vegetables. These crops can resist for short period, when damaged, hard to recover back. Not the case for the field crops and other high-resistance crops. It is necessary to find the way to manage this important sector during drought conditions with less damage.

To make this research more understandable, we will look at Jordan as a case study. Jordan is characterized by sporadic and light rainfall which results in substantial losses (≈85%) to evaporation of the estimated 8.5 billion cubic meters annual rainfall. Jordan therefore faces a future of very limited water resources. Current water use already exceeds renewable supply. The deficit is balanced by groundwater mining, pumping of fossil groundwater and reuse of treated wastewater.
There are seasonal, annual and spatial variations in precipitation in Jordan. Subsequently, drought is a common feature of the country's climate. Drought recurrence may be annual but more often it could be multi-annual. Drought creeps in un-noticed process and it is felt only when it turns into a crisis. Negative impact of drought is more severe in dry areas than it is in wet areas. The problem has two sides, the first which is natural and due to uncontrolled weather conditions like the global warming, where the other side is man-made and due to the lack of vision towards water management under drought condition. The objective of this paper is to develop a comprehensive responsiveness in the form of conceptual framework of an efficient drought management strategy for Jordan under the current aridity condition. The framework entails assessment of the current condition in terms of challenges and constraints and endeavors towards durable and sound policies for managing drought under a well defined, long term strategy that will take all the potentials into considerations. The assessment also covers current status of drought in Jordan in terms of course of events, impact trends, types, extent and severity of the droughts. Finally the framework will include recommended programs for pre and post drought management policies and evaluations. This framework will help decision makers in water industry sector better identifying the vision and then proceeding with preparing the drought management strategy, policies, long term master plan and finally short and immediate action plans in the near future.

KEYWORDS: Water, Drought, Jordan, DSS, Response, Management

THE SITUATION OF WATER RESOURCES IN ALGERIA AND PERCEPTIVE FUTURE

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ABSTRACT

In Algeria, water resources are already overstretched now threatened by pollution and drought. To ensure access to safe drinking water to every citizen, in sufficient quantity and satisfactory quality, and sanitation, a strategy of integrated management in the context of sustainable development is necessary. This strategy is based on better knowledge and understanding of water resources at. All levels to better develop, manage and protect them and to use them more efficiently, equitably and sustainably.

Furthermore, Algeria Is among the poorest countries in terms of water potential, below the theoretical threshold of rarity set by the World Bank to 1000 m3 per capita per year estimated at about 500 m3 per hour present, it will be only 430 m3 in 2020 and would be further reduced with reduced water resources mobilized.

The water issue is inseparable from sustainable development to the extent that the water must be able to respond to the needs of present generations without compromising, for little or no effects reversible, the ability of future generations to meet theirs. Would require between 15 and 20billion m3 per year, reserving 70% to agriculture to achieve a satisfactory food security. It is a daunting challenge when you know that mobilizes more than barely m3d'eau 5 billion per year.

KEY WORDS: Water Scarcity, Pollution, Sustainable Development

MONITORING EVAPOTRANSPIRATION OVER AGRICULTURAL ECOSYSTEMS WITH THERMAL INFRARED DATA: COMPARISON OF A SIMPLE ENERGY BUDGET MODEL AND A SVAT MODEL OVER VARIOUS CROPS AND WATER STRESS CONDITIONS

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ABSTRACT

Evapotranspiration (ET) monitoring presents wide range of applications from agriculture and water resources management to meteorology. Several approaches have been developed to retrieve evapotranspiration based on a joint use of remote sensing data and land surface modeling. In particular, modeling surface energy fluxes with a SVAT (Soil Vegetation Atmosphere Transfers) model or SEB (Surface Energy Budget) model, constrained or not by remote sensing data, is an extensively used way to estimate spatial distributions of evapotranspiration.

The main objective of this study is to evaluate spatialized ET fluxes at low resolution by comparing aggregated high resolution estimates from a SVAT model and direct low resolution retrieval from a SEB model constrained by geostationary land surface temperature (LST). The second and original objective of our work is to evaluate the potentialities of taking advantage of low resolution LST and ET to constrain and improve the high resolution ET estimates. Within this preliminary study, we compare the potentialities of a SEB model (TSEB) versus a SVAT model (SEtHyS) with in-situ data in terms of predicted eddy fluxes, so as to orientate and argue our future choices in modeling at high and low resolutions. TSEB (Two Sources Equation Balance) is a model of turbulent exchange (Norman & al., 1995) partitioning the available energy between soil and vegetation and driven directly via remote sensing Thermal Infra-Red (TIR) sensors. SEtHyS (French acronym for soil moisture monitoring) is a SVAT model (described by Coudert & al. 2006) which is physically based and has more inputs and parameters requirements than TSEB.

The dataset used comes from 4 sites in southern France and Morocco managed by the CESBIO ("Sud-Ouest" and "Sud-Med" projects) and local actors in charge of the water management. It covers several kinds of cultures (wheat, sunflower and maize), several vegetative states (growth, vegetation, senescence) and several water stress conditions. The application to these kinds of agricultural areas and the comparison between the applied methodologies within two different climates is quite new in the literature.

Models estimates are compared to in-situ Eddy-Correlation (EC) fluxes measurement stations. Models are then compared performing a sensibility analysis on their inputs and parameters so as to characterize their behavior and quantify the error ranges that will be induced by spatialization. Finally, a first ET estimation at low and high resolutions will be presented here, based on TIR data from MSG (3*5km) and ASTER (100*100m) sensors. We'll then explore and present the potentialities of combining low and high resolutions (ET and LST), in an attempt to recover irrigation amount and dates.

KEYWORDS: Evapotranspiration, Modeling, SEB, SVAT, TIR Data, Water Budget, Agriculture

ASSESSMENT AND COMPARISON OF USING CONVENTIONAL AND MODERN IRRIGATION SYSTEMS TO MANAGE IRRIGATION WATER SUPPLIES IN RIVER NILE STATE OF SUDAN

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ABSTRACT

The increased use of irrigation water in River Nile State (RNS) puts a great pressure on the local hydrology and ecosystem. The RNS is regarded one of the important areas where large investments in irrigation take place for food and cash crops production. The adoption of various techniques of water conservation is becoming necessitated including the large meaning of water use efficiency.

The sustainability of irrigated agriculture is questioned and the challenge is to increase simultaneously land and water productivity in the face of the limited availability of land and water in the RNS. The aim of this research is to assess the irrigation water management performance of two irrigation schemes administrations based on the option of irrigation is mandatory in both from the River Nile (RN) by pumps and to identify options to improve irrigation water performance. The analysis was based on structured survey questionnaires, field observations and literature from Elzeidab scheme where surface irrigation is prevalent which is known as a traditional system and from Bashaier scheme where sprinkler irrigation is existed as a modern system. Integrated techniques involving economic and hydrologic components are used to assess irrigation water use in both schemes under study. A Descriptive statistics and quantile analysis for crop water applied and crop water requirements for Elzeidab and Bashier field crops are presented. GAMS, Crop Wat4 and SPSS have been employed to evaluate the irrigation water performance of tow schemes administrations. The results suggest that vast irrigation water devoted for agricultural production in the State coupled with low production will need attention on water management, allocation, quantities and introduction of water saving technologies. Water management in Elzeidab scheme is not well qualified to handle irrigation water. Lack of staff awareness in Elzeidab led to inefficient water use. The paper concluded that, to improve the water management performance of Elzeidab pump irrigation scheme, numerous challenges are needed to contribute in saving irrigation water in the future: institutional support (input supply, output marketing and credit services), training of staff on improved crop and water management issues, regular supervision and monitoring of scheme activities are crucial.

KEY WORDS: Irrigation Water Use Efficiency and Environmental Conservation

THE LOSSES OF DRINKING WATER IN THE ALGERIAN SOUTH: QUANTIFICATION, ANALYSIS AND COST

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ABSTRACT

The demand for drinking water is unceasingly increasing specially in the urban centres which experience a high demographic expansion. The decrease in water losses on the supply networks can help preserve such a rare resource. The low number of water meters and the intermittent supply make it difficult to quantify the leaking water. This article presents an analysis of the demand for drinking water based on an extrapolation from a sample of consumers on whom data are available. Comparison of the volumes of water produced allows a determination of the losses in the water supply system. This analysis is completed by measurements of night flows. The results obtained may be relied on for an evaluation of the needs for drinking water in the South of Algeria, and for future regional development. The study indicates a high rate of water losses in the distribution network, reaching about 44%, and over-consumption due to an insufficient number of water meters and discontinuous supply. This analysis is completed by the calculation of the global cost of the water losses. We tried to formulate necessary recommendations for a better Cost-effectiveness of the drinking water systems in Algeria.

KEYWORDS: Eau potable, Réseau d'eau, Consumption, Water supply, Water losses, Abonnés, Drinking water, Water network

LES RESSOURCES EN EAU DANS LE BASIN MEDITERRANEEN: REALITES ET PERSPECTIVES POUR UN DEVELOPPEMENT DURABLE

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RESUME

La gestion des ressources hydriques à travers tout le bassin méditerranéen doit être abordée avec sagesse et circonspection. L'eau qui est devenue une ressource rare, est de plus en plus mal repartie. La précarité de son approvisionnement et la hausse de ses prix incluant son traitement, sans omettre le stress hydrique, l'écart de développement entre les pays riches de la rive nord et les pays pauvres de la rive sud qui nous incitent à davantage de coopération.
La Méditerranée avec près de 500 millions de méditerranéens**,** carrefour économique et berceau de toutes les civilisations, est une région à la fois une et disparate tant sur les plans géographique, climatique, économique, ethnique et religieux. Trois continents, 22 pays, une diversité de peuples et de cultures, trois religions abrahamiques.
Le développement socio-économique de la Méditerranée est un objectif principal de tout gouvernant, mais cela hélas affecte inévitablement les ressources d'eau tant sur la qualité du fait de la pollution domestique et industrielle que sur la quantité puisque la consommation augmente de façon alarmante.
La mise en place d'un développement durable exige une mise en équation des préoccupations sociales et économiques aux préoccupations environnementales en tenant compte du facteur essentiel et limite à savoir l'eau.
L'eau est un bien patrimonial commun de l'humanité. La santé individuelle et collective en dépend, l'agriculture, l'industrie et la vie domestique y sont liées. Il n'y a pas d'accès à la production de la richesse sans accès à l'eau. Chaque membre de la communauté humaine, a le droit à l'eau, en particulier à l'eau potable, en quantité et qualité nécessaire et indispensable à la vie et à l'activité économique.
L'Afrique du Nord, comme certains pays du Sud de l'Europe souffrent de la pénurie d'eau et en témoignent les nombreuses stations de dessalement en méditerranée. Dans cette conférence seront développés:

- L'état actuel des ressources en eau, les enjeux et défis futurs à relever.
- La politique de gestion : institution, réglementation, législation
- Le dessalement des eaux de mer ; une réalité incontournable ?
- Le droit à l'eau : mythe ou réalité ?
- Les grands transferts de l'eau : une nécessité ?
- changements climatiques, inondations ; sécheresse.
- Proposition de stratégies et recommandations pour la résolution de la crise de l'eau en vue d'un développement durable de la méditerranée.

MOTS-CLES: Eau, Développement Durable, Méditerranée, Organisation, Sécheresse, Stratégies, Politique, Gestion, Dessalement

EFFICIENT USE OF IRRIGATION WATER THROUGH CONSERVATION AGRICULTURE IN EASTERN INDO-GANGETIC PLAINS OF INDIA

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ABSTRACT

Declining per capita land and fresh water availability is causing serious concern. Annual water use for agriculture is about 91 per cent in the Indo Gangetic Basin but with other compelling demands, diversion of water for agriculture is going to be reduced in future. Appropriate water management technologies together with conservation agricultural technologies are needed for rational use of water. Development of efficient water-management practices in different cropping systems may reduce the water requirement without significant reduction in crop yields. Reduction of water use in land preparation (Zero tilled direct seeded rice and wheat, Zero tilled transplanted rice) and adoption of second generation resource conserving technologies (RCTs) like laser land leveling system, residue management, bed planting and crop diversification are being advocated for conservation of soil, water and energy and enhancing water productivity. The productivity of water is enhanced by increasing the productivity per unit of process depletion (crop transpiration in agriculture) or other beneficial depletion, and by reallocation of water to higher-value uses. RCTs could very well be supplemented by rainwater conservation, increased bund height, irrigation scheduling, land leveling etc for *in situ* moisture/water conservation and conjunctive use of rain, surface and ground water to enhance water productivity. Rice-wheat system is the major cropping system in the eastern Indo-Gangetic plains of India for providing food and livelihood. Due to late vacation of lands after rice harvest and moisture in the field, sowing of wheat gets delayed and it affects wheat yield**.** Judicious use and management of water is imperative in RCTs to improve productivity of land and water. It would be imperative to examine and study the impact of RCTs in water conservation and adopt water management practices to supplement better adoption of RCTs/ Zero tillage (ZT) to improve not only water use efficiency but also overall input use efficiency and water productivity.This paper focuses on the impact of RCTs on water use aspects, especially water saving based on our experience and experimentations at farmers' fields in eastern Indo-Gangetic plains of India, largely under the RCT. Wheat establishment under zero tillage (ZT) system was found to save the water up to 30 per cent in the first irrigation. Due to wheat sowing just after rice harvest at residual moisture, the pre-sowing irrigation water requirement is saved. More utilization of residual soil moisture (10 per cent) due to timely/early sowing of wheat is observed. Water use efficiency (WUE) was also found to increase by 62 per cent. There is a saving of at least 30-50 per cent of water as compared to the flat system of irrigation. By adopting proper irrigation scheduling of wheat, about 17% of irrigation water could be saved in comparison to farmer's practices. Farmers reported about 20-30 per cent water savings with zero-tillage. This was attributed to the residual soil moisture for wheat germination. In zero-tillage, less water is applied in the first irrigation and thus yellowing is not seen. The wheat cultivation under Furrow Irrigated Raised Beds (FIRB) system in has been found to save irrigation water by 35-40 per cent.

KEYWORDS: Water Management, Water Use Efficiency, Conservation Agriculture, Resource Conserving Technologies, Wheat, Irrigation

NEW MICROMETEOROLOGY TOOLS FOR MEASURING CROP WATER REQUIREMENT FROM LEAF TO REGION

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ABSTRACT

Regions classified as semi-arid or arid constitute roughly one third of the total global land cover. Within these regions, water scarcity is one of the main factors limiting agricultural development. The impact of such water scarcity is amplified by inefficient irrigation practices, especially since the irrigation consumes more than 85% of the available water in these regions. Therefore, the first step toward sound management of the scarce water resources in these regions requires an accurate estimation of the water needs and consumption of irrigated agriculture. The crop water need is defined as the amount of water needed to meet the amount of water lost to the atmosphere through evapotranspiration. Several technics have been developed to measure the evapotranspiration or transpiration from leaf to region.

KEYWORDS: Crop Water Requirement, Evapotranspiration, Micrometeorology Measurements.

AHP BASED ON GIS FOR RANKING SUITABLE SITES FOR IRRIGATION BY TREATED WASTEWATER IN NABEUL-HAMMAMET AQUIFER WATERSHED

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ABSTRACT

In Tunisia, wastewater is currently considered as an additional source of water. The collected and treated amount is in perpetual growth, going from 40 millions of m^3 in 1983 to 200 millions of m^3 in 2006. In fact, its reuse becomes strategic and included in national water policy inasmuch as the mobilisation of conventional water reached its limits and agricultural, domestic, touristic and industrial water demand is continuing its increase and stress. Treated wastewater (TWW) could fulfill a part of irrigation requirment of agricultural land.

The present study aims to establish a methodology to rank suitable sites for TWW irrigation by integrating a single-objective AHP method into a GIS model. Ranking these sites constitutes a mandatory process to select the best suitable sites for irrigation according to the available amount of TWW. Nabeul–Hammamet aquifer watershed is selected as a study site to apply the methodology using easy-to-get data from Tunisian official institutions and available satellite images.

Several parameters are identified taking into consideration simultaneously different aspects that could influence the aptitude of a site to be irrigated by TWW. These parameters are grouped in four main criteria depicting technical, social, economical and environmental aspects. Each criterion is consisted in several sub-criteria. A pair-wise matrix is used to compare these criteria and sub-criteria, leading to an establishment of their reative importance in site evaluation. Using GIS, geographical layers are obtained for the sub-criteria, from which a map that ranks suitable sites for TWW irrigation is derived.

The total suitable area occupies 11426 ha, represented by 31% of the total watershed. This constitutes a quite large zone that can absorb all the amount of treated wastewater and contributes to increase the agricultural production of the region. The best sites to receive the surplus amount of TWW, produced by the plants of the region, are located near these plants and inside agricultural lands. In addition all these sites are situated around the districts already irrigated by TWW.

KEYWORDS: AHP, GIS, Treated Wastewater, Irrigation, Mapping.

L'UTILISATION DE L'IMAGE SATELLITAIRE DANS L'ESTIMATION DU TAUX DE RECOUVREMENT VÉGÉTAL ET L'ÉTUDE DES FACTEURS DE L'ÉROSION HYDRIQUE DES SOLS DANS LE BASSIN VERSANT CHOTT CHERGUI (W.ELBAYADH)

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RESUME

Plusieurs facteurs influencent l'ampleur de l'érosion hydrique : la longueur et la raideur de la pente, la texture du sol, l'étendue du couvert végétal, cette couverture du sol est le facteur qui agit le plus efficacement contre l'érosion en protégeant la surface du sol contre la force érosive des gouttes de pluie et du ruissellement.

Notre travail consiste à faire une estimation du taux de recouvrement végétal à l'aide de l'imagerie satellitale dans une région sami aride cas du bassin versant chott chergui (wilaya d'El bayadh)

Les indices de végétation tirés des images permettent d'obtenir une idée sur la végétation qui occupe le territoire étudié. Dans la littérature, on propose un grand nombre d'indices, dont les propriétés et les sensibilités aux facteurs externes diffèrent considérablement. La relation entre le taux de recouvrement végétal et les indices de végétation peut être identifiée à l'aide de plusieurs méthodes. D'après Purevdorrj et al. (1998), de nombreuses études ont trouvé une relation linéaire entre les indices de végétation et les caractéristiques biophysiques de la végétation.

Ces indices de végétation sont des combinaisons simples (somme et quotient le plus souvent) de deux bandes spectrales ou plus. Le rouge et le proche infrarouge, aussi le moyen infrarouge peut être utilisé
Dans le cas de la présente étude, nous cherchons d'estimer le taux de recouvrement général, pour cette raison, nos calculs seront effectués avec les valeurs du taux de recouvrement prises du terrain misent en relation aux valeurs d'indice de végétation correspondante sur l'image.

MOTS-CLÉS: Risque Naturel, Erosion Hydrique, Bassin Versant, Couvert Végétal, Indice de Végétation SIG et Télédétection

USING REMOTE SENSING TECHNIQUES TO ASSESS PERFORMANCE OF AN IRRIGATION SCHEME IN HAOUZ PLAIN, MOROCCO

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ABSTRACT

Regarding competition on already-stressed water resources, climate change, growing population, appropriate planning in water resources is becoming increasingly important, especially in irrigated agriculture which is the biggest consumer of water resources. Irrigation performance assessment is a prerequisite to improve water management in an irrigation scheme since it provides policymakers and managers appreciable information at various scales allowing them to develop appropriate water management strategies.

Recently remote sensing techniques became an attractive option to assess irrigation performance from individual fields to irrigation scheme or river basin scale. These techniques can be used as a tool to directly estimate actual crop evapotranspiration (ETc), i.e. water consumption, which is one of the inputs for irrigation performance assessment. In this study, we used the FAO-56 dual approach to derive a daily ETc combining reference evapotranspiration (ET0) and crop coefficients. The basal crop coefficient and fraction cover were derived from the well-known Normalized Difference Vegetation Index (NDVI), through relationships already established. This approach was applied in the Haouz plain, a semi-arid region in the south of Morocco, especially in an irrigation scheme of 2.800 ha for the growing season of 2002/2003. A time series of high spatial resolution SPOT and Landsat images acquired was used to derive NDVI and ETc maps.

By combining ETc maps with field water supply records collected over the irrigation scheme, a set of remote sensing-based indicators, reflecting equity and adequacy of the irrigation water delivery, were estimated. This approach allows identification of areas with poor equity and adequacy, thereby providing insights into where and how irrigation systems can be managed to improve overall performance and increase water productivity in a sustainable manner.

This study demonstrates how remote sensing-based estimates of water consumption provides better estimates of system and irrigation performance (equity and adequacy) at a variety of scales than the tedious traditional ground data collection.

KEYWORDS: Irrigation Performance, Remote Sensing, Evapotranspiration, FAO-56, NDVI

THE SUDMED PROGRAM AND THE JOINT INTERNATIONAL LABORATORY TREMA DEALING WITH "REMOTE SENSING OF WATER RESOURCES IN THE SEMI-ARID MEDITERRANEAN AREA"

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ABSTRACT

The Center for Spatial Studies of the Biosphere (CESBIO, Toulouse, France) and the National Center of Studies and Research on Water and Energy (CNEREE, Marrakech) are co-leader of a Joint International Laboratory entitled "Remote sensing and water ressources in the semi-arid Mediterranean area" funded by the French Research Institute for Development (IRD). The general themes of research deal with the sustainable management of the water resources in the Southern Mediterranean area. The creation of this laboratory enables the reinforcement and the developing of the reliable partners' network in Marrakech that has been built for nearly 10 years within the framework of the SUDMED program. The SUDMED research program studies the hydro-agricultural functioning of the Tensift catchment in Morocco in the context of intense changes, both from human and natural origins. The laboratory objectives are threefold: (1) to carry out research on integrated hydrological modelling and monitoring through remote sensing observations, (2) act as a training and education center for the teaching of technics dealing with the management of water and (3) develop applied tools in close collaboration with the local managers of the catchment water. The scientific approach is based on the synergistic use of the mathematical modelling, the satellite observations and *in situ* data. The organization of the laboratory together with key results of the work in progress is presented in this paper. Finally, research perspectives are drawn.

KEYWORDS*:* Remote Sensing, Hydrological Modeling, Irrigated Agriculture, Water Quality

EVALUATION DU FONCTIONNEMENT D'UN PERIMETRE IRRIGUE EN TUNISIE APRES SA REHABILITATION

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ABSTRACT

Due to the scarcity of conventional water for irrigation that is becoming acute in Tunisia in response to climatic changes and reduced performance of the irrigated sector, a better use of water resources allocated to agriculture is then required. In addition, public irrigation area were characterized by a low agricultural intensification, a high water losses caused by the poor state of collective irrigation, the irrigation techniques adopted, and the absence of agricultural traditions.
This study aims to evaluate the performance of irrigated Zaafrane II delegation of Bouhajla (Kairouan) rehabilitated in 2005 integrated in the national strategy for water saving. This assessment based on the analysis of efficiency parameters, satisfaction crop's rate, water saving equipments, and intensification revealed that the hydraulic network's equipment and mode of operation is not a constraint for the valorisation of the perimeter. The network efficiency estimated to 95% allowed a relatively big reduction in the rate of water loss while ensuring satisfaction of crop's water requirements about 85%, which confirms a good water use. The renewal of the network distribution has encouraged farmers to move towards the practice of pressurized irrigation (46% by sprinkler and 39% by drip irrigation system). Moreover, the rate of intensification has gradually increased over time to reach 100% from the campaign year 2008/2009. These results showed that the perimeter has earned the State's investment and that the rehabilitation has contibuted to guide farmers to practice water saving techniques. Rehabilitation of public irrigation area will contribute to the rational and efficient use of the country water resources.

KEYWORDS: Public irrigation area, Water saving, Efficiency, Rehabilitation, Irrigation.

ASSESSMENT OF SOCIOECONOMIC CHARACTERISTICS IN IRRIGATION WATER USE EFFICIENCY IN THE RIVER NILE STATE OF SUDAN

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ABSTRACT

The River Nile State (RNS) of Northern Sudan can rightly be considered as a river–born nation that a high population density exists in the settled areas along the River Nile and Atbara River with a total of about 720,000 people (90%), thus, most of agriculture production depends on irrigation in valley areas close to the rivers and they covers approximately 124.000 km^2 (29.5 million feddans) out of which about 3.201.300 fed is suitable for agricultural production.

The country is below the water poverty line of 1000 cubic meter per capita per year and it may continue to be so for the foreseeable future". The competition for irrigation water and land increases resource management complexity. The paper undertook Elzeidab irrigated scheme of RNS as study area. The aim of this research is to assess the social and economical performance of Elzeidab scheme tenants and to identify options to improve irrigation system and water resource management. The community based small-scale irrigation farms (Hawasha) and the option of irrigation is mandatory in Elzeidab from the River Nile (RN) by pumps through the surface irrigation system. To realize these objectives structured survey questionnaires, field observations and literature were used. Various Elzeidab tenant' socio-economic characteristics were gathered to study the socio-economic impact of irrigation water use. A total of 70 randomly selected respondents from Elzeidab scheme were interviewed. Integrated techniques involving economic and hydrologic components are used to assess water use efficiency in RNS.A Descriptive statistics and quantile analysis for crop water applied and crop water requirements for Elzeidab field crops are presented. GAMS, Crop Wat4 and Cobb-Douglas function have been employed to evaluate the social and economical performance of Elzeidab scheme tenants. The results suggest that vast irrigation water devoted for agricultural production in the State coupled with low production will need attention on water management, allocation, quantities and introduction of water saving technologies. Water management institutions are not well qualified to handle irrigation water. Lack of tenants' awareness led to inefficient water use. The paper concluded that, to improve the economic and environmental performance of public pump irrigation schemes of the State, numerous challenges are needed to contribute in saving irrigation water in the future: institutional support (input supply, output marketing and credit services), training of tenants on improved crop and water management issues, regular supervision and monitoring of scheme activities are crucial.

KEYWORDS: Irrigation Water Use Efficiency and Environmental Conservation

COST FUNCTION AND CONSTRAINTS OF IRRIGATION SCHEDULING IN OPEN CANAL IRRIGATION NETWORKS WITH REMOTE SENSING WATER BALANCE

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ABSTRACT

Water sharing has become a serious problem around the world especially in the agricultural sector which represents the main consumer of water resources. Open canal network is a common appliance for agricultural water distribution that is characterized by its energy efficiency but also its lack of flexibility for water allocation. Our final objective is to offer the irrigation managers a complete scheduling tool for irrigation rotation, including dates and times of opening and closing the canals to irrigate plots and the amount of water needed. The methodology is three-folded: 1) Remote sensing time series images associated to a water balance authorize to estimate a pixel based water demand of crops. Irrigation is spatially triggered to provide date and quantity for the next irrigation rotation. 2) A cost function is designed taking into account crop stress and priority of irrigation among plots. 3) The constraint of water distribution are analyzed and formalized taking into account several aspects like flow capacity and operators displacement. In this study, an analysis of a 2800 ha flood irrigation system located 40 km east of Marrakech, Morocco is carried out. The results show that there is a great disparity in irrigation both in time and space. The cost function is analyzed for an actual case demonstrating that the distribution of water is not optimal from the crop water demand point of view.

KEYWORDS: Open Canal Irrigation Network, Optimization, Planning And Scheduling, Remote Sensing, Water Resource Management

AIDE A LA NEGOCIATION POUR LA GESTION INTEGREE DES RESSOURCES EN EAU: CONCEPTION D'UN SYSTEME D'AIDE A LA GESTION DES CONFLITS ETUDE DU CAS DE LA REGION DU TENSIFT

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RESUME

L'aménagement du territoire qui a pour mission d'assurer un développement social et économique pour satisfaire les besoins des populations se trouve dans la difficulté de concevoir une planification permettant le meilleur arbitrage possible entre les besoins induits par la croissance urbaine en ressources en eau à mettre à la disposition des ménages et des activités économiques, sans que cela ne se fasse au détriment du secteur agricole et du monde rural. Cette planification doit permettre d'assurer une disponibilité en eau suffisante en quantité et en qualité au profit de l'ensemble des usagers conformément aux aspirations d'un développement économique et social harmonieux et aux possibilités offertes par les potentialités en eau.

Suite aux sécheresses récurrentes ces dernières années, phénomène devenu structurel, et à la croissance démographique, l'eau devient une ressource de plus en plus rare. A cette rareté vient s'ajouter l'irrégularité des apports annuels aussi bien en eau de surface qu'en eau souterraine ce qui pose un vrai problème de gestion des ressources en eau.

En effet, les incertitudes liées aux changements climatiques et qui ne permettent pas d'assurer une disponibilité en eau suffisante pour l'ensemble des usagers se traduisent par une compétition sur la ressource ce qui rend le processus de gestion intégrée de l'eau fort complexe et de mise en oeuvre difficile.

Au niveau du Tensift, le bilan des ressources en eau de surface et souterraines est déficitaire. Le volume moyen global distribué à partir des barrages, y compris le transfert du bassin de l'Oum Er Rbia à travers le canal de rocade, durant les dix dernières années ne dépasse pas 450 Mm3 (soit 50% des besoins de l'agriculture de la région). D'autre part les prélèvements des eaux souterraines dépassent les volumes renouvelables d'un volume annuel de 180 Mm3. Il ressort donc que même en incluant aussi bien l'économie de l'eau, que le recours à la réutilisation des eaux usées et au dessalement de l'eau de mer on ne peut subvenir aux besoins futurs de la région

En fait les stratégies d'aménagement du territoire les plus réussies sont celles qui assurent une meilleure affectation, distribution, valorisation et gestion de l'eau et du sol aux besoins des populations et de développement d'aujourd'hui et de demain.

Sur le plan institutionnel et législatif le Maroc, pour faire face au défi d'une gestion rationnelle et concerté de l'eau, le Maroc a institué la loi 10/95 sur l'eau constituant la base légale de la politique de l'eau du pays qui repose essentiellement sur les principes suivants:

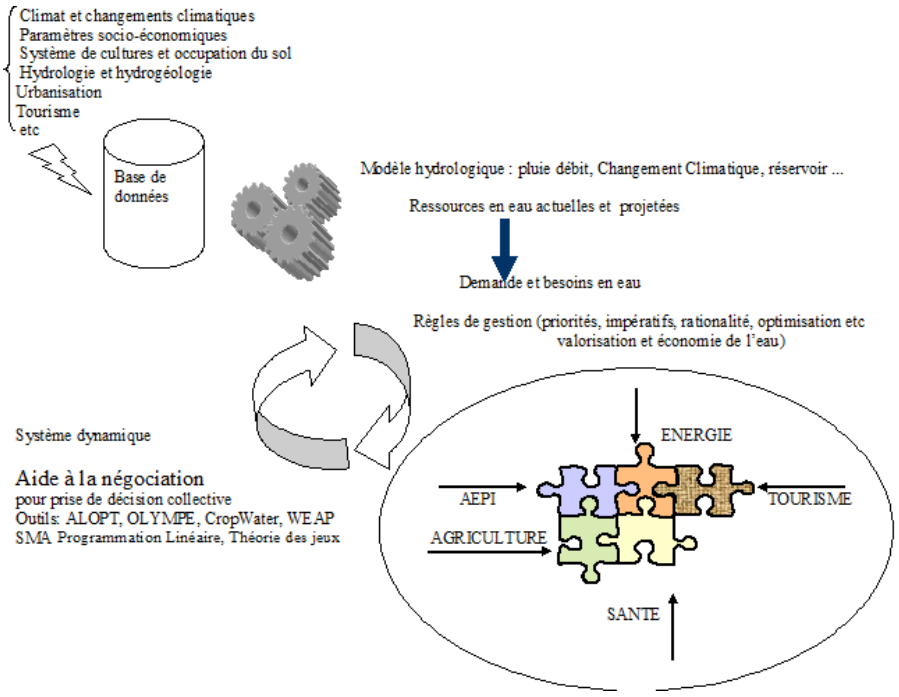
- «la protection de la santé de l'Homme par la réglementation de l'exploitation, de la distribution et de la vente des eaux à usage alimentaire»
- La mise au point d'une planification d'aménagement et de répartition des ressources en eau basée sur une large concertation entre les usagers et les pouvoirs publics : c'est dans ce cadre qu'elle a spécifié la réalisation de Plans Directeurs d'Aménagement Intégrés des Ressources en Eau (PDAIRE) des bassins versants et du Plan National de l'Eau (PNE) qui fixent entre autres, les dotations allouées aux secteurs usagers ;

- La répartition rationnelle des ressources en eau en période de sécheresse pour atténuer les effets de la pénurie ;
- Une plus grande revalorisation agricole grâce à l'amélioration des conditions d'aménagement et d'utilisation des eaux à usage agricole ;
- L'adoption du principe préleveur-payeur et pollueur-payeur .

Dans cette optique qui vise à mettre en place une politique de l'eau basée sur une vision prospective tenant compte de l'évolution des ressources et des besoins en eau ; la rationalisation de l'utilisation et de la valorisation de l'eau, les évolutions actuelles dans les modalités de la décision publique dans un contexte de développement durable, avec des orientations vers des démarches participatives et des décisions concertées, le recours à des outils qui aides à gérer les ressources en eau en intégrant tous les points de vues et résolvant les situations conflictuelles dues aux divergences d'intérêts s'avère nécessaire.

Face à de tels systèmes, complexes, évolutifs et itératifs, objets d'enjeux multiples de conflits et de compétition entre usagers, se pose la question de la pertinence des outils qui permettent de faciliter les processus de prise de décision. Il s'agit donc de proposer des outils et instruments de gestion qui accompagnent les acteurs tout au long du processus de décision vers des situations équilibrées et stables. L'accompagnement permettra à travers un processus de négociation et médiation de prendre en charge au mieux les incertitudes de la situation.

Nous présenterons dans le cadre de cet article un modèle hybride de gestion (schéma ci-après) qui s'inscrit dans une perspective ingénieriste couplant l'Aide à la Décision et Recherche Opérationnelle (AD-RO)/Informatique et la modélisation des systèmes interactifs d'aide à la décision et les méthodologies de négociation (notamment les systèmes multi-agents) et de l'information dans un esprit pluridisciplinaire intégrant toutes les parties prenantes (stakeholders).



MOTS CLES : Gestion Intégrée de l'Eau, Revalorisation Agricole, Répartition Rationnelle, PDAIRE,

EFFECT OF AIR RELATIVE HUMIDITY HARVEST ON SOIL MOISTURE CONTENT UNDER MOROCCAN CLIMATIC CONDITIONS

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ABSTRACT

In this work, we aim to analyse the effect of the harvest of air relative humidity on soil water content. Some experiments were conducted on hilly areas with various hypsographic and microclimatic conditions greatly affecting daily fluctuations of air relative humidity. The metrological data's were obtained by using a Campbell Scientific equipments station recorder on data loggers every half hour. Time Domain Reflectometers (TDR) is used for calculating water content at different soil layers. The effect of many parameters such as: minimal and maximal air atmospheric humidity, potential of soil water and minimal temperature of air on harvesting air relative humidity is also discussed. The experimental results indicate that soil moisture content in the upper soil layer fluctuates with the same manner to diurnal fluctuation of relative air humidity. These fluctuations due to the harvest of relative air humidity decreased with increasing soil depth and daily amplitude of relative air humidity. The water adsorbed according to this phenomenon increased with increasing maximal relative and decreasing minimal temperature. The contribution of this soil water collected is about 40% of losses due to evaporation process. The correlation between principal climatic data and soil water adsorption by harvest relative air humidity is presented in this paper in order to incorporate it in the total water balance during water infiltration.

KEYWORDS: Harvest, Relative Air Humidity, Soil Water Content, Water Vapor Adsorption, Evaporation.

TOPIC 2

Impact of Pollution on Water Resources and Health

IS THE SPREAD OF BACTERIA RESISTANCE TO ANTIBIOTICS IN THE ENVIRONMENT CALL TO BE TAKEN INTO ACCOUNT WHEN DEVELOPING STANDARDS?

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ABSTRACT

The spread of heterotrophic bacteria in water supply that are resistant or multiple resistant to antibiotics may represent health risk if these bacteria are opportunistic pathogens or serve as donors of the resistant factors to other bacteria that could be pathogens.
The presence of antibiotic resistant bacteria among the heterotrophic bacteria population of chlorinated drinking water from two districts in Cairo was investigated. Most strains appeared to be ampicillin resistant (89.7%). Those were followed by sulfa guanidine (78.1%) and streptomycin (56.9%). The majority of the tested strains were multiple antibiotic resistant (MAR) which represent 62.4 to 98% of the total isolates. In a typical population of 100 CFU ml^{-1} of water from the distribution system 40 to 70 of these organisms could be expected to have some antibiotic resistance. Identification of 363 MAR strains revealed that Gram-positive rods were dominant in chlorinated drinking water. Gram-negative fermentative rods, Gram-positive cocci and Gram-negative nonfermentative rods represent the second, third and fourth group of the identified MAR phenotypes.

The problem of MAR bacteria was extended to include underground water. A total of 101 isolates from underground water pumped from three water works in Cairo were classified into genera or groups according to their morphological, cultural and physiological characters and tested for their resistance towards four commonly used antibiotics namely chloramphenicol, tetracycline, neomycin, penicillin and one chemotherapeutic agent namely 2-sulfanilamide pyrimidine. Results showed that 77 and 64 isolates were resistant to penicillin and 2-sulfanilamide pyrimidine and in addition, 32 isolates were resistant to tetracycline. Only 18 and 8 isolates were resistant to chloramphenicol and neomycin, respectively. It was also found that 19 isolates belonging to 6 genera or groups were sensitive to all of the tested compounds.

The study was extended to include the bacteriological changes associated with activated carbon in a pilot water treatment plant showed that the incidence of coliform resistant strains among isolates varied significantly according to the source of water samples. MAR was not always high in the same samples in which the overall resistance was high. The species composition varied considerably in different water samples. Selection for bacteria exhibiting resistance to antibiotic or antibiotics was observed under some experimental conditions using different doses of chlorine. The antibiotic resistance character was mostly transferable. What health risk this represents, particularly when the heterotrophic bacterial population is above the 500 organisms or more per mL limit suggested for potable water, is not clearly understood.

KEY WORDS: Drinking water, Underground water, Activated carbon, Antibuiotic Resistant Bacteria

ECOLOGICAL MONITORING OF DANUBE WATER QUALITY IN BUDAPEST REGION

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ABSTRACT

Water quality monitoring of international rivers has always been a difficult task in Worldwide. Monitoring the environment with physical, chemical, biological and bacteriological systems is absolutely essential to identify human health and water ecosystem hazards, to assess environmental cleanup efforts, and to prevent further ecosystem degradation. Biomonitors and biomarkers combined with physical and chemical monitoring offer the best approach to making these assessments. According to changing in the ecological monitoring parameters of water monitoring system, our objectives are going to select the most important parameters that investigate physical, chemical, biological and bacteriological status for water quality of the main Danube River in Budapest region. The monitoring assessment of the Danube water was conducted in three replicates. The samples were collected in sterile dark bottles of 1000 ml capacity from three different zones between Erzsébet and Petőfi bridges from the Pest and Buda sides of the Danube River. Comparative studies were carried out during the time intervals 1998, 2005 and 2010. The investigated parameters of surface water: Physical (temperature, electroconductivity); Chemical (pH, dissolved oxygen content, BOD_5, COD_{Mn}, cation ions (NH_4^+, K^+, Na^+, Ca^{2+}, Mg^{2+}), anion ions (Cl^-, NO_3^-, NO_2^-, SO_4^{2-}, PO_4^{3-}), total N and P contents, some heavy metal ions (Cu, Cd, Zn, Ni), total Fe and Mn; suspended materials, total dissolved organic carbon concentrations); Biological indicator (chlorophyll-a) and Bacteriological status (Total counts of aerobe heterotroph mesophile bacteria, coliforms, faecal coliforms, faecal streptococci, *Escherichia coli*, *Enterococcus faecalis* and cellulose-decomposers) were carried out at 22°C.
According to the investigated parameters and the Hungarian assessment methods for water quality, our results demonstrate that the water quality of the main Danube River has improved during the last 12 years subsequent to the diversion which could be witnessed particularly in the unfavourable oxygen saturation levels. It was found that dissolved organic carbon content, nutrient pollution, and bacteriological parameters as well as the chlorophyll-a were higher in 2005 than in 1998 and 2010. Monitoring of the river section began after the underwater weir began operating. The data showed no significant differences between temperature, pH and electroconductivity in 1998, 2005 and 2010. With large numbers of new chemical substances introduced to river ecosystem, continuous monitoring systems for their detection will become increasingly important with respect to ecological impacts they produce, in addition to other toxic effects. Much effort has to be directed towards the detection of such pollutants in river. Thus the challenges to continuous physical, chemical, biological and bacteriological monitoring will be immense. Finally the importance of the integration of biological and chemical monitoring has to be emphasized.

KEYWORD: Monitoring, Pollution, Danube Water Quality, Ecological Parameters

QUALITE BACTERIOLOGIQUE DES EAUX SOUTERRAINES ET SOURCES DE POLLUTION DANS LE BASSIN SEDIMENTAIRE COTIER DU BENIN

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RESUME

Les eaux souterraines constituent la principale source d'approvisionnement en eau potable des populations du bassin sédimentaire côtier du Bénin, situé dans le domaine du climat subéquatorial à deux saisons pluvieuses et deux saisons sèche. Ce bassin, de 12 377 km² (10 % du territoire béninois) regorge de 35 % de la totalité des eaux souterraines du Bénin. Au regard des changements environnementaux qui l'affectent, il importe d'analyser la qualité bactériologique des eaux de puits et de forages et les sources potentielles de pollution afin proposer une approche d'approvisionnement en eau potable.

Les échantillons d'eau ont été prélevés avec toutes les précautions d'asepsie dans des flacons stérilisés de 500 ml en saison pluvieuse et en saison sèche. Onze puits de profondeur <25 m ou >25 m et huit forages (pédestres et manuels) ont été choisis en tenant compte de la morpho-structure du bassin, des fluctuations de niveaux piézométriques, de l'accessibilité et des formes d'usages de l'eau. L'analyse bactériologique a porté sur les coliformes totaux, Escherichia coli, et les streptocoques fécaux. La qualité des eaux est appréciée en se référant aux normes de la potabilité de l'OMS, la Valeur Maximale Admise (VMA).

Les puits de faible profondeur sont les plus affectés par les coliformes totaux (innombrables) et les Escherichia coli, streptocoques fécaux qui excèdent aussi les normes de l'OMS tant en saison pluvieuse et qu'en saison sèche. Les forages sont aussi contaminés par ces germes bactériens dans respectivement 75 % et 88 % des eaux analysées. La pollution est élevée au niveau des forages pédestres dont le système de tête de pompe serait un facteur important d'infiltration des eaux contaminées et d'accroissement de la charge polluante. La pollution des eaux souterraines est liée à l'action combinée de la variabilité hydroclimatique, de la nature des roches, du mode d'occupation des terres, de la dégradation de l'environnement autour des points d'eau et des modes d'exploitation de la ressource.

Ainsi le développement d'une approche écosystémique serait le gage d'une gestion efficiente de la qualité des eaux et la protection de la santé des populations des régions côtières de l'Afrique.

MOTS-CLES: Bénin, Bassin Côtier, Eaux Souterraines, Charge Bactérienne, Approche Ecosanté.

STUDY OF AL MASSIRA RESERVOIR FUNCTIONING EXPLORATION USING THE POWERFUL STATISTICAL TOOLS: MULTIVARIATE ANALYSIS (ACP AND AFD) AND ARTIFICIAL NEURAL NETWORK

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ABSTRACT

The Al Massira hydroelectric reservoir, with a surface of 138 km^2 and a maximal depth from 35 to 40 m is the main source of irrigation for the region of Doukkala, drinking water supplies and industrial manufacturers for the coastal zone between Safi and Casablanca and is also an important wildlife habitat. It has a drainage basin (catchment) of 28500 Km^2 where the expanding anthropogenic activities (extensive agricultural activities, industry of phosphates, food-processing industry, small business sector (crafts)), and the development of urban areas without adequate sewer systems could hinder the quality of reservoir's waters and contribute to accelerate its eutrophication. The study undertaken in this framework concerns the determination of the global functioning of Al Massira reservoir. To do it, a monthly to bi-monthly monitoring (from May, 1999 till November, 2001), for physico-chemical parameters of the water column was carried out in the pelagic zone.

The water column monitoring allowed building up a large database characterizing the seasonal and interannual variations of the studied variables. The water column presents a weak thermal stratification during the warm season because of the combined effect of the wind and the water withdrawals (summer irrigation). This stratification is followed by turnover of water established in autumn (November). The structure of the water column influences widely the dynamics of the physico-chemical parameters, in particular, the dissolved oxygen, the total suspension materials, the nutrients (nitrogen and phosphorus) and the chlorophyll. The use of multivariate analysis (ACP and AFD) and artificial neural networks (ANN) allowed making a global approach of the reservoir structure and functioning. These methods lead to an explanatory model according to which, the reservoir function is marked by seasonal and interannual variations governed by its morphology, the climatic conditions (wind, temperature) and the hydrology (inflow, outflow). These factors influence the processes and the interactions between the various environmental variables which control the phytoplankton development. The latter indicates a low abundance as showed by the contents of chlorophyll *a* which class the reservoir in the trophic state oligo-mesotrophe even mesotrophe.

These results could be used as the basis for planning future programs for the mitigation and control of eutrophication in the reservoir.

KEY WORDS: Al Massira Reservoir, Water Column, Physico-Chemical Parameters, Functioning, ACP, AFD, ANN

DIAGNOSIS OF WASTEWATER IN THE SUBURBAN OF CASABLANCA (MOROCCO): PHYSICOCHEMICAL QUALITY AND TREATMENT SYSTEMS

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ABSTRACT

Water is a major issue for sustainable development in Casablanca because of its climate and hydrological characteristic. This results an arid climate and small water resources with very irregular and poor quality. The supply of drinking water that rises to over 170 million m^3 (Lydec, 2007) is provided to 98% by other water catchment in the Watershed of Bouregreg in the north and Oum Er Rbia in the south.

The wastewater from various industrial and domestic activities of this city are estimated at over 500,000 m^3 / day (Lydec, 2007) in the urban sector and about 10,000 m^3 / day in the suburban Northeast sector. These suburban wastewater can be divided broadly into the area of Nouaceur / Mohammed V Airport (4000 m^3 / day), the localities of Mediouna and Deroua (2000 m^3 / day each) and other rural settlements (Ouled Taleb, Ouled Haddou / Merchich, Lahraouiyine ... ..) with a volume of wastewater would be about 2000 m^3 / day.

Qualitatively, the wastewater produced in the suburban area is predominantly domestic in spite of few discharges of industrial wastewater in the platform of the Mohammed V airport and in the town of Mediouna. Physicochemical profile of its wastewater is generally characterized by a slightly acidic pH (6.2 - 6.8), BOD_5 averaged between 550 and 1200 mg / l, COD average variable between 800 and 2200 mg / l and a load of MES of 600 mg / l on average.

Treatment systems of its wastewater were launched during the last 3 years including at Mohamed V Airport (activated sludge), Deroua / Nouaceur (lagoon) and Mediouna (activated sludge and membrane filtration). These projects purification of the 10,000 m^3 / day wastewater in the suburban northeast of Casablanca will have an annual potential in purified water of about 3.5 million m^3 can be used for agricultural irrigation and to irrigate the green areas to mitigate the effect of climate change.

KEY WORDS: Suburban, Casablanca, wastewater, diagnosis, quality, treatments

CHEMICAL, BACTERIOLOGICAL, AND ISOTOPIC BEHAVIOR OF OUED-SOUF GROUNDWATERS (SAHARAN PHREATIC AQUIFER)

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ABSTRACT

Oued-Souf City, located in the northwestern part of Algeria, has rapidly grown and been urbanized. The city and surrounding areas depend heavily on groundwater as a water source for drinking, as well as domestic, industrial, and agricultural uses. A approach combining the survey of the evolution of water dissolved chemical species, bacteriological and isotopic fingerprints (^{18}O, ^{2}H, ^{3}H) has been used to better understand the hydrogeochemical and isotopic behaviour of a phreatic aquifer and to determine the origin of its different water bodies. Besides occurring in an arid area, this aquifer which is located in the dunal formations of the Great Oriental Erg Saharan sedimentary basin (Algeria) is subjected to severe natural and anthropic constraints.

Groundwater mineralization has been found to increase along the flowpath ranging from 1.5 to 6 g/l with increasing amounts of Cl^-, Na^+, SO_4^{2-}, Ca^{2+}, and K^+. The phreatic groundwaters display bacteriological germs in sampled waters, and high concentrations of nitrates were detected in the samples due to the absence of a formal sanitation network The present isotopic and chemical study suggests that the groundwaters from the Oued-Souf phreatic aquifer are composed of two primary components, one from infiltrating recent rain waters and the other one from deep captive groundwaters, there exists a mixing and a contribution from the deeper underlying Complexe Terminal aquifer. The latter which is mainly used for water allocation and irrigation, exhibits groundwaters that are relatively enriched but homogeneous stable isotope contents ($\delta^{18}O = -4.1 \pm 0.5‰$, $\delta^{2}H = -46 \pm 5‰$ vs SMOW).
The work described here has enabled a more precise characterisation of the recharge mechanisms for the investigated groundwaters. Finally, solutions to problems encountered by the aquifers and some other recommendations are suggested.

KEYWORDS: Hydrochemistry, Stable Isotope, Bacteriology, Ghout, Groundwater Mixing, Algerian Sahara

RESPONSE OF *FICUS NITIDA* PLANTS TO MYCORRHIZAL FUNGI, ASCORBIC ACID AND FE- EDTA FOR DECREASING THE HARMFUL EFFECT OF LEAD POLLUTION

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ABSTRACT

This study was carried out at the Floriculture Nursery of the Ornamental Horticulture Department, Faculty of Agriculture, Cairo University during 2005-2007 to investigate the effect of some treatments on *Ficus nitida* plants grown in polluted soil with Pb. Lead concentrations in soil (0, 500, 1000, 2000 ppm) in 1st stage and (0, 500, 2500, 5000 ppm) in 2nd stage caused changes in growth characters and chemical composition of *Ficus nitida* plants.

Decreases in plant height, root length, branches number, leaves number and leaves area, as well as fresh and dry weights of shoots and roots were obtained in the two different stages of growth. Also, lead caused decrement in chl.a, chl.b, total carotenoids, catalase activity and micronutrients concentration, while increment in total sugars, total soluble phenols and free amino acids concentration as well as peroxidase and Superoxide dismutase (SOD) activity were recorded in plant leaves under lead treatment compared with control in the two stages.

On the other hand, a reverse trend in two stages was recorded by the plants treated with mycorrhiza fungi (500 and 1000 spores) soil addition, Fe-EDTA (130 and 260 ppm) and ascorbic acid (250 and 500 ppm) foliar application under lead soil pollution, these treatments, can be overcome , to some extent, the hazard effect of lead on *Ficus nitida* plants.

KEY WORDS: Fe- EDTA**,** Ficus nitida, Lead, Mycorrhizal fungi, Ascorbic acid.

MODELISATION DE LA DYNAMIQUE DE L'EAU ET DU TRANSFERT DES SELS DANS UN SOL SABLO-LIMONEUX DU SAHEL TUNISIEN

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ABSTRACT

One of the main constraints for irrigated agriculture development is the challenge of to satisfy the expansion of a population food needs with a poor water quality. Moreover, the threat of soil and groundwater salinization induced by irrigation has become a major issue. Particularly, in semi-arid and arid areas, the scarcity of freshwater resources, during the summer period often leads to an overexploitation of groundwater resources. It follows therefore a serious problem, especially in coastal areas where groundwater resources will be affected by seawater intrusion.

The present study aims to the simulation of water dynamics and salts transfer in order to predict the soil salinity changes and provide measures to reduce its effect. The study was conducted on a sandy loam soil irrigated with salt water and representative of the region of Mahdia in Tunisian Sahel. It focused on following the soil moisture profile (volumetric water content) and saline profile (electrical conductivity of aqueous extract). The parameterization of the model was based on an experience of internal drainage by following the water content and the pressure head, and using the RETC program to optimize the overall empirical parameters defining the hydrodynamic functions which characterise the soil.

Results showed the presence of phases of saturation and desaturation of the soil top layer and showed cycles of soil salinization and desalination generating then a breaking down of salts. The study of water and salts dynamics in the deep layer showed a deep transfer of salts and their penetration beyond 4 m. Salts profiles are of descending type with saline peaks reflecting the transfer of salts. The presence of these peaks confirms a deep transfer which may cause a long term aquifer salinization in and an increase of its current salinity.

KEYWORDS: Salinization, Simulation, Water Dynamics, Salts transfer.

OLIVE WASTEWATERS' IMPACT ON OUED BOUFEKRANE IN MEKNES-TAFILALET

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ABSTRACT

In order to preserve the environment, our goal is to show effluents' olive mill wastewaters' spatial and temporal variation in Oued Boufekrane, during the olive period and all over 2009-2010, and to assess the level of pollution analyzing physico-chemical parameters in seven stations and to value polyphenols extracted from olive wastewaters like biopesticide.

It follows from this that olive wastewaters' polyphenols' average level, suspended matters, Kjeldahl nitrogen, COD (chemical oxygen demand), and BOD5 (biological oxygen demand) greatly exceed discharge standards, and Oued Boufekrane's pollution increases from Ain Maarouf rise to Meknes downstream characterized by high levels of these parameters. Therefore, these waters cannot be used for irrigation or for swimming. The statistic approach confirmed the spatial and temporal variations of obtained results.

In order to resolve this environmental problem of insecticide used by farmers, we valued polyphenols extracted from olive wastewaters like biopesticide against Aphis Citricola. These compounds are very toxic against this pest.

KEYWORDS: Olive Wastewaters, Polyphenols, Biopesticide

POLLUTION OF SOIL AND IRRIGATION WATER BY TOXIC METALS: THREAT TO THE HEALTH QUALITY OF GARDEN PRODUCES ON THREE MAJOR GARDENING SITES OF BENIN

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ABSTRACT

This study attempted to establish a link between the level of pollution of garden sites in lead (Pb), cadmium (Cd) and arsenic (As) and the health quality of vegetables grown there, through the quality of the irrigation water. Composite samples of vegetables, irrigation water and soil taken in the same periods at two garden sites in the city of Cotonou and another one in the village of Aplahoué, were analyzed for Pb, Cd and As by atomic absorption spectrophotometer. The amounts (average ± SD) have been compared by the statistical Student p test ($T > t$) = 0.05. The results show that all the vegetables grown on the three sites are differently contaminated with Pb, Cd and as, as well as their irrigation water and the soil. However, the link attempted to be established between pollution of soil, irrigation water and quality of vegetables, could not be obvious, it has been discussed. Conversely to soil pollution, the levels of contamination of irrigation water by trace metals (Cd and As) are much closer to that of vegetables, apart Pb. Otherwise, the high urban and atmospheric pressures in Cotonou have significantly influenced the contamination. For, it is in Aplahoué, farming environment, that the lowest amounts of metals in water and in the vegetables have been recorded.

KEYWORDS: Toxic metals, Soil, Water, Gardening sites, Vegetable quality, Benin.

HEAVY METAL CONTAMINATION OF SOILS AND WATER RESOURCES AROUND SOME ABANDONED MINES IN THE SOUTHERN MOROCCO

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ABSTRACT

Morocco, mainly the southern region, has a large number of metalliferous sites, some of which are being exploited while others have been abandoned. Both active and abandoned mines previously studied in Southern Morocco contribute toxic metals (Cd, Cu, Zn, Pb, Mn) to surrounding soils, surface and/or underground water and thus may pose a potential risk to animal and human health. However, there is no data available on the impact of the mining activity on water, soils and agricultural crops grown in the affected area. The principal objective of this study was to investigate soil and water contamination in the vicinity of two abandoned mines the kettara and Bir Nhass located in the South of Morocco. Soils and waters were sampled and analyzed using AAS /ICP-MS for Cu, Pb and Zn. Mobility assays were performed by applying established methodology consisting on metal extraction of soil samples with HCl 0,5 M at 1:5 ratio during 1h under stirring. The extracts were analysed by means ICP-MS.

Both soils and waters in the kettara and Bir Nhass mines have been contaminated by mining activity in the past. High total concentrations of heavy metals (measured after total acid digestion) were found in tailings from Bir Nhass mine with maximum values, Cu (86 mg/kg), Pb (1800 mg/kg) and Zn (13300 mg/kg). For the tailings kettara mine the maximum values were: Cu (1500 mg/kg), Pb (200 mg/kg) and Zn (450 mg/kg). Furthermore, Bir Nhass mine, the maximum concentrations of the mobile fraction of metals determined by extraction in 0.5N HCl were 4 mg/L, 70.3 mg/L, 630 mg/L of Cu, Pb and Zn, respectively. For the kettara mine the values were 40 mg/L , 4.2 mg/L, and 20 mg/L of Cu, Pb and Zn, respectively.

As a result of dispersion of the metals downstream and downslope, soils sampled from both mines contained higher metal concentrations than those from nearby control sites ($P<0.05$). This may be due to surface runoff and strong wind action which caused the movement of mine waste material. The chemical properties of tailings were characterized by very low pH <3.0 and high levels of TDS (>1800mg/l) and EC (>3000µc/cm). Furthermore, the groundwater from Bir Nhass mine contained elevated levels of Cu (1.80mg/l), Pb (3.00mg/l) Zn(42mg/l), and SO_4^{2-} (1200 mg/l). Concerning the mine of kettara the results were: Cu (1.10mg/l), Pb (0.10mg/l) Zn (0.80mg/l), and SO_4^{2-} (900 mg/l).

According to this study, the agricultural activity in the vicinity of the both mines requires careful consideration. Recultivation of the tailings and the remediation of surface water and soil are recommended.

KEYWORDS: Soil, Tailings, Water Contamination, Heavy Metals, Mobility

SOURCES OF THE TIGRIS RIVER WATER DETERIORATION AND THE SUGGESTED TREATMENT

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ABSTRACT

Tigris river water is being deteriorated since long ago; its quality is slopping down before entering Mosul city and within it. Different types of wastewater are drained to it, assuming the river as a sink. According to that the organic load as BOD_5 is not less than 5mg/L upstream Mosul city, and 48mg/L down stream it. Some of 500000m3/day of wastewater is drained to the river within Mosul city. The present conventional water treatment is not capable to overcome such change in the nature of Tigris river water quality. Liming to a pH 8.5 (as a maximum permissible standard level for drinking water) had been proved to be promising. A reduction in the parameters of T.D.S, TH, BOD_5 and Total Bacterial Count (T.B.C), were 27-31%, 44%, 49-52%, and 55-66% respectively where lime has many useful applications mainly as coagulant, precipitant and disinfectant.

KEYWORDS: Tigris River, Deterioration, Lime, Temporary Hardness and Organic Load

HOSPITAL WATER SUPPLY AS A POTENTIAL SOURCE OF OPPORTUNISTIC PATHOGENS

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ABSTRACT

The presence of opportunistic pathogenic bacteria in hospitals water supply may represent a source of health risk for patients as well as children. A survey study was carried out to determine the presence of Pseudomonas aeuginosa, Aeromonas spp., and Staphylococcus aureus in water supply for three hospitals located in Greater Cairo, Egypt. Regarding P. aeruginosa (32 isolates) were subjected to virulence tests included elastase (65.6 % positive), alkaline protease (62.5% positive), and exotoxin A production 68.7% positive). Aeromonas spp. (23Isolates) was tested for production for enterotoxin (78.3% positive), hemolysin (82.6% positive) and cytotoxin (91.3% positive). All the 16 S. aureus isolates were coagulase and DNase positive producers. It was found that all the opportunistic pathogen isolates strains exhibited the character of multiple antibiotic resistances. The response of these strains to ultra violet disinfection treatment was varied, but a dose of 12 mJ/ cm^2 completely eliminated the presence of opportunistic pathogens in hospitals water.

KEYWORDS: Hospital water supply, Opportunistic pathogens, Virulence, UV disinfection, Antibiotic resistance

MICROPOLLUANTS LOAD EVALUATION OF ASSIF EL MAL POPULATION UNDERGROUND WATER SUPPLY (MARRAKECH AREA)

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ABSTRACT

In the absence of access to treated water, marginalized rural population tend to use ancient methods by making use of the closest water resources available. This is the case study of ASSIF EL MAL area where the climate is from arid to semi arid. This valley is a tributary left bank of the River Tensift, south-west at 80 km from the city of Marrakech, which drains a watershed of 517 square kilometers and where water wells and springs are used by nearby sources such as drinking water supply without prior checking.

The objectives of the present study is to determine the physico-chemical characteristics including the assessment of heavy metal water wells and springs contents in the area upstream of the valley of ASSIF EL MAL. In this sense, a comparison of these parameters with the standards is done. In addition, the significance of various correlations between the physico-chemical variables and revealed process and origin of high levels of contamination is determined.

The results obtained showed that the concentration of heavy metals in the studied water wells and springs exceeds the acceptable limits values for drinking water set by Moroccan standards. They range from 3.6 to 7.2 mg/l, 3.22-4.65 mg/l, 0.23-0.51 mg/l, 0.31-1.1 mg/l and 0.53-0.76 mg/l respectively for Zinc, Copper, Nickel, Aluminium and Lead. The maximum values track the position of the deposits, because they are recorded either in the upstream stations close to traditional operating small deposit, or downstream to the vicinity of the old mine. In addition the groundwater in the valley ASSIF EL MAL are generally rich in Mg2 + and Ca2 +, which makes it very hard.

Furthermore,this study shows that all waters are circumneutral to slightly alkaline (pH: 7.3–8.5); this demonstrates how the interaction of water with carbonate rocks is able to neutralise any potential acidity derived from oxidation of sulphide minerals and reveals the dominance of HCO3 as the major anion in the less saline springs and wells.

Since the difference in sulphate content is a feature clearly distinguishing the chemistry of springs and wells from that of mine waters, the behaviour of Strontium, Barium, Fluoride and economic base-metals will be hereafter described in relation with the dissolved SO4 content. The Sr/SO4 ratio separates the water samples in two groups, the first one with relatively low values consisting of waters related to the past mining activity (mine waters), and the second one (springs and wells) with high values resulting from the interaction of groundwater with limestone and dolostone. Beside, a positive correlation between Zn/SO4 and Pb/SO4 is obtained.

The deterioration of the groundwater quality in the studied area is due to runoff of heavy metals, that which requires a remediation to reduce this contamination.

KEYWORDS: Quality, Heavy metals, Groundwater, ASSIF EL MAL, Physico-chemical.

STUDY ON THE EFFLUENTS FROM SMALL SCALE DYEING INDUSTRIES OF KATHMANDU VALLEY

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ABSTRACT

Industrial pollution is a growing concern over the time, however, sound and systematic pollution control efforts are very poorly documented. The character and ability to treat the industrial wastewaters is highly variable and specific for each industrial activity. In this context, this research addresses the understanding of the physico-chemical characteristics of wastewater being generated, particularly from the industries involved in small scale fabric dyeing industries to aid in development of prototype treatment alternative. The laboratory analysis (Based on APHA, AWWA, and WEF 19th edition) of wastewater being generated from different processing units along with their composites and raw water from seven dyeing industries of Kathmandu Valley was done during the month of September to December 2008. The specific study on only treatment plant of Site 7 was also performed to evaluate its efficacy in treating wastewater resulting from the industry itself.

Physico-chemical parameters like Color, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Suspended solids were detected beyond the acceptable limits in most of the samples. Out of total 30 wastewater samples excluding 8 raw water samples and 1 treated effluent; 19 samples (63%) contained BOD, 27 samples (90%) contained COD, 15 samples (50%) contained Total Suspended Solids and 8 samples (27%) contained Ammonical Nitrogen values beyond the acceptable limit for wastewater to be discharged into Inland Surface water. Among the heavy metals, 5 samples (16.66%) contained Copper, and 13 samples (43.33%) contained Chromium values higher than acceptable limits. Metals like Zinc and Lead were either not detected or within acceptable limits in all wastewater samples and Cadmium & Arsenic was detected in none of the samples.

Most of these dyeing industries are situated nearby rivers and most of them discharge untreated industrial effluents into nearby rivers turning them into ecologically dead. The Primary treatment mechanism used for treating the effluent in Site 7 can be the better option for similar industries with slight modifications in the treatment system. In other hand, biological processes can be one of the better alternative, since they are cost-effective and environment friendly.

KEYWORDS: Wastewater, Industrial Pollution, Dyeing Industries, Wastewater Treatment.

CONTAMINATION PAR LES PESTICIDES ORGANOCHLORES DES EAUX DE LA BAIE D'AGADIR

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RESUME

L'intensification de l'agriculture dans la région Souss Massa a été accompagnée d'une utilisation importante de produits phytosanitaires (pesticides) en vue de protéger les cultures et d'accroitre leur rendement. Cette évolution des pratiques agricoles a effectivement permis une croissance de la production agricole mais elle constituerait un danger de pollution de l'environnement par ces produits chimiques. Les zones estuariennes et côtières, sous forte influence continentale, seraient probablement les plus touchées par cette pollution.

Dans le cadre des travaux engagés par le Laboratoire Systèmes Aquatiques : Milieux Marin et Continental sur l'évaluation de l'état de santé de la baie d'Agadir, une étude dont l'objectif est de déterminer le degré de contamination des différents sites de cette baie par les pesticides a été entamée depuis 2008. Pour ce faire, trois sites ont été choisis : la plage d'Anza située à 10 Km au Nord d'Agadir et qui reçoit les rejets domestiques et industrielles (huileries, cimenterie, dépôts de carburants et conserveries de poissons) de la ville d'Anza, l'estuaire de Oued Souss et l'estuaire de l'Oued Massa situés au sud d'Agadir et constituant deux zones humides abritant de nombreuses espèces d'oiseaux limicoles et qui font partie du Parc National Souss Massa.

Les analyses des échantillons d'eau prélevés durant l'année 2009 montrent que les eaux provenant de ces trois sites sont contaminés par les pesticides organochlorés suivants : Endosulfans, Laindane, Aldrine, Bipurimate, , Vinchlozoline, et Dichlofluanide à des concentrations variant selon la nature de la matière active et selon la période de prélèvement.

La présence de ces matières actives dans les eaux de la baie d'Agadir serait attribuée à leur utilisation intense en agriculture dans la région Souss Massa. En effet, l'application des produits phytosanitaires sur un champ cultivé peut engendrer des pertes de matières actives vers des compartiments de l'environnement non cibles via les précipitations et les phénomènes de ruissellement et de lessivage des sols.

MOTS CLES: Pesticides - Organochlorés –plage d'Anza- Estuaire de l'Oued Souss - Estuaire de l'Oued Massa- Baie d'Agadir.

IMPACT DE LA POLLUTION ORGANIQUE ET AZOTEE PAR LES INDUSTRIELLES SUR LE FLEUVE NIGER

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RESUME

Le fleuve Niger, un des grands fleuves au monde constitue pour les populations des régions qu'il traverse, la seule source d'approvisionnement en eau. Long de 4.200 km, il prend sa source en Guinée et traverse neuf pays avant de se jeter dans l'Atlantique. Toutes les agglomérations que traverse le Niger constituent des sources de pollution car le fleuve est considéré comme un dépotoir de déchets ménagers et d'eaux usées. Les problèmes de pollution, d'ensablement, de faible pluviométrie, de contamination et de salinisation des nappes phréatiques ont des impacts majeurs sur l'accessibilité à l'eau, tant en qualité qu'en quantité.

Seul cours d'eau permanent au Niger, ce fleuve traverse le pays sur 550km dont plusieurs dizaines de km la ville de Niamey. Suite au développement industriel, on assiste ces dernières décennies à une concentration des activités industrielles le long du fleuve à Niamey. Ces activités industrielles génèrent des eaux usées qui sont déversées sans traitement préalable dans le fleuve; ce qui constitue une source de pollution et de nuisance à la population, à la faune et à la flore riveraines. Ces eaux usées apparaissent comme un liquide trouble contenant des matières en suspension d'origine minérale et ou organique à des teneurs extrêmement variables.

Cette étude s'intéresse aux rejets d'eaux usées des principales industries situées le long du fleuve à Niamey. Il s'agit de 9 industries**:** SOLANI, UNILEVER, ENITEX, BRANIGER, NIGER LAIT, LABAN NIGER, ORIBA, ABATTOIR, TANNERIE.

Une gamme très diverse de produits est utilisée par ces industries lors de leurs activités. Une partie de ces produits se retrouve dans les eaux usées augmentant du coup les charges polluantes de ces eaux.

L'évaluation de la pollution du fleuve Niger et de ses conséquences sur la santé humaine et sur l'environnement a été faite en deux étapes. Une première étape a permis de mener des enquêtes à l'attention de ces industriels et à mener aussi des enquêtes au niveau des riverains.

La seconde étape a permis de quantifier la pollution à travers des caractérisations physico-chimiques des eaux usées suivant un protocole de prélèvement d'échantillon. Ce protocole permet de faire des analyses des eaux usées en amont et en aval des points de rejet de chaque industrie, suivant le sens de l'écoulement d'eau dans le fleuve. Ceci, afin d'identifier l'évolution de la pollution dans le temps et dans l'espace.

MOTS CLES : Eaux Usées Industrielles, Impact, Pollution Organique, Pollution Azotée, Fleuve Niger,

ECOTOXICOLOGICAL SCREENING OF INDUSTRIAL WASTEWATER DISCHARGES INTENSIFT RIVER OF MARRAKECH, MOROCCO

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ABSTRACT

The pollution of water resources is a worldwide problem. In addition to the direct health effects, pollutants also pose subtle dangers in that they may be mutagenic or toxic and lead to human afflictions such as cancer, atherosclerosis, cardiovascular diseases and premature aging. Screening for mutagens in complex environmental mixtures, such as industrial wastewater, is gradually being accepted as a routine method in environmental monitoring programs.

In the present work, the simplified Allium cepa root assay was utilized to evaluate the possible cyto- and genotoxic effects of surface and wastewaters collected near the Tansift River (Marrakech) over a three-month monitoring period. Physicochemical characterization of the water samples included measurements of conductivity, chemical and biological oxygen demand, levels of suspended matter and salts, sodium, potassium, calcium, magnesium, chloride and sulfate.

Morphological modifications of the A. cepa roots, inhibition of root growth, cell division and induction of mitotic and chromosomal aberrations were observed. The most highly polluted water samples (industrial effluents) caused an inhibition of root growth of over 50%, a decrease in the mitotic index of over 36%, and a considerable increase in chromosomal aberrations compared to the control (positif and negatif).The measured biological effects of some wastewater samples appeared related to the physicochemical characteristics.

Mutagenicity or genotoxicity assays should be included, along with conventional chemical analysis, in wastewater quality monitoring programs for irrigation of the land so their use would allow the quantification of mutagenic hazards in wastewaters.

KEYWORDS: Wastewater, Genotoxicity, Allium cepa root assay, Marrakech.

STUDY OF THE TOXICITY OF TREATED AND UNTREATED OLIVE MILL WASTEWATER AND ITS EFFECTS ON SOIL STRUCTURE AND MICROFLORA

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ABSTRACT

The objective of this work is to determine the performances of a soil filter in pre-treatment of modern olive mill wastewater (OMW) effluents located in Aït Ourir (Haouz area – Morocco). The experimental pilot consists of a storage basin followed by a soil filter filled with 60 cm of soil and 90 cm of gravel in the bottom of the filter. The alimentation of the filter is continuous from the storage basin starting in November 15th until the end of January. The OMW was very acidic with a pH of 4.3 an electric conductivity of 19.33, a soluble phenol concentration of 2.78 g/l and a total organic carbon of 2.78 g/l. The percolation of the OMW through the soil filter with gravel causes an increase in the pH from 4.3 to 4.9 and one abatement of the matter dries of 32%, the fat contents of 48% and the organic matter (30% of total organic carbon, 45% of the phenolic compounds). In this work we investigated to compare untreated and treated OMW and their toxicity effects with the model biotests of *Vibrio fisheri* and with germination index of maize seeds. An analysis microbial communities of soil filter was investigated in comparison to the control soil. The addition of such compounds causes significant shifts in the structure, texture of soil revealed by electronic imagery and the function of the microbial community. Results showed that the OMW treated soil exhibited significantly higher respiration activity compared to the control soil. Soil microflora and fungi increased after OMW infiltration/percolation.

KEYWORDS: Olive mill wastewater, Infiltration/Percolation, toxicity, soil microflora, phenolic compounds

ASSIF EL MAL RIVER: SOURCE OF HUMAN WATER CONSUMPTION AND A TRANSFER VECTOR OF HEAVY METALS

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ABSTRACT

The mining and metallurgical mines that were abandoned with their residues, represent an example of the transfer of metallic elements in the ecosystem, and constitute a source of metal pollution affecting the quality of water resources and soil. This is the case of mining site Assif El Mal drained by the Assif El Mal river with a watershed of 512 km2. In fact these waters are a source of consumption without any treatment by the local population either directly or through their storage in reservoirs

This work has been done initially to determine the spatial variation of some physico-chemical parameters to follow the behaviour of some metals (Pb, Zn, Cu, Al ...) from the abandoned mining district, in water and sediment samples along the river. Furthermore to monitor the behaviour of these pollutants, we analyzed these elements in water tank and the corresponding sediment, as these reservoirs feed downstream of the Oued through seguias. The assessment of the degree of metal contamination and toxicity of water through the determination of the ability to redistribute sediment metal particles (adsorbed, coprecipitated and / or included in the sediment particles) to the dissolved phase will also be considered using the sequential extraction procedure (BCR).

The results show that in water samples, there is a metal contamination that exceeds standards for human consumption, especially in the vicinity of the mine and at the storage tanks. These levels range from 0.3 to 17 mg/l, 0.02-0.05 mg/l, 0.3-2.8 mg/l, 0.03-0.1mg/l, 2.6 to 5.1 mg/l respectively for Al, Ni, Fe, Pb and Zn. At the sediment samples , the study showed that the potential toxicity of most heavy metals is due to their mobile fraction exchangeable / acid soluble often high (averaging 41% Pb, 52% Zn and 68% Fe). However, copper is present mainly as little labile (oxidizable and residual fractions) with little metal available for the medium. Total concentrations of Fe, Ni, and Zn were as high as 11, 23 and 102 g / kg, respectively, whereas concentrations of Al and Pb varied between 16 and 31.3 g / kg.

The particles size study of sediment fractions showed that the concentrations of heavy metals were higher at areas with silty clay texture of sediment. Thus, a clear correlation was observed in all the sampling areas, between water and sediment showing the degree of contamination by the micropollutants due to their release by the sediment in the dissolved phase following their physico-chemicals characteristics in each station.

KEYWORDS: Assif El Mal River, Heavy Metals, Water Quality, Sediment, Sequential Extraction.

LEAD POLLUTION IN THE AQUATIC ECOSYSTEM OF GANVIE CITY

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ABSTRACT

The Lacustrial City of Ganvié is facing serious environmental problems and Pollution affecting touristic activities. Indeed, the deposition of all kinds of domestic and solid wastes, the fraudulent traffic of leaded gasoline through pirogues, the runoff waters from Cotonou city, and the effluents from Ouémé River are source of heavy metals contamination of the ecosystem. These toxic metals constitute a risk for this aquatic ecosystem through the chronic effects they are known to cause. The aim of this study is to assess the level of contamination of this ecosystem by heavy metal (lead). Therefore, 10 samples of water, 10 samples of sediments, and 30 samples of fish were collected and mineralized before this heavy metal (lead) content were analysed using an atomic absorption spectrophotometer (AAS) (Thermo Orion assisted by Solar S2 software) at the laboratory of Management, Valorisation and Treatment of wastes (GTVD), Lomé University (Togo). The most contaminated fish species used were: Sarotherodon melanotheron, (Cichlidae), Chrysichthys auratus, (Claroteidae), Ethmalosa fimbriata (Clupeidae), Liza falcipinnis (Mulgilidae) Penaeus Kerathurus (Peneidae). All data were subjected to statistical analysis using SPSS 17.0 software. Average and standard deviation were computed with the aid of descriptive statistics. Conformity tests were performed with Student test at a probability of 5% using the section « compare means, one way ANOVA ». After the above test, the means obtained were compared to the standards set by GESAMP for water and sediments and CE 466/2001 standards for fishes. The results revealed high concentrations in lead above the safety norms in most of the samples. The different values expressed in mg/kg (fish, sediments) or mg/L (water) are: 0.56 mg/L (water), 54.04 mg/kg (sediment), 26.85 mg/kg (fish) for lead. The different results obtained show the pollution of Ganvié aquatic ecosystem by lead in the sediments and, on the other hand, the deterioration of water quality and fishes of consumed by people.

KEYWORDS: Ganvié Aquatic Ecosystem, Water, Sediment, Fish, Pollution, Heavy Metals, Lead

EFFECT OF ALGERIAN SOUTH OF THE DRINKING WATER ON THE OXALOCALCIC CRYSTALLIZATION, IN VITRO

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ABSTRACT

The precipitation of the calcium oxalate crystals in the urines and especially, the stage of aggregation play a decisive part in the process of formation of urinary stones. Indeed, urinary crystallization is definitely more frequent at the lithiasic subjects. The complexation of these lithogenous salts by some ions contained in drinking water makes it possible to make these salts more soluble. They are the fluorides ions, sulphates, magnesium. Water of the Algerian South is mainly sulphated.

Recent studies showed that the sulphates of mineral water have a metaphylaxis effect in urolithiasic risk.
What happen with sulphated water of the Algerian South?

The concentrations of sulphates of 104 tap water samples coming from various areas of the Sahara were given. Then, the study of the influence of this water on the calcium oxalate formation to physiological concentrations out of calcium and oxalate of the lithiasic patient was carried out, by the measurement of conductivity according to time.

The results obtained show that this water is sulphated. 72, 64% have a concentration higher than 250mg/l value guides recommended by the WHO and the Algerian standards of potability (NA 6360).

The experimental curves of the follow-up of the kinetics of calcium oxalate crystallization are composed of two stages. The 1st stage presents a negative slope and the 2 nd presents a positive slope. Their coefficient of correlation is R > 0, 99 and CV < 10%. The conductimetric parameters in the presence of samples of drinking water town and those in its absence show that Saharan water inhibits calcium oxalate crystallization from 13,312% to 85,320%.

There is an excellent linear relation between 70% of this sulphates water of which and anti - crystallizing effect on the growth of calcium oxalate.

KEY WORDS: Calcium oxalate, Drinking water of the Saharan South, Urinary stones, Conductimetry.

UTILISATION DES MOULES EN TANT QU'OUTILS DE LA BIODETECTION DE LA POLLUTION DANS LES MILIEUX AQUATIQUES

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RESUME :

Le suivi de l'impact des aménagements estuariens ou portuaires sur l'hydrosystème est rendu difficile par la variabilité considérable de ces environnements au cours des cycles saisonniers et de marées. Il est difficile et coûteux d'étudier ces impacts sur la seule base d'analyses chimiques des eaux, car cela exigerait un suivi quasi continu en des points multiples. L'analyse directe des polluants, bien qu'indispensable en fournissant des données physico-chimiques quantifiées, ne permet pas de connaître l'impact sur le milieu vivant.
Actuellement, on a besoin d'outils capables d'aborder de manière aussi globale et intégrée que possible ces problèmes, dans le souci d'améliorer nos connaissances et contrôler les phénomènes mis en cause.
Dans ce contexte, nous avons utilisé les moules comme moyen de biodétection de la pollution marine côtière. Leurs analyses sont faites selon essentiellement deux techniques ; la première étant l'analyse par fluorescence UV afin de déterminer la teneur totale des hydrocarbures aromatiques polycycliques (HAP). La deuxième, c'est l'utilisation de la chromatographie en phase gazeuse avec détecteur à ionisation de flamme (CG/FID) pour identifier et quantifier ces HAP. C'est ainsi que la première étape dans cette étude apparaît comme un état des lieux de la pollution par ces HAP et la seconde comme un établissement de l'origine de cette pollution. Nous avons cherché la présence des HAP durant les quatre saisons : Eté, Hivers, Printemps et Automnes. L'objectif est de voir la variation des teneurs des hydrocarbures Aromatiques sur les quatre saisons et dans différentes zones du littorale Casablanca - Mohammedia. Notre souci est de trouver la corrélation entre le régime Hydrodynamique, qui varie dans cette zone suivant les saisons, et la teneur en HAP.

MOTS CLES : Pollution Marine, Techniques d'analyse, Biodétection, Origine de la Pollution.

QUALITY OF THE GROUNDWATER IN THE EASTERN HAOUZ PLAIN AND TASSAOUT, WESTERN MOROCCO

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ABSTRACT

The Eastern Haouz plain and the region Tassaout are located in the east of Oued Zat, the west of Oued Lakhdar, the south of High Atlas and the north of Jebilet. The compilation of geological, drilling and geophysical data lead us to identify the reservoir cover, which is formed by the Mio-Pliocene and the Quaternary formation; and the underlying formation composed by the series of Triassic and Permo-Carboniferous especially (Stephano-Autunian) forming the bedrock of the aquifer.

The groundwater flow is imposed by a divided line of groundwater oriented North West-South East; we distinguish two flow axis, the first one oriented North-South, is parallel to the surface flow of oueds Lakhdar and Tassaout, the second, oriented East-West is feeding Tensift. The groundwater recharge is by anastomosis in contact with limestone outcroppings of the High Atlas, at Oueds Lakhdar Tassaout and Rdat, and by infiltration of irrigation water at the perimeter of the upstream Tassaout. We can also distinguish another recharge located downstream to the plain in the contact of Jebilet.

The results of the groundwater quality show that the electric conductivity varies between 761 µs/cm and 7680 µs/cm, and 80 % of the mineralization of the studied area has a conductivity less than 3000 µs/cm. The chemical facies is sodium chloride to mix. The content of nitrates is generally less than 50 mg / l in all the zone, which means, the water quality is average good; except where it exceeds the standard (50 mg / l), is considered as bad quality of groundwater.

Pollution sources are three categories: agricultural pollution that broadcasts in the irrigated perimeter of the Tassaout upstream, urban pollution with domestic waste and pollution by sewage discharges around agglomerations Tamalelt, El Attaouia and Ait Ourir.

TOPIC 3

Impact of Climate Change on Water Resources and Biodiversity

THE IMPACT OF CLIMATE CHANGE ON WATER RESOURCES MANAGEMENT

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ABSTRACT

In the face of limited water resources, the Arab has to be re-structuring and management of water resources to match what was expected to increase pressure on those resources due to the direct impact of climate change, where you must activate the principle of integrated management of all water resources up to reduce water losses and maximize the return from a unit of irrigation water concept of national security and economic demonstrating that harnessing the political relations to serve this purpose. Should also review the policy of distribution and consumption of water and change the crop structure commensurate with its economic feasibility from the standpoint of water, in addition to the establishment of a regional numerical model to modify the structures to control the crop in the effectiveness of the exploitation of water resources.

In general, Arab countries are developing countries, which is highly vulnerable to the effects of climate change because climate is dry if the temperature rose or fell in the area of rain, intensified pressure on natural systems and physical. According to studies of climate models that the Arab region will increase by 5.5 degrees Celsius in the surface temperature at the end of the twentieth century and the atheist. And this increase will be associated with an expected drop in rainfall from zero to 20 per cent, these changes will make the expected shorter winters and drier summers, warmer, and raise the heat waves and increase the frequency and occurrence of volatile weather events and extremes. These effects are an increase in evaporation from water bodies and natural and artificial soils, thereby reducing the available water supply. , The effects will increase the rate of evapo - transpiration products of crops and natural vegetation. That climate change will increase in future demands on the irrigation potential by 6 to 16 per cent due to the increase in transpiration with the end of the twenty-first century. And lead to changes in climate due to global warming to changes in the distribution of insects (locusts) and other vectors that transmit human and animal pathogens. The atmosphere warmer, with accompanying climatic instability growing, will increase the risk of floods and droughts are likely to increase drought-affected areas, and likely to increase in cases of rainfall is extreme, in terms of frequency and intensity, and will worsen the risk of flooding and there will be floods and droughts and a water shortages, the main obstacle in most countries in the Arab region.

The piece that incorporate measures to mitigate climate change and adaptation strategies and policies in the development of water management strategies that strengthen and increase efficiency.

GROUNDWATER FLOW SYSTEMS AND THEIR RESPONSE TO CLIMATE CHANGE: A NEED FOR A WATER-SYSTEM VIEW APPROACH

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ABSTRACT

The interest in early hydrogeological studies was the aquifer unit, as it is the physical media that stores and permits groundwater transfers from the recharge zone to the discharge zone, making groundwater available to boreholes for water extraction. Recently, the aquifer concept has been complemented by the *Groundwater Flow System Theory*, where groundwater may be defined by local, intermediate and regional flow systems. This implies that groundwater may travel from one aquifer unit to another aquifer unit (or more) located above or below the former. Water in a local flow system takes months or several years to travel from the recharge to the discharge zone. These flows usually transfer the best natural quality water, so a reduction in precipitation would lessen recharge and diminish stored water, making them most vulnerable to contamination and variability in climatic conditions. Thus, there is a need to define local flows and to enhance actions to protect them from contamination and inefficient extraction. In contrast to local flows, intermediate and regional flows travel from a region, or country, into another, with their recharge processes usually taking place in a zone located far away from the discharge zone (natural or by boreholes). There is a need of groundwater flow systems evaluation by means of an integrated wide system-view analysis of partial evidence represented by surface (soil and vegetation covers) as well as hydraulic, isotopic and chemical groundwater characterization in the related geological media where depth to actual basement rock is paramount as well as discharge areas. Flow system definition may assist in extraction management strategies to control related issues as subsidence, obtained water quality change, desiccation of springs and water bodies, soil erosion, flooding response, contamination processes in recharge areas, among others; many of which could be efficiently managed leaning on groundwater functioning. There is increasing evidence that climate becoming more variable and key driver of ecosystem health. Even with climate stability, most developing countries will confront serious water problems by the mid-21st century due to an insufficient knowledge of the functioning of their groundwater sources representing ≈99% of available water. Many such problems may be adequately controlled when local flows are defined, since changes in climatic condition are more prone to affect local flows rather than intermediate and regional flows. The value of the flow systems arises from the fact that a wide system view analysis allows adequate crossed examination among relevant data from where water management proposals might more adequately represent field conditions. Examples of successful application of the groundwater flow systems in Mexico and Argentina will be presented including: induced fluoride control, subsidence response, desiccation of springs, flooding water origin definition, basement position in flow-system control, inter-basin flow.

KEYWORDS*:* Regional flow, Discharge zone, Local flow, Recharge zone.

THE RED DEAD CANAL PROJECT: AN ADAPTATION OPTION TO CLIMATE CHANGE IN JORDAN

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ABSTRACT

In arid and semi arid regions such as Jordan, climate change impacts on the balance between available resources and demands are expected to be severe. Climate change is expected to reduce resources and increase demands which will inevitably result in enlarging the gap between supply and demand. Adaptation to these impacts can be achieved either by reducing demands via implementing demand management practices or by developing and utilizing undeveloped resources or by both. This paper investigates the impacts of the proposed Red Dead Canal (RDC) project on bridging the gap between supply and demand in Amman and Zarqa cities within Amman Zarqa Basin and in the Jordan Valley. The Water Evaluation And Planning system (WEAP) is implemented for the Jordan Valley and Amman Zarqa Basin (AZB) for this purpose. WEAP allocates water to competing demands based on the physical system characteristics as well as user defined criteria so that coverage at all competing demand sites is equal. The physical system characteristics include water availability, water demands, and transmission line capacity. The user defined criteria include demand priority and supply preference. The Jordan Valley and Amman Zarqa Basin are represented as a network of supplies and demands connected by transmission lines in the WEAP environment. AZB and the Jordan Valley are connected via Zarqa River where As Samra wastewater treatment plant effluent which treats the wastewater generated in Amman and Zarqa is discharged to the river which flows to KTD and then released to the Jordan Valley and used for irrigation after mixing with King Abdulla Canal (KAC) water. Inputs to the model were taken from MWI real time records and measurements and other sources such as the Department of Statistics. The WEAP model was run for three scenarios namely: Business As Usual (BAU) scenario, Climate Change scenario, and RDC scenario. In the BAU scenario water demands and resources trends grow as expected or planned. In the climate change scenario, climate change impacts on the resources; runoff and groundwater recharge and on the demands in the valley are imposed. Runoff and groundwater recharge are assumed to decline according to a certain formula and irrigation demand is assumed to increase by 10%. In the RDC scenario, the RDC project which will provide about 550 MCM of desalinated water per year is assumed to be implemented by the year 2022. The results showed that without implementing the RDC project, the gap between supply and demand for Amman and Zarqa for domestic use as well as in the Jordan Valley for irrigation use will continue to grow until the year 2050 for both the BAU and the climate change scenarios. However, by implementing the RDC, the domestic demand at both cities will be satisfied starting the year 2022 till the year 2050. Furthermore, the deficit in the agricultural demand in the JV for the year 2050 will drop from about 195 MCM for the climate change scenario to about 85 MCM for the RDC scenario as a result of the increased treated wastewater flow to the valley from AZB. The results also showed that groundwater resources that supply Amman and Zarqa from inside the basin as well as from outside the basin can be saved as a result of giving the supply preference to the RDC project.

KEYWORDS: Water resources management, WEAP, Climate change, Jordan Valley, Amman Zarqa basin

MISE EN PLACE DE LA CHAINE HYDROMETEOROLOGIQUE SAFRAN-ISBA-MODCOU SUR LE BASSIN VERSANT DU TENSIFT

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RESUME

Le Maroc, de par ses caractéristiques climatiques et géographiques, est sujet à des phénomènes extrêmes tels les inondations et les crues, qui sont appelés, dans la perspective d'un climat réchauffé, à devenir plus fréquent. En effet, Le régime hydrologique présente une très grande variabilité et peut générer, même en période de sécheresse, des inondations exceptionnelles impactant de manière durable le potentiel de développement des régions concernées. Il existe donc, au Maroc, un réel besoin pour la mise en place d'outils susceptibles d'améliorer notre connaissance du fonctionnement hydrologique des bassins versants, intégrant la dynamique des eaux de surface et souterraines et leurs interactions.

Dans ce contexte, La chaine hydrométéorologique SIM (Safran-Isba-Modcou ; Habets et al. 2008), a été développée à Météo-France en collaboration avec le Sisyphe dans cet objectif. La chaine SIM simule les bilans hydriques et énergétiques ainsi que les débits des rivières et les niveaux des nappes. Elle est composée du modèle de ré-analyse météorologique SAFRAN (Lemoigne, 2002; Quintana-Segui et al. 2008), du modèle ISBA (Noilhan et Planton, 1989; Noilhan et Mahfouf, 1996) pour les échanges verticaux d'eau et d'énergie entre la surface et l'atmosphère et du modèle hydrogéologique MODCOU (Ledoux et al. 1989) pour le routage de l'eau vers les rivières et la dynamique des eaux souterraines.

La chaine SIM, développée et évaluée sur des écosystèmes des latitudes tempérées, a été testée sur le bassin versant, semi-aride au régime d'écoulement intermittent, du Tensift. Dans le cadre du projet de mise en place de la chaine SIM sur le Tensift, le modèle d'analyse météorologique SAFRAN a été testé et validé sur le bassin du Tensift en utilisant les données observées et prévues par le modèle météorologique ALBAHIR. D'autre part, le système de ré-analyse SAFRAN a été couplé au schéma de surface ISBA pour lequel les bilans hydrique et énergétique ont été testés sur un site de blé irrigué.

KEYWORDS: Climat, Modelisation Hydrologique, Impact des Changements Climatiques sur les Ressources En Eau

IMPACT OF CLIMATE CHANGE ON GROUNDWATER RECHARGE IN THE WEST BANK, PALESTINE

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ABSTRACT

One of the most chief challenges facing us nowadays in terms of the management actions needed to limit its effects is climate change. Climate change causes serious environmental, human health, and economic threats, and its effects will be strongest in regions with scarce resources. The Middle East is the World's most water-stressed region. Climate models predict more extreme weather events, a decrease in precipitation and an increase in temperature which will, according to most models, increases by 1.2 to 3°C in the region. This will increase the evaporation rate, and therefore decrease the portion of available water from rainfall, which will accordingly affects the groundwater recharge adversely. As groundwater resources provide vital freshwater supply for Palestinians, the estimation of its recharge is considered a basic element for optimal water resources management of the West Bank.

This paper aims at quantifying the groundwater recharge for the entire West Bank with respect to rainfall. The Soil Moisture Deficit (SMD) Method was utilized in this regard due to its applicability under arid and semiarid conditions. Based on the historical rainfall records, starting from 1975 to 1997, the long-term average groundwater recharge for the West Bank was estimated along with recharge for different years. An MS Excel sheet was developed for this regard to enable the prediction of the impact of climate change scenarios on groundwater recharge.

SAND ENCROACHMENT AND ITS ENVIRONMENTAL IMPACT ON THE NILE RIVER MORPHOLOGY

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ABSTRACT

Nile basin is among the largest river basins in the world. It is the longest one (6695 Km) and ranks second when considering the number of countries sharing its water resources. The River Nile watershed area is about 3.0 million km^2. It covers parts of ten African countries (Burundi, Congo D.C., Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, and Uganda).

River Nile is an alluvial one where it adjusts its slope, width, depth and hence velocity to achieve stable conditions at specified water and sediment flows. The recent phenomenon of sand encroachment on the Nile in the northern part of Sudan represents a serious problem endangering the river course. Sand encroachment exacerbates the morphological behaviour of the River Nile in the Northern part of Sudan. It leads to many negative impacts in addition to frequent flood damages. The implications of this phenomenon is not limited to the physical system of the Nile river, but extent to the socio-economical aspects of the people living in those areas, i.e. the encroaching sand destruct the limited area cultivated on the flood plains of the river and buries their homes. In some locations of the river course the sand encroachment affected over 50% of the irrigated areas.

In some reaches of the Nile the creeping sand covers both banks and pours large amount of its particles inside the course of the river and particularly at the bed, i.e. choking its course dangerously. All signs lead to the seriousness of the situation and the final result may lead the Nile River to abandon its regular course. If the latter situation occurs the Northern Sudan and Egypt may not get any considerable amount of water.

In this paper the phenomenon of the sand encroachment along the River Nile is studied and evaluated. The danger of the sand creeping towards the Nile course is highlighted. The major goal of this paper is to evaluate the magnitude of the problem of sand encroachment on the River Nile morphology and the socio-economical implications. The paper concludes with mitigation measures and recommendations.

KEYWORDS: Nile Basin, Sand Ecroachment, River Morphology, Environmental and Socio-Economic Impacts, Northern Sudan

IMPACT OF THE CLIMATIC WARMING OF THE WATER RESOURCES

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ABSTRACT

For several decades our planet has become hostage of a proven climatic change, caused by anthropic origin emissions of gas, known under the denomination of greenhouse effect gas . The experts of the Intergovernmental Panel one Climate Changes (IPPC) are unanimous on a planetary warming for the century to come about 3°C compared to last century.

The recent planetary temperatures prove that it is a warming of human origin since that during the last quarter century, the temperatures increased at a rate of 0,19°C per decade. It is obvious that the consequences of the climatic warming are going to influence in an undeniable way the water resources in the world as well as like on their use.

In this context, the World Bank considers that the impact of climatic change on water resources became a major concern which needs all the human and financial means to contain this problem. In the present paper we draw up a statement of the deplorable effects of the climatic warming and its impact on the water resources by emphasizing the tools and the methods to fight against climatic warming in the area of the Maghreb by putting forward the potentialities of this area in renewable energy resources considered as an inescapable guarantor of a durable development for the future generations.

KEY WORDS: Warming, Anthropic, Renewable Energy, Water Resource,

MODELING RAIN-FLOW IN THE MANAGEMENT INTEGRATED OF SURFACE WATER RESOURCES IN THE BASIN OF VOLTA IN0 BENIN

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ABSTRACT

In tropical Africa and in the basin beninese of Volta, of many studies show that surface water and their management are very dependent on climatic variability. Thus, the rainfall instability of years 1960 at our days, contributed to a modification of hydrological modes and by consequence with nonthe control of water resource in the basin of Penjari.

The goal of this study is modeling rain-flow starting from model GR2M during dry and wet sequences. It is also a question of analyzing the availability of water resource to leave the indices hydrous deficit, the coefficients of flow and drying up, in order to appreciate the role of geological substratum and climatic evolution of basin.

This study is based on the data of rains and ETP of the rainy stations of basin and the surrounding stations of Togo and Burkina-Faso on the one hand; flows at the hydrometric station of Porga and Tiele on the one hand. A cubic interpolation spline which is based on the triangulation of Delauney will be made for obtaining field of rain in each hydrometric station in order to better determine the relation rain-flow in under-basin.

The results obtained made it possible to note a persistence of the dryness since the 1970, with a rainfall of about 10 %, which amplified a fall of flow of about 30 to 40 %. This very marked fall sometimes associated the total environmental changes generate a fast drying up prejudicial with the availability and the management of surface water.

KEY WORDS: Benin, Basin of Volta, Modeling, GR2M

QUALIFICATION OF SALINITY OF THE SOIL AND WATER IRRIGATION IN THE PALM GROVE OF SKOURA IN SOUTH OF MOROCCO

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ABSTRACT

The main objective of the present study is to characterize the salinity of soil and waters of irrigation in the palm of Skoura of the region of Ouarzazate in the South of Morocco. A dynamic monitoring of the quality of soil, of the evolution of the depth of tablecloth, of the electric conductivity and the temperature of irrigations waters was made since June, 2005. The soil Salinization is caused by the concentrations of Sodium chloride (NaCl) and sulphates of sodium (Na2SO4) as a white crust on the surface. This concentrations result from the washing of the évaporitic formations of the upstream watershed and of the irrigation by waters of floods and ground waters charged enough in salts. The accumulation of Na + and Cl- of groundwater towards to the downstream of the palm is due to the unique sense of the tablecloth and to its bad system of drainage. A portion of sodium (Na +) is an integral part of the soil and finds its source in the bedrock. In irrigation, anther portion of sodium unfixed by the soil is driven toward the ground with all the chlorides. Following the high evaporation of water, these harmful ions accumulate in the root zone by capillary rise.

KEY WORDS: Water of Irrigation, Soil, Palm Grove, Salinity, Desertification

OUTIL METHODOLOGIQUE POUR LA DETECTION D'EVENTUELS CHANGEMENTS CLIMATIQUES DANS LA SERIE HYDROLOGIQUE ET CLIMATIQUE AU NIVEAU DU BASSIN DE TENSIFT (MAROC)

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RESUME

Le changement climatique, au fil du temps, se réfère à tout processus d'évolution lente qui affecte les caractéristiques climatiques dans une région comme le réchauffement ou le refroidissement [1]. Les variations globales du climat de la Terre ont des cycles de réchauffement plus ou moins en alternance avec le refroidissement différent dans leur durée.

La compréhension de ces changements nécessite une analyse approfondie des données hydroclimatiques de l'ensemble des données disponibles sur les sites d'observation au niveau d'un bassin versant. Les documents relatifs au traitement des séries temporelles de ces paramètres (précipitations, températures, débits) exigent d'abord l'étude des caractéristiques stochastiques.

Une série est dite non-stationnaire si les changements de variabilité varient dans le temps ou si les valeurs de chaque jour sont en corrélation les une avec les autres et montrent ainsi une certaine tendance. Si le processus de traitement de séries temporelles est invariant, il est appelé à l'arrêt. Nous pourrons alors traiter la série par des outils de modélisation. La stationnarité assure que le modèle choisi peut être utilisé en dehors de la période pendant laquelle il a été estimé.

Dans le cadre de l'étude du phénomène à travers le bassin hydrographique du Grand Tensift, toutes les données disponibles seront analysées pour détecter la présence ou l'absence de perturbations majeures dans les observations. Un autre objectif est de corréler l'histoire hydroclimatique de la région avec des phénomènes à grande échelle tels que la NAO. Les modèles de séries chronologiques, retenus pour cette étude sont basés sur les processus ARIMA correspondant à une famille de processus aléatoires. Il existe une relation entre les observations éventuellement retardées et les erreurs de prévision. Les modèles ARMA (p, q) sont utilisés pour modéliser les séries temporelles, comme les précipitations, le débit ou d'autres phénomènes environnementaux.

Nous distinguons les processus autorégressifs qui peuvent faire des prédictions simples et des processus fiables et que l'on appelle la moyenne mobile est utilisée pour éliminer ou atténuer les fluctuations cycliques, saisonnières et accidentelles.

La modélisation des précipitations et la température vont tenter de déterminer les processus et les modèles capables de reproduire l'évolution de ces variables. Cette approche possible sera grâce à l'application de la méthode univariée de Box-Jenkins (1976), la procédure comporte les étapes suivante: ajustement stationnaire et saisonniers, estimation, validation et test et prévision final. Il sera utilisé une combinaison de méthodes d'ajustement du modèle ARMA et la prévision sur le traitement des composants non-stationnaires y compris les tendances et la saisonnalité

APERÇU DE LA VULNERABILITE DU SECTEUR DE L'EAU, AGRICULTURE ET ENERGIE AUX IMPACTS DES CHANGEMENTS CLIMATIQUES AU MAROC: CAS DE LA PREFECTURE AGADIR IDA OUTANANE

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RESUME

Les modèles du Groupe Intergouvernemental d'Experts sur l'évolution du Climat (GIEC) prévoient une augmentation globale de la température moyenne et une diminution de la précipitation. Sur les régions du Maroc, ceci se traduira par une augmentation de température moyenne de 0.6 °C à 1,1 °C et une réduction des précipitations de l'ordre de 4 % à l'horizon 2020. Ces changements du climat peuvent avoir des conséquences néfastes sur les écosystèmes et les ressources en eau. Les écosystèmes marins, le couvert végétal et en particulier l'agriculture seront sévèrement affectés.

La présente étude a été réalisée sur la préfecture Agadir Ida Outanane dont l'objectif d'évaluer la vulnérabilité de cette région aux changements climatiques ; et ce à travers une enquête auprès de 240 personnes (décideurs, agriculteurs, employés du secteur touristique, jeunes et différents acteurs sociaux) réparties sur différents secteurs de la préfecture.

L'étude montre que l'eau et l'agriculture sont des secteurs très vulnérables, le secteur d'énergie est jugé comme vulnérable. L'étude montre aussi qu'il n'y a pas de vraies implications des citoyens, ce qui engendre des pratiques non durables, ni une réelle communication entre eux et les décideurs aux processus nationaux liés aux changements climatiques.

MOTS CLES: Vulnerabilite, Eau, Agadir Ida Outanan, Energie, Agriculture, Changements Climatiques, Maroc, Adaptation.

WASTEWATER TREATMENT AND CLIMATE CHANGE: DISINFECTION EFFICIENCIES, ENERGY AND CARBON MANAGEMENT OPPORTUNITIES OF WASTE STABILISATION PONDS IN SUB-SAHARIAN AFRICA

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ABSTRACT

Developing countries and particularly those of sub-Saharan in Africa are characterized by low indices of wastewater treatment. According to WHO (2008), These unsanitary conditions are responsible for one hundred deaths higher in developing countries than in developed countries.. Moreover, the effects of desertification caused by the excessive destruction of forests in these countries render them more vulnerable to the effects of climate change. In response to these two constraints, the use of low cost, simple wastewater treatment technologies combining disinfection efficiencies and energy production could be a response to the question of long term sustainability of water resources protection and the associated issues of carbon management. For instance, wastewater stabilization ponds are known to be best adapted to warm climates like those that characterize most African sub-Saharan countries. Their potential disinfection and pathogen reduction capacity through sunlight-powered aerobic treatment with possible reuse of treated wastewater in agriculture are among the most tangible benefits in areas where the scarcity of water resources becomes more and more threatening. As explained by different authors (Green et al., 1995; Craggs et al.,1999; deGarie et al., 2000; Mara 2004; Park et Craggs, 2007), energy may also be cost-effectively produced as biogas from anaerobic ponds. The reuse of this biogas with high methane content (Green et al., 1995; Picot et al., 2003) may be a way to reduce greenhouse gas (GHG) emissions, of which methane is considered as a very powerful GHG: i.e a tonne of CH_4 is equivalent to 21 tonnes of CO_2. However, algae production in facultative and maturation ponds can have a role in abating greenhouse gas through the biofixation of CO_2. With all these considerations (environmental, sanitary and financial benefits of WSP technologies), African countries can benefit from these approaches to organize wastewater management. The results and experiences gained from wastewater management and the operating of full scale stabilization ponds for the municipality of Ouagagoudou (Burkina Faso) are shared in this paper.

KEYWORDS: Disinfection, Energy, Biogas, GHG, Wastewater Stabilization Pond, Burkina Faso

TOPIC 4

Processing Technologies and Wastewater Reclaim

OVERVIEW OF MEMBRANE PROCESSES FOR THE RECOVERY OF POLYPHENOLS FROM OLIVE MILL WASTEWATER (OMW)

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ABSTRACT

Olive mill wastewater (OMW) is an ambivalent by-product of the olive oil production, which appears in huge amounts every year after the olive-harvest in the production countries, mainly in the Mediterranean area. OMW is characterized by a high organic load and i.a. contains considerable amounts of phytotoxical polyphenols, which cause important environmental problems. However, due to their antioxidant properties the use of these polyphenols is also popular in several industry branches, which results in high sale values for this group of chemicals.
Thus, the removal of polyphenols from biological wastewaters like OMW does not only reduce the pollutant load but also shows great potential for a beneficial recovery of these antioxidants. This is the reason why a growing number of studies deal with a combined wastewater treatment, which, besides water purification, also regards the ability of recovering polyphenols.
Membrane separation is one of these techniques to purify the wastewater. It allows an effective water treatment in a small operation area has a low energy-consumption and generally works without chemical additives. Its use is popular in water treatments and it is qualified for the OMW treatment as well. The specific separation limits allow adjusting this treatment with regard to the particular wastewater, whose characteristics vary with olive origin, extraction method and other factors. In that way, the amount of organic carbon for instance can be reduced by mircofiltration and ultrafiltration, while the larger part of polyphenols can pass the membrane.
Hence, after separating the phenolic compounds from other organic constituent parts, nanofiltration and reverse osmosis can be applied in order to produce a concentrate, which contains high concentrations of polyphenols. Furthermore, these processes produce water, that can be reused in the olive mill as process water or alternatively for irrigation.
This article is an overview of reports concerning polyphenol recovery from OMW via membrane technologies. Patents and studies, which appeared in literature, are reviewed in order to identify the potential of membranes as well as making comparisons possible. Moreover, some pretreatments, feasible for membrane processes, are covered. Depending on the initial wastewater and its polyphenol content the concentration in the obtained solution ranged from 0.5 – 9.9 g/l polyphenols. A recent study mentions an experimental set-up that even obtained a concentration of 19.3 g/l. Polyphenols such as hydroxytyrosol, procatechuic acid, tyrosol, caffeic acid and oleuropein were found in this concentrate and make it suitable for the use in industry.
The membrane processes in sequential design in particular show good results and offer an alternative to other OMW treatments especially in terms of polyphenol recovery.

KEYWORDS: Overview, Membrane Process, Polyphenol, Olive Mill Wastewater

INDUSTRIAL HERBAL EXTRACTION WASTEWATER TREATMENT USING AN ANAEROBIC MEMBRANE BIOREACTOR

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ABSTRACT

The focus of this presentation is the treatment of an industrial herbal extraction wastewater, Therefore we collaborate with the major water consumer of an industrial area in Casablanca, which is a natural extraction company. The wastewater has a high organic content and its biological anaerobic treatment is feasible and recommended. The anaerobic treatment has the advantage of biogas production and is capable of contributing to the energy demand of the company. The main constraint is the need to have a high reactor temperature and the lower stability of the process compared to an aerobic biological process. But as the temperature of the wastewater is nearly 30° C the energy need to heat the reactor is comparably low.
The stability of the process will be enhanced by using an immersed membrane separation, which will completely separate the biomass in the event of a system failure, which in a conventional anaerobic digestion process would result in a loss of the micro organisms.

The wastewater of the herbal extraction company is mimicked by using an aqueous extraction of rosemary, as rosemary is one of the main raw materials in the industrial process. The rosemary is boiled for 3 hours in water (1 kg rosemary per 10 L water). The produced concentrate is diluted to a COD concentration of 10,000 mg/L.
The reactor has a volume of 23 L and was started under anaerobic mesophilic conditions (36°C) with an organic loading rate OLR = 4 kgCOD/(m^3*day). With the given feed properties this results in a HRT of 2.5 days. The OLR will be optimized with a target range of 4 to 15 kgCOD per m^3. The reactor was inoculated with anaerobic digestion sludge of a municipal wastewater treatment plant. The separation of the biomass is assured by an ultrafiltration membrane with a pore size of < 0.1. The total membrane area of the used plate membrane module sums up to 0.272 m^2.
First batch experiments were conducted in 250 mL pressure resistant glass bottles at a temperature of 35°C. After an experiment time of 28 days the COD elimination reached 63.3%. As the biomass concentration of this experiment was comparably low (about one third of the envisaged amount) this is a promising result.
The anaerobic membrane bioreactor has just been started. The expected results until the conference are: the behaviour during start-up, the elimination of COD, the biogas yield and quality at two to three OLRs.

KEYWORDS: Wastewater Treatment, Biogas, Membrane Bioreactor

CONTROL, FAULT DETECTION, AND SUPERVISION IN TECHNICAL PROCESSES - APPLICATION TO SURFACE WATER TREATMENT

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ABSTRACT

In water treatment, the technical processes study aims generally to deal with problems that natural processes are not able or only inadequate to perform. The technical systems aim for a good control of process and therefore a good stability. It is for example the case of coagulation process in drinking-water treatment by removing suspended particles. The coagulation process is essential to several post-treatments, especially filtration process. It involves the addition of a chemical coagulant, typically aluminium sulphate, used for destabilization (charge neutralization). A bulky precipitate is formed, which electrochemically attracts solids and colloidal particles. The solid precipitate is removed by allowing it to settle to the bottom of the tank and then periodically removing it as sludge. The coagulation process requires a good knowledge of raw water characteristics to ensure adequate choice of the coagulant rate. Without the adequate coagulant this method is not effective.

In this work, we present a connectionist approach in combination with a fuzzy approach to study the impact of raw water characteristics on the coagulation process control involved in a drinking water treatment plant. The key descriptors of these characteristics are considered as INPUT variables for modelling procedure, the cost function to optimise is the optimal coagulant rate and a states sequence of plant operation. Using the concepts of evolutionary algorithms and that of the marginal adequacy derived from fuzzy logic, we could propose and develop a hybrid system to predict the optimal dose of coagulant after a step of data validation and data reconstruction, and to identify a sequence of normal and abnormal states of plant operation. The simulation results show the reliability of this approach, based on algorithms developed and adopted to descriptors variations, and also the possibility to apply this approach type for optimizing other technical processes considered crucial in water purification.

KEYWORDS: Drinking-water treatment, Coagulation process, Modelling, Optimization, Neural Network Approach, Fuzzy Approach

CARMINE INDIGO AND METHYLENE BLUE REMOVAL FROM TEXTILE WASTEWATER BY MYTILUS EDULIS SHELLS

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ABSTRACT

Effluent from the textile industry are loaded of non-biodegradable dyes which makes it difficult to apply biological treatments, several techniques have been employed to remove dyes from wastewater, biosorption is the most used actually. The marine biomaterial Mytilus Edulis shells were used as a new low-cost biological adsorbent for the removal of textile dyes (Indigo Carmine and Methylene Blue) from aqueous solutions.

The Mytilus Edulis shells were characterized by several techniques X-ray powder diffraction, spectrophotometry of the fluorescence X, spectrophotometry infra-red and Microscopy electronic balayage.

A sample of Mytilus Edulis shells has been utilized as a sorbent for uptake Indigo Carmine and methylene blue. Experiments were conducted to investigate the biosorption characteristics of dyes by Mytilus Edulis shells. Operating variables studied were contact time, Sells quantity, granulometry, initial dye concentration, temperature and pH. The equilibrium state was reached within 60 min contact time. Biosorption capacity seems to be enhanced by increasing the biosorbent mass. Rising the temperature has also a positive effect on dye removal rate. Initial pH played the most important effect on the adsorbed amount of dyes, maximum colour removal was observed at pH 2 for indigo Carmine and between 3 and 10 for Methylene Blue. Pre-treating shells increased considerably the biosorption capacity. At a lower dyes concentration, biosorption could reach maximum in a higher quantity of shells.

The constants in the freundlich, Langmuir isotherms and the pseudo-first order, pseudo-second order kinetics models were calculated through the linearization of the equations. Kinetic and equilibrium data for shells were well described by the pseudo-first order and freundlich models, respectively. Besides, the sorption study has showed that the dye-sorption phenomenon onto Mytilus Edulis shells was good and favourable.

The shells biosorption capacity was compared to biosorption capacity of wood sawdust, marine algae and activated carbon. Considering low-cost, local availability and environmentally friendly materials, the comparison showed that Mytilus Edulis shells is an effective biosorbent and could find application in the treatment of dye contaminated wastewater.

KEYWORDS: Biosorption, Mytilus Edulis shells, Indigo Carmine, Methylene Blue, Isothermes, Cinetiques, Modelisation

THE PERFORMANCE OF DIFFERENT ANTI-SCALANTS ON SILICA-SCALING IN REVERSE OSMOSIS PLANTS

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ABSTRACT

The effectiveness of anti-scalants for calcium carbonate and calcium sulphate is often determined in laboratory tests like the NACE Standard Test Method 03-74. These test methods have the advantage that they are easy to apply, but the interaction with the membranes under real operating conditions is neglected. Particularly in the case of silica-scaling these test methods are not reliable, due to the different chemical scaling mechanisms of the calcium hardness and of silica.
When the concentration of silica in water increases, the soluble silica tends to polymerise, following an ionic mechanism. The monomer reacts more rapidly with dimers and higher oligomers than with another monomer. Thus, it is difficult to observe the polymerisation of silica and to predict the resulting molecules and their concentrations.

To investigate the performance of different anti-scalants at a reverse osmosis plant, a new membrane-based test method was developed in the present work.
The water, to be examined, is concentrated to a defined level with two reverse osmosis test cells of 80 cm² membrane surface each. Until the test water is concentrated up to the desired concentration level, a constant amount of permeate is produced and the concentrate is recycled to the feed tank. As soon as the desired volumetric concentration ratio is reached, the test plants is operated continuously at that concentration level and at a constant permeate flux, due to automatic controlled pressure adjustment.
The permeate flow is adjusted at a constant value of 480 mL/h equivalent to a permeate flux of 30 L/m²h. From the measured data recorded by a PC-System the permeance is calculated by dividing the actual permeate flow by the driving pressure difference.
Three criteria for measuring the performance of an anti-scalant are used:

- The time for the period of permeance decline
- The slope of the permeance decline
- The total running time until a pressure of 60 bar is reached

Besides the operating parameters of the plant, the ionic composition was generally analyzed once per hour by means of ICP. In addition a confocal laser scanning microscope is used to measure the thickness of the silica scale layer.

In this work the performances of 12 different anti-scalants on silica scaling in the range up to 250 ppm SiO_2 and with different pH-values are presented.
It is obvious that by using a suitable anti-scalant the slope of the permeance decline can be reduced considerably and in the case of very high SiO_2-concentrations the time for the permeance decline is prolonged.

KEYWORDS: Reverse Osmosis Plant, Anti-Scalant, Silica-Scaling, Performance

DAIRY EFFLUENTS TREATMENT BY SEQUENCING BATCH REACTOR (SBR)

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ABSTRACT

After experimenting with the conventional activated sludge process [Yahi & al, 2008]), [Yahi & al, 2009], we dedicate this phase to treatment of dairy effluents, strongly loaded with organic matter, by a sequencing batch reactor (SBR).

This study aims to evaluate treatment performance by reduction of COD and TSS under the influence of the variation of organic load (COD) and aeration time.
The results show that whatever the COD of the effluent to be treated varies between 220 and 6200 mg / l, the COD of the treated effluent is reduced when aeration time increases.
For low levels of COD applied (220 - 2640 mg / l), aeration time of 20 hours appears to be an optimum value ensuring an effluent composition very much in line with the discharge standards (< 90 mg / l).
This result shows that the choice of sequential bioreactor is more advantageous than the conventional activated sludge process, used by [Yahi & al, 2008], which required 24 hours of ventilation with 100 % recycling to eliminate only 1250 mg COD / l .

For organic loads to the largest entry (3120 - 6200 mg / l), the aeration time required is higher. Thus, it takes 48 hours to reduce 6200 mg COD / l to a value hardly consistent with the discharge standard for the nature of the sludge produced (filaments) and the settling time limit process performance.
It also appears that the removal efficiency of COD depends on the values of volumetric loading (cv) and mass loading (cm) applied and age of the biomass. For cv values ranging from 0 to 2.5 kg DBO_5/m^3.d and Cm values between 0 and 5 kg DBO_5/kg MVS.d, performance is inversely proportional to the applied load and varies roughly between 80 and 99% for cv and between 90 and 99% for cm.

The sequential bioreactor appears more advantageous than the conventional activated sludge process that requires 4.5 days of aeration to remove 6110 mg COD / l without recycling with volumetric loading from 0.29 to 0.92 kg BOD_5 / m^3.d and mass loads from 0.17 to 0.42 kg BOD_5 / kg MVS.d, [Yahi et al 2009].

KEYWORDS: Food Processing Effluents, Dairy Wastewater, Biological Treatment, Sequencing Batch Reactor.

CONSTRUCTION, EXPERIMENTS AND CFD SIMULATIONS ON THE PERFORMANCE OF TUNNEL SPACERS IN SPIRAL WOUND MEMBRANE MODULES

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ABSTRACT

The membrane technology is getting increasingly more importance in the field of water treatment. Nowadays there is a significant research effort in the area of membrane materials and construction of modules, to improve the capacity of membrane applications and to develop new application areas. Beside the module construction and the material of the membrane, the feed spacer which transmits the feed flow to the membrane, is also a component which has a significant effect on the performance of a membrane module. The spiral wound membrane module is one of the most frequently used module types, as it possesses a big membrane surface due to its compact construction. The limits of it applications are determinated by the narrow feed channels and the feed spacers. Research works on new forms of spacers can extend the application areas of spiral wound membrane modules.

The aim of the present work was to develop, to construct and to test a tunnel spacer with free flow channel in a spiral wound element with reverse osmosis membrane (RO membrane) and to compare it with a commercially available parallel spacer.

For this purpose, the influence of the flow characteristics and of the tunnel spacer on mass transfer through the RO membrane is determined experimentally as well as with CFD simulations. In addition the influence of the tunnel spacer on the performance of the membrane is examined with special consideration of the concentration polarization. For this purpose, different solutions at varying conditions are tested. As result it is shown that spiral wound membrane module with tunnel spacer can operate with higher flow rates because of the free flow channel, until the maximum allowed pressure loss of 0.7 bar is reached in the module. The experiments have shown also that the maximum flow rate of 3000 l/ h suggested by the manufacturers of spiral wound membrane modules leads only to 50 % of the pressure loss in a membrane module with tunnel spacer in comparison with a membrane module with parallel spacer. Therefore, higher flow rates up to 5000 l/h were tested, whereby the concentration polarization was minimized and so the permeate flow could be increased.

KEYWORDS: Reverse Osmosis Membrane, Tunnel Spacer, Construction, Experiment, CFD Simulation

INFLUENCE OF OPERATING PARAMETERS ON THE PURIFICATION DEGREE OF THE FLOTATION PLANT SPLIT-O-MAT®FLO OF THE COMPANY ENVIRO-CHEMIE

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ABSTRACT

The flotation plant Split-O-MAT®FLO, produced by the company Enviro-Chemie, is a pressure expansion flotation plant based on the current state-of-the-art. It is intended to handle industrial wastewater with volume flows from 0,5 up to 30 m³/h. By the industrial wastewater treatment, flows and compositions of wastewater can vary considerably. At weekends and nights the flotation plants are usually deactivated. In order to use the plants despite changing feed conditions, manual adjustment of the process operating parameters is essential. This is particular important for restarting up plants that have been stopped for a substantial time. The consecutive increase of personal requirements raises unreasonable costs and simultaneously causes shortages on personal availability. Besides the attainment of purification aims, the retrenchment of personal is a substantial purchase decision criterion for the producing industry as consumer of flotation plants.

The aim of the present investigation was therefore the development of a fully-automated purification process for the pressure expansion flotation plant Split-O-MAT®FLO, produced by the company Enviro-Chemie. Hence it was intended to reduce personal expenditure through an extended grade of process automation. For that, various operating states are to be acquired. Therefore, the recordings of the feed wastewater (quality, soiling, flow), of the flocculation characteristics (particle sizes/floc sizes, pH, conductivity), and of the flotation characteristics of the plant (compressed air volume flow, bubble visualization, turbidity in the flotation cell, thickness of flotation sludge layer) are necessary. For the recording of these different measurement and control parameters, the processing of online recorded values in a flexible and adaptive operation control system and the processing in congruent automated control commands are required. An integrated remote surveillance of the plant assures a mostly automatic operation, while on-site personal ideally only provide process chemicals (precipitants, flocculants, acid or lye for pH-regulation). For the consumer, the advantage is an improved competitiveness. Furthermore considerable market opportunities through the upgrading of consisting systems of other providers are created.

Because of the complexity of the present problem, the tasks were divided between 3 cooperation partners. The Institute of Process Engineering and Plant Design has undertaken fundamental research and the development of the metrology and process engineering of the standardized pressure expansion flotation plant. The company Enviro-Chemie has undertaken the following tasks: the redevelopment of standard flotation, the construction of a complete plant with integrated measurement and control technology, and the testing with pilot customers. The company aps had to develop the control systems of the plant.

KEYWORDS: Flotation Plant, Pressure Expansion, Purification Degree, Operating Parameters, Optimization

PROJECT OF PLANTING OF JATROPHA CURCAS VALUING WASTE WATER OF OUJDA CITY

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ABSTRACT

It's generally agreed that our city (Oujda) undergoes a critic period of drought and lack of water for irrigation. So, the reuse of raw waste water in peri-urban agriculture of Oujda city is a lot of developed (1150 hectares) and interest many type of cultures especially market gardening.

The present study aims at the promotion of wastewater of the city of Oujda across the irrigation of Jatropha curcas « plant with energy value » for which, the appeal in wastewater allows at the same time, to fertilize and to irrigate without posing health problem since it is not intended in most cases for feeding.

The first results showed that the irrigation with wastewater significantly ameliorated the parameters of growth of Jatropha curcas:

- The plant's length increased
- Augmentation in the number of branches in the plant, as well as the number of inflorescence in the plant
- Increase in the number of flowers in each inflorescence.

In addition to the numerous advantages that Jatropha curcas can assure, this project also aims to check on its resistance to the arid climate of Oujda city, especially at winter frost which makes it weak.

Therefore, the success of this study will be advantageous because it will contribute to the development of the country and even to sustainable development. I'm looking forward to using this plant in all rural areas which suffer from water shortage and use sewage for irrigation.

KEY WORDS: Dryness, Wastewaters (Sewage), Arid Climate, *Jatropha Curcas*, Sustainable Development.

WASTE WATER TREATMENT BY AUTONOMOUS CLEANING – UP FOR THE PRESERVATION OF WATER RESOURCES IN ALGERIAN SAHARA

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ABSTRACT

In the absence of sanitation networks, wastewaters originating from dwellings located in rural areas are, in the best case, generally collected in individual septic tanks that are to be periodically emptied. These tanks present quite very often leakages that pollute the riparian aquifers occurring in the region. This constitutes a permanent contamination danger as it allows waterborne bacteria and thus waterborne diseases to develop. The main objective of the work presented here is to promote autonomous sanitation techniques leading to efficient purification of domestic wastewater that are released into the environment. Ain-Louissig is a village that is located 70 km south of Ghardaïa county (central Algerian Sahara). It has been selected in 1994 as the first pilot study site for such an experimentation in Algeria. Since then, no additional work worth to be noted has been performed elsewhere. The experiment consisted of two seriate septic tanks followed by a vertically drained sand filter. The latter is conceived in such a way to alternatively use two filtrating bodies.

The network consisted of connecting 30 four-room dwellings to the experimental purification system. Each family leaving in that area is generally composed of four to six children in addition to the two parents. The experimentation was designed in the form of a semi-collective housing estate. After nearly a decade of operation, one has reached the point to know whether the progress achieved in terms of advantages and disadvantages of the investigated autonomous sanitation process should incite or not the local authorities to proceed with its generalisation for the whole region. This is what is meant to explain in more details in the course of this paper.

KEY WORDS: Septic Tanks, Rejects, Purification, Filter, BOD, COD, Pollution, Conservation.

PHYSICO CHEMICAL PARAMETERS IN MATURATION WASTE STABILIZATION PONDS -CASE OF IMZOUREN – BÉNI BBOUAYACH STATION (PROVINCE AL HOCEIMA, NORTH OF MOROCCO).

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ABSTRACT

Wastewater treatment systems have to deal with current and upcoming challenges like growing population, increasing treatment requirements and limited water resources. Wastewater ponds offer much potential to meet these demands, as shown for several aspects like technological upgrading, water reuse and wastewater disinfection.

The study proposes to monitor the quality of water leaving the maturation pond which flow into a river (Oued Neckor) which in turn joins the sea (Mediterranean Sea), this phase is register in a logical contribution to sustainable development and growth of the region.

The approach adapted in this work is based on the study of hydraulic and physico-chemical of wastewater by regular monitoring (monthly) from April 2010 to May 2011.

The samples are collected at the entrance and exit of each pond, some physico chemical parameters are measured in situ (dissolved Oxygen, T°), the chemical and organic parameters of pollution were measured on grab samples at the outlet of the basin.

The results showed that lagoons eliminated from 30%to 70% of BOD_5, till 66% of Suspended Matter. In winter a decrease of the epuration efficiency has been observed of most of parameters (conductivity, dissolved oxygen, pH, BOD, COD) due to a decrease of pH and algal growth.

KEY WORDS: Waste Stabilization Ponds, Maturation Pond, Quality Of Effluent, Province Al Hoceima.

COMPARAISON DES PERFORMANCES D'UN CHENAL ALGAL A HAUT RENDEMENT ET D'UN LAGUNAGE NATUREL SOUS CLIMAT SEMI-ARIDE

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RESUME

Les techniques d'épuration sont nombreuses, et leur efficacité ainsi que leur rentabilité sont variables en fonction de la nature des polluants à éliminer. Le choix de la méthode la plus fiable, dépend d'un grand nombre de facteurs dont le plus limitant est certainement le coût du traitement en question. Dans ce sens il est judicieux de proposer des techniques d'épuration qui soient à la fois suffisamment performantes et économiquement rentables. Actuellement, de nombreux travaux de recherche ont montré l'efficacité des systèmes de traitement extensifs tel le lagunage et leur adaptabilité à nos conditions socio-économiques.

Ce travail consiste en l'étude du comportement de deux variantes du lagunage (lagunage naturel et chenal algal à haut rendement) situés dans la commune périurbaine SAADA sous climat aride de Marrakech. Plus de détails sur les filières de traitement et la nature des effluents. La comparaison des deux filières Lagunage à Haut Rendement (LHR) et Lagunage traditionnel (appelé aussi Bassins De Stabilisation BDS) a montré que les taux d'abattement de la filière LHR sont supérieures à celles de la filière BDS concernant l'élimination des MES (68% contre 47%) de la charge organique DCO (80% contre73%), l'azote total (79% contre 54%) et le phosphore total (64% contre 62%). Cependant, la filière BDS donne des rendements épuratoires plus importants que ceux de la filière LHR en ce qui concerne l'élimination de l'azote ammoniacal (88% contre 66%) et des orthophosphates (60% contre 51%). La comparaison du traitement secondaire de chacune des deux filières : Chenal Algal à Haut Rendement (CAHR) et bassin facultatif a montré l'efficacité du CAHR. Les performances épuratoires du CAHR sont supérieures à celles du bassin facultatif pour la charge organique et les nutriments. L'élimination des matières en suspension (MES) est plus importante avec le CAHR qu'avec le bassin facultatif, de même pour la DCO brute. Egalement, l'efficacité du CAHR en ce qui concerne l'élimination de l'azote est nettement supérieure à celle du bassin facultatif, que ça soit pour l'azote total (63,80 %) ou pour l'azote ammoniacal (50,13 %) l'examen des Flux Spécifiques Eliminés (FSE) des paramètres physico-chimiques montre une prééminence du CAHR sur le bassin facultatif. Le CAHR est particulièrement intéressant pour les Flux Spécifiques Eliminés des nutriments.

En comparaison avec le bassin facultatif, les FSE obtenus pour le CAHR sont de 1,6 fois pour les MES, 1,1 fois pour la DCO, 4,58 fois pour l'azote total, 1,72 fois pour l'azote ammoniacal, 1,08 fois pour le phosphore total et 0,89 fois pour les orthophosphates.

De ce fait, l'adoption d'un CAHR au lieu du bassin facultatif permet une réduction remarquable de la superficie de Terrain Requise (STR) nécessaires pour le traitement des eaux usées. Elle permet aussi d'augmenter les performances épuratoires concernant l'élimination des paramètres physico-chimiques. Les dimensions du bassin facultatif et du CAHR dévoilent la grande surface du bassin facultatif (5870m^2) par rapport à celle du CAHR (544 m^2) et qui est 10 fois plus grande que celle du CAHR.

MOTS CLES: Lagunage Naturel, Chenal Algal A Haut Rendement, Efficacité Epuratoire, Flux Spécifiques Éliminés (FSE), Climat Semi-Aride.

POTENTIAL USE OF DECENTRALIZED WASTEWATER TREATMENT PLANTS IN THE JORDAN VALLEY AND ITS ECONOMIC CONSIDERATIONS

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ABSTRACT

Jordan faces a great challenge to meet water demands and manage its limited water resources. Therefore, it is important to optimize the utilization of nontraditional source of water in a manner. The decentralizing treatment plants can be installed in rural areas in the Jordan and provides these communities with additional source of water to be used in agriculture. This research focuses on the use of the treated wastewater from farmers' points of view. The main objectives of this research to investigate the farmers' acceptance for the treated wastewater generated from decentralized wastewater treatment plants (DWTP), and to identify the main socioeconomic factors affecting the use of treated wastewater. A descriptive analysis was used to construct a socioeconomics profile of farmers in rural areas. Contingent Valuation method in addition to Logit and Probit model was used to analyze farmers' acceptance of using treated wastewater generated from DWTP. Farmers respond to water shortage in several ways, including: (a) water saving by improving on-farm water management practices, (b) adopting improved micro-irrigation technology, (c) shifting cropping patterns to low water consumption crops, (d) renting out land, (e) crop rotation with fallow land (f) augmenting water supply by using treated wastewater and or using brackish water with fresh water.

The analysis shows that farmers willingness to pay for treated wastewater is affected by family size, willingness to expand cultivated areas, crops types, lack of capital and available credit facility, labor shortage and products prices. Findings show that farmer is winning to pay almost \$ 0.133 m^{-3} of treated wastewater. Irrigation water is now charged at an average price of \$0.018 m^{-3}. WTP is high as compared with the current price since water costs are negligible compared to input and labor costs. It recommended expanding the use of treated water in agriculture and adopting the use of the decentralized wastewater systems that can be used in the rural areas like the Jordan Valley. Farmers' technical advices are necessary overcome to many technical problems, such as the clogging of emitters, non uniformity of water application, and crop selections.

KEY WORDS: Willingness To Accept, Probit Model, Jordan Valley, Decentralized Wastewater Treatment Plants.

TESTS ON A PILOT EXPERIMENTAL PROCESS WASTEWATER TREATMENT BY MACROPHYTES PLANTS: CASE OF *PHRAGMITES AUSTRALIS*

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ABSTRACT

The environment remains a major preoccupation which becomes integrated into every territorial project today. The conservation of our natural environment, the water of which is doubtless the essential element, pulls the development of numerous techniques to answer this objective. The domain of the waste water treatment does not escape this phenomenon. The Algerian experience in this domain made us certain number of reports the obligation of which is to suggest sectors of alternative treatment in the classic networks. For this reason, it is absolutely necessary, ecological, economic and social points of view, to favor the development, the probation and the broadcasting of new techniques of purification. The purpose of this work is to study the épuratoires performances of the waste water of the small communities by means of the system using beds planted in vegetables. The experiences (experiments) worldwide, show the interest growing of this technique and its reliability both from the point of view of hydraulics and on the economic and ecological plan

In the perspectives of an application through the towns with rural character, we proceeded to essays on an experimental pilot accompanied with analyses at the level of the entry and brought out of some waters. Four (04) scenarios were made, by opting on the choice of the type of flow (vertical and horizontal). Each of the variants consists in making get through effluent of beds ponds, filled with gravels and planted there phragmites. The results of the performances épuratoires, mainly the DBO5, the DCO, N, P, etc., compared with those obtained by station classics, seem to be very competitive and open the promising perspectives to this process in Algeria.

KEYWORDS: Phytoépuration Waste Water Macrophytes Environmental Protection Sustainable Development.

STRATEGIES OF PROMOTION OF THE ECOLOGICAL SANITATION APPROACH AND POLICIES FOR ACCEPTABILITY AND ADOPTION OF THE URINE-DIVERSION DEHYDRATION TOILETS - CASE OF DAYET IFRAH –

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ABSTRACT

Most of people in Dayet Ifrah village in Morocco don't have adequate systems of collection, evacuation and transport of black and gray water. They simply defecate in nature. This has been shown from the survey carried out in 2009, sampling 24 families of this locality. There is a huge demand, which cannot possibly be met by conventional sanitation systems due to the enormous costs for the pipe network, lack of water and serious environmental drawbacks in order to avoid the disadvantages of conventional wastewater systems. For this reason, we have thought to promote ecological sanitation, or "ecosan" for short, that recognizes human excreta and water from households not as a waste but as resources that can be recovered, treated where necessary and safely used again. Ecosan is a philosophy which houses a multitude of different technologies applied in ecological sanitation projects such as Urine Diversion Dehydration Toilets (UDDT).

But, it's necessary at the beginning to sensitize people in Dayet Ifrah and to convince to adopt and accept urine diversion dehydration toilets. Marketing has been more successful than anything else in changing the behaviour of people when they can see direct personal benefits. Choosing a (social) marketing approach means that the attractiveness of the product is one important factor. That was what happened in 2009.

After this phase of sensitizing, the households were convinced of the benefits these infrastructures afford them. Ecosan reduces the health risks related to sanitation, contaminated water and waste, prevents the pollution of surface and groundwater, prevents the degradation of soil fertility and optimises the management of nutrients and water resources. Dayet Ifrah site is one of the ground waters of Ifrane's area and constitutes a wetland and water resource for drinking water via fountains and wells. Future users found ecosan toilets to be a radical solution to the cleansing of their waste water. In Sweden, the annual produced urine quantity contains quantities of nitrogen, phosphorus and potash being equivalent to 15 - 20% of that of the nutrients used like mineral manure in 1993. Currently, pilot projects similar to that of Dayet Ifrah, called "GTZ-ecosan projects", are applied in more than 40 countries worldwide, including Afghanistan, El Salvador, Eritrea and Nepal.

KEYWORDS: Acceptability, Ecological Sanitation, UDDT, Rural Areas, Morocco, Sensitizing

WASTE STABILISATION POUND IN THE CHAOUIA-OURDIGAHA REGION IN MOROCCO

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ABSTRACT

Due to its geographical location, Morocco has adopted since the 90th waste stabilization ponds as the best technical solution adapted to the economic environment and climate. Compared with technics already experienced in Morocco, the waste stabilization ponds is the most widespread, many number of treatment plants are actually completed like for the cities of Settat, Berrechid, Essaouira, Ouarzazate, Skhirat,... etc. The present work aims is develop an analysis of treatment performance and give a feedback of five treatment plants using waste stabilization ponds (WSP) in the cities of Settat, Berrechid, Ben Ahmed, El Gara and Soualem-Sahel, and examine the reliability treatment in the study area.

The five plants covered by this study are located in the region of Chaouia-Ourdigha, characterized by a sub humid to semi arid climate, with mild winters and warm summers, the average temperatures ranging between 11°C and 25°C and average annual rainfall is 350 mm. Cleaning systems studied cover a wide range of varying population from 14,000 inhabitants in Soualem city to 130,000 inhabitants in Settat city with a tertiary treatment for Settat, Berrechid and Soualem (anaerobic, and maturation ponds) and a secondary treatment for Ben Ahmed and El Gara (anaerobic and facultative ponds).

Purification yields observed for all treatment plants exceeding 70% for BOD_5. The higher average yield is observed in Settat city with 92% using a tertiary treatment facility, the lowest yield is observed in Ben Ahmed city with 70%. The average rate of in the study area is about 81%. The average treatment efficiency goes between 63 and 83% for COD, and between 54 and 87% for TSS, and the largest average yield is observed for the STEP Settat with a drawdown of 87%. For nitrogen and phosphorus, the purification performance remains weak and very unstable and depends on the season. The observed average reductions vary between 14 and 59% for nitrogen and between 11 and 43% for phosphorus.

In conclusion, the performance of the waste stabilization ponds with secondary or tertiary treatment in the region of Chaouia Ourdigha is satisfactory for organic pollution with a yield exceeding 70%. This pathway is very well adapted to the context of the study area and able to produce good levels of treatment, except for the parameters of nitrogen and phosphorus. The residual concentrations of these effluents are interesting for reuse in agriculture. The purification system by stabilization ponds can be very flexible for variable number of population goes between 20,000 and 120,000.

KEYWORDS: Waste Stabilisation Pound, Chaouia-Ourdigaha Region,

FEASIBILITY OF TREATED WASTEWATER REUSE IN AGRICULTURE: A CASE STUDY FROM HEBRON DISTRICT IN PALESTINE

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ABSTRACT

Hebron city lies between the mountains in the heart of southern Palestine 35k.m south of Jerusalem. The water and sanitation systems and services are under the responsibility of the Hebron Municipality. Hebron city faces great difficulties in finding water quantities that are adequate to meet the demand especially for agriculture. Ninety percent of Hebron city is covered by a sewerage system, and the produced flow is disposed into an opened area called "Wadi Samen" in southern part of city.

Due to the insufficient quantity of water supply, the amount of water used for irrigation purposes is minimal and the percentage of irrigated land does not exceed 1% of the total agricultural area in the district. There is rich agricultural land (18,250,000 m^2) owned by nearly 330 farmer that needs volume of 10,493,750 m^3/year water for irrigation. This agricultural area is located between, Yatta and Bani-Naem south of Hebron city.

If the wastewater were treated and re-used for irrigation, Hebron municipality would have been able to cover 49% of the actual demand during the first year (2000), and the percentage could have increased gradually, based on the increase of the wastewater due to the natural increase of the population and its water consumption. It was expected that in the fifth year the, the municipality would have been able to cover 61% of the actual need of the irrigated area, and could reach up to 79% in the 10th year, and increase to about 100% in the 15th year.

A detailed financial analysis was performed, including investment needs derived from the technical needs (land, storage tanks construction, pumping station, forcemain??, network, equipments, building/200 m^2, new pumping station at the end of 8th year), operating expenses (salaries, electricity, maintenance, depreciation, in addition to overhead and others), and the revenue with the introduced price of US$ (0.25) per cubic meter of treated effluent is considered competitive if compared with the price of the used drinking water of US$ (1.2) per cubic meter provided by Hebron Municipality, or the water provided by tanks for US$ (2.4) per cubic meter.

The financial indicators used for determining the economic feasibility of this case study are the Net Present Value (NPV) of US$ 363,549, Internal Rate of Return (IRR) 13.5%, and the payback period was computed as 6.6 years.

It is necessary to implement such projects to solve the environmental and health problems resulting from raw wastewater, to guarantee effective use of agricultural land, to generate income from selling the treated wastewater, to develop the technical levels of expertise in the field of agricultural re-use of treated wastewater products, adding to the total available water to the Palestinian population by re-using more of this valuable resource.

APPLICABILITY OF COAGULATION-FLOCCULATION COUPLED WITH BIOLOGICAL TREATMENT WITH FUNGI TO OLIVE MILL WASTEWATERS (OMWW)

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ABSTRACT

Olive mill wastewaters (OMWW) are a significant source of potential or existing environmental pollution in the Mediterranean countries. Treatment and reuse of OMWW presents significant challenges, both due to the nature of olive oil production (seasonal and small scale) and due to the characteristics of the wastewater (high chemical oxygen demand (COD) and high phenolic content). In the present work experiments of different pretreatment methods were undertaken and compared in order to select the adequate pretreatment process to be applied before biological treatment of olive mill wastewaters. Accordingly preliminary studies have compared the effectiveness of two natural organic coagulants, such as alginate and Kim2120 to Electro-coagulation. At the second stage, bioremediation of pretreated OMWW (using white-rot fungus) were investigated. Tests were conducted with raw OMWW and diluted by tap water at neutral pH adjusted by adding lime coagulant. The raw effluent presents chemical oxygen demand contents about 178 g d'O_2.l^{-1}, total suspended solids (TSS) of 6.4 g.l^{-1}, Conductivity (mS.cm^{-1}) of 29, pH of 4.8 and turbidity of 50 NTU. The maximum organic matter removals by Electrocoagulation processes was achieved after 90-min '(49%), by using 15V/m^2 voltage kept constant for each run at initial pH of the OMWW (4.4). The optimum removals of COD and turbidity were 39% and 75% respectively by 20 mg.l^{-1} dose of alginate coagulation was achieved at pH (7). Similarly, liming OMWW diluted at 50% and treated by Kim2120, a reduction of COD and turbidity exceeded respectively 53% and 85% at 10 mg.l^{-1}. Maximum removal of polyphenols, Tyrosol and Hydroxytyrosol were 60.1%, 23.1%, 59.1% with (lime/alginate), 64.2%, 67.8%, 76.3% with (lime/kim2120) and 57% with (Electrocoagulation) respectively. The pretreated effluents by different physicochemical processes showed that the best yields were obtained with kim2120. Olive mill wastewater was then treated aerobically with white-rot fungus. The results show that the white-rot fungus is capable of reducing chemical oxygen demand to 68% and 75% respectively for the diluted OMWW at 50 % treated by lime and lime/Kim2120, after only 5 days of growth. Neutral pH seems supported aerobic treatment.

KEYWORDS: Olive Mill Wastewater; Biological Processes; Electrocoagulation; Coagulation; Kim2120; Alginate; Fungi.

DENITRIFICATION EN CONTINU PAR MICROORGANISMES FIXES SUR SUPPORT EN PLASTIQUE

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RESUME

Actuellement, le traitement de la matière carbonée et azotée par voie biologique passe par l'utilisation d'au moins deux types de microorganismes, les premiers spécialisés dans le traitement de la matière carbonée, les deuxièmes spécialisés dans le traitement de la matière azotée. En effet, la dépollution de la matière organique se produit généralement dans des bassins à boues activées dans lesquels la matière carbonée est transformée en biomasse. Cependant, la charge azotée des effluents en cours de traitement reste importante. Son traitement nécessite une étape ultérieure impliquant des microorganismes spécialisés.

Il existe différents procédés exploités à ce jour pour transformer l'azote sous forme ammoniacale ou oxydée contenu dans les effluents aqueux en azote gazeux (N_2). Le traitement le plus répandu à l'heure actuelle est la dénitrification anoxique. Elle consiste en la réduction des formes oxydées de l'azote minéral (nitrites, nitrates) en composés gazeux, par une population microbienne fonctionnelle dénitrifiante, la plupart du temps hétérotrophe, en présence d'un donneur d'électrons. Ce processus est réalisé par de nombreuses bactéries incluant, par exemple, des espèces appartenant aux genres Pseudomonas, Bacillus, Paracoccus, Thiobacillus, Alcaligenes. La réduction des formes oxydées de l'azote est donc couplée avec l'oxydation d'un composé organique.

L'objectif de ce travail est d'étudier la dénitrification des eaux fortement chargées en nitrates par bioréacteur à biomasse fixées sur trois supports différents en plastiques de nature ou de type et de rugosité différentes. Les paramètres opératoires auxquels nous nous sommes intéressés en premier lieu sont la vitesse de passage (de séjour) et la charge massique en polluant.

Les résultats obtenus sont très prometteurs, en effet les rendements de dénitrification obtenus, depassent les 90% pour tous les supports utilisés et ce quelque soit la charge en polluants et ce meme avec une concentration initiale de 600 mg/l de nitrate. La vitesse de passage optimisée est de l'ordre de 1m/h .

MOTS CLES : Traitement Des Eaux, Dénitrification, Nitrates, Bactéries Dénitrifiantes

REMOVAL OF PHENOLIC COMPOUNDS FROM OLIVE MILL WASTEWATER BY ADSORPTION ONTO WHEAT BRAN

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ABSTRACT

The use of wheat bran for removal of phenolic compounds from olive mill wastewater at different adsorbent doses (10-60g/L), pH (3-11) and contact time (0.25-24h) were investigated. Our findings demonstrate that wheat bran, an inexpensive and easily available biomaterial, can be an alternative for more costly adsorbents used for removal of phenolic compounds from olive mill wastewater. It showed good adsorption ability to phenolic compounds. Increase in the wheat bran dosage from 10 to 50 g/L significantly increased the phenolic compounds adsorption rates from 45 to 67%. Increase in the pH to high alkalinity resulted in an increase in the phenolic compounds adsorption capacity. The adsorption process was found to be relatively fast, ant it reached equilibrium in 4h of contact time. The Freundlich and Langmuir adsorption models were used for the mathematical description of the adsorption equilibrium and it was found that experimental data fitted very well the Freundlich model. Batch adsorption models, based on the assumption of the pseudo-first order, pseudo-second order and intraparticale diffusion mechanism were applied to examine the kinetics of the adsorption. The results showed that kinetic data followed more closely the pseudo-second order model than the pseudo-first order and intraparticale diffusion. Desorption studies showed that low pH value was efficient for desorption of phenolic compounds.

KEYWORDS: Wheat bran; adsorption; phenolic compounds; olive mill wastewaters; Desorption.

MODELING OF ADSORPTION AND BIO-ADSORPTION OF PHENOL IN CONTINUOUS SYSTEMS

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ABSTRACT

Phenol, a recalcitrant aromatic compound, is frequently found in wastewater produced by various industries such as the pharmaceutical, petrochemical, pulp, tanning and coal refining industries. Phenol is toxic to most microorganisms and potentially carcinogenic to humans.
The main objective of the present study is to evaluate the removal of phenol by activated carbon and by the combined action of activated carbon and *Pseudomonas aeruginosa*.
The biofilm on activated carbon performs a combination of physical and biological removal mechanisms; adsorption onto GAC and biological degradation by microorganisms grown on GAC.
Pseudomonas aeruginosa is a gram-negative, aerobic rod-shaped, belonging to the bacterial family Pseudomonadaceae. It has commonly been used, due to its high removal efficiency of phenol from water
However, in order to obtain efficient biodegradation, microbial acclimatization to phenol is necessary.
The results indicated that the performance of bio-adsorption was significantly better than that of adsorption in all cases, showing the practical use of biological granular activated carbon (BGAC) in filtration process.

The main and interactive effects of three different experimentally controlled environmental factors like bed height H, initial concentration of phenol C_0, and the volumetric feed flow rate Q are investigated through the model equations designed by a two-level full factorial design and central composite design in an ascendant continuous systems. The results predicted using factorial regression model showed high values of regression coefficients (R^2 Adsorption = 0.969 and R^2 bio-adsorption = 0.997) indicating good agreement with experimental data.
Optimization of the two processes was carried out by using by the method of steepest ascent and by reporting the first derivatives of response in zero.
The highest quantity of phenol eliminated on breakthrough point was theoretically predicted to be 6406.5mg for adsorption. The results showed the elimination of the inlet flow factor, the optimal condition is C_0= 300mg/l and H=9cm.
For the bio-adsorption, the model of the response was defined as a function of the three parameters, the highest quantity eliminated of phenol was 7672.35mg under optimal conditions (C_0 = 300mg/l, H = 9cm and Q = 10ml/mn).
The performance of the Bio-adsorption was determined by the evaluation of the elimination rate at breakthrough point. The model of the regression was given in the second order form.
In the optimal conditions (C_0 = 787.9mg/l, H = 4.5cm and Q = 5ml/mn) the elimination rate was 103.13%.

KEYWORDS: Phenol, Adsorption, Bio-Adsorption, Full Factorial Design, Central Composite Design.

A RAPID SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF TRACE AMOUNT OF LEAD (PB) ION IN AQUEOUS MEDIUM USING PAN AS A CHELATING AGENT.

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ABSTRACT

A very simple, sensitive and highly selective non-extractive spectrophotometric method for the determination of trace amount of Lead (Pb) has been developed by using 1-(2-pyridylazo)-2-naphthol named PAN as a spectrophotometric reagent. PAN reacts in slightly acidic solution (pH 4.500 ± 0.02) with Lead to give an pink chelate that has an absorption maximum at 548 nm. The reaction is instantaneous and absorbance remained constant for over 48 hrs. The average molar absorption co-efficient was found to be 6.32×10^{4} $^{Lmole^{-1}}cm^{-1}$. Linear calibration graphs were obtained for 0.10 – 3.0 μg mL^{-1} of Pb. The stoichiometric composition of the chelate has been found 1:2(Pb : PAN). Large excess of cations, anions and some complexing agents have been studied to understand the effect of foreign ions. The method was successfully used in the determination of Pb in some environmental water and industrial waste water and made a comparison with those results obtained by Atomic Absorption Spectrophotometric Method. Although many sophisticated techniques such as HPLC, AAS, ICP-AES, ICP-MS etc. are available for the determination of Lead at trace level in numerous complex materials, factors such as the low cost of the instrument, easy handling, lack of requirement for consumables etc. have caused uv-spectrophotometry to remain a popular technique particularly in laboratories of developing countries with limited budgets.

KEYWORDS: 1-(2-pyridylazo)-2-naphthol, Chelate, Environmental water.

DECOLOURIZATION AND MINERALIZATION OF THE ACID RED 14 BY HOMOGENEOUS AND HETEROGENEOUS FENTON AND FENTON-LIKE PROCESSES

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ABSTRACT

Dyes are an abundant class of colored organic compounds that represent an increasing environmental risk. They are highly used in different kind of industries that generate a large amount of wastewater with intensive color and toxicity that can reach the aquatic system. Many different approaches have been proposed to remove them (coagulation, adsorption on activated carbon, reverse osmosis, ultrafiltration…) but these traditional physical methods do not mineralize the dye, being necessary and expensive the post-treatment. To obtain a complete degradation of the dyes, electrochemical and catalytic methods seem to be effective.

In this study Advanced Oxidations Processes like Fenton and Fenton-like have been applied to eliminate the color and compounds from an aqueous solution containing the azo dye Acid Red 14. Both processes have been used in homogeneous and heterogeneous form in order to evaluate the yield of the decolourization and mineralization of the dye. Heterogeneous reactions have been carried out using Y Zeolyte as catalyst support of the Fe^{2+} and Fe^{3+}. The dye degradation for the Fenton oxidation process has been shown to be faster initially than for Fenton-like oxidation but the degradation achieved for the four systems has been found to be similar after 9 min.

All processes have shown good results being the heterogeneous more convenient economically and for the environment because the catalyst can be recovered from the solution and reused at least three times avoiding the generation of contaminated sludge as it occurs in the homogeneous Fenton. Moreover, the regulation of the pH of the solution is not necessary and the solution after the treatment is free of toxicological compounds as the microtox analysis has shown.

KEYWORDS: Fenton, Fenton-like, Heterogeneous, Zeolite, Mineralization.

BIODEPOLLUTION DES SOLS CONTAMINES PAR DES HYDROCARBURES PAR LE PROCEDE BIOPILE: ETUDE DE L'ASPECT MICROBIOLOGIQUE

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ABSTRACT

Le problème majeur rencontré dans les sols pollués par les produits pétroliers est l'atteinte des nappes phréatiques affectant ainsi la qualité des eaux. La décontamination des sols pollués nécessite l'intervention des procédés physicochimiques et biologiques pour éliminer la pollution. En dépit de l'utilisation multiple des procédés physicochimiques dans la restauration des sols pollués par les produits pétroliers, la bioremédiation reste la solution la plus efficace, la plus demandée, la mieux maîtrisée et la moins coûteuse. Il s'agit en effet d'une technique douce dont le principe repose sur la minéralisation complète des produits pétroliers et ne génère aucun sous- produit toxique, contrairement aux procédés physicochimiques qui consistent souvent en un transfert de la pollution d'un milieu à un autre ou encore à son confinement.

Le but de notre étude consiste à restaurer un sol contaminé par du gasoil par un procédé biologique et d'étudier de près le métabolisme microbien qui s'accompagne avec la biodégradation des hydrocarbures. Nous avons pu restaurer un sol pollué par le gasoil à l'aide de la technique biopile dont le principe consiste à optimiser les conditions de biodégradation du contaminant dans le sol après excavation (ex-situ). En effet, au bout de 90 jours nous avons obtenu une décontamination de 70% à l'échelle laboratoire. La microflore responsable de la biodégradation est à prédominance de la population bactérienne, une synergie a été enregistrée entre les levures et les bactéries pour la biodégradation du gasoil, il s'agit du phénomène de cométabolisme.

KEYWORDS: Biorestauration, Biopile, Bactérie, Levure, Biodégradation des Hydrocarbures.

TOPIC 5

Treatment, Recycling and Recovery of Solid Waste

BIOLOGICAL BREAKDOWN DURING COMPOSTING: CASE OF SLUDGE FROM MARRAKECH WASTEWATER PURIFICATION STATION

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ABSTRACT

This study concerns the processing of activated sludge from a wastewater treatment plant (Marrakech) mixed with green waste (date palm fronds), by means of composting. The experiment was conducted in Marrakech municipal nursery where a mixture (2/3 green waste + 1/3 sludge) was composted for two months. The intense microbial activity during composting resulted in a high temperature (over 65°C) during the first weeks (thermophilic phase) and a level of degradation reaching about 30%. After the two months of composting, the final composts presented a C/N ratio close to 10, an NH4+ / NO3- ratio <1 and a pH around neutrality. Analysis of the total lipids in the mixture was carried out at the beginning and end of composting, after accelerated solvent extraction and analysis with GC/MS. The total lipid content fell from 57 905 ppm (T0) to 27 115 ppm (T8 weeks), that is to say an abatement of 53%. This reduction is explained by the oxidation of the lipids, in particular the fatty acids, cholestene, and cholestan-3-ol which oxidizes to yield cholestan-3-one. These results confirmed the maturity of the final composted product.

KEYWORDS: Activated Sludge, Composting, NH_4^+ / NO_3^- Ratio, Lipids, GC/MS.

TREATMENT OF HOSPITAL WASTE AND DETERMINING THE IMPACT OF INCINERATION RESIDUES IN GROUNDWATER

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ABSTRACT

It has been shown that waste infectious risk cares WIRC generate environmental damage if not stored properly. That is why many researchers have already begun some years ago to worry about problems of storage and valorization of these wastes.
Incineration is one of the techniques used in waste treatment. The significant reduction (90%) of the initial volume of waste is one of the major advantages of this practice. However, it generates significant amounts of residues including bottom ash which represents between 10 and 35% of the total mass of incineration waste, and fly ashes, which is always considered as a dangerous waste leaching various toxic organic and inorganic substances. These are partly soluble (10 to 40% of the total mass) and contain high levels of metal contaminants (lead, cadmium, and zinc) as sulphates, chlorides and oxides. It was found that some trace metals in fly ashes often exceeded regulatory thresholds of toxicity. Those that meet these thresholds still have a great tendency to contaminate soil and groundwater in the long term.
Because of its dangerous character, the management of fly ashes requires to develop economical and sufficiently effective processes to stabilize or to decontaminate them. The current state of research reveals a number of studies on the chemical stabilization, vitrification, and the removal of metals by chemical leaching.
The objective of this work is to present the management mode of fly ashes from the incineration of infectious health-care risk and particularly the possibility of containment by vitrification. This will be preceded by a presentation of the main physical and chemical characteristics of these fly ashes. This process allowed us to stabilize the toxic elements existing in these ashes in a glass matrix of the stable base phosphate. This choice is justified by the energy gain due to the low melting phosphate glasses compared to silicate glasses usually used for such application.
Finally, we tested the effectiveness of trapping by the tests of mobility of metals into groundwater using an experimental device, and we determined the effect of pH on the stabilization

KEYWORDS: Hospital Waste, Heavy Metals, Storage, Matrix Phosphate, Groundwater.

HEAVY METALS, CU AND ZN, ADSORPTION ON MODIFIED BENTONITE AND THE USE OF CHITOSANE AS FLOCCULENT COAGULANT OBTAINED AT ROOM TEMPERATURE

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ABSTRACT

The main objective of this study is to prepare a mineral adsorbent, the modified Algerian bentonite, to evaluate its adsorbing capacity of metal cations Cu and Zn and to study the influence of different parameters.

The results show a rapid adsorption kinetic for both metals (that does not exceed two hours) following the pseudo-second order model with high elimination rates (91% for Cu and 54% for Zn); the pH optimal values are equal to 6 which corresponds to an adsorbent concentration of 3g/l. The study of the adsorption isotherms revealed the conformity of the Lamgmuir model to our experimental results. The use of chitosane, obtained at room temperature, as flocculent coagulant accelerates the speed of settling of the colloidal particles in suspension of bentonite after their adsorption of these metals.

KEY WORDS: Adsorption, Heavy Metals, Copper, Zinc, Sodic Bentonite, Adsorption Kinetic, Adsorption Isotherms, Chitosane.

CHARACTERIZATION AND VALORIZATION PROSPECTS OF INDUSTRIAL SLUDGE FROM THE INDUSTRIAL AREA OF TANGIER (MOROCCO)

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ABSTRACT

The work presented in this paper is undertaken in the framework of a sustainable management of sludge collected from industrial wastewater treatment. The industrial sludge is bulky as it generally contains 95-99% of water and is generating nuisance, since it often contains toxic materials. This solid waste doesn't generate specific pollution; however, this waste put into landfills, even non-hazardous, contributes to saturation of these facilities and produces environnemental impacts. The health and environmental impact of sludge lies at the level of disposal operations:

- Spreading, if mishandled, can cause pollution of soil and water. - Incineration: smoke pollution can be dangerous if incineration is poorly controlled and fumes are untreated.
- Land filling may pollute soil and water and be a source of emission of greenhouse gases, as well as being the source of olfactory and visual nuisance in a location that is not suited to control these nuisances.

The first step of our study is to carry out a complete characterization of two types of industrial sludge by chemical, physical and environmental analysis. Chemical characterization is used to evaluate their potential pollutant. Their environnemental impacts are explored through leaching tests. The obtained results allow proposing valorization ways.

The industrial sludge can be used as building materials (traditionally, civil engineering is a way of recycling this kind of material):

- Bricks: the thin sludge may substitute in part the natural clay bricks.
- Cement: sludge can replace part of the clay used in cement manufacturing. The management of industrial sludge is currently a very important environmental challenge.

KEYWORDS: Industrial sludge-Valorizatio-Building materials-Wastewater

VALORIZATION OF OLIVE MILL WASTEWATER BY CO-COMPOSTING WITH OTHER ORGANIC WASTES

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ABSTRACT

In Morocco, the olive oil production is one of the most promising sectors in the national economy. The olive growing agricultural activity provides for generating over 15 million workdays a year (Ouaouich and Chimi, 2007). Unfortunately, this industry is facing to a big problem which is the olive mill wastewater (OMW) produced by the three-phase extraction of olive oil. The disposal and treatment of this liquid waste are very difficult because of its high organic load and antibacterial phenolic substances,

Furthermore, as in many countries, the production of household solid waste (HSW) increases every year in Morocco and only a little proportion is recycled (2%).

In the current work, we have studied the possibility of treatment and valorization of the olive mill wastewater by co-composting with household solid waste and Lime sludge (LS); waste of sugar industry produced in the purification step and rejected outside the factories without any valorization or study on the impact on the environment.

An experiment was carried out with four windrows made by mixing HSW with LS and GW (green waste). These windrows differed in terms of their initial composition and the liquid used for their irrigation. In the first windrow the LS in the concentration of 50 % was composted GW and HSW and irrigated with the OMW. In the second windrow the compost containing GW and HSW in the same proportions was irrigated with water only. While, in the third windrow the LS in the concentration of 50 % was composted with only HSW and irrigated with the OMW and in the last windrow compost containing LS and HSW in the same proportions was irrigated with water only.

A good evolution of the temperature and humidity was observed for all composts. At the final step of composting, all composts have pH around 8 - 8,5. The ratio carbon / nitrogen was reduced to the recommended value (≤ 20) and the mineral composition was good. The results obtained can be considered as a good opportunity for treatment of OMW as well as industrial wastes and household solid waste in the context of sustainable development.

KEY WORDS: Olive Mill Waste Water, Household Solid Waste, Compost, Lime Sludge, Sustainable Development.

A COMPARATIVE STUDY OF AERATION SYSTEMS WITH JET AERATION

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ABSTRACT

The paper presents an investigation of the aeration efficiency of plunging liquid jet aeration. Aeration process is commonly used in waste treatment and fermentation processes. The existing aeration devices differ in the manner of supplying air to liquid which needs treatment. The aeration efficiency is measured by the kg of O_2 supplied from air per kWh of energy used. A review of various aeration devices with their problems is presented and compared with jet aeration system. The aeration efficiency of bubble aeration system using compressed air is in the range of 1- 2.2 k_g O_2/kWh except Danjes system having 3 to 5 kg O_2/kWh. These devices suffer from clogging of diffusers; hence air is to be filtered. The mechanical aerators have higher efficiencies in the range of 1.7 to 3 kg O_2/kWh but tend to pollute the environment with liquid droplets and mixing of liquid contents is also poor. In contrast the jet aeration system has aeration efficiency of about 4 kg O_2/kWh determined by sulphite method. The jet aeration imparts good mixing. It has low investment and negligible operational and maintenance costs. The jet aeration has the merit over diffusers and rotating aerators.

KEYWORDS: Aerators, Diffusers, Jet aerator

Topic 6

Desalination

PILOT PLANT OF A SOLAR VACUUM MEMBRANE DISTILLATION FOR SEAWATER DESALINATION IN MAHARES, TUNISIA

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ABSTRACT

Desalination of seawater might represent the main important source of potable water for arid and semi arid zones. The technologies of desalination of the sea water are operational since many years. But their cost often limits their utilization to the rich countries. The possibility of designing innovative processes based on the coupling of this technology with the solar energy is becoming an attractive way to reduce the production costs and for increasing the performance of the processes.

This paper deals with the MEDINA (MEmbrane-based Desalination: an INtegrated Approach) project supported by the European Commission. Despite the advantages of solar membrane distillation (MD) systems, very few experimental systems have been developed compared with the reverse osmosis and solar distillation.

Vacuum membrane distillation (VMD) for seawater desalination is based on the evaporation of seawater through hydrophobic porous membranes improved by applying a vacuum or a low pressure on the permeate side. Permeate condensation takes place outside the module inside a condenser.

The main objective of the project is to improve the overall performance of membrane-based water desalination processes by applying innovative technologies to reduce energy consumption by using renewable energy and save energy of condensation. We develop an autonomous desalination system (PV – thermal collector) for a capacity about 0.5 m^3/d .

The membrane system consists of 806 fibers in PVDF with an internal diameter of 1,4 m, the length of the module is 1,129 m and offering a total membrane surface of 4 m^2. The collector is a selective flat plate collector with an efficiency of 0.73 and 51 m² area.

Power supply of the plant with photovoltaic cells to aggregate power of 1.5 kilowatts, a peristaltic pump which can ensure a vacuum of 5000 Pa with 100 l/h flow, a heat exchanger with titanium plates of 26 kW power, exchanger area 1,08m^2 and 27 plates, a tubular condenser in titanium 60 kW power with 41 tubes, 7mm internal diameter and 1mm thickness.

The pilot plant was installed in the village of orphaned children (S.O.S MAHRES).

Experimental tests were carried. These tests showed the effectiveness of the solar collectors and photovoltaic cells as well as the plates heat exchanger selected and to estimate the quantity of water to be produced.

KEYWORDS: Solar Energy, Membrane Distillation, Pilot Plant, Performance, Reduce Energy Consumption

NANOFILTRATION: A PROMISING TECHNOLOGY FOR BRACKISH WATER DESALINATION IN MOROCCO

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ABSTRACT

Desalination of brackish water offers a potential for water supply enhancement in Morocco. The most commonly used technology in brackish water desalination is Reverse Osmosis (RO), due to its lower energy consumption compared to thermal processes. A competing membrane process to Reverse Osmosis (RO) for brackish water desalination in the near future is Nanofiltration (NF). In this work, the possibility of producing drinking water from brackish groundwater (TDS ~ 4 $g.L^{-1}$) using Nanofiltration (NF) process was investigated. Pilot scale testing was performed at Tan Tan BWRO plant in Tan Tan city (South of Morocco) with a small scale NF/RO desalination unit. The pilot unit, which is equipped with one pressure vessel housing on spiral wound module (4"x40"), was fed with the pretreated brackish water from the full scale plant. The studied membranes were four NF membranes (NF90, NE90, ESNALF and NE70) and one Low Pressure RO membrane (BW30) which is the existing membrane installed in Tan Tan plant. The membrane modules were tested under various operating conditions: feed flow (up to 2 $m^3.h^{-1}$), permeate flow (up to 0.2 $m^3.h^{-1}$), recovery rates (from 10% to 90%) and applied pressure (from 4 to 20 bars). The temperature was maintained at 21 °C. The performance of the studied membranes was compared in terms of water productivity, desalination efficiency (retention of total dissolved solids and individual elements) and specific energy consumption. The results showed that NF is actually better efficient vs LPRO since it highly reduced the salinity of Tan Tan brackish water (>80% Salts rejection) at higher permeates fluxes, higher recovery rates (up to 90%) and lower applied pressures (11 bar). The amount of power required with NF modules was ranged from 0.23 to 0.43kW h/m^3 while the values found for BW30 membrane were from 0.54 to 0.93 kWh/m^3. This study confirms the potentialities of NF for brackish water desalination and proved that NF is technically and economically viable to cope with water scarcity and overcome the water deficit in Morocco.

KEYWORDS: Brackish groundwater, Desalination, Drinking water, Nanofiltration, Reverse Osmosis, Water scarcity, Morocco

EVALUATION OF THE BORON CONTENT IN DESALINATED WATER PRODUCED BY MSF AND SWRO BEFORE AND AFTER TREATMENT

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ABSTRACT

Seawater contains about 5 mg/l of boron mainly from industrial discharges, urban and domestic by its presence in high concentrations in detergents as perborate. Contributions of boron by urban and industrial discharges are small compared to contributions from natural erosion and dissolution of rocks.

The toxicity of boron derivatives is variable: the boron hydrides are highly toxic digestive tract, respiratory or skin. However, naturally occurring forms of boron in drinking water are not considered harmful to health, natural concentrations of 0.1 to 0.3 mg/l according to WHO. Also, if the man consumes large amounts of food containing boron, the boron concentration of the body can increase to levels toxic to their health.

The purpose of this study is to monitor and compare the obtained boron content in desalinated water for human consumption and produced by four desalination plants in the north-west Algeria: desalination plant in Arzew Kahrama whose method Desalination is of MSF desalination plants Bousfer, the Dunes (Oran), and the Beni Saf Ain Temouchent-powered reverse osmosis.

The results show that the boron content of the water produced by the station Kahrama process (MSF) before and after treatment was 0.9563 mg/l and 0.5608 mg/l respectively. On station Bousfer, reverse osmosis water ranges from 0.9344 mg/l to 2.0231 mg/l and treated water varies between 0.1499 mg/l and 2.1680 mg/l. For the Dunes resort, reverse osmosis water ranged from 0.6361 mg/l to 2.0271 mg/l and treated water ranged from 0.6299 mg/l to 1.8665 mg/l. Finally, the station of Beni Saf-osmosis produces water whose concentration of boron is 1.10 mg/l and treated water is 1.25 mg/l.

WATER AND POWER CO-GENERATION IN REMOTE AREAS USING RENEWABLE ENERGIES

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ABSTRACT

Desertification constitutes a major scourge in Maghreb countries. According to estimations of United Nations Convention to Combat Desertification ([UNCCD]), the arable land available worldwide will significantly be reduced by 2025. Desertification has to be understood as degradation of land in arid and semi-arid regions and not as the expansion of existing deserts. One reason for this reality is the scarcity of freshwater resources in these areas rich in underground brackish water.

The use of raw brackish water does accentuate soil degradation. In order to combat this phenomenon; reverse osmosis (RO) emerges as a feasible desalination technology, renewable energy sources as necessary complement and decentralized water-electricity supplies as a solution for this particular problem. However, water desalting in remote areas require a high level of plant reliability as well as a dependable system.

These facts are the basis for the OPEN-GAIN project which stands for 'Optimal Engineering Design for Dependable Water and Power Generation in Remote Areas Using Renewable Energies and Intelligent Automation', whose overall strategic goal is:
"To co-ordinate R&TD joint effort to produce sustainable essential life-resources at minimum environment loads by introducing high technology and automation".

For remote arid areas, decentralised solutions for energy and water co-production offer advantages over large central production sites. Since skilled personnel are not available in such areas, dependable systems are necessary. This project offers a solution to cost optimal co-production of energy and water using renewable energy besides diesel generators. Cost optimization is achieved through a high level of automation, which is necessary to adapt the working conditions to the strongly varying renewable energy supply, and remote maintenance. The approach is based on thorough modelling of the processes and offers a large degree of flexibility in the design to meet different production requirements.

The project involves a consortium composed of several Mediterranean Partner Countries (MPC) as well as institutions from EU which are specialised in the desalination, renewable energy and automation systems.
A pilot plant has been constructed in the techno-pole of Bordj-Cedria, Tunis, Tunisia. This prototype system is composed of a hybrid power supply system (PV, wind and diesel), a reverse osmosis plant and a storage system. The whole compound is controlled by an energy management and fault control system.

KEYWORDS: Desalination, Solar Energy, Wind Energy, Diesel Engine, Pilot Plant, Energy Management System

DISTRIBUTION AND POTENTIAL USE OF BRACKISH GROUNDWATER IN THE CENTRAL BAHIRA-MOROCCO

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ABSTRACT

In the plain of Bahira, much of the population uses groundwater for drinking. However salinity affecting this water is a constraining factor to the use of groundwater, even for irrigation.

In this study, field measurements and chemistry analysis were performed to delineate the distribution of brackish groundwater in the Central Bahira plain. A Geographic Information System (GIS) is developed. This GIS aims to show available information on water resources including surface water runoff, groundwater salinity maps, wells productivity and groundwater depth. In another hand the GIS presents information about the water uses such as size and type of habitats, land uses and agricultural areas.

The results indicate that areas with low salinity (electric conductivities less than 2 mS/cm) are located along the Jbilet and Ganntour, while the middle of the plain is characterized by moderate to high water salinity. Concentration of chloride can reach up to 800meq/l in the center of the plain (Sabkha of Sed Al Majnoon). The wells productivity varies from few liters per second to more than 20 l/s.

Regarding the rural habitats, there is a significant dominance of small and medium villages (less than 800 population). Over 87% of the population lives on agriculture. Larges areas are covered by rainfed agriculture. Irrigated agriculture from groundwater is generally based on cereals, vegetables and olives. However, there are vast non-used lands due to the high salinity especially around the Sabkha of Sed Al Majnoon.

In the study area, the drinking water demands are currently estimated from 1 to $60m^3$/village/day. The majority of villages' water needs are less than $20m^3$/day (70%). Around 20% of the villages require 20 to $40m^3$/day. Demands exceeding $50m^3$/day are expressed by 10% of the villages. The majority of these villages are located in the area where the groundwater is brackish. Their water supply is currently provided by the deep aquifer of relatively acceptable salinity or by pipes from farther areas.

Small solar desalination systems with a capacity of less than $60m^3$/day could be used to produce good quality of drinking water. In terms of agriculture, the cultivation of plants that can tolerate high salinity, for example, pistachio, olives and some medicinal plants, could be an alternative solution in this context.

KEYWORDS: Salinity, Groundwater, Drinking, Irrigation, Bahira

SEAWATER DESALINATION IN ALGERIA

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ABSTRACT

According to recent demographic statistical data, the number of inhabitants in Algeria should double in the next thirty years whereas conventional water resources will not change. The hydrologic situation especially for the coastal areas reflects severe drought conditions that are lasting since two decades. Seawater desalination could be an efficient alternative in order to tackle the serious problem of water shortage. In fact, due to rural depopulation a large majority of the people and the economic activities are nowadays concentrated in the coastal cities of the Mediterranean Sea along ~1200 km of coast. The good physico-chemical features of Mediterranean seawater (19°C and medium salinity as compared to Persian golf seawater which exhibits 30°C and much higher salinity) make of Mediterranean desalination plants more profitable with less operating costs and better efficiencies The reverse osmosis has been chosen as the best desalination process because it has seen many improvements of its technology especially with regard to better performance and longer lasting membranes. The present study has focussed on three small desalination plants located not far from the capital city Algiers namely: Palm-beach sea resort, la Fontaine and Bou Ismaïl. Our main objective was directed towards the evaluation of the cost of the chemical consumables and the overall cost oft the desalinated cubic meter of water. The latter was found lower than 0.5 euro, which is quite interesting. All in all, the desalination option seems to be a good alternative to deal the most urgent matters in terms of ensuring durable water allocation in the present climatic context prevailing nowadays.

KEYWORDS: Desalination, Reverse Osmosis, Plant, Drought, Resource, Cost.

TOPIC 7

Legislation, Management Tools, Governance and Sustainable Development

IMPORTANCE OF THE INTERNATIONAL COUNCIL OF ENVIRONMENTAL ENGINEERING EDUCATION (ICEEE)

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ABSTRACT

Due to the climatic changes and the ecological variations of the biosphere, global natural resources including the atmosphere, hydrosphere, lithosphere, biodiversities, genetic resources, and climate, as well as energy, radiation, electric charge, and magnetism, and etc., must be safeguarded for the benefit of present and future generations through careful planning or management as appropriate. Today, environmental engineering includes many specialization e.g., water management, air quality, remediation of contaminated areas, civilization, impact and assessment, environmental sustainability concepts, environmental biotechnology, etc. As with civil engineering, electrical, mechanical and chemical engineering elements are incorporated into the discipline of environmental engineering.Based on the above mentioned concepts, the Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Protection Engineering (Budapest, Hungary), the Technical University of Košice, Faculty of Mechanical Engineering (Košice, Slovakia) and Uzhhorod National University, Faculty of Chemistry at the (Uzhhorod, Ukraine) agreed to establish an international organization dealing with the management of environmental engineering education. The International Council of Environmental Engineering Education (ICEEE) is defined as the international non-profit independent organization of non-governmental cooperation for environmental engineering education and scientific research in the future, joint efforts of the world youth activities. The ICEEE exists solely to provide programs and services that are of self-benefit. These include effective management and monitoring the performance of various fields of Environmental Engineering Education (EEE) as well as the technological development of EEE. The main aim of ICEEE is to improve the education of environmental engineers living in different European countries as well as all over the World to explore opportunities for operational contact for the nations, in order to encourage the emergence of cooperation, with the appropriate forum. Such cooperation is identified as an important issue to assess the problems of basic and higher education and scientific research, discuss and submit recommendations on the basis of the conclusions extracted from the scientific meetings.

The main points of ICEEE are to:

Enhance services to its members. Work with educational institutions to improve environmental engineering education and promote the under graduate (basic) university degree (B.Sc.) and graduate higher degree (M.Sc.) and Ph.D. development. Facilitate productive cooperation among industry, academy and government. Enhance the participation and success of under-represented groups in the environmental engineering education enterprise. Promote the value of the engineering profession. Unify the environmental engineering education programs throughout the EU in cooperation with other World Countries. Exchange the environmental engineering education professionalism among the international institutions. However, the dynamic development by coordinating our professional reforms and combined with effective use of scientific potentials agreed to improve the standards of environmental engineering education. Our institutions are agreed to fund the International Council of Environmental Engineering Education.

KEYWORDS: Environmental engineering, biosphere, development of technology

FOOD SECURITY IN THE MIDDLE EAST

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ABSTRACT

The Middle East region has been faced with various challenges that are associated with food security. These are perpetuated by water scarcity, an increase in the population numbers in the region, climate change and unemployment. Notably, these factors are intricate and self augmenting and thus, the problem is very complex. Most recently, the theory of virtual water has been proposed as the best approach of addressing this scenario. However, this study found out that various social, cultural, economic and political factors undermine its implication. The present trends indicate that the region is highly dependent on food imports and that the trend is set to increase in future. Besides highlighting the various challenges that the region faces in a bit to attain food security, this study presents viable approaches like the population control and the increased education levels and awareness creation that can be used to address the challenges in a sustainable manner.

KEYWORDS: Middle East, Food Security, Virtual Water, Trends

DEVELOPMENT OF DEMAND MANAGEMENT AND PROTECTION INDICATORS UNDER THE DPSIR FRAMEWORK, CASE STUDY: WEST BANK

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ABSTRACT

Indicators serve a variety of policy goals. They help in the improvement of water resource management policy through better assessment of the water resource. Indicators on Integrated Water Resources Management (IWRM) are comprised of measurements and derived values that track the changes of water resources conditions and their management efforts and success/failure over time. In this research, the IWRM indicators for the West Bank were developed depending on the IWRM indicators in the ESCWA region which were discussed in ESCWA Water Development Report 2 of 2007, in addition to the groundwater indicators which were presented on the Groundwater Resources Sustainability Indicators created by the United Nations Educational, Scientific and Cultural Organization- UNESCO in 2007. The IWRM indicators were developed to fit with the reliable and available data in the West Bank. The water status was analyzed depending on the Driving Force-Pressure-State-Impact-Response DPSIR framework, the IWRM indicators for the West Bank were developed and categorized, one of the categories is Demand Management and Protection which includes (efficiency of water supply systems, efficiency of water use, economic returns and water resources allocation, economic tools, cost recovery, water resources protection). The main findings of this research indicate that in the West Bank, efficiency of water use as the unaccounted for water averages 37%, and this is the highest in the region, water reuse is widely applicable in the ESCWA region; however, specific techniques or levels of treatment depend on local priorities and local economic feasibility. The amount of treated wastewater reused is so small percent of area irrigated with treated wastewater to total irrigated area is 0.18%, the average ESCWA countries percent for the agriculture GDP as a percentage of the total GDP is 8.0%, while it is in the West Bank in the common average 8.2%, and there is possibility to increase the percentage by networking and planning with related sectors.

KEYWORDS: Demand Management, Protection Indicators, Economic Tools, Cost Recovery.

FOR A GLOBAL STRATEGY OF THE ADAPTATION OF THE MOROCCAN COASTAL ZONES: THE NECESSARY INTEGRATION OF THE WATER POLICY

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ABSTRACT

The scientific community agreed on the strategy to be followed in adaptation of the coast to climatic changes. This one amounts essentially to three methods: protection, retreat and accommodation. In Morocco, second national communication for the United Nation framework Convention on climate change (UNFCCC) remind these methods which, according to it, should have to constitute the skeleton of the future strategy of coastal adaptation. Nevertheless, protection, retreat and accommodation are answers recommended exclusively for sea level rise, which constitutes only one of the aspects of the impact of climate change in coastal zone. The future strategy of coastal adaptation in Morocco should also foresee the other measures better to take into account various facets of the climatic risk in coastal zone. Indeed, the complex nature of these zones of interaction between terrestrial and marine ecosystems, confronts them so much with risks resulting from land that in those of maritime origin. Floods illustrate perfectly land risk. They require, consequently, to implement measures adapted for the coastal zones. The objective of this paper is to try to encircle the vulnerability of the Moroccan coastal zones in front of climatic changes by focusing on aspects others than the sea level rise.

So having analyzed the vulnerability of this coastal zone, it is worth to study the connexion of the water policy, notably in prevention of floods, with the future coastal adaptation strategy. It is finally important to suggest some ideas to take into account for the elaboration of this strategy.

KEY WORDS: Coastal Adaptation, Morocco, Strategy, Water Policy, Floods.

SUSTAINABLE MANAGEMENT ISSUE OF THE ECOSYSTEM OF THE ATLANTIC SAHEL OF OUALIDIA-SIDI MOUSSA (MOROCCO)

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ABSTRACT

The Atlantic Sahel of Oualidia-Sidi Moussa (Province of El Jadida, Morocco), is characterized by the presence of different water bodies: groundwater, wetland (lagoons of Oualidia and Sidi Moussa, marshes) and Atlantic Ocean. The main human activities in the area are agriculture, urbanization and tourism.
In this context, to protect the coastal ecosystem and sustain socio-economic activities (tourism, agriculture and fisheries), it is necessary in a first stage to determine:

- the hydraulic functioning of the system ;
- salinization and pollution mechanisms ;
- the sensitivity of the ecosystem (aquifer - wetland) to human pressures and climate changes.

The geological and hydrogeological studies helped conceptualizing the aquifer system as a bilayer system with karstic functioning, open to hydraulic exchanges with surface water (ocean and lagoons). Groundwater is affected by salinity attached to saltwater intrusion from the ocean and the lagoons. A geological origin of the salinity is also highlighted. Contamination by nitrate and Pb affects groundwater, confirming the impact of human activities.
The lagoons of Oualidia and Sidi Moussa are fed by the Atlantic Ocean. They constitute also discharge points of the groundwater. The groundwater discharge yield, difficult to assess, brings to the lagoons freshwater volumes which are necessary for their biological viability. The discharge could also bring pollutants to the lagoons.
The results indicated that the natural protection of the aquifer is low due to the dominant hydrogeological and geomorphological conditions, the surface and groundwater pollution risk is high because of uncontrolled anthopogenic activities. The interactions between the different water bodies in the Sahel imply that the sustainable management of its ecosystem should be carried out using an integrated approach that includes all the components of the hydrosphere (ocean, wetland and groundwater). Increased human activities in the area and the impact of climate changes are serious challenges to the Action Plan being implemented for the sustainable management of the Sahel.

KEYWORDS: Groundwater, Wetland, Salinization And Pollution Mechanisms, Oualidia, Morocco

ATTAINING SUSTAINABLE INCOME THROUGH BUSINESS MODELS FOR WATER USERS ASSOCIATIONS IN THE MENA REGION (THE CASE OF MOROCCO AND EGYPT)

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ABSTRACT

The formation and strengthening of water user associations (WUAs) for improved water management has been a widespread effort in Asia and Latin America for more than thirty years, but it is a relatively recent phenomenon in the MENA region. In Jordan, Egypt and Morocco, WUAs were introduced by donor agencies and government bodies responsible for water management little more than a decade ago. There is evidence of improved water efficiency and more equitable distribution. However, the associations have not assumed the full range of operation and maintenance responsibilities possible, which limits attaining higher levels of efficiency improvement. Moreover, the WUAs have largely been relegated to water management roles and have rarely fulfilled their potential on the production side. They have not played an effective role interacting with the other stakeholders in the supply chain, maximizing farmer member benefits and attaining sustainable incomes. This paper is based on efforts conducted under the USAID Advancing the Blue Revolution Initiative (ABRI) in the MENA region. Over a period of about two years, ABRI team worked with a small number of WUAs in Jordan, Egypt and Morocco to bridge the gap between water management and improved incomes through commercialization. Its approach is to establish business models as part of a collaborative process among major stakeholders, including the associations, line agencies, and the private sector. We believe that the absence of business models, that is, a clear and agreed upon vision of how WUAs can become production and income unit, has been a major stumbling block to WUA sustainability. Business models are a general framework of transactions needed for a WUA to generate income. The most basic business model for a WUA is simply producing agricultural products, providing services and selling these products and services to generate revenues.

In this paper, the researchers focus on an innovative process of designing a business model for WUAs in Egypt and Morocco. The main issues that are tackled by the model:

- Income generation and sustainability
- Higher quality production for domestic and international markets
- Win-win options that can be established with the concerned government agencies to resolve water management problems.

Currently, none of the WUAs in the targeted countries are operating as business units. The developed business models in this research are the first attempt at a national level and to tailor business plans for individual water user associations. The innovative business models have the real potential to improve the performance of the WUAs. The results of this activity are expected to enable WUAs that are on the edge of becoming business groups contributing to provide high quality products for domestic and export markets. This activity will also indentify what will take to make a "sustainable business group." We believe that the potential for replicability is very powerful. The business modeling and business plan approach, once tested and verified, could be tailored to and adopted by WUAs across the MENA region. ABRI has disseminated the final country business models and individual plans through workshops in Egypt and Morocco.

KEYWORDS: Water Users Association, Business Models

PROPOSAL FOR A SUSTAINABLE WATER RESOURCES MANAGEMENT IN THE OASIS OF FIGUIG, MOROCCO

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ABSTRACT

The Oasis and the small town of Figuig are located in the Oriental region of Morocco, in the far South-east of the country, near the Algerian border. In this desert area water resources are limited and the sanitation is very poor. Then, water resources are limited in quantity and quality. Water used for potable and irrigation (mainly palm trees) is obtained from wells, scarce and temporary surface sources and mines (*foggaras*). The main irrigation technique in use is border irrigation, but drip systems are being introduced. A new dam is being built at some distance from the village and the possibility of reusing treated wastewater after the implementation of wastewater treatment plants has been considered.

Over the last years, there has been an increase of cultivated land due mainly to the proliferation of new wells mainly built without any control. This situation has lead to an overexploitation of the aquifer with a salinisation of the groundwater resources and as a consequence of the soils.

On the other hand, sanitation is very poor. Most houses are only provided with septic tanks or cesspits. Although part of the community has a piped sewerage system this is still not fully in use since the main wastewater treatment plant has not been constructed yet. The main problem associated with poor wastewater management is the contamination of the aquifer.

At present, Hammam-Foukani is the only ksar (neighbourhood) with a complete sanitation system: a sewerage system and a wastewater treatment plant (WTP) using a series of stabilization ponds (WSP). The WTP was built in 1998 in order to treat and reuse the wastewater for agricultural irrigation purposes. In which respects to the soils, the occasional floods after heavy rainstorms are causing important losses of this non-renewable resource due to erosion.

Món-3 NGO and several research teams from the University of Barcelona (UB) have been collaborating since 1999 with the municipality for the implementation of a sustainable water management project. The activities carried out in the Oasis within the frame of the project "Support to the public policy of water management in Figuig" have been up to now focused on water resources, but the need to cope with the rest of the components of the SPAC (Soil-Plant-Atmosphere Continuum) arose. Within this future needs, the development of a MAR (Managed Aquifer Recharge) system seems to be paramount.

The tasks performed by the working teams have been the aquifer characterization, the implementation of a water user's community, the planning and management of wastewater treatment and reuse, and the implementation of communication and capacity building programs.

TOPIC 8

Water Economics, Allocation and Pricing

ESTIMATION OF THE ECONOMIC VALUE OF IRRIGATION WATER IN JORDAN

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ABSTRACT

Insight into the different values of water is essential to support rational decision making about policies, management and investments in the water sector as well as with regard to the efficient allocation of water and water pricing. This holds in particular for water use in agriculture, which has to compete with other sectors of water demand in the case of water scarcity. A simple comparison of partial productivities, i.e. the return per m³ of water, is no appropriate criterion, since it ignores, amongst others, required other production factor inputs. The Residual Imputation Method (RIM) provides a substantially more meaningful approach for water valuation, since it allows for the determination of shadow prices for un-priced inputs under the assumption of a given production set-up. There are shortcomings in the application of RIM, too, which include the difficulties of applying full cost approaches in agriculture. However, its central focus on the marginal value of an element within a complex production process complies to the demands of truly economic approaches and its comparatively simple application allows for a flexible use in different situations.

Results from a valuation of irrigation water in Jordan by RIM revealed an aggregated, and weighted average water value for field crops of 0.44 JD/m^3, 1.23 JD/m^3 for vegetable crops and 0.23 JD/m^3 for fruit trees. The overall weighted average water value in irrigation amounted to 0.51 JD/m^3. With regard to individual crops, cucumbers had the highest water values with about 6.05 JD/m3, followed by string beans with 2.64 JD/m3, and sweet pepper with 2.54 JD/m3. The lowest returns per m³ among annual crops were provided by squash with 0.67 JD/m3, radish with 0.66 JD/m3 and hot pepper with 0.38 JD/m3. Water values in the irrigation of fruit trees ranged from about 0.79 JD/m3 in, followed by oranges of the Shamouti variety with 0.58 JD/m^3, mandarins with 0.54 JD/m^3, apricots with 0.53 JD/m^3, apples with 0.5 JD/m^3 and olive trees with only 0.069 JD/m^3.

The estimated values represent the maximum price that farmers might be willing to pay for water under the current market conditions. However, the study results indicated a high level of variability in the calculated water values. Reasons are the differences in the individual farmer's knowledge about markets. The interpretation of these results must take the inter-annual variation of product prices into consideration, which lead to continuous shifts in the ranking of crops according to their profitability.

KEY WORDS: Residual Imputation, Water, Horticultural Crops

THE PRICE AS INCENTIVE FOR THE RATIONAL AND EFFICIENT USE OF WATER: THE SPANISH CITIES

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ABSTRACT

As a direct consequence of the Water Framework Directive (WFD), water services in Spain during the last years have been transformed, suffering a deep evolution. As result, there is a general consensus on the need to reach a sustainable use of the resource and the complete guarantee of water safety. Nevertheless, such consensus does not exist in all aspects because there is not an agreement on how the increased costs incurred during the last years must be assumed.

The WFD enforces the obligation to recover all costs incurred. The costs must then be reflected in the rates, which is not true in Spain. Then, two questions arise: is the water cheap or expensive in the country? Is the real cost of water paid by the users?

To answer the first question is necessary to analyze which is the price of urban water services in Spain and compare it with several expenses concepts. In this way it can be realized and stated if, in relative terms, the water is or is not expensive for the citizen. At the same time it seems relevant to establish the differences among rates in Spanish towns and the main causes of such differences. The comparison finishes comparing the most important Spanish towns with several European ones.

To answer the second question is paramount to know the cost of the water service and what is paid for it; in other words which is the price paid for water urban services and which is the effective cost of these services. From the analysis performed it can be observed that in Spain citizens pay far less than the cost, and it is also to note that the citizen ignores the real cost of the integrated water cycle in the present Spanish society.

If a policy of translation of costs into prices is applied, this is known as the principle of full cost recovery, incentives for the conservation and most efficient use of water resources could be implemented, thus helping to fulfil the environmental objectives of the WFD.

Finally, and considering the international context, the capability for making rates evolve is being considered. Suggestions are also made on the ways to achieve costs reductions in the context of the global and integrated management of the urban water cycle.

KEYWORDS: Water, Price, Efficiency, Cost, Water Framework Directive

ASSESSMENT OF A COST-COVERING SANITATION TARIFF FOR ALEXANDRIA/EGYPT

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ABSTRACT

Alexandria, the "Second Egyptian Capital", faces major inefficiencies regarding financial sustainability of sanitation services. Wastewater tariffs in Alexandria are only covering around 20% of the total cost and 60% of operation and management costs. Aim of the study is to assess the possibility of introducing a cost – covering sanitation tariff. For this purpose the overall influences are examined, starting with a situation analysis of Egypt and Alexandria and ending with a financial analysis of the sanitation utility in Alexandria. The assessment also includes the review of "Best practices" from Morocco and Germany and the development of scenarios for implementing a cost-covering sanitation tariff. Results showed that complexities of constraints but also optimistic policies are influencing sanitation tariff adjustments in Egypt. Optimistic policies are the newly established institutional framework, which paves the way for a less bureaucratic decision-making process. Constraints are the low public wages, which do not allow cost covering sanitation tariffs. Besides, there are other constraints like the questionable influence of the newly established regulatory agencies or the lack of service quality. Both mentioned aspects are essential to justify tariff increase. Financial analysis and affordability to pay showed that people can easily afford to pay the costs of operation and management but not the total cost. One of the developed scenarios, showed how cost could be covered within two to three years by complying to the current policy discussion.

KEYWORDS: Wastewater, Sanitation, Tariff, Cost, Operaion, Management, Alexandria

THE DYNAMIC OF THE FARMING SYSTEM AND THE WATER USE EFFICIENCY: THE CASE OF THE IRRIGATED AREAS IN SEMI-ARID REGION OF TUNISIA

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ABSTRACT

Given the climate constraints and the limited resources, Tunisia has developed the irrigated sector in order to diversify the agricultural production and to meet the food needs of the population. Therefore, the irrigated areas reached 433 000 ha of which 229 000 ha were arranged in irrigated public areas (IPBAs). In such areas, farmers share a common resource according to a collectively organized scheme. The rest, called irrigated private areas (IPRAs), use surface wells as private resources. The total irrigated area accounts for only 8% of the total agricultural land, but it contributes up to 35% of the national agricultural production. This development of the irrigated sector has been achieved goodness to the government efforts in terms of the water harvesting and the development of hydraulic infrastructure. Today the rate of the water mobilization is more than 90%. Therefore, this policy of water supply reaches its limits and the efforts should be turned to the management of the water demand. In the other hand, the government planes to improve the contribution of the irrigated sector in order to reach 50% of the national agricultural production. One weakness of the Tunisian water policies undertaken until now is that they did not take into account the motivations and practices of the farmers. These practices involve the cropping system, the kind of access to the water resource and the intrinsic operational conditions of the households (Capital, Skills, livelihoods constraints, futures purposes…). So the question remains how to enhance the process of the technology in order to improve the water use efficiency? This question raises basically two issues regarding the farming practices performance. In fact the water use efficiency depends on the technology itself and on the manner to implement it.

Within this context, this research aims to analyse the farming system, the technology performance and the water use efficiency of the irrigated farms in the Sidi Bouzid region. By monitoring the sample of 47 farms during the cropping years 2007, 2008 and 2009 we have gathered database which involved technical and economical details of 82 plots of which 37 plots belong to the IPBAs. By analyzing the farming system we have identified the technology process in order to estimate the production frontier using the Data Envelopment Analysis (DEA) approach.

The empirical findings show that farmers grow olive trees, cereal crops, forage crops and horticulture crops. During the surveyed period the share of the different crops did not change significantly. The water consumption reaches only an average of 2700 m^3/ha. However, the charge of irrigation represents more than 40% out of the total expenditures. The results of the DEA model show that 50% of farms are inefficient and the technical efficiency reaches an average of 81%. The average of the scale efficiency reached 88% but only 3 farms operated at the optimal scale between 2007 and 2009. However, the water use efficiency did not exceed an average of 68%. Hence, 32% of the water currently used should be saved. Therefore, there is a wide gap to improve skills and the ability of the farmers to achieve the best of the water use efficiency. Thus, we suggest that the state intervention is necessary not only to reduce the wasting of water but also to set up an accompanying device that reconciles water conservation and the production targets.

KEYWORDS: Irrigated areas, Technical efficiency, Water use efficiency, DEA model

RECOGNIZING THE ECONOMIC VALUE OF DOMESTIC WATER IN JORDAN AS A WAY FOR APPROPRIATE SETTING OF WATER PRICING

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ABSTRACT

Water resources in Jordan are very scare and proper and effective water allocation is a key decision to ensure sustainable water management. The water demand of the domestic sector is the first sector to be fulfilled according to Jordan's water strategies and policies. However, many of the Jordanian residents are undervaluing the value of water. The Domestic water is provided by the Water Authority of Jordan (WAJ) at low prices for most residents in comparison to the actual cost of supply. This situation accompanied with the modest improvement of the operation and service performance leaded to large deficit in investing in the water system infrastructure to maintain and expand it. Many residents are paying higher cost for water sources other than the public water provided by WAJ due to the need for better water quality and additional water quantities.

The objective of this paper is to estimate the value of water used for domestic purpose as a way to set appropriate water tariff and through recognizing the actual economic value of water. Estimating the economic value of domestic water is a complex process since using water for domestic water does not contribute directly to an economic production while most of its value comes from the extrinsic values. The value to users of water is a key component of the extrinsic values that can be measured using the willingness to pay approach which could be expressed by the cost of water on users. The full supply cost and the opportunity cost are key components of the cost of water on users that were estimated in this paper to measure the economic value of the domestic water. The opportunity cost is the additional cost accrued on the water users from using an alternative water source.

The cost of public water on domestic consumers in 2009 is 0.42 JD/m^3 while the average cost of service is 0.89 JD/m^3. The opportunity cost of water varied over the Jordan's region and is estimated to be around 3.6 JD/m^3. The water value of the cubic meter is estimated at 4.47 JD and the total domestic water in Jordan is estimated at JD 819 million. The actual domestic water value is higher since other components of water value were not accounted for in the estimation. Recognizing the actual value of the domestic water, which is at least 10 times the cost paid by domestic consumers, should help decision makes to set appropriate domestic water tariff in Jordan.

KEY WORDS: Domestic Water Value, Opportunity Cost, Water Pricing, Jordan

SPATIAL WATER RESOURCES ALLOCATION CONSIDERING INTEGRATED WATER RESOURCES MANAGEMENT APPROACH

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ABSTRACT

Water shortages and deteriorating water quality have forced many countries in the world for reconsidering their options with respect to the management of their water resources. The growing populations of Egypt and related industrial and agricultural activities have increased the demand for water to a level that reaches the limits of the available supply. The government has promoted an ambitious program to increase the inhabited area in Egypt by means of horizontal expansion projects in agriculture and the creation of new industrial areas and cities in the desert. All these developments require water.

This research is aim to manage the water resources distribution at the medium level (canal command area) based on the integrated water resources management approach. In addition, the water gap between the water supply and water demand for agriculture use is estimated with relevant to the spatial location. Water quality of the water resources at the study area is considered.

This could be achieved by constructed a comprehensive geo-database included the different water resources in the study area, cropping patterns, drainage system, water quality monitoring station for irrigation and drainage system major water supply and demands. Establishing the relationship between all those entities which are collected from different sources in different format based on the integrity to facilitate effective quires. Through different spatial analysis methods the water gap could be estimated. Several alternatives could be studied for increasing the demand on the non-conventional water resources, reuse drainage waste and ground water based on the water quality of these water resources.

This approach is applied on one of the biggest canal in the eastern part of the Nile Delta (ismailiya canal command area) which its actual capacity reach to7.8 mm^3/day and served approximately79, 000 feddan for agriculture use and 2.5 mm3/day for drinking use. The total abstracted groundwater reaches to 370,000 to m^3/day. The official reuse for the drainage water is neglected due to the deterioration of the water quality.
The water gap map represents the spatial distribution of the difference between the water supply and water demand at the study area. Moreover, several interventions could be executed to fill the gap with respect to the water resources quantity and quality. The developed system could be applied in other regions considering water management is essential issue.

KEYWORDS: Water Gap, Water Management, Spatial Analysis, Eastern Delta

EVALUATION DE L'IMPACT DE LA PARTICIPATION PAYSANNE DANS LES AMENAGEMENTS HYDRO AGRICOLES: LE CAS DES PROGRAMMES DE FORMATION POUR LE RENFORCEMENT DE L'APPROCHE PARTICIPATIVE

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RESUME

En 1996, l'aménagement des périmètre irrigués de la Petite et Moyenne Hydraulique (PMH) des provinces du mord marocain, a connu plusieurs projets de réhabilitation intégrés dans le cycle de projet participatif. S'inscrivant dans une nouvelle approche, la Gestion Participative de l'Irrigation (GPI), la principale composante du projet d'aménagement était la mise en place des Associations des Usagers des Eaux Agricoles (AUEA) pouvant prendre en charge la gestion et l'exploitation de l'infrastructure et des équipements en place et s'impliquer d'une façon concrète dans les différentes phases du projet d'aménagement, allant de l'identification, la contribution dans les études, le contrôle des travaux et au mesures d'accompagnements à travers les formations et le suivi évaluation.La présente communication essais de faire un diagnostic sur la participation des usagers dans ces projets, à travers, le diagnostic des Associations des usagers des eaux agricoles et leur fonctionnement, leur participation dans les différentes phases de réalisations pour en mettre les points sur les facteurs qui freinent cette dynamique participative dans les phases de ces projets pour en tirer les enseignements pour des projets similaires dans le futur; la place de la femme dans ces projets et le renforcement des mesures d'accompagnement à travers des programme de formation au profit des AUEA et usagers des eaux agricoles ou potables.

Toutefois, on relève de multiples formes d'appropriation et des points forts de cette approche participative à travers l'instauration de nouveaux partenariats de travail entre Usagers, entreprises et administration, la formation de nouveaux leaders et la crédibilisation des interventions étatiques dans ces zones sensibles.

KEYWORDS: Aménagement Hydro Agricole, Approche Participative, AUEA, Suivi Evaluation, Approche Genre, Changement Climatique

POSTER PRESENTATIONS

TOPIC 1

Rational and Efficient Use of Water Resources

GESTION D'UN SYSTEME AQUIFERE PAR L'UTILISATION D'UN MODELE HYDRAUDYNAMIQUE: APPLICATION A LA PLAINE DE MAGHNIA (NW ALGERIE)

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RESUME

L'Algérie a connu durant la période 1975-2000, une succession de périodes de sécheresses intenses et persistantes ; cette sécheresse a été caractérisée par un déficit pluviométrique important, et a touché l'ensemble du territoire. Elle a sévit particulièrement dans les régions Ouest du pays. Face à ce problème, la gestion active des aquifères s'impose dans la perspective d'un environnement durable.

La plaine de Maghnia, (NW de l'Algérie), renferme des ressources hydriques importantes (14 Millions m^3). Cependant l'accroissement des besoins en eau pour l'alimentation des populations, les activités industrielles et agricoles a conduit les services de l'Hydraulique à intensifier les prélèvements au niveau des principaux champs captant ce qui a entraîné une chute du niveau de la nappe et une diminution des débits des oueds.

Dans cette contribution nous présentons pour la première fois un modèle hydrodynamique de la nappe de Maghnia. L'utilisation de ce modèle basé sur la méthode des différences finies, avec des conditions en régime transitoire, a permis d'améliorer la connaissance des caractéristiques hydrodynamiques de l'aquifère et l'évaluation d'un bilan hydrologique complet. En outre, l'impact des débits prélevés sur l'évolution piézométrique de la nappe a été démontré pour plusieurs scénari d'exploitation.

MOTS CLES : Hydrogéologie, Nappe Alluviale, Ressource en Eau, Modélisation, Méthode des Différences Finies, Maghnia, Algérie.

ANALYSE STATISTIQUE DU REGIME HYDRAULOGIQUE SUR LA PLAINE DU HAOUZ (MAROC)

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RESUME

La plaine du Haouz est marquée par un climat continental semi aride. Les précipitations sont faibles avec 85% durant la saison pluvieuse, leur répartition montre une variabilité régionale, les valeurs importantes sont enregistrées au niveau de la zone piémontaise. Les températures sont élevées (moyenne annuelle de 19.32°C) introduisant de fortes évaporations et évapotranspirations. L'approche statistique des fluctuations des pluies montre des distributions de type logarithmique et hypogaussique, avec une diminution des précipitations futures de 85% dans une période de retour de 100 ans.

Ce type de climat influence l'hydrologie de surface, le ruissellement à l'échelle de la plaine est pratiquement nul et les infiltrations sont faibles, ce qui agit sur le bilan hydrologique de la plaine. Les séries de débits annuels s'ajustent à des lois logarithmiques, les potentialités hydriques seront pratiquement nulles pour une période de retour de 10 ans seulement.

MOTS CLES: Hydrologie, Débit, Pluie, Corrélation, Lois, Ajustement.

BILAN ET QUANTIFICATION DES RESSOURCES EN EAU AU NIVEAU DU PIEMONT; EN MILIEU SEMI-ARIDE CAS OUED RHERAYA AVEC LA PLAINE DU HAOUZ (MAROC)

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RESUME

Les études en ces derniers temps sont devenus plus intenses sur les zones arides et semi-arides, puis ce qu'ils présentent un grand nombre de population et ils sont adéquats à plusieurs cultures agricoles, ce qui engendre une intense consommation d'eau en usages domestique et celui agricole par rapport aux apports hydriques en ces zones-là.
La plaine du Haouz et plus précisément, la région de Tahanaout où coule l'Oued Rheraya est classée par son indice d'aridité comme une zone semi-aride, notre objectif c'est d'étudier la relation qui lie l'eau de surface et l'eau souterraine et d'en sortir le bilan hydrique et quantifier les apports. Pour cela nous avons choisi la station de Tahanaout comme une entrée pour le bassin de Rheraya et un autre point comme l'exutoire du bassin suffisamment en aval du contact piémont-plaine et aussi suffisamment engagé en plaine pour pressentir si cela existe l'effet de l'écoulement de la surface sur la nappe du Haouz à notre endroit.

La méthodologie suivie a été établie comme suite; en 1er temps ; le choix du meilleur MNT à utiliser dans notre étude, ce choix a été effectuer par une succession de calcul statistique, en second temps la mesure des apports hydriques de l'Oued par un certain nombre de jaugeages différentiels qui et en même temps le taux d'infiltration de ce dernier, la pluie serra celle enregistrée dans la station de Tahanaout, et 3ème temps le calcul des pertes ; l'évapotranspiration estimée par télédétection (Outil SAMIR : satellite Monitoring of irrigation) et les déviations par seguias (canaux d'irrigation) seront mesurées par jaugeage, deux campagnes piézométriques ont été réalisées, étalées sur 21 km² et contenant 41 puits.

Les résultats ont été élaborés dans un système d'information géographique, les résultats de la télédétection corroborent parfaitement avec les résultats de la piézométrie, dont on peut tirer les zones de recharge et les zones de pompages.

MOTS CLES : Hydrologie, hydrogéologie, SIG, télédétection, MNT, bilan hydrique.

MODELISATION DES ECOULEMENTS SOUTERRAINS DE L'AQUIFERE ALLUVIONNAIRE DE L'OUED ISSER (BOUMERDES, NORD-EST ALGERIE)

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RESUME

L'aquifère de la plaine alluviale de l'oued Isser se situe à environ 60km à l'Est d'Alger. Il constitue une ressource en eau de grande importance pour les usagers locaux. Cependant, l'augmentation de la population, l'urbanisation progressive du territoire, le développement des superficies aménagées pour l'agriculture et de nombreuses autres activités économiques, menacent cette eau dans sa pérennité et sa qualité. Il s'avère nécessaire de prévoir à moyen et long terme la réaction de l'aquifère, et la ressource qu'il contient, au développement et à l'exploitation.

À l'aide du logiciel ''MODFLOW'' on a pu élaborer un modèle mathématique destiné à apprécier le comportement de l'aquifère de l'oued Isser vis-à-vis des prélèvements. Ce modèle qui demeure suffisamment réaliste en dépit des simplifications inéluctables reproduit adéquatement l'allure des isopièzes et le sens d'écoulements souterrains observés sur le terrain. Les simulations en régime transitoire ont servi à analyser le niveau de la nappe selon plusieurs scénarios d'exploitation. Elles ont montré très clairement qu'un accroissement des débits pompés ne ferait qu'accroître les risques pesant sur l'aquifère.

Cette approche basée sur la modélisation constitue un instrument de prévision efficace aux mains des gestionnaires. Le modèle pourrait être enrichi avec de nouvelles informations afin d'assurer sa mise en œuvre périodique et affiner son calage.

MOTS CLES : Modele Mathematique, Ressource En Eau, Aquifere, Plaine Alluviale de l'Oued Isser, Modfow.

ROLE DU CONTROLE STRUCTURAL SUR LE FONCTIONNEMENT HYDROGEOLOGIQUE DE LA PLAINE DU HAOUZ

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RESUME

La plaine du Haouz se situe dans la partie méridionale de la meseta marocaine occidentale. Elle est allongée en direction E-W entre la chaîne du Haut-Atlas au Sud et le massif hercynien des Jbilet au Nord. Elle s'étend sur une superficie de 6 000 km2 environ avec une altitude qui diminue progressivement de 900 m au Sud à 300 m au Nord. Le Haouz de Marrakech est une cuvette de sédimentation tectonique dans laquelle se sont accumulées durant le Tertiaire et au Quaternaire d'importantes formations détritiques, résultant de l'érosion de la chaîne Haut-Atlase mise en place lors de l'orogenèse atlasique (Ferrandini et Marrec, 1982). Ces formations reposent en discordance sur un substratum constitué d'un socle hercynien qui affleure à la faveur des massifs paléozoïques des Jbilet et des Guemassa. La structure de ces massifs anciens est relativement bien connue grâce aux nombreuses études dont ils ont fait l'objet en raison notamment de leur potentiel minier.

La présente étude a pour objectif d'améliorer la connaissance du fonctionnement hydrogéologique des différentes structures du bassin du Haouz en se basant sur l'analyse des nouvelles données géologiques, hydrogéologiques et chimiques. Elle confirme la distinction d'épaississement du système aquifère en allant du Nord vers le Sud. La dissymétrie du bassin et l'épaisseur du remplissage sédimentaire permettent d'orienter d'une part les sondages profonds vers la bordure et la plaine, et de protéger les zones vulnérables à la pollution d'autre part.

MOTS CLES : Bassin du Haouz, Hydrogéologie, Géologie et Ressources en Eau.

EVALUATION OF EFFICIENCIES OF THE USE OF WATER ON THE LEVEL OF THE MINA IRRIGATED PERIMETER (ALGERIA, WESTERN NORTH)

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ABSTRACT

Algeria is classified today among the poorest countries as regards hydrous potentialities. Narrow association between water and food safety makes to agriculture a first nonsparing user of the water available (65%) whose request tends to exceed the durably mobilizable resources. Under an arid semi climate, the irrigated perimeter of Mina (West-Algeria) is found with limited, vulnerable water resources and unequally distributed.

The objective of our work is to estimate the efficiency of the use of water with the level of the irrigated perimeter of Mina. For this purpose, the determination starting from the evapotranspiration of reference (ETo) and the farming coefficient (Kc) of the water requirements of the cultures, the net requirements for irrigation of each group of cultures and of the efficiency of the irrigated perimeter of Mina enabled us to appreciate the water losses caused by the various practiced systems of irrigation.

In order to produce of advantage with less water and to avoid water the shortages, an improvement of the performances of irrigated agriculture, a rational and sustainable management of the water resources become a paramount challenge. Its valorization thus requires besides the realization of a hydraulic infrastructure necessary to the extension of the irrigation, the creation of the technical requirements, socio-economic and legal favorable for an intensive and efficient agricultural development in the zone of study.

KEYWORDS: Irrigated Perimeter, Mina, Semi Arid, Efficiency, Management Rational, Sustainable.

TOPIC 2

Impact of Pollution on Water Resources and Health

QUALITY OF THE GROUNDWATER IN THE EASTERN HAOUZ PLAIN AND TASSAOUT, WESTERN MOROCCO

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ABSTRACT

The eastern Haouz plain and the region Tassaout are located in the east of Oued Zat, the west of Oued Lakhdar, the south of High Atlas and the north of Jebilet. The compilation of geological, drilling and geophysical data lead us to identify the reservoir cover, which is formed by the Mio-Pliocene and the Quaternary formation; and the underlying formation composed by the series of Triassic and Permo-Carboniferous especially (Stephano-Autunian) forming the bedrock of the aquifer.

The groundwater flow is imposed by a divided line of groundwater oriented North West-South East; we distinguish two flow axis, the first one oriented North-South, is parallel to the surface flow of oueds Lakhdar and Tassaout, the second, oriented East-West is feeding Tensift. The groundwater recharge is by anastomosis in contact with limestone outcroppings of the High Atlas, at Oueds Lakhdar Tassaout and Rdat, and by infiltration of irrigation water at the perimeter of the upstream Tassaout. We can also distinguish another recharge located downstream to the plain in the contact of Jebilet.

The results of the groundwater quality show that the electric conductivity varies between 800 µs/cm upstream and 4000 µs/cm downstream, and 70 % of the mineralization of the studied area has a conductivity less than 1500µs/cm. The chemical facies is sodium chloride to mix. The content of nitrates is generally less than 50 mg / l in all the zone, which means, the water quality is average good; except where it exceeds the standard (50 mg / l), is considered as bad quality of groundwater.

Pollution sources are three categories: agricultural pollution that broadcasts in the irrigated perimeter of the Tassaout upstream, urban pollution with domestic waste and pollution by sewage discharges around agglomerations Tamalelt, El Attaouia and Ait Ourir.

KEYWORDS: Eastern Haouz Plain, Tassaout, Quality of the Groundwater, Flow, Pollution, Nitrates

CARACTERISATION HYDROCHIMIQUE DES EAUX DE LA PLAINE DE LA BAHIRA (MAROC CENTRAL)

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RESUME

La rareté des ressources en eau est devenue un problème difficile à résoudre pour satisfaire tous les besoins en cette matière vitale. En effet, la croissance démographique au Maroc et le développement socio-économique ont pour conséquence l'augmentation de la demande en eau (eau potable, irrigation…) ce qui conduit à une baisse très significative des réserves d'eau de surfaces et souterraines et une dégradation de la qualité de celle-ci.
Dans ce contexte, la plaine de la Bahira au Maroc central est l'une des régions les moins favorisées par la nature de son climat où les données hydroclimatiques et l'irrégularité de la pluviométrie confirment un climat semi-aride.
La nappe souterraine de la Bahira, dont la forme est synclinale, est constituée par deux systèmes aquifères ; la nappe libre est formée par des dépôts de sable d'âge Yprésien et des alluvions Quaternaire et une nappe profonde captive formée par des sables phosphatés et des marnes siliceuses d'âge maestrichtien et Thanétien. La recharge des nappes se fait par les eaux de pluie et par les eaux de ruissellements provenant des Jbilet au Sud et de Rhamna et les plateaux calcaires de Ganntour et les Mouissate au Nord.
Les paramètres physico-chimiques des eaux sont déduits de mesures directes sur le terrain (la conductivité, la température et le ph), et des analyses au laboratoire regroupent les principaux ions majeurs. Les échantillons montrent une très grande variation de la conductivité, la Température oscille entre 17 et 25 °C, et le pH qui est légèrement basique. La qualité chimique de l'eau de la nappe libre est généralement moyenne à mauvaise ; La salinité des eaux des formations plio-quaternaires est très élevée autour des deux lacs de Sed-El-Mejnoun et Zima, elle dépasse par endroit 6g/l. Les eaux de la nappe profonde sont par contre de meilleure qualité, puisque la salinité dépasse rarement 2 g/l.

MOTS CLES: Water, Hydrochemical, Bahira Plain, Central Morocco

SIG, OUTILS D'EVALUATION DE LA QUALITE DES EAUX SOUTERRAINES, CAS DU BAS CHELLIF – BASSIN HYDROGRAPHIQUE CHELLIF ZAHREZ - ALGERIE

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RESUME

L'existence de toute sorte de vie est liée à la présence de l'eau, l'insuffisance de cette dernière est l'un des problèmes les plus cruciaux auquel l'homme est confronté. Celle-ci l'a contraint véritablement à sa recherche, notamment, par l'exploitation des eaux souterraines et autres.
Bien que cette difficulté soit préoccupante, il n'en demeure pas moins que la qualité de ces eaux présente, néanmoins, un intérêt majeur.
Les systèmes d'information géographique représentent des moyens puissants d'analyse, de structuration et de synthèse de données, ils apparaissent comme les meilleurs outils, contribuant à la compréhension du monde réel pour une meilleure représentation du problème de la qualité des eaux dans notre étude.
Le choix de la région du bas Chéliff, comme terrain d'étude, est essentiellement motivé du fait qu'il est alimenté en majorité par des eaux souterraines à partir des captages implantés dans des zones à aménagement varié (zones urbanisées, zones agricoles et zones industrielles).

MOTS CLES: Système d'information Géographique, Qualité Des Eaux, Eau Souterraine, Base de Données, Bas Cheliff

INFILTRATION AND FIXING OF THE HYDROCARBON OIL IN SAND SATURATED WITH WATER

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ABSTRACT

Oil infiltration and trapping within sandy beds of various granulometry are experimentally studied through a macroscopic approach. Two different behaviours according to the grain size are observed. For coarser grains, the oil is adsorbed preferentially at the grain surface, and then may be easily moved through water drainage. For finer grains, the oil is fixed within the pores, and hardly moved by water drainage.

The oil viscosity evolution across the sand layer confirms that longer chains are preferely trapped. In the nearshore, trapped oil may be then moved under water drainage for coarse sands. For finer sand beaches, the time of residence is strongly increased, and oil mobilisation may be significant if the sandy bottom is moved to suspension due to hydrodynamic forcings.

KEYWORDS: Saturated Porous Environment, Sand, Infiltration and Fixing, Hydrocarbon Oil, Darcy.

EVALUATION DE LA POLLUTION METALLIQUE CHEZ UN MOLLUSQUE (PATELLA FERRUGINEA GMELIN, 1791) ET UN POISSON (TRACHURUS TRACHURUS LINNE, 1758) DANS LA BAIE DE HONAINE (EXTREME OUEST ALGERIEN)

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RESUME

La pollution marine est un problème majeur qui affecte notre environnement. La qualité des eaux côtières de la ville de Honaine a été suivie de Mars à Juin 2010 par l'utilisation de deux espèces animales :

- la Saurel Trachurus trachurus procuré de la baie de Honaine, en analysant les branchies, les gonades, le foie et le filet
- La Patelle Patella ferruginea prélevée de deux stations (Ouest de la plage et extérieur du port de Honaine

Cinq éléments ont été recherchés : le Cd, Cu, Ni, Zn et Pb

Après minéralisation par voie sèche des deux espèces et le dosage par Spectrophotométrie d'Absorption Atomique des éléments traces métalliques, les résultats montrent :

Un taux élevé de cuivre par rapport aux autres métaux lourds avec une concentration importante au niveau du foie de Trachurus trachurus. Cette concentration en Cuivre a atteint la dose maximale admissible pour les poissons, alors que les teneurs en Zn, Pb, Cd et Ni semblent normales à Honaine.

Le gradient d'accumulation dans les organes se présente comme suit Foie>Gonades>Branchies>Filet

Les concentrations des métaux chez la patelle ne présentent pas de différences significatives à l'exception du Nickel qui est élevé à l'ouest de la plage.

Pour confirmer nos résultats, nous avons utilisé la variance à un facteur (ANOVA).Le test a été également utilisé pour comparer les teneurs d'un même métal dans les différents organes (comparaison inter-organes).

MOTS CLES: Pollution Marine, Eléments Traces Métalliques, Trachurus Trachurus, *Patella Ferruginea*, Bioaccumulation.

PROBLEMES DES EAUX CHLORUREES CALCIQUES DU LD2 ET LEURS INCIDENCES SUR LE FORAGE ET LA PRODUCTION DU CHAMP DE HASSI MESSAOUD, PLATE FORME SAHARIENNE, ALGÉRIE

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RESUME

Le champ de Hassi Messaoud est vaste de part son histoire de production pétrolière, mais aussi de part sa renommée mondiale. Cependant les connaissances géologiques accumulées sur plus de 1500 puits forés au cours des 60 dernières années, n'ont pas permis de résoudre les problèmes liés à la phase 8''½.

Le champ de Hassi Messaoud reste à ce jour délicat en raison notamment du problème de cavage, des différentes zones aquifères et des pertes de boue, signalées lors de cette phase, essentiellement dues aux différentes caractéristiques que présentent les formations

Cette étude concerne tout le champ de Hassi Messaoud et le choix des puit à étudier est fonction de la disponibilité des données de diagraphies et des rapports de fin de sondage. Notre objectif est d'essayer de faire une analyse du problème des venues d'eaux chlorurées calciques rencontré au lias dolomitique.

En effet, de par leur nature et leur pression dans le gisement, anormalement élevé, ces eaux ont une incidence néfaste sur le forage et peuvent provoquer l'endommagement et la corrosion du casing de production.

Le but à atteindre étant de présenter d'abord l'aspect pétrolier de la région et le puit LD2, d'énumérer les différents problèmes rencontrés, de proposer des solutions ainsi que des recommandations.

MOTS CLES: Champ de Hassi Messaoud, Eaux Chlorurées Calciques, Lias Dolomitique, Endommagement, Casing de Production et Solutions.

ASSESSMENT OF WATER QUALITY IN COASTAL ENVIRONMENTS OF MOHAMMEDIA APPLYING RESPONSES OF OXIDATIVESTRESS BIOMARKERS IN THE BROWN MUSSEL PERNA PERNA

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ABSTRACT

The present work aims to assess the marine environment quality in Mohammedia, using the response of the oxidative biomarkers in the brown mussel Perna perna. The Oxidative stress is evaluated using catalase (CAT), a well-known anti-oxidant enzyme, and malondialdehyde (MDA) accumulation as marker of oxidation of membrane phospholipids through lipid peroxidation. The results show that CAT activity and MDA concentration in whole mussel bodies, are a higher and significant ($p < 0.05$) in mussels collected at polluted site when compared to specimen sampled from control one. The oxidative biomarkers confirm that mussels from Mohammedia have been submitted to polluted environment.

KEYWORDS: Oxidative Biomarkers, Catalase, Malondialdehyde, Mussels, *Perna perna*, Marine Pollution.

PHOTODEGRADATION DE L'IBUPROFENE, ANTI INFLAMMATOIRE, DANS LES EAUX NATURELLES PAR IRRADIATION SOLAIRE SIMULEE

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RESUME

La présence de polluants organiques et de leurs produits de dégradation dans le compartiment aquatique est devenue une des préoccupations majeures de l'opinion publique, en matière d'environnement et/ou en matière de santé. Parmi les problèmes émergents relatifs à la qualité de l'eau, de nombreux travaux de recherche sont actuellement menés sur les résidus pharmaceutiques. Ces produits à usage thérapeutique ne sont que partiellement utilisés par l'organisme et excrétés plus ou moins métabolisés dans les urines et les selles pour atteindre en fin de parcours, les eaux résiduaires urbaines et ou les eaux naturelles où ils peuvent subir une photodégradation sous la lumière solaire naturelle. Parmi ces produits pharmaceutiques on note l'Ibuprofène, médicament largement utilisé comme un anti-inflammatoire et un analgésique récemment détecté comme polluant organique dans les eaux naturelles. Notre étude a concerné la photodégradation simulée de l'Ibuprofène en eaux naturelles et en eau-ultra pure en présence des ions nitrates, chlorure et matière organique. Les ions chlorures n'ont aucun effet sur la photodégradation de l'Ibuprofène. La matière organique, en l'occurrence l'acide fulvique diminue nettement la photodégradation de l'Ibuprofène. Les ions nitrates quant à eux, augmentent significativement la vitesse de la photodégradation de l'Ibuprofène en trois photoproduits majeurs identifiés comme l'acide 2-[4-(1-hydroxy-2-méthylpropyl)phényl] propan -oïque, l'acide 2-[4-(2-hydroxy-2-méthylpropyl) phényl] propanoïque et l'acide 2-hydroxy-2-(4-isobutylphényl) propanoïque. Le mécanisme de la photodégradation de l'Ibuprofène incombe largement à ces ions nitrates connus comme sources de production de radicaux hydroxyles oxydants très puissants. La chromatographie en phase liquide munie d'un détecteur de masse a été utilisée pour l'identification des photoproduits formés.

MOTS CLES : Composé Pharmaceutique, Ibuprofène, Phototransformation Solaire Simulée, Photoproduits

IMPACT DE L'IMPLANTATION DU SYSTEME DE MANAGEMENT ENVIRONNEMENTAL SUR LES PERFORMANCES ECONOMIQUES DE L'ENTREPRISE

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RESUME

Le développement de l'activité humaine modifie l'environnement, et ces modifications menacent directement l'activité humaine : pour protéger l'environnement, et par la même pour nous protéger, nous devons donc être capables de maîtriser les conséquences de notre activité sur l'environnement.

Une première partie de ce travail de thèse présente le contexte liant actuellement, au Maroc, les entreprises à l'environnement. Nous y présentons une étude de cas dans laquelle nous exposons l'expérience d'implantation du SME au sein d'une entreprise spécialisée dans le transport ferroviaire et ce conformément à la norme ISO 14001 régissant la protection et la mise en valeur de l'environnement.

Durant cette phase nous avons commencé à collecter les données en se basant sur des fiches bilan entrées/sorties remplies à l'aide des responsables de chaque atelier, ensuite nous avons procédé à l'identification, l'évaluation et l'hiérarchisation des aspects environnementaux.

Après avoir identifié les aspects qui ont un impact significatif sur l'environnement, nous avons entamé une analyse de conformité réglementaire en se basant sur les lois et décrets nationaux.

Conformément à la norme en vigueur, nous avons élaboré le manuel environnemental comprenant les 12 procédures régissant la mise en œuvre du système de management environnemental.
L'élaboration d'un programme environnemental était impérative afin de définir l'ensemble des actions à mettre en place ainsi que les responsables chargés de veiller à leur application et ce moyennant les techniques nécessaires et dans les échéanciers programmés.
Finalement, la première phase a été glorieusement récompensée par l'obtention du certificat ISO 14001.
Dans la deuxième phase, nous avons identifié les indicateurs de performance issus des objectifs et cibles de la politique environnementale de l'entreprise et nous projetons de dresser un tableau de bord pour leur suivi moyennant des modes de calcul bien définis et ce afin de pouvoir étudier l'impact de la certification sur les performances économiques de l'entreprise objet de notre recherche.

MOTS CLES: Impact Environnemental, Système de Management Environnemental, Norme ISO 14001, Indicateurs de Performences Economiques.

LEVELS OF HEAVY METALS (ZN, PB, CU, CD, NI) IN TISSUES OF *SARPA SALPA* FROM HONAINE BAY IN THE WESTERN PART OF ALGERIAN COAST

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ABSTRACT

The objective of the study is to determinate the bioaccumulation of heavy metals in various organs (gonad, muscle, liver and gill) of Saupe *Sarpa Salpa* from Honaine bay in western part of Algerian coast. The elements Zn, Pb, Cu, Cd and Ni were assayed using Rayleigh WFX-120 Atomic Absorption Spectrophotometer and the results were given as $mg.kg^{-1}$ dry wt. The accumulation of heavy metal gradually increases in liver. Mean concentrations in gonads, liver and gill of *Sarpa salpa* followed the sequences Cu > Ni > Zn > Cd > Pb, in muscle Cu > Zn > Ni > Cd > Pb respectively. Results of linear regression analysis showed that, except in a few cases, significant relationships between metal concentrations and fish size were negative. Highly significant ($P<0,001$) negative relationships were found between fish length, and zinc, lead and copper concentrations in liver and gill and cadmium concentration in liver of *Salpa sarpa* (SS). Principal component analysis (PCA) was applied using as variables the metal concentrations in fish and sizes. PCA indicated that species explained significantly 54, 6% of the total variance (40, 3% for factor 1 and 14, 3 % for factor 2) of the metal concentration.

KEYWORDS: Heavy metals, *Sarpa salpa*, ACP, Honaine bay, Algeria.

METHODOLOGIE DE DIAGNOSTIC DES RESEAUX D'ASSAINISSEMENT ET DES ACTIONS A ENTREPRENDRE POUR LA CORRECTION DES ANOMALIES DE CONCEPTION ET DE POLLUTION

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RESUME

L'exploitant d'un réseau d'eau potable ou d'assainissement a la charge de faire de sorte que l'eau provienne en quantité et en qualité au consommateur abonné ou que l'eau usée provenant de ce même consommateur raccordé soit bien évacuée et traitée sans risque pour le milieu naturel.

Pour effectuer son travail, il doit disposer d'outils indispensables: détecteurs de fuites, outillage de réparation…mais aussi, il doit connaitre parfaitement le réseau dont il a la responsabilité.

Dans ce sens, une méthodologie se basant sur le diagnostic d'un réseau d'assainissement est développée afin de lutter contre les inondations et la pollution.
Notre approche repose sur un audit du réseau d'assainissement et de ses ouvrages annexes, le calage de celui-ci sur un modèle et une analyse spatiale des paramètres géomorphologiques et géométriques.
Testée sur deux localités de la wilaya de Tiaret (Ain Bouchekif et Medroussa), notre approche a donné des résultats très encourageants, en fait on a pu grâce à l'analyse spatiale déterminer les anomalies dues à une mauvaise conception du schéma hydraulique, et proposer les actions de corrections nécessaires sans pour autant refaire tout le réseau d'assainissement.

MOTS CLES: Réseau d'assainissement, Diagnostic des Réseaux, Cartographie, Conception

CARACTERISATION DES REJETS DE LA SUCRERIE DE L'ORIENTAL ET SON IMPACT SUR OUED SEBRA AFFLUENT DE LA BASSE MOULOUYA

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ABSTRACT

Le danger de la pollution industrielle réside d'une part dans la diversité des substances polluantes (métaux lourds, phénols, cyanures, PCB,…) et d'autres part dans leur variabilité dans le temps à cause de l'activité saisonnières de certaines industries comme le cas des huileries et des sucreries qui engendrent des cas de pollutions sévères.
La ville de Zaio est située au nord de la plaine de Sebra, souffre de problèmes d'aspect environnementaux qui portent préjudice sur la qualité des eaux d'Oued Sabra, un des plus grands affluent de l'Oued Moulouya.
La sucrerie de l'oriental a pour principale activité l'extraction et le raffinage du sucre de betterave.
Les 4 grands types de rejets de la sucrerie sont d'abord stockés dans des bassins situés à proximité de l'usine. Une partie des eaux s'infiltre vers les eaux souterraines entraînant avec elle le déversement de ces bassins est acheminé vers l'oued Moulouya.
Les rejets ainsi envoyés représentent une très forte charge organique qui contribue à la dégradation des ressources naturelles.
La description des ressources en eau permet de localiser et de caractériser les différents aquifères et oueds existant au environ de la sucrerie, en vu de ressortir dans la suite de l'étude, les impacts potentiels sur les ressources en eau par les différents points de rejets.
L'étude du diagnostic de l'état actuel de l'environnement et des nuisances causés par les rejets industrielles.
La caractérisation physico-chimique des rejets de la sucrerie et des eaux de l'oued Sabra et l'évaluation de la micropollution à travers le suivi par un certain nombre de métaux lourds.
Les rejets liquides de la sucrerie ont fait l'objet d'analyse effectué au laboratoire
Cinq stations ont été choisies au niveau de la sucrerie
Les mesures à fréquences saisonnières ont été effectuées le long du bassin de l'oued Sebra durant l'année 2010/2011
Analyses effectuées in-situ : (Température, pH, Conductivité, Oxygène dissous).
Analyses effectuées au laboratoire : Demande biochimique en oxygène pendant 5 jours, Demande chimique en oxygène, Matières en suspension, Nitrates, Nitrites, Ortho-phosphates, Sulfates, Chlorures, Dureté.
Les résultats du suivi spatio-temporel des paramètres physico-chimiques et de pollution nous ont permis de constater la nette dégradation de la qualité des eaux
De l'oued Sebra.
La qualité de l'effluent global montre que les paramètres de pollution dépassent les valeurs limites pour : La température du rejet moyen final, la DBO5, la DCO, les MES et le NTK, le ratio Débit/quantité de betterave
Les paramètres de pollution calculés seront utilisés comme base de dimensionnement des ouvrages d'épuration ; dans une phase futur.

MOTS CLES: Rejets Liquides, Pollution, Oued Sebra, Basse Moulouya

EFFET D'UNE IRRIGATION A L'EAU SALEE SUR LE TRANSFERT DU CD ET DU CU CHEZ DEUX PLANTES FOURRAGERES: *TRIFOLIUM ALEXANDRIUM L.* ET *HORDEUM VULGARE*

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RESUME

Au Maroc, la superficie des sols salés constitue environ 35% des zones agricoles irrigués. Les plantes exposées aux éléments traces métalliques au niveau de ces sols doivent donc faire face à deux contraintes qui sont la salinité du milieu et les métaux lourds. La salinité des sols peut influencer la biodisponibilité et le transfert des métaux lourds ce qui peut se répercuter sur les plantes.

L'objectif du présent travail est d'étudier l'effet d'une eau salée (à 10g/l de NaCl) sur la biodisponibilité du Cd (2 et 10mg/l) et du Cu (100 et 500 mg/l) chez deux plantes fourragères : Trifolium alexandrium L. et Hordeum vulgare.

La caractérisation de la phytodisponibilité de ces deux métaux a été suivie à l'aide de plusieurs paramètres physiologiques et biochimiques dont le poids de la matière fraiche et sèche, les teneurs en éléments minéraux, les teneurs en sucres solubles et les contenus en protéines et en proline.

Les résultats obtenus ont montré que le stress métallique induit une diminution de la biomasse chez les deux espèces étudiées et que cette diminution s'accentue avec la salinité.

Par contre, les teneurs en Ca++, K+, Na+, Fe, Zn, et N sont plus élevées chez les cas irrigués avec l'eau salée que chez les cas irriguées avec l'eau courante. De même que les teneurs en sucres solubles, en protéines et en proline augmentent avec l'ajout de NaCl.

La salinité influence également l'accumulation des deux métaux dans les plantes étudiées. Ainsi, pour le Cd, les teneurs augmentent de 9.05mg/Kg MS (Cd10) à 11.62 mg/Kg MS (Cd10-10g/l de NaCl) chez l'orge et de 8.78mg/Kg MS (Cd10) à 23.62 mg/Kg MS (Cd10-10g/l) chez le trèfle. Pour le Cu, l'ajout de NaCl entraine une augmentation de l'accumulation chez l'orge et une diminution des teneurs chez le trèfle par rapport aux cas non traités par le sel.

Les résultats suggèrent que l'influence de la salinité sur la biodisponibilité des deux métaux dépend d'une part du métal en question et d'autre part de l'espèce végétale considérée.

MOTS CLES : *Trifolium alexandrium, Hordeum vulgare,* Cadmium, Cuivre, Biodisponibilité, Croissance.

TOPIC 3

Impact of Climate Change on Water Resources and Biodiversity

ETUDE D'IMPACT DES CHANGEMENTS CLIMATIQUES SUR LES RESSOURCES HYDRIQUES DU BASSIN VERSANT DE L'OUERGHA (RIF-MAROC)

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RESUME

Dans un climat aussi variable et aussi contrasté que celui du Maroc, le problème majeur posé est celui de l'eau. Le bassin versant de l'Ouergha, régularisant le 1/3 des ressources hydriques du Maroc, forme un passage entre le Rif et le moyen atlas étalé sur 7300 Km2, occupant l'essentiel du versant Sud atlantique de l'arc rifain et s'étend sur la majeure partie de la montagne rifaine. Sa situation géographique favorise la pénétration de la douceur et de l'humidité et des masses d'air de l'atlantique lui permis d'être la région la plus pluvieuse au Maroc. Cependant, sa structure lithostratigraphique essentiellement marno-argileuse empêchant l'infiltration des eaux de pluie et donc lui empêche d'avoir une contribution d'eau souterraine. De ce fait, le bassin versant de l'Ouergha renferme le plus grand aménagement hydraulique (Barrage El Wahda) du Maroc. L'étude du changement climatique est indispensable pour la conception, la gestion et le contrôle des ressources en eau surtout avec l'intensification de leurs pénuries au fil du temps d'une manière inquiétante. Notre étude se focalise sur le changement climatique (pluviométrique et thermique) dans le temps et dans l'espace en se basant sur une étude illustrative, fréquentielle et cartographique. Cette étude a mis en évidence une régression pluviométrique avec une succession de sécheresse météorologique au cours des dernières années. L'étude du climat de ce bassin a montré que sa température annuelle moyenne est de l'ordre de 19°C, l'humidité moyenne est de 71,71% permettant de le classifier le bassin de l'Ouergha comme humide avec un ETR de 493 mm/an; Aussi, le bilan hydrique du bassin a permis de savoir les périodes de déficience d'eau, et donc qui nécessite une intervention humaine pour satisfaire les besoins des végétaux. Ainsi, l'Ouergha peut être subdivisé en trois zones pluviométriquement homogènes (Zone Est, zone Nord et Nord-Ouest et zone Sud–Ouest) permettant d'étudier les régions dépourvues de mesure. L'étude du changement thermique montre un réchauffement de 0,15°C/an, alors que le changement pluviométrique a autorisé la distinction entre deux périodes différentes : 1956/57-1982/83 humide et pluvieuse et 1982/83-2007/08 ; sèche et mois pluvieuse. La pluviométrie annuelle tend vers la diminution avec une différence d'une station à l'autre dont les plus fortes intensités ont été enregistrées aux stations de montagne; La classe d'intensité de pluie [400-600 mm] est fréquent alors, la classe [0-200 mm] est absent ; avec des hivers rigoureux et des été secs. La lame d'eau tombée au cours de la période sèche a pour moyenne : 728,27 mm, et donc un déficit pluviométrique calculé comparativement à la période humide est de 94 mm / 25 ans par diminution de la pluviométrie de 3,74 mm/an.

La moitié de la période est formée des années météorologiquement sèches ce qui va se refléter négativement sur les ressources en eau au bassin de l'Ouergha où les eaux météorologiques forment le seul moteur de son hydrologie.

MOTS CLES: Ouergha, Changements Climatiques, Sécheresse, Réchauffement.

CHANGEMENT CLIMATIQUE ET VULNERABILITE DES RESSOURCES EN EAU DANS LE BASSIN DE LA MEKROU AU BENIN

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RESUME

Depuis les trois dernières décennies, les ressources en eau du bassin de la Mékrou, un des affluents de la rive droite du fleuve Niger au Bénin, ont connu d'importantes modifications, en relation avec les fluctuations pluviométriques enregistrées sur l'ensemble de la sous-région ouest-africaine.

L'analyse de la variabilité spatiale et temporelle des précipitations dans ce bassin porte sur les chroniques de la période 1955-1992. Il ressort de cette analyse, une tendance générale à la baisse de la pluviométrie depuis les années 1970. Les tests de Pettitt et de Mann Kendall appliqués aux séries pluviométriques montrent une rupture en 1972. Cette baisse de la pluviométrie à de séreuses répercussions sur les ressources en eau du bassin.

L'étude de la variabilité pluviométrique sur les sous périodes 1955-1972 et 1973-1992, montre que les déficits pluviométriques entre ces deux sous périodes s'amplifient dans les écoulements et la recharge. Un déficit pluviométrique de 14% entraîne un déficit d'écoulement de surface de 40 à 70% et une déficit de recharge de 30 à 60%, soit une amplification de trois à quatre fois le déficit pluviométrique. Ceci s'explique par une diminution des apports souterrains, ce que met en évidence l'étude de la variation des coefficients de tarissement sur la période d'étude.

MOTS CLES: Changement Climatique, Ressources en Eau, Recharge, Déficits.

THE POTENTIAL OF UTILIZING GREENHOUSE CONCEPT FOR AGRICULTURE AND WATER DESALINATION FOR RED-DEAD SEA REGION

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ABSTRACT

Jordan is considered to be one of the 4 poorest countries worldwide in water resources. The available renewable water resources are dropping drastically to an annual per capita share of 145 m^3 in recent years, compared to 3600 m^3/capita in 1946. Jordan's Renewable freshwater resources are estimated to about 850 million m^3/year, consisting primarily of surface and ground water. Options for non-conventional water resources that can be mobilized are modest where nearly all of Jordan's renewable water resources have been developed and most citizens in Amman receive water only once a week. The total renewable safe yield of the groundwater resources in the whole of Jordan is 277 MCM/year, which does not include the Disi aquifer as this is a non-renewable source. Although extraction from these sources exceeded this safe yield by more than 200 MCM/year in recent years, Water Authority of Jordan was unable to meet the substantially increasing demand. Continuation of this overexploitation of groundwater sources at these high levels will lead to mining these sources as well as deteriorating the quality of abstracted water, which will lead at the end to an extensive damage of the aquifers.

Jordan is characterized by an arid to semi-arid climate and its population increases at a high growth rate. The water demand in Jordan is steeply increasing, and the gap between water supply and demand is getting wider. The annual rainfall on Jordan ranges from 50 to 600 mm. Desalination of Red Sea water might be technically and economically viable to cope with water scarcity and overcome the water deficit in Jordan. Also, Jordan is relatively poor in conventional energy resources and is basically a non-oil producing country, i.e. its energy supply relies to a very large extent on imports. It is therefore unlikely that any future energy scenario for Jordan will not include a significant proportion of its energy to come from renewable sources such as solar energy.

The Dead Sea is drying up, with severe negative consequences on the ecosystem, industry and wildlife in the area. There have been several proposals for a canal to transport Red Sea water to the Dead Sea. The present study aims to shed some light on the technical and economic feasibility of using the greenhouse concept to create a suitable environment for growing valuable crops and produce fresh water in the region covered by the Red Sea and Dead Sea. The Red Sea-Dead Sea project can produce power and desalinated water is being currently considered as a viable project. The salty Red sea water is to be pumped to a higher elevation and allowed to drop by gravity a net potential head of over 400 meters to generate hydroelectric power. Part of the power produced will be used for seawater desalination for agricultural crop growing in the project area which extends over 300 km along the project route. The area covered by the project is characterized by dry and hot climate with virtually no fresh water sources. Considering the huge amounts of sea water transferred from the Red to the Dead seas the potential of sea water desalination alongside the project area with solar energy becomes obvious.

KEYWORDS: Red Dea Sea Conduit, Green house, Jordan Valley, Solar

INTEGRATED WATER RESOURCES MANAGEMENT IN INDIA UNDER UNCERTAINTIES IN CLIMATE

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ABSTRACT

Maintaining water security under an uncertain climate and fast rising population is a major challenge in India. India is one among the countries highly vulnerable to the impacts of climate change. Drylands of India are potentially threatened by desertification. Indian economy and life of the majority has been traditionally linked to agriculture, the largest consumer of water. Though irrigation developments programmes have been going on for decades, agriculture in a vast area is still rain-dependent. Abnormalities in rainfall seriously affect the timely availability of water and this is reflected in agricultural production. Changes in the onset of monsoon and in the seasonality and intensity of rainfall adversely affect production in different parts. Impacts of climate change on water resources affect hydropower generation and industrial production. Present economic growth is likely to be haltered by the climate extremes. High seasonality in certain parts reduces groundwater recharge and summer water availability. Irrigation in the dry zones largely depends on groundwater resources and the falling water table has become an issue. Extremes like floods and droughts destroy agriculture in vast areas every year. Changes in the intensity, frequency and tracks of storms cause widespread damage to coastal agriculture, in addition to salinising coastal aquifers. In the Western Ghats Mountain area, high seasonality and intensity of rainfall results in erosion and sedimentation, reducing reservoir capacity and summer flow in rivers. Retreat of Himalayan glaciers is likely to have large impact on agriculture in almost all parts of north India, as the major rivers originate here. Study shows that slight increase in rainfall predicted in some parts may not be able to compensate for the loss in soil moisture. Water related health issues also worsen when climate changes. Vector-borne and water-borne diseases extend into new areas. Changing climate leads to social and economic issues such as worsening of disputes over water allocation, migration, pricing of water that is unaffordable to millions and large expenses for the adaptation and mitigation programmes. Present economic growth is likely to be haltered. India's preparedness for the effects of climate change is poor and India is too late to develop a climate policy. National polices including water policy and wetland policies are only guidelines and they lack information on the effective implementation. This paper assesses the impact of climate change on water resources of India and its reflections on the environmental and socio-economic conditions. Changes in water availability under an altered climate have been estimated using hydrological model and the existing policies and adaptation strategies have been critically reviewed. Results show that water availability will be drastically reduced in most parts of the country. Though several initiatives have been started in the water sector as part of adaptation, they often fail in fulfilling objectives because of issues like lack of coordination of departments, weak and corrupt administrative mechanism, social issues and vested political interests. Vulnerable groups are often neglected in the typical political setup. Projects lack transparency and accountability. India urgently needs to develop an appropriate strategy for water management and climate change adaptation and a comprehensive environment policy that includes, water and climate and an efficient mechanism for the implementation. Guidelines for this have been provided. As the degree of changes in climate are still uncertain, India should be prepared to face the worst condition.

QUANTIFICATION OF SUSPENDED SEDIMENT IN THE WATERSHED OF OUED EL ARDJEM

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ABSTRACT

The problems of conservation and management of water resources have become increasingly pressing. The need for these resources, always growing, increases the risk of degradation. Millions of tons of land each year and depart into the sea via rivers and a significant amount will be deposited at the bottom of our dams.
Our job is to present a monographic approach to both analytic and synthetic methods of flow, the hydrological regime and sediment transport in suspension to determine the water surface and their spatio-temporal variability.
Also, our study consists of two main parts:
First, the diagnosis of physical geographical catchment area which will characterize the main factors involved in the natural water flow and thus determining the behaviour of the basin.
Second-part study of the gauging station Ouled Ben Abdelkader and quantification of suspended sediment based on the regression method using different regression models linking water discharge and sediment discharge at different scales.

KEYWORDS: Watershed, Regressive Model, Sediment Transport, Quantification, Suspension.

MOBILISATION DES RESSOURCES EN EAU DE SURFACE A DES FINS AGRICOLES DANS LES DEPARTEMENTS DU MONO-COUFFO

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RESUME

Les Départements du Mono-Couffo sont réputés comme une région de forte production agricole abritant plusieurs ‘’greniers’’ du Sud-Bénin. Mais, depuis quelques années, la production agricole est mise en mal par les aléas pluviométriques dans ce secteur.

Les données utilisées concernent les hauteurs pluviométriques mensuelles extraites de la base de l’ASECNA-Cotonou pour la période 1960-2005. Ces données sont complétées par des informations issues des investigations auprès des principaux acteurs de la région étudiée (producteurs, agents de la promotion agricole, etc.) de même que les observations directes de terrain. L’analyse tendancielle, l’utilisation des fréquences, et l’utilisation du modèle Force, Pression Etat Impacts Réponses (FPEIR), ont été mis à contribution pour traiter les données.

Les résultats montrent une fréquence plus accrues d’anomalies pluviométriques caractérisées par une installation tardive et fin précoce de la saison pluvieuse dans le milieu d’étude. En raison du caractère argileux des sols, l’anomalie pluviométrique provoque des assèchements prononcés des sols, ce qui affecte considérablement le rendement des produits agricoles. Les efforts de mobilisation des eaux de surface à des fins agricoles constituent la principale mesure d’adaptation aux conséquences des aléas pluviométriques dans la région d’étude. Ces efforts méritent d’être poursuivis et soutenus pour une production agricole durable.

MOTS CLES: Mono-Couffo (Bénin), Aléas Pluviométriques, Mobilisation de L’eau, Production Agricole.

ETUDE DE LA CONCENTRATION DES SEDIMENTS ET DES DEBITS LIQUIDES DE L'OUED SIKKAK (N.W ALGERIE)

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RESUME

L'objet du présent travail est de mieux comprendre le phénomène des exportations de matières solides en suspensions véhiculées par le cours d'eau Oued Sikkak.

Le bassin versant de Oued Sikkak se situe en zone semi aride. Les données acquises par la station de Ain Youcef, débits liquides $Q_l(m^3/s)$ et la concentration en matières en suspension C(g/l), sont utilisées pour la quantification du transport solide.

En vue d'en déterminer leurs fiabilité et validité, une analyse a été effectuée par des corrélations entre les concentrations en matières en suspension et les débits liquides journaliers.

Les résultats d'analyse graphique des valeurs instantanées des concentrations en matières en suspension dans le cours d'eau de l'Oued Sikkak et leurs relations avec les débits liquides, durant les compagnes de prélèvements de 1972-1989, ont permis de suivre leur évolution.

La corrélation entre les deux paramètres (C et Ql) est étudiée de manière qualitative. Le rapport C/Ql a été soumis à des relations linéaire, puissance et exponentielle. Généralement les meilleurs résultats sont obtenus par une équation de type : $C = aQ_l^b$ avec a et b : coefficient empirique. Les résultats ont permis d'identifier de manière assez concluante les modèles saisonniers. Ils sont très représentatifs du phénomène de transport solide dans le bassin d'étude.

MOTS CLES : Concentration en Matières En Suspension, Débit Liquide, Transport Solide, Bassin Versant, Oued Sikkak.

EFFECT OF NACL STRESSES GENETICALLY IMPROVED COTTON (*Gossypium hirsutum* L.)

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ABSTRACT

Present experiment was conducted under greenhouse. Its primary objective was to assess differential growth behavior of cotton genotypes (NIAB-78 and Bt-901) at various growth stages, like as germination, seedling and maturity under NaCl (100mM) stress. Salinity had adversely affected both seed germination and vegetative growth of both varieties. However, Bt-901 showed better response at germination stage under salinity. Plant height, fresh and dry weight of shoots, number of leave and leaf area were higher in Bt-901 under saline-stressed conditions than NIAB-78. Physiologically, Na^+, Cl^- and reducing sugar contents were increased in both the varieties under NaCl stress. Bt-901 accumulated more sugar and protein contents than NIAB-78 under saline conditions. Salinity had decreased K^+, chlorophyll a, b and carotenoids contents, in both genotypes, while higher NIAB-78. Leaf demography also effected significantly in presence of NaCl. Yield related characters i.e., number of bolls per plant, number of seeds, total seed weight and delinted cotton weight decreased significantly in Bt-901 than NIAB-78.

KEYWORDS: Abiotic Stresses, Nacl, Gossypium Spp., Ionic Cotents, Morphology

TOPIC 4

Processing Technologies and Wastewater Reclaim

CHROMIUM MOBILITY AND SPECIATION IN *Phragmites Australis* SYSTEM FOR TANNERY WASTEWATER TREATMENT

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ABSTRACT

The present study illustrates the treatment, distribution, mobility, bioavailability and speciation of total chromium in the various strata of constructed red bed in comparison to unplanted soil under arid climate conditions.

The system pilot consisted of six plots filled to 15 cm of gravel and 60 cm of soil (88% of sand). Three plots were planted with *Phragmites australis* (Cav.) Trin ex Steudel (36stems/m^2). Three unplanted plots were used as a control. The plots irrigated by diluted tannery wastewater (50%) with a daily hydraulic load of 5 cm per day (approximately 10 litres every day). Dilution is made by well water. The water flowed vertically through the soil. The operationally determined speciation of Cr was investigated by using selective five steps sequential extraction method. The bioavailability of Cr was performed by $CaCl_2$ (0.1 M).

The results of the potential of *Phragmites australis* to remove chromium from diluted tannery wastewater in comparison to unplanted soil indicated that, during 13 months of experiment, the pH of the effluent at the outlet of the planted (PP) and unplanted systems (NPP) increases by two to three units in comparison with the wastewater at the inlet. The PP system is more efficient in removing total COD (74%) than the NPP one (60.5%). The total chromium undergoes an overall removal of 99% for the two systems.

The results of the distribution of total chromium in the various strata of constructed red bed indicated a significant accumulation of total Cr reaching 80% in the surface strata for the planted (PP) and unplanted (NPP) systems. The application of the ANOVA test showed a significant difference of Cr accumulation in the surface of the soil between the PP system 48±4 g/kg and NPP one 39±7 g/kg ($p<0.05$). Furthermore, the results showed that the Cr could migrate also towards deeper levels of the soil. The speciation results indicated that the percentage of Cr in the exchangeable phase was very low. The chromium was mainly associated with the oxidizable phase 36±10 % for the PP system, 54±9 % for the NPP system and residual phase 26±3 %, 25±2 % for the PP and NPP systems respectively. The carbonate fraction presented 19.5±5 % for planted system and 10.7±5 % for unplanted system, while reducible fraction presented 18±6 % for the PP system and 10±4 % for the NPP system. Sequential extraction showed that pant had the ability to partially transfer Cr from the oxidizable fraction mobile, to the less mobile fractions of carbonate and reducible. Indeed, Cr presented a weak bioavailability towards the plant. The results showed that *Phragmites australis* accumulated significantly high amount of Cr in the roots (1690 mg/kg dry matter). Furthermore, after 13 months of experiment, the soil accumulates high content of Cr (94%) and 5% of Cr accumulated in *Phragmites australis.* The presence of plant ensures a sufficient porosity for the percolation of water for treatment, which makes it possible to treat a more important volume of wastewater and to reduce the required surface area by treated capita.

KEYWORDS: Chromium; Tannery, Soil, Treatment, Speciation, Bioavailability, *Phragmites australis*.

REMOVAL OF SYNTHETIC DYE USING NATURAL AND PURIFIED CLAY

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ABSTRACT

Wastewater of the textile industries are loaded many organic pollutants, especially some synthetic dyes. These last are often used in excess to improve the dyeing and thus the waste water is highly concentrated in pigments. Moreover, some dyes pose important problems (Bouberka et al., 2008; Erdal, 2009). Slightly biodegradable makes biological treatments less effective and disposal of wastewater, based on flocculation by ferrous sulfate and lime, do not always respond effectively. Indeed, the treated water is sometimes colored and is generally used in agriculture and may contaminate plants due to the toxicity of dyes (Bouberka et al., 2008).

The crystal violet is also known as basic violet 3, gentian violet, and methyl violet 10B (molecular formula C25H30N3Cl and molecular weight 407.99) and belongs to the class of triphenylmethane dyes. This dye has also been used in textile industries for dyeing nylon, wool, silk and cotton (Tahir et al., 2006), as a pH indicator (yellow to violet with the transition at a pH 1.6). In the medical community, it is the active ingredient in Gram's stain, and is employed as a bacteriostatic agent (Alok et al., 2010).

Crystal violet is toxic. It may cause cancer, severe eye irritation and it is harmful by inhalation, ingestion and through skin contact (Tülin and Gamze, 2009). Hence the dye removal from the water bodies becomes essential.

The several techniques are available for the treatment of industrial wastewaters. Among these methods, chemical coagulation, oxidation, filtration and biological treatment, this proved effective but, in most cases very expensive. this is wherefore in recent years some authors (Tülin and Gamze, 2009; Erdal, 2009; Erdal et Al., 2010) are then oriented to methods of treatment using natural materials such as clays, agricultural materials (sawdust, agricultural waste,...) and some industrial wastes (by products of combustion in blast furnaces, ...) due to high efficiency, low cost and of their availability.

In this context, we studied the physicochemical phenomena that govern the interactions between clay available (Bakhti et al., 2001) and crystal violet, and use this understanding at a fundamental level to decrease the bioavailability of the latter.

KEYWORDS: Clay, Purified, Crystal Violet, Sorption, Water Treatment

WASTEWATER TREATMENT BY ACTIVATED SLUDGE AT THE TEGGOURT AREA/SOUTH OF ALGERIA

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ABSTRACT

Water is found almost everywhere on Earth and is a compound essential for all known living organisms, it plays an important role in economic development and a human stability. Improving the performance of this sector has become imperative thing. That explains the importance of wastewater treatment in the Touggourt town-South of Algeria.
In this context, we are interested in quality control of wastewater at the purification station in the town of Teggourt. The process followed is the activated sludge.
The analysis by the activated sludge of different parameters considered allowed us to determine the effectiveness of this process and to obtain better water such as: The values of MES vary between 25 mg / l and 32 mg / l for the treated water. For BOD_5 we obtained variations between 3 mg / l and 11 mg / l. The values of COD are between 0.09 mg / l and 29 mg / l. The nitrite and nitrate respectively represent the following variation intervals [0.07 to 0.18] mg / l and [9 to 14] mg / l. For phosphorus values range from 1 mg / l and 3.20 mg / l. In general, almost all the measurements found in these waters are in the norms.

KEYWORDS: Wastewater, Activated Sludge, Teggourt

EFFICACITE D'UN CHENAL ALGAL A HAUT RENDEMENT AVEC DEUX SYSTEMES D'AGITATION AIR LIFT ET ROUE A AUBE SOUS CLIMAT SEMI-ARIDE

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RESUME

La technique d'épuration des eaux usées par chenal algal à haut rendement semble présenter plusieurs atouts aussi bien à l'échelle de l'efficacité qu'à l'échelle des surfaces requises. Cette technique proposée par Oswald et ses collaborateurs depuis les années 50, met en œuvre un chenal fonctionnant en boucle. Il se distingue du lagunage traditionnel par un temps de séjour plus court, une faible profondeur, et une agitation mécanique constante. L'agitation dans un chenal algal est d'une importance capitale. Elle permet de circuler et de mettre l'eau en mouvement grâce à un jet d'eau, une roue à aube, ou encore un air lift. Cette agitation permet également d'homogénéiser la colonne d'eau et empêche ainsi tout dépôt. Cependant, mis à part les études menées par Zouhir [1], peu d'études ont comparé les différents systèmes de mise en circulation du liquide, ainsi que leur influence sur l'hydrodynamisme des réacteurs. Pour cela une comparaison de deux systèmes d'agitation, air lift et roue à aube a été faite dans une installation de taille réelle installée dans la commune périurbaine de Saada (limitrophe de Marrakech). Cette installation présente 17m de largeur, 32m de longueur, 544m^2 de surface et 0.5m de profondeur. En plus, une confrontation entre l'hydrodynamique du système et les performances opératoires a été réalisée. Cette comparaison vise :

- La comparaison des paramètres hydrodynamiques principaux (temps de circulation, vitesse de circulation, Pe, Ezl, n) pour les deux systèmes, pour divers réglages ainsi que la comparaison des deux systèmes au point de vue consommation énergétique
- La comparaison des deux systèmes au point de vue des performances épuratoires obtenus sous les conditions climatiques semi-arides de la ville de Marrakech.

Les résultats obtenus ont montré qu'en matière de consommation énergétique, l'air lift est plus économique 3 à 5 fois que la roue à aube et ceci pour des vitesses d'eau usuellement rencontrée pour des installations type CAHR. Sur le plan épuratoire, l'utilisation de l'air lift comme système d'agitation permet d'avoir des performances plus importantes que la roue à aube, notamment pour l'élimination de l'azote par activation du processus de stripping.
L'ammonium représente le produit final de la réduction de l'azote organique les rendements obtenus pour cette forme est de l'ordre de 56% et 50% respectivement avec la roue à aube et l'air lift. Cependant, on note un rendement remarquable d'élimination de l'azote total (NTK) quand le chenal est agité par l'air lift (70%).
Pour le Phosphore total le CAHR élimine 31 % et 45 % respectivement avec la roue à aube et l'air lift, alors qu'en matière de PO_4, il élimine 26% avec la roue à aube et 44% avec l'air lift
De ceci on peut dire qu'un bon fonctionnement du chenal algal peut être obtenu en utilisant l'air lift comme système d'agitation, mais il faudra encore faire des essais de transferts gazeux et notamment des transferts d'oxygène pour conclure sur lequel des deux systèmes étudiés est le plus efficace.

MOTS CLES : Air Lift, Roue à Aube, Hydrodynamique, Efficacité Epuratoire, Chenal Algal à Haut Rendement, Climat Semi-Aride

LA FILTRATION SUR SABLE, RECHERCHE ET OPTIMISATION

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RESUME

Dans un pays comme l'Algérie caractérisé par la faiblesse de ses potentialités en eaux aussi bien souterraines que superficielles ; le recourt aux ressources non conventionnelles (épuration, dessalement) est plus qu'une nécessité. Aussi et pour assurer une eau de bonne qualité, le traitement des eaux effectué dans nos stations passe par un certain nombre de phases en passant par le dégrillage, dessablage, Floculation coagulation, lits bactériens, … jusqu'à la filtration puis désinfection.

Le processus de filtration en Algérie comme ailleurs dans le monde est basé sur le passage d'une quantité d'eau qui sort des bassins de décantation et floculation – coagulation sur un filtre de sable à filtration rapide ou lente. Les solides en suspension ainsi retenus par le milieu poreux s'y accumulent ; il faut donc nettoyer ce milieu de façon continue ou de façon intermittente. Le sable utilisé est importé de l'étranger, impliquant des frais en devises non négligeables, sachant que pour une station donnée, les lits de sable utilisés doivent être changés ou réajustés après un certain nombre d'opérations.

Dans l'objectif de chercher un matériau filtrant (un gisement de sable), susceptible de remplacer les sables importés dans nos stations, nous avons lancé une étude expérimentale au laboratoire, en utilisant un pilote de filtration verticale. Nous exposons dans cette note quelques résultats préliminaires.

MOTS CLES: Filtration, Sable, Traitement, Matériau Filtrant,

DISINFECTION OF TREATEDWASTEWATER AND REUSE IN IRRIGATION OF GOLF GRASS: THE CASE OF PLANT M'ZAR AGADIR-MOROCCO

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ABSTRACT

Treated wastewater of plant M'zar of Agadir has a best physico-chemical quality and an important input of nutrients (NPK). However, reuse for irrigation withoutdisinfecting the turf of golf grass in the Agadir regionrevealed the presence of a bacterialloadthatcanhinder the quality and suitability of spaces for a population verychallenging.
Among the various methods of water disinfection, chlorinationis the least expensive, easiest systematically and effectiveness depends only on the pH of the water to disinfect.

This study reports the results of disinfection of treatedwastewater of plant M'zar with a solution of sodium hypochlorite, and their reuse for irrigation of golf grass. For this purpose, we conducted a monitoring protocol for germination and growth parameters of plant grass that is the number of tillers and leaf length to study the impact of wastewater disinfected in golf grass in comparison with groundwater.

KEYWORDS: Treated Wastewater, Disinfection, Groundwater,Reuse, Irrigation, Golf Grass, Germination, Growth.

KINETIC, EQUILIBRIUM AND DESORPTION STUDIES ON THE ADSORPTION OF THORIUM (IV) ONTO MOROCCAN CLAYS AND OIL SHALES

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ABSTRACT

It is well known that thorium is one of the most vital elements for human beings and that the contamination caused by thorium is a serious environmental problem. A number of processes for the treatment of natural and synthetic materials have been reported, the principle being based on the elimination of specific species radiotoxic such as the isotopes of U and Ra. Solvent extraction, ion-exchange and adsorption are the possible ways of removing thorium, among which the adsorption is the most effective approach for dilute solution.

Up to now, numerous experimental studies on Th(IV) adsorption by minerals, phosphates, resins, zeolite and microorganisms adsorbents have been published.

In the present study, the ability of two natural materials clays and oil shales as a natural adsorbent to remove Thorium ions from aqueous solutions has been investigated.

In the first time, the natural samples were decarbonated by the hydrochloric acid and characterized by physico-chemical methods (X-ray diffraction, X-ray fluorescence and infrared spectroscopy).

Batch method was carried out during adsorption process. The uptake of thorium ions was found to be very rapid during first thirty minutes and equilibrium time is independent of initial Thorium concentration. The kinetics of adsorption shows that oil shales fix more thorium ions than clays. Moreover, the treated adsorbents have high adsorption capacity compared to the rough adsorbents. Different kinetic models (Pseudo-first-order model and Pseudo-second-order model) have been applied to fit the experimental kinetic data and kinetic data were analyzed by an intra-particle diffusion model to elucidate the diffusion mechanism. The results are compared, and indicated that the best fit is obtained with a pseudo second-order.

Maximum adsorption capacity of clays and oil shales (natural and decarbonated samples) in contact with Thorium ions was calculated by applying Langmuir and Freundlich adsorption models. Results indicate the following order to fit the isotherms equations: Langmuir > Freundlich.

Desorption studies indicated that Thorium desorption was very slow and its level is very low.

KEYWORDS: Clays, Oil Shales, Thorium, Kinetics Adsorption, Equilibrium Isotherms, Desorption.

APPLICATION OF NATURAL BIOSORBENTS TO OLIVE MILL WASTE WATER FOR PHENOLIC COMPOUNDS REMOVAL

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ABSTRACT

Olive mill waste waters (OMW) generated by the olive oil extraction process is the main waste product of this industry and a major environmental problem in the Mediterranean area. This effluent is characterized principally by a high content in phenolic compounds and a low pH that ranges generally between 4 and 5. Direct reuse of this wastewater cause serious environmental deteriorations among others: difficult biological degradation, phytotoxicity …etc. Nowadays, the management of this effluent before its discharge in nature becomes imminently indispensable to minimize its effects. Several conventional methods were used to remove hazardous compounds from OMW notably coagulation, membrane processes, and various others. However, industrial application of such processes is often restricted because of technical and or economic constraints. Adsorption has been shown to be the most promising option for the removal of non-biodegradable organics from aqueous streams. Moreover, this method is considered to be the best in terms of effectivity, flexibility, and ease of operation. As the most widely used adsorbent material for treatment of toxic effluents especially OMW, is actived carbon. Nevertheless, the high cost of the activation process limits its use as excellent adsorbent. Recently, research interests have oriented to unconventional adsorbents as an alternative of costly actived carbon, economically cheap and abundant in nature. Many low cost sorbents derived from agricultural by-product and vegetable wastes had been used for sorption mainly of heavy metals or dyes from aqueous solutions, which included tea waste, dry plant and coffee residue. However, the removal of specific organics from OMW, employing those sorbents, has not been reported. A unique study on the adsorption of phenol from this effluent by banana peel was recently published and has showed important results.

The aim of this present work is to investigate the efficiency of a wide range of natural sorbents to removal of phenolic compounds from OMW. In this context and as a prior and fundamental study, the rate of adsorption for a number of adsorbents chosen in this experience will be tested. Then, adsorbents which present a high potential of adsorption and consumed in less quantities, will be selected to evaluate another important parameter mainly kinetic of adsorption. In this step, only adsorbents up taking a maximum of adsorbate in short time will be chosen finally to be as a best and most suitable for removing phenolic compounds from OMW. Subsequently, the effects of various operating parameters and optimal experimental conditions will be determined such as initial pH, particle size and temperature.

KEYWORDS: Olive Mill Waste Waters (OMW); Natural Biosorbents; Phenolic Compounds; Removal.

ELABORATION, CARACTERISATION ET APPLICATION D'UNE MEMBRANE CERAMIQUE DE SILICE

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RESUME

Le travail consiste à élaborer des membranes céramiques de filtration à partir d'oxydes minéraux.
La couche active poreuse de silice est élaborée selon la voie sol-gel en utilisant un sol de SiO2. Elle est obtenue par coulage d'une solution de silice dans un support argileux tubuleux préparé localement à partir des argiles tunisiennes. L'étape suivante consiste à sécher puis à fritter le matériau à 600°C pendant 2 heures.
L'effet du temps de prise sur l'épaisseur puis sur le volume, la taille et la répartition des pores de la couche active a été étudié.
Les performances des membranes obtenues en terme de perméabilité à l'eau et à des solutions modèles de BSA (bovine serum albunin) ont été étudiées et comparées.

MOTS CLÉS: Membrane, Silice, Céramique

REMOVAL OF O-CRESOL BY ELECTROCHEMICAL OXIDATION AND BY ADSORPTION ON ALGERIAN MONTMORILLONITE CLAY

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ABSTRACT

Cresol compounds are widely used in the manufacture of antioxidants, biocides, disinfectants, insecticides, herbicides, dyes, pulp, paper and other synthetic chemicals. They are found among the most prevalent contaminants of industrial wastewater streams coming from oil refineries, petrochemicals, polymeric resins, pharmaceuticals, coal conversion plants, chemical industries, etc. Cresols are toxic and biorefractory products that can cause health chronic effects at contents. To avoid the dangerous accumulation of cresols in the aquatic environment, research efforts are underway to develop powerful oxidation techniques for achieving their overall destruction from wastewaters. Cresols have a high solubility in water and have two groups ($-CH_3$ and OH), which could be oxidized. Several methods have been developed for the elimination of cresols in water such as incineration, adsorption, chemical oxidation or conversion to less toxic or biodegradable compounds and electrochemical treatment (reduction or/and oxidation).The main disadvantage of the electrochemical oxidation of phenolic compounds is the fouling of the electrode surface by the polymeric products. The extent of fouling depends on the nature of the electrode. Thus, a proper selection of the electrode material is required in order to reduce these polymeric products.

In this work, we study the treatment of o-cresol with adsorption on Algerian purified montmorillonite clay and the electro-oxidation of o-cresol on platinum electrode and on glassy carbon electrode. Cresol removal is dominated by adsorption at low initial concentrations.

KEYWORDS: O-Cresol, Electrode, Adsorption, Montmorillonite, Oxidation, Cyclic Voltammetry

TRAITEMENT DES EAUX CONTAMINEES PAR LES HYDROCARBURES PAR PSEUDOMONAS AERUGINOSA IMMOBILISEES DANS L'ALGINATE DE SODIUM

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RESUME

La dégradation de l'environnement par le rejet brutal et massif de résidus toxiques est, en fait, générale et concerne tous les milieux. Notre étude est orientée vers la problématique du traitement des eaux contaminées par les hydrocarbures, spécialement le phénol.

Pour cela et pour éviter les effets toxiques des substances phénoliques rejetées dans l'eau sur l'environnement, l'organisation mondiale de la santé (OMS) donne comme concentration maximale souhaitable des composées phénoliques dans les eaux de boissons 1µg/l ainsi qu'il convient de procéder à un traitement approprié de ces substances avant leur rejet dans le milieu naturel.

Face aux techniques physico-chimiques qui ne font, souvent, que transférer la pollution d'un milieu à un autre en la concentrant, les techniques de biodépollution prennent de plus en plus de place car elles permettent généralement d'éliminer véritablement les contaminants par minéralisation totale des composés phénoliques.

La dégradation du phénol par les cultures pures et mixtes a été un sujet de beaucoup d'études. Un certain nombre de micro-organismes, notamment les Pseudomonas (P.aeruginosa, P.putida) sont capables de croître en utilisant le phénol comme source de carbone et d'énergie.

L'utilisation directe des cellules bactériennes sous forme de suspension dans les procédés à boues ou dans des réacteurs agités rencontre plusieurs problèmes tels que la nécessité d'avoir une concentration de biomasse élevée donc des volumes de réacteurs importants ainsi que limitation de la vitesse et du rendement global de conversion suite à l'inhibition par les concentrations élevées en phénol.

La solution à ces problèmes l'immobilisation (fixation) de ces bactéries sur des supports sous forme de particules poreuses afin de garantir la réutilisation de la biomasse aussi longtemps quelle garde son activité, atteindre des concentrations de cellules très élevées avec pour conséquence des volumes de réacteurs ou des temps de séjours fortement réduits, stabiliser l'activité du biocatalyseur et diminuer l'effet d'inhibition par création d'un microenvironnement à l intérieur des pores ou la concentration du phénol est plus faible qu'à l'extérieur suite aux limitations diffusionnelles .

Le présent travail est une étude de biodégradation du phénol par des cellules immobilisées « Pseudomonas aeruginosa» dans des particules d'alginate de sodium. Cette étude concerne l'influence des plus importants paramètres qui affectent le fonctionnement du bioréacteur. Les résultats obtenus montrent que les cellules Pseudomonas aeruginosa ont pues dégrader totalement 700 mg/l de phénol en 70h dans un milieu où le pH est de 7, et une température de 37°C.

MOTS CLES : Biocatalyseur, Immobilisation, Billes d'alginate, Biodégradation Du Phénol

REMOVAL OF INORGANIC POLLUTANT FROM AQUEOUS MEDIA BY BIOSORPTION USING JUJUBA (ZIZIPHUS) SEEDS BIOMASS

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ABSTRACT

A Jujuba (Ziziphus) seed was used to remove inorganic pollutant chromium (VI) from aqueous solution. Batch adsorption studies were conducted to evaluate the effects of contact time (1–24 h), initial polluant concentration (5–100 mg/l) and solution temperature (20–45°C) were investigated. Equilibrium data were fitted to Langmuir and Freundlich. The kinetic data were fitted to pseudo-first-order, pseudo-second-order and intraparticule diffusion models and was found to follow closely the pseudo-second-order kinetic model. Thermodynamic parameter such as standard enthalpy (ΔH°), was evaluated. The adsorption interaction was found to be exothermic in nature. Maximum adsorption was observed in the acidic medium at pH 2 with a contact time of 180 min at 110 rpm stirring speed. The maximum monolayer adsorption capacity was 119 mg/g at 20°C. The results showed that studied adsorbent can be an attractive low cost alternative for the treatment of wastewaters.

KEYWORDS: Biosorption, Jujuba (Ziziphus) Seeds, Chromium VI, Removal, Kinetics

ADSORPTION KINETICS OF ANTIBIOTIC TYLOSIN ON POWDER ACTIVATED CARBON

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ABSTRACT

The presence of pharmaceuticals and their accumulation in natural waters is an emerging pollution leading to the ecosystems disruption and increased malfunction in the aquatic species reproduction such as fish.

Among the pharmaceuticals pollutants, antibiotics deserve special attention due to their greater use in one hand, and their interactive biological activity, leading to the emergence of the resistance phenomena of potentially pathogenic microorganisms such as bacteria.

Preventive action is therefore essential to reduce their presence in natural aquatic environments.

In this study, we applied the technique of activated carbon for the removal of an antibiotic present in an aqueous medium.

The selected pharmaceutical pollutant is tylosin which is an antibiotic reserved exclusively to veterinary medicine. Its use is authorized to treat pneumonia and metritis in cattle and red mullet, chronic colitis in small animals and respiratory diseases in poultry.

The objective of this work is to study the adsorption of tylosin on activated carbon powder. The kinetics are determined and then the equilibrium time. Subsequently, the adsorption isotherms are defined as suitable models.

Initially, the contact time required for adsorption equilibrium of studied liquid/solid system is determined. The concentration evolution of tylosin during adsorption is presented. It decreases exponentially over time until it reaches a constant value equivalent to 50 minutes, which is characteristic of the equilibrium between activated carbon and tylosin present in the aqueous solution.

The adsorption isotherm, typical representative of thermodynamic equilibrium between the adsorbent and the adsorbate, has a classic look isotherm of type I. Saturation of adsorption sites is gradually done until reaching a saturation level. The maximum adsorbed amount q_{max} is about a value of 2,56 $mg.g^{-1}$.

The Langmuir model gives a good representation of the adsorption isotherm of tylosin on powdered activated carbon.

KEYWORDS: Adsorption, Activated Carbon, Tylosin, Kinetics, Isotherm

TRAITEMENT DES EAUX POLLUEES PAR UN PESTICIDE PAR ENERGIE SOLAIRE

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RESUME

La forte utilisation des pesticides, engrais et herbicides sont les principales sources de contamination des eaux de surface et des nappes phréatiques. Il est donc urgent de traiter efficacement ces eaux contaminées. Le traitement idéal et économique est celui qui consiste à éliminer voir minéraliser les composés organiques par voie biologique. Malheureusement ce type de traitement a ses limites car il reste souvent certains produits organiques qui ne peuvent être éliminés par cette voie, c'est ce qu'ont appelle les Produits Organiques Persistants (Pops). Les techniques d'oxydation avancée (TOA) permettent de traiter ces Pops. Les TOA les plus efficaces sont celles qui conduisent à la formation de radicaux hydroxyles °OH, qui ont un pouvoir oxydant très fort. C'est le cas de la photocatalyse hétérogène.

Au cours des 20 dernières années, les études ont démontré que la plupart des composés organochlorés ainsi que de nombreux pesticides, herbicides, surfactants et colorants sont complètement transformés en produits non toxiques en utilisant également le soleil comme source d'irradiation

Cet article présente l'initiation de notre projet de recherche pour la réalisation d'un réacteur photocatalytique expérimental de type CPC et l'évaluation de ses performances.

Afin de bien mener nos expériences, notre choix de pesticide s'est porté sur le linuron comme molécule polluante. Nous avons suivi la dégradation du linuron par différents procédés de dépollution, dont la photolyse, l'adsorption et la photocatalyse hétérogène. Cela dans le but de proposer l'application de la photocatalyse hétérogène solaire dans les procédés de dépollution et de désinfection des eaux de rejets utilisés en Algérie.

MOTS CLES : Epuration, Eaux de Rejets, Photocatalyse Hétérogène, Photoréacteur.

ETUDE DES PHENOMENES D'ADSORPTION DE BLEU DE METHYLENE PAR LES TIGES DU MAÏS

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RESUME

La présence des colorants dans les effluents aqueux industriels à des concentrations dépassant les normes imposées aux industries, constitue de nos jours une préoccupation majeure. Le présent travail s'inscrit dans le cadre de la recherche de nouveaux procédés de traitement utilisant des matériaux naturels en raison de leurs disponibilités et de leurs faibles coûts.
L'objectif de ce travail est l'étude de la fixation du Bleu de Méthylène sur un matériau adsorbant d'origine végétale à base des tiges du Maïs.

La caractérisation de notre matériau adsorbant a été faite par La spectroscopie d'adsorption Infrarouge de Transformée de Fourier (FTIR) et L'analyse par microscopie électroniques à balayage (MEB).

Dans le but d'optimiser les conditions opératoires du processus d'adsorption, différentes études concernant la cinétique, la capacité, la masse, le pH des solutions, et la concentration initiale sur les tiges du Maïs et été réalisées. Les résultats expérimentaux des isothermes d'équilibre d'adsorption ont été validés de façon précise par les modèles de Langmuir et Freundlich.

MOTS CLES : Adsorption, Maïs, Bleu de Méthylène, Modélisation, Isotherme

MODELISATION DU PROCESSUS D'ABSORPTION DE L'EAU LIQUIDE DANS LE BOIS AU DESSUS DE POINT DE SATURATION DES FIBRES.

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RESUME

Dans ce travail, nous avons étudié le processus d'absorption de l'eau liquide dans le bois au dessus de point de saturation des fibres. Plusieurs paramètres permettent de quantifier le phénomène : La teneur en eau absorbée à l'équilibre la diffusivité interne et la forme de l'échantillon. La méthode que nous avons adoptée dans cette étude, est le couplage entre la modélisation et l'expérimentation.

La modélisation du phénomène, à l'aide des modèles analytiques et numériques, a permis de déterminer à chaque point d'intégration, l'évolution de la concentration en fonction du temps et des conditions ambiantes. Le transfert de masse est décrit par une équation de diffusion non linéaire.
Les modèles demeurent valables pour toutes les dimensions et fournissent les profils de concentration de la teneur en eau à chaque instant et à chaque point de l'échantillon.

Ces modèles analytiques et numériques peuvent être utilisés dans le cas de transfert d'un solvant autre que l'eau dans le bois.

MOTS CLES : Absorption, Bois, L'eau, Modélisation, Profils de concentration

TREATMENT AND REUSE OF WASTEWATER USING SURFACE AND SUBSURFACE WETLANDS

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ABSTRACT

This research was carried to evaluate the use of two types of constructed wetlands on partially treated wastewater and improve the quality of treated wastewater effluent. A free water surface (FWS) wetland composed of three cells in series of which two are open water surface and one is a channel bed planted with *Cyperus alternifolius* was designed and constructed. Four different mixtures of TWW effluent and the primary TWW effluent were used under different hydraulic retention times of 3, 6, 9, and 12 days within the FWS wetland. Water quality parameters (turbidity, EC, P, TKN and pathogens; fecal & total coliforms) were monitored for both inflow and outflow on regular basis. A sub-surface flow (SSF) wetland was constructed and evaluated. The outflow from the wetlands along with a TWW effluent (control) was directed to irrigate a fodder crop field. The quality of wastewater and/or HRtime in FWS constructed wetland significantly affected the pH, EC, TSS, E.coli, P and turbidity to greater levels and insignificantly affected the concentrations of BOD_5, COD, TKN, and NO_3. It appears that, evapotranspiration from the surface wetland increased hydraulic retention time and constituent concentrations. Lower HRTimes were attributed to either short circuiting effects or overloading of the wetland. The SSF wetland affects the concentration of pH, EC, TSS, nitrate, E.coli, P, turbidity Fe, Cu, Zn and Mn to greater levels. Results also indicated the possibility of using the SSF wetlands for the production of specific fodder crops with high feeding value.

KEYWORDS: Wastewater, Wetlands, *Cyperus alternifolius*, Hrtime.

REMOVAL OF COPPER AND NICKEL IONS ON NATURAL AND SYNTHETIC APATITE FROM AQUEOUS SOLUTIONS

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ABSTRACT

The sorption mechanism of divalent copper and nickel ions in from aqueous solutions of natural and synthetic hydroxylapatites was investigated in batch mode at temperatures from 295 K to343 K and concentration of copper and nickel 10^{-4}mol/L to10^{-2}mol/L using A.A.S analysis. The sorption isotherms were fitted to the Langmuir or Freundlichmodelequation. Both apatites were found efficient in removing copper or nickel ions , despite their different compositions and morphologies. The sorption mechanism would invole an ion exchange between Caof hydroxyapatite and copper or nickel. The sorption efficiency depends on the experimental conditions and the specific physicochemical properties of apatites used.

KEYWORD : Sorption, Hydroxyapatite, Liquidwaste, Copper Ions, Nickel Ions

CARACTERISATION D'UN REACTEUR PHOTOCATALYTIQUE SOLAIRE

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RESUME

Le traitement photo catalytique solaire se présente comme une technologie de choix pour la dépollution et l'intégration des eaux usées, car il s'agit d'un système performant simple et économique utilisant une énergie renouvelable. Ces différentes caractéristiques attractives ont engendré un grand intérêt pour la compréhension, l'optimisation et l'application industrielle de ce procédé.

Avant d'entamer le traitement photocatalytique des eaux contaminées, il est nécessaire de caractériser le photoréacteur de type CPC. L'installation expérimentale est constituée d'un réacteur, un réservoir contenant le mélange réactionnel et d'une pompe assurant la circulation du fluide. Le collecteur, d'une capacité de 20 litres, est constitué de 05 tubes en verre montés en série et la circulation de la solution à traiter est assurée par une pompe qui sera alimentée par énergie solaire photovoltaïque afin que le photoréacteur soit complètement autonome.

La caractérisation du photoréacteur se fait par la méthode de distribution des temps de séjour DTS, la connaissance de la fonction de distribution des temps de séjour noté E(t) représente un outil de diagnostic très précieux qui permet de se rendre compte du fonctionnement hydrodynamique global du réacteur.

L'exploitation des résultats expérimentaux permettra de visualiser le disfonctionnement du photéréacteur. A partir des résultats de la DTS nous pouvons déterminer le nombre de Peclet P_{eA} ainsi que le coefficient de dispersion axiale D_a affin d'attribuer un modèle d'écoulement simple à nos résultats.

KEYWORDS: Photoréacteur, DTS, Caractéristaion, Hydrodynamique

URBAN WASTEWATER REUSE IN DIFFERENT CONTEXTS: LARGE AND SMALL COMMUNITIES

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ABSTRACT

Water imbalances and lack of water at certain times of year are not new situations in some countries such as the Mediterranean area. Are a feature of the area, with which we must learn to live together, anticipating and managing foreseeable consequences thereof. Globally, they seem to be accentuated by the effects of climate change, but above all by the increase in water demand due to increased population growth, irrigation of crops and increased tourism. Worldwide it is estimated that about 54 countries will present water scarcity and water stress for 2050. On the other hand, growth in demand for high quality water in urban and agricultural areas, mainly in arid, semi-arid and densely populated areas will increase pressure on this resource (WHO, 2006).

In the above context, the use of alternatives such as the reuse of treated wastewater, is a valuable option to alleviate the water demand, especially in applications that do not require drinking water quality, contributing to divert flow of the channels under natural helping to ensure the improvement of ecological state of the same (Martín, 2010).

However, when the reuse of treated urban wastewaters is considered we should start from the premise that these typically contains a range of parasitic and pathogenic microorganisms which, depending on the species and concentrations, pose a potential risk to human health and whose presence must therefore be reduced in the course of wastewater treatment (Singh & and McFeters, 1993; Ramirez *et al.*, 2005).

There may be many factors that allow a differentiation between the wastewater reuse in large and small communities, where can be included rural and decentralized areas, or more specifically between more developed and most disadvantaged areas. The aim of this paper is to show the differences between those zones, based primarily on three factors: (1) health and hygiene level of the area, (2) availability of adequate infrastructure for the wastewater treatment, according to the population size, and proper management of treatment processes and (3) cost associated with wastewater treatment and water reclamation, which in turn is directly related to the quality required for end use, aware that there are uses which require more restrictive qualities than others, and to obtain these qualities implies the use of reclamation treatments as conventional disinfection systems later.

KEYWORDS: Wastewater Treatment, Reuse, Reclamation, Small Communities, Large Areas

AGRONOMIC APPLICATION OF OLIVE MILL WASTEWATERS IN MAIZE CROP

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ABSTRACT

This study deals with the evaluation of olive-mill wastewaters (OMW) spreading effect on the fertility of soil described as poor in the area of Marrakech (semi-arid region) in Morocco. The treated plots were amended with untreated OMW generated by a traditional extraction process at the amounts of 10 l/m2 during two years periods. Results of these two years treatments with crude OMW at relatively high dose reveal an important increase of soil physico-chemical characteristics notably electric conductivity, Na+, K+, phosphorus, azote, organic matter and soluble phenolic compounds. Electrical conductivity of treated soil was enhanced from 0.34 to 2.91 ms/cm as compared to the control soil. The amounts of nutritive elements of the soil increased after OMW spreading by 81% concerning nitrogen, 66% for phosphorus and 88% for potassium. However, this enrichment in mineral and nutritive elements decreased three months after OMW application revealing OMW biodegradation in the studied calcareous soil. In parallel, land spreading of OMW causes an increase in the contents of the soluble phenolic compounds on the upper layer of soil. Besides, plants growth was efficiently raised by OMW inputs. Significant amelioration was obtained notably in term of fresh and dry weight of leaves, leaves area, spikes fresh and dry weight, 100 seeds weight and straw yield (37, 54, 27, 24, 14 and 9% respectively). Accumulation of phenolic compounds and the increase of total peroxidase activity provide evidence of their protective role against the physiological stress induced by OMW. These results highlight the importance of OMW amendment six months before maize sowing for toxicity mitigation. Along with the correct choice of convenient soils notably calcareous ones and tolerant crops such as maize, this method could constitute an efficient approach for avoiding problems attributed to the uncontrolled disposal of these effluents and an effective strategy to regenerate degraded soils and represents an economical alternative that provides a local source of fertiliser.

KEYWORDS: Olive Mill Wastewater, Phenolic Compound, Soil, Maize Crop

OPTIMISATION DU COEFFICIENT DE TRANCHEE AUTOUR D'UN COLLECTEUR ENTERRE

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RESUME

Cette étude vise à contribuer à la compréhension de l'interaction sol – conduite enterrée et plus particulièrement les paramètres influençant le coefficient de concentration, caractérisant la répartition des charges autour d'une conduite enterrée. L'analyse bibliographique montre que divers travaux ont été consacrés à l'évaluation du coefficient de tranchée caractérisant la poussée en contrainte sur un collecteur enterré. La différence dans les formules mises en évidence réside dans le choix des paramètres caractérisant le sol durant l'effet de la poussée du sol sur l'ouvrage.
Dans ce contexte, la démarche consiste à déterminer une expression globale donnant le coefficient correcteur ou de concentration, en tenant compte d'un minimum d'hypothèses avec une finalité opérationnelle d'amélioration des méthodes de dimensionnement et mise au point d'un modèle numérique approprié ainsi que sa validation. Le développement d'un modèle numérique permettra d'aider à la compréhension des redistributions et élargir le domaine des simulations en tenant compte de l'effet du temps et des non linéarités matérielles sur le comportement de la conduite.

MOTS CLES: Conduites, Interaction Sol - Structure, Modélisation, Tranchée, Poussée, Charges.

NATURAL TECHNOLOGIES FOR WASTEWATER TREATMENT IN SMALL COMMUNITIES

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ABSTRACT

The Directive 91/271/ECC on the treatment of urban wastewater required all towns with less than 2000 pe (person equivalent) to adequately deal with their wastewater by the end of 2005. Nevertheless, it appears that intensive systems are not appropriated for small or seasonal towns and villages, where flows are not continuous and vary enormously on daily, weekly and seasonal patterns. Moreover, several weak points, which include the amount of energy consumed and the surface needed, were detected after the initial years of operation of a number of small wastewater treatment facilities.

Alternative solutions have been developed, based on small-scale natural treatment trains. The advantages associated to this type of treatments are relatively low building costs, reduced energetic requirements and easy and reduced O & M expenses. Three systems, constructed wetlands (CW), infiltration-percolation (IP) and pond systems are usually selected and implemented, because of their adaptation to the local wastewater and climatic conditions and the capacity to cope with flow variations.

This study presents the experience carried out at several Catalan municipalities treating their wastewater with the mentioned natural systems. Each wastewater treatment plant (WWTP) analyzed presents a combination of these natural technologies. The performances (removal of physicochemical and microbiological parameters) of three systems were analysed. The results are also discussed for the capability of the effluents for being reused, making a comparison with the Spanish Royal Decree on wastewater reuse (RD1620/2007).

COD, SS and NH_4^+-N are adequately removed by the combination of infiltration-percolation and constructed wetlands. When algae are present, higher values of SS in the effluent are detected. This SS value can limit the reuse possibilities of the effluent. WWTPs ending with ponds better reduce microbiological parameters. On the other hand, the simple combination of two different types of CWs does not achieve a good quality regarding microbiological parameters.

TOPIC 5

Treatment and Recovery of Solid Waste

INTEGRATION DES DONNEES MULTI-SOURCES DANS UN SYSTEME D'INFORMATION GEOGRAPHIQUE (SIG) POUR LE DIAGNOSTIC ET L'AMENAGEMENT DES SOLS SALES DU SOUS BASSIN VERSANT DE L'OUED YELLEL – WILAYA DE RELIZANE – (ALGERIE)

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RESUME

L'objectif de ce pressent travail rentre dans le cadre d'une étude écologique et agro-pédologique des terres dégradés du sous bassin versant de l'oued Yellel, principal affluent de l'Oued Mina, draine une superficie estimative 15 000ha. Il est constitué essentiellement de marnes tertiaires d'où son appellation "zone des marnes".
Le caractère semi-aride du climat du bassin versant de l'Oued Mina accentue le phénomène de salinisation qu'on peut classer selon leur origine, rares sont les données concernant des surfaces salées avant l'exécution des travaux d'irrigation, ce qui montre les caractéristiques communes entre le sol et l'eau d'irrigation. Le recouvrement de la végétation n'est que de 7.20%, ce qui conduit à un début de dégradation du sol.
Nous avons adopté une méthodologie fondée sur l'utilisation des Système d'Information à Référence Spatiale (S.I.R.S.), Parmi ces données on a choisi l'inventaire des sols et de la végétation en vue de les cartographier et de les intégrer dans une base de données dans le but de valoriser l'information dans le milieu environnemental. L'intérêt de cette méthode En termes de perspectives, il s'agit de faire un suivi spatio-temporel pour permettre de caractériser les changements en termes de salinisation et de dégradation du milieu physique. Ce suivi se fera par des observations directes sur terrain, des analyses au laboratoire ainsi que par utilisation des Système d'Information à Référence Spatiale (S.I.R.S.).
Les résultats obtenus montrent que les sols sont souvent argileux avec une teneur élevée en argile (36 à 50 %) et des sels, ils sont occupés soit par l'agriculture, soit abandonnés pour être occupés par la végétation halophyte. Les premiers résultats obtenus sont mis à la disposition des aménagistes pour leurs prises de décision ou propositions d'aménagement.

MOTS CLES : S.I.G, Bassin Versant, Agro-Pédoloqie, Semi Aride, Dégradation, Terres, Oued Mina, Relizane, Algérie

ÉTUDE DES PARAMETRES D'INFLUENCE SUR LE TRAITEMENT DES EAUX USEES PAR LE PHOSPHATE NATUREL

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RESUME

Avec une consommation toujours plus grande et plus diversifiée partout dans le monde, le traitement des eaux usées constitue le premier enjeu de santé publique. Toutes les eaux chargées de différents éléments provenant de la population mais aussi des activités commerciales et industrielles, sont généralement déversées, dans les milieux naturels, sans aucun traitement préalable. De ce fait, et vu leur composition physico-chimique et leur faible taux de biodégradabilité, ils causent de sérieux problèmes environnementaux.
L'objectif de ce travail est de construire des outils d'aide à l'analyse de l'impact de l'élimination des déchets industriels dans les écosystèmes. L'adsorption est l'une des techniques les plus utilisées pour l'élimination des colorants des effluents industriels.
Dans le but d'optimiser les conditions opératoires du processus d'adsorption, différentes études ont été réalisées :

- Les cinétiques d'adsorption
- L'effet des paramètres réactionnels sur les rendements d'adsorption
  + La masse de l'adsorbant
  + La granulométrie
  + La concentration initiale
  + La température de traitement et la température de la solution
  + L'agitation
  + Le pH
- Les résultats expérimentaux des isothermes d'équilibre d'adsorption ont été validés de façon précise par les modèles de Langmuir et Freundlich.

MOTS CLES: Adsorption, Cinétiques d'adsorption, Isothermes, Phosphate naturel, Diffraction des rayons X

HEAVY METALS REMOVAL BY COMBINING THE MAGNETIC PROPERTIES OFIRON OXIDE WITH ADSORPTION PROPERTIES OF CARBON NANOTUBES DWCNT

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ABSTRACT

Drinking water or groundwater may be contaminated with heavy metal ions such as lead, chromium and cadmium discharges from industrial wastewater. These heavy metal ions are considered highly toxic pollutants because they can cause a wide range of health problems in case of long-term accumulation in the body.
For this type of decontamination agent, the removal mechanism is the formation of a strong bond between metal ions and the surface of metal oxides. Regeneration of the active surface due to a binding reaction of metal ions remains a major challenge if we could build an agent for the disposal of recyclable metal ions. The aim of our study is the development of a nanocomposite which contains properties of iron oxides and high adsorption capacity of carbon nanotubes biparois.
Composites of DWCNT/nano-iron oxide were prepared, and were characterized by X-ray diffraction (XRD), field emission scanning electron microscope (FESEM) and Fourier transforms infrared spectroscopy (FTIR). XRD suggests that the magnetic phase formed is magnetite and/or magnetite. The adsorption capability of the composites was tested in batch and fixed bed modes. The composites have demonstrated a superior adsorption capability to that of activated carbon.

KEYWORDS: Heavy Metals, DWCNT, Iron Oxide

ESSAIS DE TRAITABILITE DES LIXIVIATS PAR PHOTOCALYSE (UV/TIO_2)

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RESUME

A l'aube de siècle, la gestion des déchets est devenue un axe prioritaire de par le monde. Parmi les procédés de traitement des déchets, la mise en décharge dans les Centre d'Enfouissement Technique (CET) représente, de par sa rentabilité technico-économique intéressante, Le créneau le plus utilisé. Contrairement au biogaz dont l'élimination par combustion et valorisation énergétique s'avère satisfaisante, les lixiviats, qui résultent de la percolation des eaux à travers le massif de déchets enfouis, constituent, par leur composition complexe et leurs variations temporelles, un effluent délicat à traiter.
Cette étude a pour objectif principal, d'introduire un procédé innovant qui est la photocatalyse hétérogène et d'étudier son application et son efficacité dans le traitement du lixiviat de vérifier l'efficacité.
Des lixiviats de la décharge de Oued Smar, située à Alger, récoltés en mois d'hiver et d'été de l'année 2009 sont utilisés dans ce travail. Les analyses réalisées sur ces lixiviats ont montré une DCO élevée, une teneur élevée en NH_4^+ et une forte charge microbienne, d'autre part, l'effet des précipitations sur la qualité des lixiviats est très négligeable.
Une contamination des eaux souterraines par des composés détectés dans le lixiviat, a été observée. Une expérience réalisée à l'obscurité a permis de montrer que la photocatalyse hétérogène se déroule exclusivement en présence de la lumière UV.Le système TiO_2/UV a montré son efficacité sur l'élimination de la charge microbienne du lixiviat.
Le pH est le paramètre primordial étudié dans ce travail. Le pH maintenu à 5 a permis l'élimination de 92 % de DCO. En revanche, l'azote ammoniacal à une tendance d'être éliminé à pH alcalin.
La photodégradation du lixiviat semble suivre une cinétique d'ordre 1 lorsque le traitement est effectué à pH ajusté initialement à 6, à 5 et à pH naturel du lixiviat. On observe en revanche un changement lorsque ce lixiviat est traité à pH maintenu à 5, la cinétique de photodégradation de la DCO devient d'ordre 0.

MOTS CLES : Lixiviat, Photocatalyse, TiO_2, Décharge

AMELIORATION OF DEMINERALIZATION OF WHITE SHRIMP (*Parapenaeus longirostris*) SHELLS BY LACTIC ACID FERMENTATION

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ABSTRACT

Processing fishery industries generate annually millions tons of marine invertebrates shells riche in chitin. These chitinous residues are either discharged in sea, creating a pollution problem, or simply buries in the soil.
Chitin and derivatives have a high economic value thanks to their physicochemical properties and their many industrial and biomedical applications. The extraction of chitin involves two steps: demineralization and deproteinization. This extraction can be realized by two methods: chemical method which is harmful to the environment or biological method.
The objective of this study is to improve the demineralization of white shrimp (Parapenaeuslongirostris) shells by lactic acid bacteria using Lactobacillus helveticus.
The use of glucose as a fermentation medium has allowed us to obtain 61% of demineralization at 35°C. The replacement of glucose by date juice has ameliorated demineralization which reaches a maximum of 98% with 100gL^{-1} reducing sugars at 20°C.
This study allowed us to improve the biological demineralization of shrimp shells compared to previous work, which is almost complete.

KEYWORDS: Chitin, Carapace, Lactic Acid Bacteria, Fermentation, Demineralization

RECOVERY OF NICKEL FROM NIO/AL_2O_3 CATALYST

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ABSTRACT

Nowadays, economical and environmental requirements impose the development of effective and inexpensive methods for the recovery of valuable metals from secondary sources such as spent catalysts. In fact, recovering metals comprises about 20 to 30% of the total supply, lowering the raw materials cost about 15% to 50%. For purposes of establishing a recycling process for heavy metals, hydrometallurgical extraction is a branch of industry for which the research work is ongoing to develop processes which are less costly, more environmentally friendly and acceptable economically. Hydrometallurgical extraction of metals is considered as the process of dissolving high value metals with a solution of acid or base.

In the literature, studies dealing with leaching processes generally used one acid as a leaching reagent by which different operation conditions are optimized for a maximum dissolution efficiency of the material studied. The study of the behavior of different acids in the leaching process of one or several materials under the same operation conditions may be an interesting task to compare their efficiencies and determine which one should be used.

In this study, an acid hydrothermal leaching process was used to recovery nickel from 10% NiO/α-Al_2O_3 (n/n) catalyst used in primary reforming of methane (ammonia unit). After deactivation, the components of the catalyst can be reused as secondary sources of metals. This is considered as more beneficial from environmental and economical point of views than landfill depositing.

Three mineral acids (H_2SO_4, HCl and HNO_3) were tested to study the best leachant for this separation. The effects of acid concentration, liquid/solid ratio, stirring speed, and temperature on the recovery of nickel were evaluated using the three acids.

The results have shown that HCl was the best leachant for the recovery of nickel from the catalyst. In the other hand it was observed that under moderate conditions such as ambient temperature and static leaching (absence of agitation), no dissolution of nickel was observed. The dissolution needed drastic conditions such as high acid concentration (2M), high temperature (80°C) and stirring (400rpm) to attain 99% of dissolution with HCl after 25min. Under the same operation conditions, nitric and sulfuric acids dissolved 88.3% and 73.4% of nickel respectively after 3 hours.

Strong mineral acids are completely dissolved in water, leading to the same number of moles of H^+ ions in the case of HCl, H_2SO_4, and HNO_3 when used at the same concentration. The dissolution efficiency of oxides in such acids should be the same if H^+ is responsible for the dissolution reaction. However different results were obtained with the three acids. The unique difference between these acids is the presence of three different anions, namely, Cl^-, HSO_4^-, and NO_3^-. This indicates that anions participate to the dissolution reactions.

KEYWORDS: Recovery, Dissolution, Heavy metals, Inorganic acids, Industrial wastes.

VALORISATION DES EFFLUENTS D'HUILES D'OLIVE DANS LES BIOFILMS COMME BIOCONTAMINANTS

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RESUME

L'industrie oléicole, en plus de sa production principale qui est l'huile d'olive et huile de grignons, génère deux résidus, l'un solide (les grignons) et l'autre liquide (les margines). Ces eaux de végétation, de fortes charges organiques, hautement toxiques et faiblement biodégradables contribuent à de sérieux problèmes environnementaux, non résolu par les traitements biologiques. Toutefois, par leurs richesses en molécules bioactives, les margines sont des rejets naturels valorisables**.** Elles peuvent être utilisées pour l'inhibition dans la formation des biofilms. Dans ce contexte nous nous sommes intéressés à étudier l'effet des margines sur l'adhésion microbienne et sur la formation de biofilm, testant leur aptitudes d être inhibiteur ou agent de décontamination.

L'objet de ce travail est d'évaluer l'effet des margines sur les propriétés physico-chimiques (hydrophobicité, donneur-accepteur d'électron) de la surface du verre et leur aptitude à limiter l'adhésion microbienne aux surfaces.

A l'issue des essais entrepris, les résultats obtenus ont montré que le contact des margines avec le verre entraine une modification de ces propriétés physico- chimiques qui sont dues a un dépôt des constituants des margines sur la surface du verre. Cette modification est due probablement à ce dépôt. Le verre est passé d'un caractère hydrophile à un caractère hydrophobe (Θw = 35.7 à Θw =73.6) pendant 30 minutes. Cette hydrophobicité augmente d'avantage avec le temps (Θw = 95.4) pendant 180 minutes. D'ailleurs une forte diminution du caractère donneur d'électron (γ⁻ =20,5 à⁻ = 0.75) a été observée tandis que le caractère accepteur reste relativement élève (γ+ = 0.75 à+ =10.8). De ces résultats, il ressort que le recouvrement de la surface du verre par les margines entraine les modifications de ses propriétés physico-chimiques.

MOTS CLES: Waste Water Olive Mill, Biofilm, Biocontaminant

CARACTERISATION ENVIRONNEMENTALE ET COMPORTEMENTS GEOCHIMIQUES DES REJETS MINIERS DE L'ANCIENNE MINE DE SIDI BOU OTHMANE (MAROC)

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RESUME

L'ancienne mine de Sidi Bou Othmane, située à 2,8 Km au Nord-Est du village de Sidi Bou Othmane, lui-même, à 35 km au Nord de Marrakech (région à climat semi-aride), a permis l'exploitation des minerais de plomb et de zinc de 1953 à 1980. Elle a généré plus de 81.280 tonnes des rejets solides qui ont été stockés sous forme de bassins à stériles. Exposés aux conditions atmosphériques (air, eau), les sulfures de la digue à stériles s'oxydent pour produire de l'acide sulfurique. Ce phénomène se nomme drainage minier acide (DMA) capables de mobiliser et libérer de fortes teneurs en métaux lourds. Divers prélèvements d'échantillons de résidus et de stériles ont été effectués dans ce site. Leurs teneurs en soufre varient entre 0,185 et 2,14 % dont une partie est déjà oxydée. Les tests statiques de type Sobek modifié ont montré que les rejets miniers de Sidi Bou Othmane sont riches en carbonates et illustrent un potentiel d'acidité (PA) très faible varie de 0,99 à 38,14 kg $CaCO_3$/t et un potentiel net de neutralisation (PNN) varie de -20,06 à 66,84 kg $CaCO_3$/t. Les essais cinétiques, en mini cellules d'altération, ont montré que les eaux de percolation présentent au cours du temps un pH neutre qui varie entre 6,33 à 7,87 durant toute la durée de l'essai (40 cycles). Les concentrations en sulfates dans les échantillons d'eaux de rinçage sont maintenues à de très faibles valeurs (37,13 à 1454,32 mg/l). L'évolution des concentrations des métaux montre des teneurs faibles de fer (2,85 mg/l), de cuivre (4,89 mg/l), de nickel (Ni) (0,15 mg/l) ; alors que le plomb, le zinc, l'arsenic, le cadmium et le chrome ont des concentrations très faibles ou inférieures à la limite de détection.
L'extrapolation des données obtenues par les essais de prédiction à long terme a montré que les rejets étudiés sont classifiés comme non générateurs d'acidités.

MOTS CLES: Drainage Minier Acide, Sulfures, Essais Statiques, Mini Cellules D'altération, Maroc, Climat Semi-Aride

ESSAYS OF PHOSPHORUS RECOVERY FROM FERTILIZER INDUSTRY EFFLUENTS

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ABSTRACT

Discharge of untreated phosphate industries wastewater is a problematic issue, which my cause eutrophication of receiving water. Fertilizer industry effluent, contains high strength of phosphorus in the range (228-1025 mg/l of PO_4^{3-}), which could be recovered into phosphorus fertilizer. However, the presence of Fluoride in this type of effluent could limit the extraction and valorization of phosphates

The objective of this work was the recovery of phosphates from fertilizer industry effluent in the form of struvite. The influence of pH on the separation of fluoride and phosphates during the precipitation processes when applied to Fertilizer industry effluent was studied**.** Batch experiments were conducted to examine the feasibility of previous precipitation of fluoride at pH4 and to study the effects of final pH and the initial influent concentrations of ammonium on the removals of NH_4^+ and PO_4^{3-} by forming struvite. The pH was an important parameter in the removals of ammonium nitrogen and orthophosphate. It was found that the separated precipitation of fluorides and phosphates is possible. The degree of elimination of fluorides in the first stage and phosphates in the second stage amounted to ca. 95.62% and ca. 98%, respectively.

KEYWORDS: Fertilizer Industry, Wastewater, Phosphorus, Fluoride, Precipitation, Struvite (Phosphate Ammonia- Magnesium), Ammonium, Calcium Fluoride.

ADSORPTIVE REMOVAL OF INDIGO CARMINE FROM AQUEOUS SOLUTIONS

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ABSTRACT

The adsorption of two cationic gemini surfactants [N,N'-didodecyl-N,N,N',N' tetra-methylbutane-1,4-diamonium bromide (12-4-12) (1) and N,N'-dihexadecyl-N,N,N',N'-tetramethylbutane-1,4-diamonium bromide (16-4-16) (2) on bentonite from aqueous solutions and the effect of this adsorption on the removal of Indigo Carmine dye. Batch studies were performed to evaluate the effects of various experimental parameters such as contact time, adsorbent dosage, pH and initial concentration on the removal of Indigo Carmine dye. Equilibrium isotherms for the adsorption of dye were analyzed by Freundlich and Langmuir isotherm models. Both isotherms were fitted well.

KEYWORDS: Gemini Surfactants, Adsorption, Pollutant Removal, Clay, Adsorption İsotherms

TRAITEMENT DES EAUX USEES PAR BOUES ACTIVEES

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RESUME

La station d'épuration de la ville de Marrakech est de type boues activées. Réalisée pour un débit nominal de 90 820 m^3/j, elle reçoit en moyenne 110.000 m³/jour d'eau usée, Sa mise en œuvre passe par deux phases dont la première est déjà mise en service depuis Avril 2009 et qui consiste en un traitement primaire des eaux et en une filière de traitement des boues par digestion anaérobie suivi de déshydratation, sans oublier une cogénération de l'énergie électrique qui épargne une bonne partie des frais d'exploitation. En deuxième phase, le traitement des eaux usées passera du traitement secondaire partiel jusqu'au niveau tertiaire afin de pouvoir mobiliser les eaux traitées pour l'irrigation des espaces verts tandis que la filière des boues sera dédoublée afin qu'elle reçoive les boues issues du traitement secondaire. (La deuxième phase sera exploitée en fin 2011).
Les études du schéma directeur actualisé d'assainissement liquide prévoient de doter la ville de Marrakech d'une deuxième station d'épuration d'une capacité de 60.000 m³/jour. Mais du fait que le débit entrant à la station actuelle dépasse la valeur nominale et avec le développement de la ville à court terme, il s'avère intéressant d'étudier la possibilité d'extension de la station.
Un suivi de l'exploitation de la première phase de la station ainsi qu'un diagnostic de son état de fonctionnement a donné lieu à l'étude de deux variantes d'extension : une extension par des modules SBR « Sequencing batch reactor » comparée à une solution Boues activées classique apparaît comme étant la plus avantageuse vu ses performances techniques, sa compacité et son coût de mise en œuvre.

MOTS CLES : Station d'épuration, Réutilisation, Boues activés.

REMOVAL OF PARA-CHLOROPHÉNOL BY ADSORPTION ONTO SURFACTANT –MODIFIED PILLARED CLAY

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ABSTRACT

Synthesis of new complexes organo-inorgano clay minerals was investigated, the clay used was an Algerian montmorillonite (Maghnia west of Algeria) and these materials are designated primarily for the adsorption of organic contaminants from polluted water.

First the cation exchange sites of a montmorillonite were modified by intercalation of metallic polycations from either Fe(III) or Ti(III) to space as possible the interlamelar space of clay then cetyltrimethylammonium bromide cations were adsorbed in order to obtain two hydrophobic and organophilic clay compounds.
The clay adsorbents prepared were characterized by X-ray diffraction (XRD) and the examination of rays shows enlargements interlayer until approximately 23A ° for reflection angle. The adsorption efficiency of surfactant-modified pillared clay was tested by adsorption of para-chlorophenol. According to adsorption isotherms, para-chlorophenol sorptions increased when pH decreased, especially for Fe-SMPM in comparison with inorganic pillared clay without cationic surfactant. This new adsorbents could thus be considered as powerful competitors to activated carbon for the water treatment of industrial effluents in acidic medium.

KEYWORDS: Surfactant, Pillared Clay, Para-Chlorophénol, Adsorption, Polluted Water

HEAT AND MASS TRANSFER IN EVAPORATION AND CONDENSATION OF FALLING FILM ALONG A VERTICAL CHANNEL

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ABSTRACT

Heat transfer through a thin film with evaporation or condensation poses many theoretical problems and presents a great practical interest. Thin films find applications in industrial processes: the heat coefficients occurring are large for small deviations between the wall temperature and the saturation temperature of the liquid film. According to the application, the concern is the drying of the film and thus its evaporation or the cooling of the wall. With respect to evaporation, thin films are met in cooling, petroleum refining, thermal protection of heated walls, food industry, etc., while other applications concern film evaporation with condensation in desalination processes that use salted water distillation. The process is based on humidification and dehumidification of air at low temperature, inside a channel. First, water evaporates at the free surface of a liquid film falling along the internal face of a heated wall. The vapor is transported by natural convection flow. On the opposite wall, maintained at a temperature lower than the saturation temperature, a fraction of the steam contained in the gas mixture is condensed.

The present work present a numerical study of coupled heat and masse transfer caused by the evaporation and condensation of film liquid water in a vertical channel, formed by two plates. The first plate is covered by a liquid film of water, which evaporates under the effect of constant heat flux received by the plate. The second one is maintained at a fixed temperature. A laminar co-current flow of air is assumed as an ideal gas.

The coupled governing equations are solved together with the boundary and interfacial conditions using implicit method. The systems obtained are solved using the Thomas algorithm. A detailed parametric analysis on the effects of several operating variables such as the temperatures of the plates and the inlet conditions of the gas on the phase change process and on the heat and mass transfers was conducted. A detailed parametric analysis on the effects of several operating variables such as wall temperature of the plate and the inlet conditions of the gas on the phase change process and on the heat and mass transfers was conducted.

The obtained results allow us to describe the thermodynamic state of the heated film by means of the liquid temperature and evaporation flow rate. The heated film presents two zones: a heating zone located near the inlet of the cavity and an evaporation zone which covers the rest of the wetted surface. The extent of this effective surface of evaporation has been studied with respect to the operating parameters: on the one hand, the heat flux and the temperature of the condensation wall that in general depend on the climatic conditions, on the other hand, the water feed temperature and flow rate that can be varied by the user and act directly on the liquid film. The influence of the two latter parameters on the exchanges at the liquid–gas interface has been characterized in terms of local Sherwood and Nusselt numbers.

KEYWORDS: Evaporation, Condensation, Desalination, Heat and Mass Transfer

ECOULEMENT ET CARACTERISATION D'UNE BOUE A BASE D'EAU AVANT ET APRES VIEILLISSEMENT ET CONTAMINATION

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ABSTRACT

Le comportement des fluides est complexe et variable en fonction des additifs qui rentrent dans leur formulation d'une part et des conditions dans lesquelles ils sont utilisés d'autre part.
De plus, les lois d'écoulement (rhéogrammes) des boues sont difficiles à définir sur le plan théorique, l'expérience reste actuellement la seule voie permettant de les maitriser.
C'est dans cet objectif que nous allons déterminer expérimentalement les caractéristiques physiques (composition, masse volumique, pH à 25 °C, et surtout les modèles d'écoulement des formulations étudiées sur un échantillon de boue à base d'eau conventionnelle (fraîche), après vieillissement (à différentes températures) et enfin après contamination.
Ce travail nous a permis de confirmer, la contamination de la boue, physiquement à l'aide des paramètres physiques (masse volumique, viscosité plastique, viscosité apparent, gel_{10}, filtrat API…etc.) et mathématiquement par les paramètres des modèles adéquats linéaire et en puissance (τ_{0c}, μ_{pc}, K, N) aux rhéogrammes expérimentaux de la boue conventionnelle avant et après vieillissement d'une part et après la contamination par les solides d'autre part.
La chute de la YP et du gel_{10} après vieillissement (dépôt dans l'étuve rotative à 280°F) ce qui explique la dégradation des polymères sous l'effet de la température, en revanche il re-augmente après la contamination puisque le YP varie à peu près comme le carré de la teneur en solides.
Les rhéogrammes expérimentaux et les paramètres de ces modèles, reflètent bien la consistance de cette boue et sa résistance à l'écoulement au seuil (à travers K et τ).
Les remèdes utilisés généralement pour éliminer les solides, (centrifugation, dessiltage, etc. ou par dilution à éviter sauf dans l'obligation immédiate le traitement chimique), ou toute intervention sur la boue contaminée est conditionnée par la vérification de paramètres physiques qui doivent respecter les normes recommandées universellement.

KEYWORDS : Boue De Forage, Comportement, Formulation, Rhéologie, Conventionnelle, Contaminée

THE PERFOMANCE OF ORGANIC MATTER DEGRADATION IN AERATED LAGOON OF THE WASTE WATER PLANT TREATMENT OF OUJDA/ MOROCCO

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ABSTRACT

In Morocco, as in all developing countries, sanitation and sewage treatment constitute certainly one of the largest environmental problems. The lack of public network, lack of waste water treatment plants, absence of control and of environmental awareness contribute to the spread of diseases, the degradation of landscape and the contamination of surface and groundwater. Currently, Morocco produces about 600 Mm³ / year (900 Mm³ / year in 2020), and discharges more than 50% of the untreated waste water in the coast or used directly for the irrigation without treatment.

Wastewater is considered the primary sources of pollution for the ground water and surface water. The Wastewater Treatment Plant at Oujda is in operating phase from January September 2010 and evaluated to assess the system performance in term of removal efficiency for the Aerated Lagoon system. This study attempts to highlight the factors leading to the adequate performance of WWTP in removing organic matter, solids and nutrients. The efficiency of the different stages of the treatment process and the overall plant performance has been demonstrated.
Collection and analysis of data revealed a constantly removal efficiency of chemical oxygen demand (COD), biochemical oxygen demand (BOD), total suspended solids (TSS) and nutrient (NTK).
Analysis of data showed that the combined system removal reached 89%, 90%, 88%, 90% and 29% of the influent COD, BOD5, TSS and TKN respectively with an effluent concentration of 106 mg/l, 50 mg/l, 67 mg/l and 51,7 mg/l. This removal efficiency of the pollutants appeared to be due to the increase in the hydraulic and organic load.
To increase the performance the whole station, it is important to start up the tertiary treatment of the clarified waste water and the sand filtration.

KEYWORDS: Aerated Lagoon, WWTP, COD, BOD5, Wastewater, Oujda.

SUSTAINABLE UTILIZATION OF STONE SLURRY WASTE IN THE WEST BANK

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ABSTRACT

In the west bank, the stone cutting industry consumes large amounts of fresh water and produces even larger amounts of viscous liquid waste known as "Stone Slurry Waste". Calcium Carbonate (CaCO3) is the main constituent of slurry waste in addition to other minerals from parent rock. Stone slurry waste is usually disposed in open areas in the west bank. This practice causes serious environmental problems. Every year death of humans and animals are reported due to drowning in open slurry waste ponds. Moreover, disposal of slurry waste in agricultural land causes a reduction of water infiltration, soil fertility and plant growth.

This paper presents the engineering properties of stone slurry waste and documents successful attempts to utilize the stone powder from stone slurry waste in the production of different construction materials. In this study, waste water from stone slurry was used in concrete production and the resulting properties were compared with the concrete produced with tap water. The results showed that the waste water of stone slurry can be used successfully in concrete production.

KEYWORDS: Stone Slurry, Sustainable, Utilization

TOPIC 6

Desalination

COMPARATIVE STUDY OF THE ADSORPTION CAPACITY OF VARIOUS NATURAL MATERIALS ON THE BRACKISH SAHARAN DRINKING WATER

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ABSTRACT

In this present work, we are interested in the experimental determination of isotherms and adsorption kinetics of fluoride ions in aqueous solution of sodium fluoride NaF, on materials (activated alumina, clay). Initially, we proposed the characterization of these materials by different techniques such as SEM, FTIR and X-ray. In a second step, we performed the reduction of fluoride ions by the adsorbents. The observed adsorption capacity is 1.29 mg / g of activated alumina and 0.72 mg / g of clay. The adsorption kinetics is fast enough: 45 min for both materials at pH = 4. Indeed, the amount of fluoride ions adsorbed decreases with increasing temperature. Retention is predictable from these isotherms in agreement with the Langmuir model. According to the results found activated alumina and clay Algeria is an effective solution to reduce levels of fluoride present in the brackish waters of Algeria.

KEYWORDS: Fluoride Ions, Activated Alumina, Clay, Brackish Water

IMPACT OF DESALINATION OF SEAWATER ON THE ENVIRONMENT IN THE STATION MAINIS, WILAYA OF CHLEF.

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ABSTRACT

Desalination of seawater is possible in particular to increase the freshwater resources available to provide a solution to drought and to cope with shortages and crises. Still several drawbacks: negative environmental consequences (of brine discharge, chemical effluents ...), the high energy demands (and therefore impact on climate, plants are mainly powered by fossil fuels) and a high selling price of water and produced.

Despite the many advantages of desalination's, its advantages and disadvantages should be assessed in terms of costs and benefits, societal and environmental, and compared to other methods of producing fresh water environmental impact remains a major concern.

KEYWORDS: Desalination of Sea Water, Brine, Impact, Energy, Chemical Effluent.

EFFECT OF WETTED WALL TEMPERATURE ON HEAT AND MASS TRANSFERS IN A HUMIDIFIER INTENDED FOR A DESALINATION SYSTEM

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ABSTRACT

The aim of the present study is to investigate numerically the effect of the wetted wall temperature on heat and mass transfer in a humidifier intended for a humidification dehumidification desalination system. A vertical parallel-plate channel constitutes the humidifier. One of the plates is wetted by a liquid water film and maintained at a constant temperature, while the other is dry and thermally insulated. An upward airflow enters the channel with constant temperature, lower than that of the wetted wall, humidity and velocity. The wetted wall temperature was varied in order to examine its effect on the flow field as well as on heat and mass transfer characteristics. The results show that the increase of wetted wall temperature affects seriously the performances of the humidifier as it induces evaporation of the water liquid film. On the other hand, it was stated that the humidifier works well for high wetted wall temperature. On the other hand, a warming of the airflow as it enters the channel has been found, and the mass transfer increases between the airflow and the liquid film due to the increase of the wetted wall temperature. Moreover, buoyancy forces act in the same direction than that of the upward airflow and accelerate it's near the isothermal plate while there are decelerated and induce a flow reversal near the adiabatic wall. A recirculation cell appears near this insulated plate. The dimensions of this cell depend strongly on the wetted wall temperature. Indeed, as the wetted wall temperature increases, the recirculation cell resulting occupies a large part of the channel length. Indeed, increasing the wetted wall temperature increases strongly the sensible and latent heat transfer.

KEYWODS: Desalination, Numerical Study, Heat and Mass Transfer, Evaporation, Mixed Convection, Flow Reversal, Humidifier.

HYBRID SYSTEM FOR WATER AND ENERGY PRODUCTION USING RENEWABLE ENERGIES: CASE OF THE OPEN-GAIN PROJECT

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ABSTRACT

Desertification constitutes a major scourge in Maghreb countries. According to estimations of United Nations Convention to Combat Desertification (UNCCD), the arable land available worldwide will significantly be reduced by 2025. Desertification has to be understood as the degradation of land in arid and semi-arid regions and not as the expansion of existing deserts. One reason for this reality is the scarcity of freshwater resources in these areas rich in underground brackish water.

The use of brackish water does accentuate soil degradation. In order to combat this phenomenon, reverse osmosis (RO) emerges as a feasible desalination technology, renewable energy sources as necessary complement and decentralized water- electricity supply as a solution for this particular problem. However, water desalting in remote areas require a high level of plant reliability as well as a dependable system. These facts are the basis for the Open-Gain project which stands for 'optimal Engineering Design for dependable Water and power Generation in Remote Areas Using Renewable Energies and Intelligent Automation', whose overall strategic goal is: "To co-ordinate R&TD joint effort to produce sustainable essential life-resources at minimum environment loads by introducing high technology and automation".

For remote arid areas, decentralized solutions for energy and water co-production offer advantages over large central production sites. Since skilled personnel are not available in such areas, dependable systems are necessary. This project offers a solution to cost optimal co-production of energy and water using renewable energy beside diesel generators. Cost optimization is achieved through a high level of automation, which is necessary to adapt the working conditions to the strongly varying renewable energy supply, and remote maintenance; the approach is based on thorough modeling of the processes and offers a large degree of flexibility in the design to meet different production requirements.

The project involves a consortium composed of several Mediterranean Partner Countries (MPC) as well as institutes from EU which are specialized in the desalination, renewable energy and automation systems.

A pilot plant has been constructed in the techno-pole of Bordj-Cedria, Tunis, Tunisia. This prototype system is composed of a hybrid power supply system (PV, wind and diesel) a reverse osmosis plant and a storage system. The whole compound is controlled by an energy management system and fault control system.

KEYWORDS: Hybrid System, Renewable Energies, Desalination, Energy Management System

TOPIC 7

Legislation, Management Tools, Governance and Sustainable Development

RESERVOIR MANAGEMENT USING GENERATED INFLOW

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ABSTRACT

Several methods are available for reservoir storage-yield design but they rely on long inflow sequences, which are often scarce in arid and semi-arid regions. A large number of reservoirs has been designed and constructed in such low rainfall, high evaporation rate areas. In such cases, reliable estimates of inflows are particularly important, because the reservoir yield results are very sensitive to input data. The reservoir capacity determination problem involves the computation of the capacity of a reservoir required to meet specific water demands. Selection of a storage capacity for the design of a river reservoir is made traditionally by the Rippl mass curve method or the sequent-peak algorithm. In the present study these two approaches are used. Since the objective of the record extension was to make available long enough data records for reservoir yield assessment, model performance in reproducing the reservoir storage-yield-reliability relationship during calibration was examined. Planning is used here to mean the determination of storage capacity required at the reservoir site to meet a given demand with a specified level of reliability. In this study, river flow data of Bouhamdene catchments located in eastern Algeria has been considered. The data was available only for a short period of time. Generation of data generally assists in planning, operation and management of reservoirs. So long inflow sequences have been generated by keeping intact the statistical properties of the historical data and then determined the capacity. The generation was carried out using SAM's software. In this study a decision support, which includes management scenarios, is developed. Regulations that required minimum releases from the reservoir for conservation purposes are presented.

KEYWORDS: Reservoir Storage -Yield, Inflow Generation, Management, Decision Support.

MODELISATION DU SYSTEME D'ALIMENTATION EN EAU POTABLE DU GROUPEMENT URBAIN DE TLEMCEN - ALGERIE

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RESUME

Tlemcen suit une évolution démographique rapide depuis une dizaine d'années ce qui nécessite des investissements importants concernant les structures d'alimentation en eau potable.
Actuellement, l'alimentation en eau potable dans le groupement urbain de Tlemcen est caractérisée par une production insuffisante qui ne peut pas couvrir les besoins actuels, principalement dû à la diminution des précipitations au cours des dernières années. L'alimentation en eau potable des quartiers se fait une à deux fois par semaines pour quelques heures. A cela s'ajoute un taux énorme de pertes d'eau qui dépassent 50%. Ces pertes sont la conséquence d'un état avancé de corrosion des conduites en acier, matériau inadapté aux conditions de sol, mais aussi d'une mauvaise qualité d'exécution des travaux, d'un manque d'entretien et de renouvellement des conduites.
Le système dans son ensemble est mal structuré suite à des extensions réalisées sans conception de base. Pour permettre d'améliorer la situation de l'alimentation en eau potable une étude globale et structurée est indispensable.
L'objectif de notre travail est de mettre le point sur les problèmes liés à l'AEP dans le groupement Urbain de Tlemcen, décortiquer le système d'alimentation et modéliser ce dernier pour pouvoir proposer les solutions adéquates aux problèmes rencontrés.

MOTS CLES: Réseau d'AEP, Modélisation, Actualisation, Groupement urbain de Tlemcen

IMPLEMENTATION OF AN INTEGRATED SYSTEM BASED ON GIS FOR HYDROMETEOROLOGICAL FORECASTING APPLICATION TO WATERSHED BOUREGREG

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ABSTRACT

In Morocco, floods have become, over the past two decades, a very frequent natural disasters that generate significant materiel and human damages: Ourika (1995), Mohammedia and Settat (2005), Tafilalet (2008), Tanger (2008), Gharb (2009), Casablanca and Rabat (2010). The control and mitigation of floods consequences require a continuous hydrological monitoring, an understanding of the watershed hydrologic behavior, through the measurement and analysis of hydrologic and rainfall variables that govern the whole process of flood genesis, and the use of computer simulation and forecasting tools. This study is part of a research project conducted by a team of research professors of the Hassania School of Civil Engineering in partnership with The General Departure of Water Resources, The National Departure of Meteorology and The Water Basin Agency of Bouregreg and Chaouia, and aims to develop a computer system coupling hydro-meteorological forecasting models with GIS tools.

His interest is to provide water resource managers with a tool for decision making support that provides the necessary elements (watersheds characteristics, mean precipitations, maximum precipitations, flows, volumes, quintiles, hydrographs ...) to anticipate in the knowledge of the flood formation process in order to help better manage the risk of this disaster by taking adequate warning and protection measures.
The development of this system is focused on combining the functions of GIS (preparation, handling, retrieval and display of data) and those of prediction models to develop an integrated, ergonomic and extensible tool. The development platform chosen was ArcGIS Engine that allows the implementation of such tools without requiring huge knowledge in GIS.
The work of the system is based on the preparation of basic inputs (DEM, land use, soil, river network and stations network) from which the system will calculate the various physiographic properties of the basin. The loading of forecasting data will thus simulate the basin response using the three prediction models integrated into the tool (HEC-HMS, model based on multiple regression and the empirical model).
The application of the study concerns the watershed of Bouregreg River at the dam site Sidi Mohamed Ben Abdellah, located in north-central Morocco. It represents an area that cover a surface of approximately 9600 square kilometers with a mountainous contrast ranging from 46 m to 1627 m, a mean annual precipitation of about 420 mm and a surface water potential of the Bouregreg River at the dam SMBA evaluated to about 680Mm^3/year.

KEYWORDS: Tool for Decision Making Support, GIS, Forecast, Hydro-Meteorology, Watershed of Bouregreg

FLOOD RISK ASSESSMENT FOR THE MANAGEMENT OF WATER RESOURCES AND THE SUSTAINABLE DEVELOPMENT IN THE BASIN OF WADI TINN (N-W OF ALGERIA)

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ABSTRACT

Control the physical environment of the basin of Wadi Tinn and hydro-morphological behavior allows with the knowledge of the spatial variability of these characteristics, an approach to flood risk characterization.

Access to this physical and ecological information is facilitated by using technical, methodological and theoretical operational tools that manage and use the multi-source information. The establishment of a Geographic Information System (GIS), allows assembly, organizing data flood risk in the basin of Wadi Tinn.

The different sediment analysis can refine the diagnosis of the current state of the latter by statistical processing and correlation between different factors. The multicriteria spatial analysis, conducted in the GIS has allowed the mapping of flood risk areas. This map consists of four classes ranging from low to high flood risk. It can be used not only for prevention of flood risks but also for the management of natural resources in the basin of Wadi Tinn.

Spatial applications derived from this analysis further confirm the interest of the GIS tool for the assessment of natural risks related to water and characterization of the phenomena causing flooding and the vulnerability of wetland ecosystems in the Macta and ensure sustainable development of the natural environment and its resources.

KEYWORDS: Flood Risk, Basin, Macta, GIS, Water Resources, Sediment

THERMAL CONDUCTIVITY OF POROUS MATERIALS BASED ON THE MASS CONTENT OF WATER

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ABSTRACT

This article focuses on the experimental study of thermal behavior of calcarenite stones used in the construction of the monuments in Rabat (Morocco). Water is the main factor of susceptible agents to degrade the buildings by stones, we felt it necessary to conduct the study on the influence of humidity on the thermal physical properties (thermal conductivity) of the material. Our measurements were performed by two different methods: Method boxes and optical method (Thermal Conductivity Scanning) for the contents of water selected intermediate between the dry and saturation.

These measurements are carried out to determine changes in thermal conductivity over time. They show that the conductivity varies according to the content of water.

RESILIENCE AS A WAY TO OPERATIONALYZE SUSTAINABLE DEVELOPMENT, AN ILLUSTRATION WITH URBAN WATER SYSTEMS

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ABSTRACT

Exogenous and endogenous disturbances are at the root of the complexity amplification to organize human societies. The firsts put more and more pressure for decades as shown by climate change and its propensity to catalyse vulnerabilities. In the seconds, bad and lack of governance appears as the main problem. These factors cause unpredictable shocks. Thus, since 2000, we are living in an uncertainty paradigm compelling us to learn the management of unpredictability (Simonovic 2009). This new context reduces capacities to forecast and increases the complexity of sustainable governance.

Indeed, sustainable development (Bruntland 1987) has to associate social, economic and environmental dimensions to account for their interactions. So, a need for a holistic approach appears, reinforced by contextual uncertainty. Thereby, governance for a sustainable development must turn societies toward a form which allows dealing with the unforeseeable. System's resilience lies in its ability to recover from disturbance. Thus, resilience should be able to respond to this new challenge of sustainability. This communication discusses whether mobilizing the concept of resilience operationalize the broad objective of sustainability. Resilience implies the study of behaviour and systemic persistence from disturbance (Holling 1973; Walker *et al.* 2002). Governing such socio-ecological systems, from a resilience analysis, leads to policies and behaviours dealing and coping with shocks to develop opportunities (Lallau 2008). So, resilient governance reinforces capacities (Perrings 1995). From that perspective, we argue that resilience contributes to the implementation of governance capable of internalizing the unforeseen, constituting a structuring dimension of sustainability by offering a better view of it.
This communication contains three parts. Each one uses a different analytical level. The first deals with theoretical consideration evaluating the coherence between resilience and sustainable development. We will consider the compatibility and the relevance of resilience with sustainable development. The second section demonstrates the pertinence of the resilience concept with an empirical analysis. Urban water systems are our fieldwork. The third section is pragmatic. It estimates resilience efficiency to support decision making. We will show the efficacy of an adaptive management based on practical tools of the resilience (heuristics diagram, models, and statistical indicators).

KEYWORDS: Sustainable development; Governance; Resilience; Urban water systems

TOPIC 8

Water Economics, Allocation and Pricing

SOLAR WATER PUMPING: A COMPLEMENT TO USUAL IRRIGATION SYSTEMS IN THE ZIZ VALLEY (SOUTH EAST OF MOROCCO)

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ABSTRACT

Solar water pumps have not been widely used in Moroccan dry and semi-dry areas, in part due to the cost, the little knowledge of the rural population about the advantages of these systems, and also the non availability of solar water pumps sellers in the proximity. Solar pumps work at capacity when needed most during warm, sunny days when water is becoming scarce in the dry and semi-dry areas. This is particularly important for palm date trees which are dying from summer dry conditions and low precipitations. The maximum power points of the current-voltage characteristic of the photovoltaic system to be used should be matched with the I-V load line of the pumping system. This is necessary if we wanted to create a system with high overall efficiency over the widest possible range.

Solar pumping systems are suitable for the Oued Ziz Valley (OZV) because the already drilled wells are not very deep, and the underground water is relatively low du to the dry conditions of the area. In the OZV, during May-September period the solar energy can reach 7.5kWh/m^2 per day and the cloudy days are rare outside May-September. Wind pumping systems are not suitable du to the irregularity and low wind speed. The cost of 1m^3 water pumped with solar PV system in the OZV was calculated for two periods (for July-August period, and for 12 months). We have seen that the solar PV pumping is competitive with diesel pumping for the OZV. In addition to the environment benefits, the rural community will no longer have to bother with buying and transporting diesel fuel to their pumps if they opt for solar PV pumping. A transportable solar PV pumping system may help to lift the needy shallow water left in the river. In this paper we will discuss and present the technical and financial problems encountered by the rural population in (OZV), to find a suitable solar water pump. The environmental and financial gain when using solar water pumps instead of oil engines will be addressed. Substitution of oil engines by solar powered ones will have surely a positive impact on the environment. The results may be extended to most of the south Mediterranean dry and semi-dry areas

KEYWORDS: Photovoltaic, Solar, Water, Pumps, Environment, Ziz Valley

OPTIMISATION DES RESEAUX DE DISTRIBUTION D'EAU POTABLE

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RESUME

Un réseau de distribution d'eau potable, alimenté par une ou plusieurs stations de pompage, est mis en charge par des réservoirs surélevés. Ces réservoirs ou châteaux d'eau sont remplis par les stations de pompage à travers le réseau de distribution auquel ils sont raccordés par une conduite de distribution- refoulement. On constate que les réservoirs ne se vident pas et ne se remplissent pas à la même vitesse. Ce phénomène est la conséquence des différences pertes de charge dans le réseau en fonction du comportement des consommateurs et de leurs répartitions. Il s'ensuit qu'en régime dynamique les remplissages des réservoirs peuvent être très différents à un moment donné, ce qui présente l'inconvénient de laisser des capacités de stockage inutilisées dés lors qu'un réservoir atteint sa cote de trop plein en provocant l'arrêt du pompage.

Pour remédier à ces déséquilibres, une méthode consiste à équilibrer automatiquement et en permanence les niveaux. Le principe de la méthode impose l'équirépartition de la distribution vers le réseau ou du refoulement vers les cuves, de telle sorte que les niveaux évoluent de la même façon. Ainsi la capacité de stockage est optimisée, car il est possible de la remplir au mieux pendant les heures de pompage à faible coût. Une autre conséquence est la mise en charge équilibrée du réseau puisqu'il y'a équirépartition simultanée des charges.

Les coûts d'investissement pour la construction d'un nouveau château d'eau et les coûts d'exploitation relevant de la consommation d'énergie électrique sont tels, que l'utilisation réelle des capacités de stockage doit être assurée dans les meilleures conditions.

L'optimisation du réseau signifie dans cet aspect l'utilisation optimale des ouvrages de stockage existants.