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SECOND WATERBIOTECH INTERNATIONAL CONFERENCE

BIOTECHNOLOGY FOR AFRICA'S SUSTAINABLE WATER SUPPLY

BOOK OF ABSTRACTS

08 – 10 January 2014

University Cadi Ayyad, Marrakech, Morocco

PREFACE

The International Conference "**Biotechnology for Africa's sustainable water supply"** is the closing event of WATERBIOTECH project, a Coordination Action supported by the European Union under the Seventh Framework Programme (FP7).

The conference to be held in Marrakesh (Morocco) as the culmination of more than two years of intensive work under WATERBIOTECH initiative, will bring together members of WATERBIOTECH consortium in conjunction with national and regional decision makers, water professionals, scientists and practitioners. The event includes the presentation of scientific papers related to relevant aspects of water management, water treatment and water supply in Africa as well as discussion panels and workshops.

Development in Africa needs bottom-up approaches in which the necessities of all actors are taken into account as WATERBIOTECH project has pursued. The network between Africa and Europe resulted from WATERBIOTECH project has led to mutual learning experiences.

The intention of this conference is to extend this fruitful cooperation to all participants of this event and widely disseminate the results of WATERBIOTECH initiative.

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PLENARY CONFERENCE

WATER-FOOD-ENERGY: THE ROLE OF BIOTECHNOLOGY IN THE SEARCH FOR SUSTAINANBLE WATER MANAGEMENT IN SOUTHERN AFRICA

Professor Gideon Wolfaardt,
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Africa is blessed with natural resources and with more arable land than any other continent. However, despite having amongst the lowest population densities, the continent has the highest incidence of food insecurity. This enigma is an urgent challenge; but also one that can and should be addressed by employing African know-how, with appropriate leverage and participation of international collaborators. At the core of meeting this challenge is to garner ecosystem services such as water and renewable energy in a way that is sustainable, socially uplifting and contribute to economic development. The increased emphasis on trans-disciplinary collaboration, and in fact, frequent insistence by funding organizations for multi-national cooperation, presents tangible opportunities towards achieving these goals.

The very complex nature of water supply, including potentially competing demands for different sectors ranging from human settlement – to agriculture – to industry should be recognized. Increasing population and resource pressure urgently necessitate innovation in all supply domains and careful planning for directing the evolution of resource utilization towards sustainability.

While these developments will benefit researchers in the field of water biotechnology, they also highlight the need for solution-driven research, as eloquently demonstrated amongst the presentations at this conference. This talk will attempt to outline the role of biotechnology solutions to water treatment in the sustainable supply of water, food and energy in southern Africa.

ORAL PRESENTATIONS

TOPIC 1

Biotechnologies for water treatment and reuse in the African context

SEQUENCING BATCH REACTORS AND TRICKLING FILTERS FOR DECENTRALISED WASTEWATER TREATMENT AND RE-USE IN NORTHERN AFRICA AND MIDDLE EAST

Gerhard Schories, Fabio Pereira
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ABSTRACT

Water is essential for life, but water is a very scarce good in many regions of the world, especially if a certain quality is considered. Water is needed for drinking purposes, for agriculture, for any kind of household purposes, and last but not least for various technical purposes. The different applications require also different water qualities. There is a high need for technological developments for water purification. Although water is a very essential resource its value is in many cases underestimated. Furthermore, all available water sources need to be considered for purification and re-use. The presentation will introduce different biotechnological concepts to purify municipal and industrial wastewater for water re-use. Sequencing Batch Reactors (SBR) and trickling filters will be mainly in the focus of this presentation. The presentation will include practical experiences with these technologies in hot climatic zones. To consider such experiences will be of high relevance for their application in Northern Africa and Middle East. System performance and operational requirements will be discussed and elucidated by practical case studies.

Treatment target is to provide water where nutrient concentrations (e.g. nitrogen) can be adjusted to the later re-use purpose (e.g. irrigation of crops in agriculture). In opposite to membrane bioreactors (MBR) SBRs and trickling filters require lower investments, lower maintenance efforts and consume less energy. These aspects could increase local acceptability especially in those regions where skilled personnel is rare are or not available at all. This can be an option for villages in remote areas. Another issue for remote areas could be the energy supply. SBR and trickling filters usually consume less energy per m^3 of treated water than MBRs. Most important disadvantage of these systems is the fact, that the effluent is not germ free as they do not include a mechanical barrier for microorganisms the membrane in a MBR is. This limits water re-use or requires additional disinfection measures such as UV or chemical disinfection. Different options and opportunities will be discussed.

KEY WORDS: Sequencing Batch Reactors (SBR), trickling filters, wastewater re-use, water scarcity.

TREATMENT OF TEXTILE DYE WASTEWATER BY MEMBRANE BIOREACTOR (MBR) WITH COMMERCIAL AND NOVEL LOW-FOULING MEMBRANES

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ABSTRACT

Since water scarcity is a growing problem particularly in the Northern African countries the use of alternative water resources will be more important in near future. In this context reuse of treated wastewater offers a viable option to reduce freshwater consumption. The textile industry which plays an increasingly important role in African countries is long regarded as a water intensive sector due to its high demand of water for all parts of its processes. Membrane bioreactor (MBR) systems are very attractive for industrial wastewater treatment as the implementation of membrane micro/ultra-filtration for solids retention into biological treatment system leads to several substantial improvements compared to conventional biological processes. However, membrane fouling is regarded as the most important bottleneck for further development of MBR technology. It is the main limitation for faster development of this process, particularly when it leads to flux losses that cleaning cannot restore.

This paper presents findings of an EU funded project "Development of the next generation membrane bioreactor system (BioNexGen) which aims at developing novel functionalized low-fouling membranes for membrane bioreactors (MBRs) in wastewater treatment.

The results were obtained in a small pilot-scale submerged membrane bioreactor treating model textile dye wastewater (MTDW). For this purpose a novel membrane material has been developed as special coating on commercial membranes. For benchmarking submerged commercial and novel MBR modules were tested in the same MBR tank to compare the performances of both modules. To keep the operating process conditions constant, MTDW has been used as test media. Because, the composition of real textile dye wastewater change over the time and season of the year. For this work, MTDW was developed using red and blue reactive dyes based on different publications and a pilot-scale automated MBR unit was applied to carry out the tests with this model wastewater over a period of 6 months. The hydraulic volume of the employed MBR reactor was 57 L. The commercial as well as the novel module consisted of 3 sheets, with 25 cm × 25 cm dimensions of each sheet covering total active membrane area of 0.33 m^2. Within the pilot-scale trials different process parameters such as COD, BOD, TOC, pH, conductivity, flux, TMP, MLSS, colour contents, air supply, O_2 consumption, HRT, SRT, drying residue, nutrients etc. have been investigated. Experiments have been conducted with the commercial and novel membrane under similar operating conditions and the same process parameters have been investigated. The COD removal efficiencies with the commercial and novel module were around 90% and 96% respectively for 2450 mg/L inlet COD fed to the membrane bioreactor. The red dye and blue

dye colour removal efficiencies with the commercial membrane were 20% and 40% respectively and with the novel membrane these values were 30% and 60% respectively. In addition, the novel membrane shows lower varying flux compared to the commercial process within operation of around 6 months.
These results indicate that the process with novel membrane is improved having about 7% higher COD removal efficiency and 10-20% more color (red and blue dye) removal efficiency compared to the commercial membrane process and high fouling resistance.

KEY WORDS: Wastewater treatment, textile industry, membrane bioreactor (MBR), low-fouling membrane

DEVELOPMENT OF SUBMERGED MEMBRANE BIOREACTOR FOR THE TREATMENT OF TEXTILE WASTEWATER

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ABSTRACT

Textile industries are among the largest water consumers in the world and contribute enormously to water pollution by discharging in the environment large volumes of wastewaters containing processing bath residues from preparation, dyeing, finishing and other operations. These wastewaters are complex mixtures of toxic pollutants, often in high concentrations, such as dyes and pigments, salts, heavy metals, surfactants and various organic and inorganic components. Thereby, textile effluents may cause severe pollution if not properly treated before discharge to the receiving waterways. Various kinds of treatment processes have been used to treat these wastes mostly biological degradation, chemical coagulation and chemical oxidations. However, advanced treatment technologies are necessary, especially if the reuse of treated wastewater is the objective and extensive removal of organic contents as well as complete decolourisation is required. In this frame, membrane based separation processes have increasingly become an attractive alternative to the conventional separation processes in the treatment of industrial wastewaters.

An aerobic membrane bioreactor (MBR) was applied, in the frame of the FP7 BioNexGen project, for textile wastewater treatment aiming at colour elimination and biodegradation. The MBR was continuously operated and fed with the textile wastewater. This system consisted of a tank having a working volume of 60 L and coupled to a submerged cross-flow ultrafiltration flat sheet membrane module (Microdyn-Nadir GmbH, Germany) and operated with a variable wastewater loading rate (OLR) from 0.8 to 2.1 g COD l^{-1} d^{-1}. The membrane used is a cross flow flat sheet ultrafiltration membrane having a total effective filtration area of 0.39 m^2, a cut-off of 150 kDa and an operating transmembrane pressure (TMP) ranging between 70 and 350 mbar.

The study was conducted with real textile wastewater samples supplied from a Tunisian textile factory SITEX located in Kasr Hellal, Tunisia. The company production line comprises dying fabrics and finishing processes and utilizes different dyes (reactive, direct and sulphur) and chemical substances such as detergents, salts, auxiliaries (e.g. surfactants, emulsifiers). Their amounts depend on the kind of process that generates different effluents. Generally, this factory produces about 600,000m^3 of wastewater per year. The aerobic consortium used as seed culture for the for the pilot plant was a sample of the sedimentation sludge from a full scale activated sludge plant treating textile liquid wastes with some organic nutrients from domestic wastewater.

The MBR presented high COD elimination and colour removal efficiencies of 95.5% and 92.4%, respectively, obtained with a total hydraulic retention time (HRT) of 2 days and total OLR of 1 g COD l^{-1} d^{-1}. The increase of OLR and the decrease of HRT below 2 days diminished the performances of this system in terms of decolourization and COD removal explained by the sloughing of the degrading biomass.

KEY WORDS: Aerobic submerged MBR, wastewater treatment, textile effluents.

ACKNOWLEDGMENTS: The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 246039 for the project BioNexGen "Development of the next generation membrane bioreactor system", (2010-2014).

PERFORMANCES OF DIFFERENT PHYSICO-CHEMICAL, ENZYMATIC AND BIOLOGICAL TREATMENT FOR MAXIMUM TEXTILE DYE EFFLUENTS DECOLOURIZATION

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ABSTRACT

The textile dye industry is far from being ecologically correct and sustainable. The dyeing process consumes large volumes of water. Wastewater from textile industry has a high environmental impact and therefore needs to be treated before being discharged in the environment or planning any reuse. This study investigated the applicability of various physico–chemical, enzymatic and biological treatments for the removal of reactive dye from textile wastewater. A particular focus is given to coagulation/flocculation (CF), enzymatic catalysis (EC) using commercial Laccase, nanofiltration (NF), aerobic sequencing batch reactor (SBR) and membrane bioreactor (MBR) using a novel bacterial consortium.

The first part of the present study evaluates the performances of CF, EC and NF processes. A series of experiments are conducted on laboratory-prepared wastewaters combining chemically two reactive dyes (Blue Bezaktiv S-GLD 150 and Black Novacron R), auxiliaries and chemicals. To optimize the CF and EC treatments, response surface methodology is applied. CF leads to a maximum percent of color removal of about 93% at 593nm and 94% at 620nm. Whereas, applied commercial Laccase catalysis reduces color by up to 99%. Nevertheless, these two processes have not the same behavior on chemical oxygen demand (COD) and salinity removal since the obtained results show that applied CF permits a partial removal of COD without effect on salinity. However, Laccase treatment has no effect on COD and on salinity retention. The application of NF shows excellent performances in term of decolorization (superior to 99%). In the same time, a partial retention of COD and salinity respectively of about 56% and 35% is obtained. Thus, NF seems to be an efficient process in color removal of textile wastewater. The obtained permeate can be reused in the dyeing process of the textile industry.

The second part of the present investigation assesses the performances of biological treatment as a single process to treat a textile wastewater. Biodegradation was accomplished employing laboratory-scale unit of a sequencing batch reactor (SBR) (8L) fed with reconstituted textile wastewaters based on reactive Bleu Bezaktiv S-GLD 150 dye. SBR was inoculated with an acclimated novel microbial consortia ‘Bx’. Decolorization efficiency was studied for different volumetric dye loading rates (3–20 g dye/m^3.d) at room temperature, under aerobic conditions at pH 7. The experimental results indicated that Bx displayed highest purification capabilities under aerobic conditions giving maximum decolorization rates in the range of 88–97% and COD removal percentages of about 95–98% when volumetric dye loading rates were under 15 g dye/m^3.d. Whereas, when volumetric dye loading rates were increased to 20 g dye/m^3.d, the means rates of decolorization and COD removal were decreased to 70% and 90% respectively. Obtained results indicate that the volumetric dye loading rate can influences the efficiency of dye removal through a sequencing batch reactor.

The third part of the present work investigates the performances of the combination of a membrane process essentially the microfiltration with a suspended growth bioreactor (Membrane bioreactor, MBR) for the treatment of synthetic textile wastewater and to investigate its capability to achieve a water quality meeting reuse criteria. At the beginning, the MBR was conducted at a low biomass concentration (4 $gMLVSS.L^{-1}$). Decolorization performances were maintained at very high rates (90-100 %) for dye mass loading rates in the range of 1.25 – 5 $mg.g^{-1}.d^{-1}$. Then, when the dye concentration was increased to 7.5 $mg.g^{-1}.d^{-1}$, the performances of MBR have been affected in terms of color retention (which was decreased up to 81-87 %) and organic matter biodegradation. Following, our study was conducted by increasing the biomass concentration to 8 $g_{MLVSS}.L^{-1}$. a total MBR decolourization was then observed (100%). Consequently, a high biomass concentration leads to improve the textile wastewater treatment using MBR process. On the other hand, for organic matter concentrations (COD soluble) under 1300 $mg.L^{-1}$ and regardless of the operating period of the MBR, all the microorganisms and microfiltration membrane allows the elimination of most soluble COD of the treated effluent. It should be noted also that a total retention of MLVSS was observed.

KEY WORDS: Decolourization, Textile wastewater, Reactive dyes, Biological Treatment, Coagulation/flocculation, Enzymatic Catalysis, Membrane Filtration.

FEASIBILITY OF OLIVE MILL WASTEWATER TREATMENT BY MEMBRANE BIOREACTOR

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ABSTRACT

Olive mill wastewaters (OMWW) generated by the oil extraction industry are a significant pollutant in Mediterranean countries. OMWW is considered as a contamined and toxic effluent. Their harmful effects derive largely from their high content of polyphenols hardly biodegradable. Several processes have been proposed to treat this effluent, among others advanced oxydation technology and adsorption on actived carbon. However, their applications are very limited due to their high economic costs and/or their low efficiency.
In addition, the biological treatment of OMWW by specific bacterial strains and/or activated sludge, showed removal rate of phenolic compounds between 50% and 60%.
The membrane bioreactor (MBR) is an interesting alternative that has already proven its efficiency in the biodegradation of complex effluents with toxic and recalcitrant composition .They allow natural biodegradation of pollution by the development of a vast and varied consortium. The acclimation step is therefore of importance to select, multiply the type of specialized biomass and adapted for maximum biodegradation of OMWW.
The main objective of this study is to demonstrate the feasibility of the treatment of OMWW in an external ceramic MBR, through eventually an acclimation step.
The acclimation was held over 170 days, by gradually increasing the proportion of OMWW against the synthetic effluent consisting of $C_6H_{12}O_6$ (organic carbon), $NaHCO_3$ and minerals $MgSO_4$, KH_2PO_4 and $CaCl_2$. During 90 days, the reactor was fed only with OMWW. By calculating the cumulative production of sludge, the reactor was maintained stable for about 40 days at a mass loading of 0.2 $g_{COD}.g_{MLVSS}^{-1}.j^{-1}$ and a MLVSS concentration of 8 $g.L^{-1}$. During this stationary period, very good removal rates of COD and polyphenols were obtained respectively of 90% and 80%. The main phenolic compounds removed by the biomass have been identified by HPLC. This is among other Caffeic acid and Tyrosol.
The stability of the system during this experience reflects the good response of the biomass to the treatment and the operative conditions applied.

KEY WORDS: Acclimation, Membrane bioreactor, Olive mill Wastewater, Phenolic compounds

NOVEL HYDROPHILIC AND ANTIFOULING COATINGS FOR MEMBRANE BIOREACTOR (MBR) APPLICATION

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ABSTRACT

The objective of this paper deals with the preparation, characterization and application of novel hydrophilic coatings on commercial ultrafiltration polyethersulphone (PES) membranes.
Coating was obtained by modifying commercial membrane surface increasing its smoothness, hydrophilicity and giving a high antimicrobial activity. Novel membranes with a great potential in wastewater treatment, and in particular in MBRs application , were, thus, obtained and tested. Preliminary characterization tests were directed to investigate: membrane morphology by Scanning Electron Microscopy (SEM) and Atomic Force Microscopy (AFM), surface properties by contact angle measurements (CAM), antimicrobial activity and antifouling behavior.
SEM analyses showed an interconnected structure of the coating made up of an interwoven network of polymeric channels alternated with cylindrical voids. From AFM analyses it was demonstrated the very smooth surface of the coating responsible (together with the relative high hydrophilic antimicrobial surface) of the antifouling property of the membrane.
From CAM, commercial membranes presented a contact angle of about 68° while novel membranes showed a contact angle of about 47°. A reduction of about 30% in contact angle values was found. The higher degree of hydrophilicity resulted in better performances in terms of water permeability and foulant rejection.
Antifouling activity of the coating was proved by using a model foulant compound such as humic acid (HA) for filtration tests. After 24h of filtration, with a subsequent backflushing, PES commercial membranes showed a clear tendency to be affected by fouling (it was observed by the deposition of a dark layer on membrane surface). On the contrary, modified novel membranes were less prone to fouling phenomenon especially towards the irreversible type.
Finally, the prepared coated membranes were assembled in a module and they were applied in a submerged MBR where they were tested with model textile dye wastewater. Two different dyes, Acid Red and Remazol Brilliant Blue, were used and their rejection was determined. The novel coated membranes showed a dyes removal efficiency higher (around 20%) than the commercial ones. Furthermore, also the COD removal efficiency for the novel coated membranes was higher (more than 7%). Therefore, this novel coating, can be considered as a promising membrane surface modification technology for potential application in MBR process for wastewater treatment.

KEY WORDS: Hydrophilic coatings, MBR, Wastewater treatment

ACKNOWLEDGEMENTS: The work was funded by BioNexGen (grant agreement no. CP-FP- 246039-2) EU-FP7/project

KINETIC AND EQUILIBRIUM STUDIES OF COPPER ELIMINATION FROM WASTEWATER BY BIOSORPTION ON THE NATIVE BIOMASS OF STREPTOMYCES RIMOSUS

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ABSTRACT

Biosorption is an interesting depollution process. Since it is simple, effective and economic, it emerged as an alternative treatment technology for the removal of heavy metals from water. The present study proposes the native biomass of *Streptomyces rimosus* as a biosorbent for elimination of copper from water. This biomass is a mycelial bacteria, Gram+, belonging to actinomycetes. It constitutes a solid waste of SAIDAL pharmaceutical company, unit of Medea (Algeria), support of oxytetracyclin production. Infrared spectroscopy analysis shows that *S. rimosus* presents some groups: hydroxyl, methyl, carboxyl, amine, thiol and phosphate. optimum conditions of biosorption are found to be: a biomass particle size between 250 and 560 µm, a biomass content of 7 g. L^{-1} , agitation of 250 rpm, temperature of 25°C and pH≈5. Langmuir, Freundlich and Dubinin–Radushkevich (D–R) models are applied to describe the biosorption isotherms. The maximum biosorption capacity of the native *S. rimosus* biomass under the optimized conditions is 90,9 $mg.g^{-1}$. The mean free energy calculated from D–R isotherm in optimized conditions (7,45 $kJ.mol^{-1}$, ≈8 $kJ.mol^{-1}$) is situated between the margin of the physio-sorption and the one of the ionic exchange. The native biomass of *S. rimosus* is very efficient in elimination of copper since its biosorption capacity is three times more important than the one found for the same biomass treated with NaOH 0,1N.

KEY WORDS: Copper, S. rimosus, Biosorption.

RELATIONSHIP BETWEEN HYDRAULIC LOADING RATE AND TREATMENT PERFORMANCE OF MULTI-SOIL-LAYERING (MSL) SYSTEM APPLYING CONCENTRATED DOMESTIC WASTEWATER IN DRY AREA OF MOROCCO.

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ABSTRACT

Wastewater infrastructure in rural areas of Morocco are either poorly developed or non-existent. Most of rural areas of Morocco are suffering from pollution, and the potential for illness caused by untreated wastewater discharged in the environment. Technologies that are low cost and non-conventional such as Multi-soil-layering (MSL) system are the adequate solution for the treatment of wastewater for small communities in rural areas of Morocco. The MSL system is a technology that uses natural soil in a unit to facilitate wastewater treatment. This has been successfully developed in Japan, China, USA and Thailand, to treat different types of wastewater. Wastewater levels and hydraulic loading rate (HLR) are important factors that influence the treatment efficiency of the MSL system. The MSL technology has been never tested in Morocco. The aims of this study are as follows: i) to adapt the MSL technology to small communities in Morocco, ii) to evaluate the efficiency of a MSL system to treat rural area wastewater characterized by high concentrations of organic matter (BOD5 and COD) and nutrients (nitrogen and phosphorus) and iii) to compare the MSL system performances under varying HLRs.

An MSL pilot plant was established in 2013 at the village Talat Merghen (Al Haouz Province) in order to treat domestic wastewater of 7 houses (48 inhabitants). Three parallel similar MSL systems were established in cylindrical plastic box measuring 65 cm in height and 41 cm in diameter. The 3 MSL systems were composed of soil mixture layers and gravel layers that are arranged in a brick-layer like pattern, and this structure keeps the high water permeability and reduces the risk of the system clogging. Domestic wastewater from 7 lived houses was collected by a holding tank with a volume of 1 m^3 and used to feed the 3 MSL systems at different hydraulic loading rate of 1000, 2000 and 4000 L/m^2/day. The mean characteristics of domestic wastewater used in this experiment are: 609.33 mg/l of BOD5, 891.25 mg/l of COD, 45.34 mg/l of NH_4^+-N, 1.62 mg/l of NO^-_2-N, 30.79 mg/l of NO^-_3-N, 35.65 mg/l of total Kjeldahl nitrogen (TKN), 113.41 mg/l of total nitrogen (TN), 4.32 mg/l of orthophosphates (PO_4^--P) and 13.05 mg/l of total phosphorus (TP).

The obtained results showed that the removal of organic load and nutrients by the MSL systems are affected by changes in the HLRs. The % removal of the MSL system under HLR 1000 l/m^2/day are 70.17 %, 63.87 %, 74.17 %, 61.37 %, 58.30 %, 59.09 %, 64.95 %, 57.70 % and 60.25 %, respectively for BOD5, COD, NH^+_4-N, NO^-_2-N, NO^-_3-N, TKN, TN, PO^-_4-P and

TP. At higher HLR (4000 l/m^2/day), the Removal rates of BOD5 and COD were 52.69 % and 43.13 % respectively. For the removal of nitrogen, denitrification (limiting factor of nitrogen reduction) is promoted by increasing anaerobic conditions favored by the highest HLR. However, the maximum removal percentage of TN was recorded in the HLR-4000 treatment (66.88 %). In addition, the mean removal percentage of phosphorus tended to be higher at lower HLRs (57.70 % and 60.25 % for HPO^-_4 and TP respectively). The changes in HLRs possibly affected phosphorus removal by influencing the contact time of phosphorus and adsorbents in the system.
The MSL biotechnology could be considered as a promising wastewater treatment alternative for small communities in Morocco. Based on these results, MSL system could be considered as an efficient alternative to treat rural domestic wastewater characterized by high concentration of organic matter and nutrient. The low hydraulic loading rate of 1000 l/m^2/day is recommended for efficient removal of organic matter.

KEY WORDS: domestic wastewater treatment, hydraulic loading rate, multi-soil-layering system, nutrients, organic matter, rural area.

STUDY OF SLOW SAND FILTRATION FOR WASTEWATER IN TROPICAL ENVIRONMENT

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ABSTRACT

Wastewater treatment by slow sand filtration is a biological process which consists in filtering wastewater through a porous media, in the occurrence the sand. The sand serves as support for the microorganisms, but in addition of the biological process, chemical and physical mechanisms that contribute to the elimination of different form of pollutions are present. With a good efficiency, the slow sand filtration allows treating wastewaters that meet the standards for the reutilization in the agriculture. It is particularly convenient for regions having space and with a low technical qualification. However, the purification performances must be studied in particular in the case of wastewater used under tropical climate before any application of this biotechnology. The objective of this study is to evaluate the purification mechanisms by slow sand filtration for wastewaters under tropical environment. Three sand filters were built and installed at ONAS (Camberene wastewater treatment plant in Dakar Senegal). The filters were built with local materials, and were constituted with a feeding tank of approximately 180 litters, a column (two meters of high and 25 cm of diameter). The filters were filled with sand (75 cm), gravel (25 cm) and wastewater (90 cm).

The study has shown that with a sand of d10 equal to 0.58 mm and flow of filtration of approximately 0.05m/h, the filtration cycle was relatively long for the first run with the preliminary treated wastewater. At the level of the primary treatment tank, with a rate of 8 cm /h, the slow sand filtration showed a reduction of 72% of the TSS, 56.5% of the COD and 38.6% of the BOD5. For nitrogen 35.45% of the content and for phosphorus of 58.05% of the content were removed. At the level of the clarifier, with a filtration rate of 15cm /h, the slow sand filtration shows a reduction of 81.75% of the TSS content, 30.5% for the COD and 38.9% for the BOD5.

KEY WORDS: Wastewater; sand; filtration; TSS; COD ; BOD5; nitrogen; phosphorus.

CHARACTERISATION OF BIOLOGICAL ACTIVITY OF TREATED WASTEWATER ON MCF-7 HUMAN BREAST CANCER CELLS-CASE STUDY IN TUNISIA

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ABSTRACT

As a Mediterranean region, Tunisia has encountered a mounting water stress, in terms of both water scarcity and water quality degradation. In order to meet water demand, wastewater treatment and reclamation and developing nonconventional water resources have been implemented as potential intervention strategy. Thus, Tunisia has long experience in treated wastewater reuse. However, treated waste water issued from WWTP in Tunisia has been discharged in surface water such as the case of Medjerda River receiving daily discharges from WWTP nearby.

Therefore, the impact of wastewater treatment technology on the physical environment should severely be considered. The treated wastewater quality being discharged into the aquatic environment should be ensured to avoid environmental contamination threatening living organisms and risking human health as well. However, only conventional pollution parameters such as biological and chemical oxygen demand, pH, total suspended solids, heavy metals and microbiological load safety has been considered before.

As an alternative, *in vitro* bioassays are being widely used for environmental risk assessment as an effective screening tool to characterize treated wastewater (TWW) which contains persistent organic pollutants like endocrine disrupting compounds (EDCs) after conventional treatment. Thus, in order to grasp the current situation of the TWW and examine the necessity of *in vitro* bioassay, the current study assessed the estrogenic activity of the TWW from all wastewater treatment plants (WWTPs) discharging in a daily basis into Medjerda River which is a main river in Tunisia. Our sampling involved the TWW discharged into Medjerda River from the upstream to the downstream. Thus, WWTP of Jendouba, Bousalem, Beja, Mjez elbab and Jdaida were sampled consecutively for biological screening.
To achieve this aim, modified E-screen with human breast cancer MCF-7 cells was implemented to assess the estrogenicity which is generally detected by a proliferative response of MCF-7 cells.

The proliferative response was dose dependent in the targeted samples. Hence, the implemented assay pointed out the insufficiency of the applied treatment technology to completely eliminate the EDCs from TWW with slight differences in the performance of each WWTP. In fact, the water discharged in recipient water bodies still contains EDCs which include a wide range of molecules such as organochlorine pesticides, phthalates, alkylphenols, natural hormones and pharmaceuticals.

These results made the emphasis on the importance of *in vitro* bioassay as an integral tool for evaluation of the estrogenicity as well as the cytotoxicity. Indeed, *In vitro* assays have advantages of being rapid, cost effective for the identification of biologically active chemicals in water sample**.** Also such study allows identifying the environmental risks of surface water pollution and contamination by TWW, to ensure an efficient management of water resources and the protection of recipient water bodies. On a broader scope, the study contributed to develop local information systems to support decision-making and it can contribute to management of the treatment plant.

KEY WORDS: environmental risk assessment, estrogenic activity, Modified E screen assay, treated wastewater TWW, MCF-7 cells, endocrine disrupting compounds EDCs.

MARAIS ARTIFICIELS: UNE APPROCHE POUR LE TRAITEMENT DES EAUX GRISES

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RESUME

Dans le cadre de la gestion intégrée des ressources en eau et face à la pénurie d'eau dont souffre notre pays, le recours au tri à la source des eaux grises et eaux noires et leur traitement par des technologies appropriées « Low cost technologies » en vue d'une réutilisation adéquate s'avère un impératif technique incontournable et une voie privilégiée qui s'impose avec rigueur dans la conjoncture actuelle marquée par la raréfaction de l'eau et l'accroissement accentué de la Population.
Ce travail de recherche vise l'évaluation du potentiel épuratoire et hydraulique d'un Filtre Prototype planté de Roseaux (*Typha Latifolia*) à écoulement horizontal sub-surfacique pour le traitement des eaux grises émanant des lavabos collectives d'une école sous le climat aride de Marrakech.
La justification d'un tel choix repose sur :une bonne intégration paysagère de la filière, des rendements épuratoires compétitifs, une gestion aisée, l'usage des matériaux locaux pour le garnissage du Filtre, le cout d'investissement rationnel et l'absence d'apport énergétique
Un suivi des performances épuratoires du filtre planté pendant 3 mois, après sa mise en service, a permis d'obtenir des résultats satisfaisants en termes d'abattement des paramètres physicochimiques : DBO5 80%, DCO 75, NT 56%, et PT 37%.
Pour les germes fécaux et organismes pathogènes, l'étude préliminaire a révélé un taux d'élimination de 92% pour *Echerichia coli*, 95% pour *Pseudomonas* sp, 92% pour *Staphylloccus* sp, 75% pour les Germes Totaux, 73% pour les Coliformes totaux et 70% pour les Coliformes Fécaux. Pour le comportement hydraulique, Les résultats des prélèvements tridimensionnelles ainsi que des essais de traçage ont démontré que le Filtre présente des efficacités hydrauliques et volumétriques généralement bonnes avec relativement peu de couches mortes, et moyenne distribution des temps de séjour. Finalement, il a été démontré que le bilan hydrique est marqué par un taux d'évapotranspiration estivale élevé jusqu'à 15 mm/jour.
La justification d'un tel choix repose sur: une bonne intégration paysagère de la filière, des rendements épuratoires compétitifs, une gestion aisée, l'usage des matériaux locaux pour le garnissage du Filtre, le coût d'investissement rationnel et l'absence d'apport énergétique

MOTS CLES : Eaux grises, filtre planté de Roseaux, écoulement horizontal, capacité de traitement, comportement hydraulique

APPLICABILITY OF CONSTRUCTED TREATMENT WETLANDS IN SUSTAINABLE SANITATION SYSTEMS WITH EMPHASIS ON WATER REUSE

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ABSTRACT

Constructed wetlands (CWs) are engineered water treatment systems that optimize the treatment processes found in natural environments. CWs are popular systems which efficiently treat different kinds of polluted water and are therefore sustainable environmentally friendly solutions. Compared to other technologies CWs compare quite favorable due to the robust treatment performance and their low operation and maintenance (O&M) requirements (e.g. Haberl et al., 2003; Kadlec and Wallace, 2009).
CWs are used in sanitation systems for treating greywater, storm water and/or the total wastewater flow. Especially concepts with greywater separation compare quite favorable compared to concepts where the total wastewater flow has to be treated (Masi, 2009; Weissenbacher and Müllegger, 2009; Paulo et al., 2013).
CWs have been found to reduce pathogens with varying but significant degrees of effectiveness thus making constructed treatment wetlands very suitable in systems where water reuse is anticipated. The elimination efficiency is increasing with the retention time of the wetland (e.g. García et al., 2003; Kadlec and Wallace, 2009). For vertical flow CWs with intermittent loading pathogen elimination of at least 2 logs can be expected for each filter bed (e.g. Sleytr et al., 2007). This makes CWs
It is commonly agreed that CW systems require only little O&M efforts. If O&M is carried out by professionals it is more likely to detect problems before they become visible in a reduction of treatment efficiency. It is a characteristic of CWs that mistakes in operation are buffered over a long time. In the case of long term these malfunctions might lead to soil clogging (Mitterer-Reichmann, 2012).
Langergraber (2013) concludes that CWs compare quite favorable against the 5 SuSanA sustainability criteria (SuSanA, 2008), i.e. the high treatment efficiency of CWs contributes to health and hygiene, and protects environment and safes natural resources, CWs are a simple technological solution which is easy to operate and maintain, CWs can be implemented at reasonable costs and especially have low O&M costs, and being a natural treatment technology CWs have high socio-cultural acceptance and can be an appropriate technological solution.
This makes CWs a technology suitable for sustainable implementation of sanitation systems as well as for being used in resources-oriented systems (e.g. Langergraber and Haberl, 2004). However, for a sustainable implementation of any sanitation system the whole sanitation chain has to be considered. Although CWs as a technology compare quite favourable to the SuSanA sustainability criteria, a sustainable implementation can only be reached when the whole system is considered. This includes e.g. the consideration of O&M requirements (e.g. Müllegger et al, 2012) from the beginning and the treatment of residues from the CW treatment systems (e.g. sludge).
CW technology is affordable and adaptable to local conditions and thus very suitable for the application in developing countries (e.g. Kivaisi, 2001). However, experience (Hierzegger et

al., 2012) showed that long term operation of systems can only be successful if the owner of the sanitation system i) has a benefit from the system (e.g. faecal compost, irrigation water, etc.), and ii) is aware of the necessity and scope of O&M work required.

KEY WORDS: Constructed wetlands, operation & maintenance, sustainability, water reuse

UPGADING OF BLACK WASTEWATER TREATMENT AND REUSE VIA HYBRID WETLANDS

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ABSTRACT

Water shortage is currently one of the biggest concerns of human being worldwide and it becomes a global problem that affects seriously the lives of high numbers of the world population. Water is an essential element for the economic development and political stability. Limited water resources are recognized as the most important obstacle to the development of the agricultural sector. The North African region belongs to the countries most affected by water scarcity in the world.

Urban wastewater treatment in small rural communities, where technical and financial resources are usually limited, can pose a problem. Experience has shown that, when treating wastewater in small communities, the solutions used in larger cities are not applicable. In order to solve the problems involved, a number of alternative solutions have been developed, based on small-scale treatment systems which are adapted to the needs of these areas (non-conventional technologies).

In Egypt, as well as in many African countries, there are a large number of towns with small populations which have insufficient financial resources or management capacity to deal with the problem of their wastewater treatment using the classical treatment systems which, owing to their operational and maintenance costs and the need for qualified personnel, are not feasible in such towns.

Therefore, the present study aims to investigate the efficiency of simple, low cost construction, operation and maintenance wetlands technology for wastewater treatment. Pilot study on real black water was conducted in this investigation. This research describes the feasibility of applying of sedimentation tank as primary treatment followed by hybrid horizontal-vertical subsurface flow wetland for the treatment of concentrated black (toilet) water. The results showed that sedimentation tank was able to remove about 55.8%, 26.3%, and 40.3% for TSS, BOD and COD respectively for the raw black wastewater. When the effluent of the sedimentation tank was further treated by the horizontal wetland, the removal efficiency of TSS, BOD and COD increased to 82.2%, 85.1%, and 89.9%, respectively. For upgrading the treated effluent, it was further subjected to vertical wetland. Therefore, the total removal of the pollution parameters by the hybrid wetland reached 97.2%, 95.5%, and 97.4% for TSS, BOD, and COD successively. As a result, the final effluent was found to be complying with the National Regulatory Standards for the treated effluent reuse. The present investigation concluded that the constructed wetlands (CW) offer a low-cost alternative for wastewater treatment according to the climate of Africa. Further conclusion is that upgrading of the treatment system could be implemented easily if the land area is available, particularly in the African arid and semi-arid areas.

KEY WORDS: Black water; Hybrid wetlands; Wastewater treatment/reuse.

POTENTIALITIES OF WASTE WATER RE-USE IN WATER STRESSED REGIONS. THE CASE OF TREAT&USE PROJECT IN SPAIN

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ABSTRACT

In the context of water scarcity suffered by numerous regions in the world, in Europe there is an emerging strategy of promoting the use or reclaimed water for certain purposes including agriculture, one the main sector in terms of water consumption especially in Southern Europe. In the frame of this strategy, the European Commission has funded TREAT&USE project whose aim is to construct and implement a commercial prototype for treating municipal wastewater and apply the effluent directly for irrigating and fertilizing crops in a test site in Southern Spain. Main objectives of this technology are minimizing O&M costs and ensuring safe use of reclaimed water in agriculture.

KEY WORDS: MBR, reclaimed water, waste water re-use, water scarcity

THE WAY TO DEVELOPING COUNTRIES TARGET: WASTEWATER REUSE IN AGRICULTURE

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ABSTRACT

Choosing the most appropriate technology for wastewater treatment should based on two bases which are affordability and appropriateness that relates to the economic conditions of the community and to the environmental and social conditions, respectively. Populat-ion density and location and the efficiency of the technology as compared to the cost should be considered. The community should be able to finance the implementation, operation and maintenance of the system. For a system to be environmentally sustainable, it should ensure the protection of environmental quality, conservation of resources, and the reuse of water as well as the recycling of nutrients. Understanding the receiving environment is crucial for technology selection and should be accomplished by conducting a comprehensive site, soil and water evaluation as well as assessment processes. The social aspect mainly relates to factors that can directly affect the operation and maintenance of a certain system. These include the local community habits, and life style, public health protection, government policy and regulations as well as public acceptance. Generally, the main driving forces for the selection of a treatment technology are performance requirements, site conditions, and wastewater characterization. The reason for success or failure of a project, most often depend on the appropriateness of the implemented technology. There is a need for an integrated management approach, to ensure that all the perspectives of effective management that include economical, social, technical and environmental dimensions are taken into consideration. Properly managing a system helps in protecting public health and local water resources, and avoiding expensive repairs. Such management systems should address the major problems related to wastewater approaches primarily in developing countries including funding; public involvement and awareness; inappropriate system design, selection processes; inspection, monitoring and program evaluation components. Training programs are essential for the proper operation and maintenance of equipments and facilities including monitoring of wastewater quality. While there are many impediments and challenges concerning wastewater management in developing countries, these can be overcome by suitable planning and policy implementation. For widening the base of wastewater reuse in agriculture and to reach the requirements for unrestricted irrigation, there are needs for optimizing wastewater treatment plants performance with a correction program as well as the new appropriate technology transfer.

KEY WORDS: Developing countries, Wastewater reuse, Wastewater treatment technologies.

FEASIBILITY STUDY OF WASTEWATER REUSE IN AGROFORESTRY DOMAIN IN MARRAKESH CITY

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ABSTRACT

Morocco is a country where the availability of water resources is a key factor in the development of the agricultural sector which is the basis of the Moroccan economy. Rainfall, hydroelectric dams, rivers and groundwater supply daily water for the farmland. However, these water resources have known in recent decades a drop in volume, due to natural conditions more difficult, the lack of political management at the institutional level and the lack of sensitivity to the users' water, including farmers. Indeed, this pressure led to water resources has had severe impacts on the agricultural sector in many parts of Morocco and consequently on the economy.

The wastewater reuse is one of the alternatives that could be reliable and highly beneficial for irrigation and at the same time for agriculture. In fact, the wastewater can be an alternative to the use of clean water for agriculture, leaving fresh water used for other purposes including drinking water supply (WHO, 1989). Indeed, environmental and socio-economic advantages of this reuse can only be achieved if water through a WWTP (waste water treatment plant) that will eliminate the components liable to harm the environment and public health.

The present study is within the framework of the FAO project **GCP/RAB/013/ITA** "Regeneration of Forests in Algeria, Egypt, Morocco and Tunisia by the use of treated wastewater in order to support livelihoods of smallholders and farmers." This project involves the construction of demonstration projects on the use of wastewater in forestry and agro-forestry systems in the different partner countries. In areas with arid or semi-arid climate, characterized by weakness of water resources, wastewater is a significant potential for forestry. The low level of health risk in agro-forestry applications also allows to extend the interest to the reuse of water with a high content of organic matter and nutrients (N and P). In this way we increase the value of reclaimed water and reduce the environmental impacts associated with the water treatments. Some experiences in Southern Italy did not show any kind of problem after 10 years of experimentation.

In the Marrakesh region, and in order to protect the environment and water resources, by supporting their sustainable management and conservation, the FAO project will allow through the treatment and reuse of treated wastewater in irrigation of forest plantations who settled as part of the creation of a green belt throughout the Oued Tensift over an initial area of about 10 hectares, extensible.

The present study is aimed to illustrating the site analysis for assessment of the environmental and agronomic sustainability of the urban wastewater reuse in agro-forestry and agriculture irrigation, in the first the climate and soil analysis after that an agronomic study in the way to assess the water crops needs and finally the hydraulic study for designing the both of irrigation and waste water treatment plant systems.

KEY WORDS: Urban wastewater, wastewater treatment plant, wastewater reuse, organic carbon recovery, phosphorus and nitrogen recovery**.**

WASTEWATER REUSE ON THE CULTURE OF JATROPHA CURCAS (OUJDA; EAST MOROCCO):STUDY OF THE CHEMICAL CHARACTERIZATION OF THE JATROPHA CURCAS OIL

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ABSTRACT

In the climatic conditions of the city of Oujda characterized by recurrent droughts and permanent water deficit, the reuse of wastewater for agricultural purposes has grown significantly. This practice covers an area of about 1150 ha, and involves a wide range of crop type, including vegetable crops.

This study provides a new perspective for the recovery of treated wastewater through irrigation of *Jatropha curcas* "plant energy" for which the use of wastewater allows both to fertilize and irrigate without causing problems as it is not primarily intended for nutrition food.

The first results showed that irrigation with treated wastewater has significantly improved the growth parameters of *Jatropha curcas*. Thus, there was an increase in growth in height (45 cm on average), the number of branches per plant (41% (TSW) and 33% (SW) higher than controls) and therefore, the number of inflorescence per plant, and an increase in the number of flowers in each inflorescence.

In addition to the effect of sewage on the growth parameters of *Jatropha curcas*, it also caused an improvement in oil content of Jatropha seeds by an increase of approximately 30% compared to controls. This improvement is also significant in almonds. The oil content of the seeds of *Jatropha curcas* is positively influenced by irrigation with wastewater and thus, rich water intake fetilisants elements.

The analysis of the chemical composition of the oil of *Jatropha curcas* showed that this oil is unsaturated linoleic type and contains mainly fatty acids linoleic (34,%), oleic (20%), stearic (21,10 %) and palmitic (11,36%). The study showed that the fatty acid composition of the oil is influenced by new soil and climatic conditions of the city of Oujda

Our study also showed that the oil of *Jatropha curcas* is capable of inhibiting the corrosion of steel in a solution of HCl (1 M). The inhibition efficiency increases as the inhibitor concentration increases to a maximum value of 99%. This feature can easily be valued in the industrial field.

KEY WORDS: drought, wastewater, arid climate, *Jatropha curcas*, fatty acid, corrosion.

SUSTAINABLE MANAGEMENT OF SEWAGE SLUDGE: CONDITIONING AND VALORIZATION

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ABSTRACT

In Algeria, the sector of the wastewater treatment uses two main process: the lagooning and the activated sludge which is mainly applied. Worldwide, this treatment process is recognized for its significant electricity consumption and sewage sludge production. So, to reduce the electricity consumption, the management of the wastewater treatment plants integrated the sewage sludge electricity generation.

This is not the case in Algeria where the sewage sludge are mechanically dehydrated then discharged in landfill sites. This situation induces significant lost of energy, money and recyclables. These losses will drastically increase in the future because Algeria has programmed the building of 40 new wastewater treatment plants in the Five-Year Plan 2010/2014.

As a contribution for reduce the negative effects the current sewage sludge management, this study suggests the integration of a sustainable management of sewage sludge through three successive steps. First, by the sludge methanisation for the biogas cogeneration for save until 30% of electricity consumption. Then, by the use of solar energy for the sludge dryness which could save about 2% of electricity consumption. And, at last, by the forestry fertilization for the sludge recovery which could increase about 70% of the biomass plantation and improve the soil texture. This should particularly successes the reforestation undertaken in Algeria since the seventies' to fight against desertification and climate change which threatening all the African countries.

KEY WORDS: sewage sludge, methanisation, biogas cogeneration, solar dehydration, forestry fertilization.

IMPACT DE LA SERRE VENTILÉE SUR LES PERFORMANCES DES LITS NON PLANTÉS POUR LE SÉCHAGE DES BOUES DE VIDANGE DOMESTIQUES

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RESUME

La promotion de l`assainissement autonome au Sénégal rentre dans le cadre du Programme National d`Eau Potable et d`Assainissement du Millénaire du Sénégal (PEPAM) va entrainer la construction de plus de 100 000 ouvrages individuels d'assainissement et la production de grandes quantités de boues de vidange. Généralement les boues collectées sont rejetées sans traitement dans l`environnement, ce qui pose de graves risques pour les ressources en eau et la santé publique. Cette situation est due au fait que ce programme de vulgarisation de l`assainissement autonome n`est pas accompagnée d`une politique de gestion appropriée des boues de vidange domestiques. Le défi majeur est de développer des systèmes de traitement fiables, facile à exploiter et pouvant générer des sous-produits à forte valeur ajoutée. C'est dans ce cadre, que se situe cette étude sur le traitement des boues de vidange, par les lits de séchage non plantés qui se révèle comme faisant partie des biotechnologies les plus adaptées dans le contexte des pays en développement permettant le traitement et la valorisation des boues de vidange.

Dans cette étude, nous avons conçu et utilisé six (6) lits de séchage de 4m2 chacun dont les trois (3) sont sous serres et les trois (3) autres hors serre à l'air libre. La serre est constituée d'une toile transparente de 70µm d'épaisseur. Chaque serre est munie d`un extracteur d`air et d`un ventilateur qui fonctionnement simultanément et continuellement avec une heure de marche et une heure de repos. La répartition des lits nus hors serre à l'air libre et sous serres est faite de manière aléatoire. Les lits sont constitués d`un filtre à trois couches et d`un drain central d`évacuation du percolât. Une charge de 300 kg/m2/an est appliquée en deux apports espacés de 24 heures. Le suivi de la siccité a débuté au quatrième jour après l`alimentation. Des échantillons composites sont réalisés et amenés au laboratoire pour analyse. Les analyses sont faites par déshydratation à l`étuve et pesée différentielle. Parallèlement l`humidité et la température de l`air (dans la serre et celle ambiante) ont été mesurées. Par ailleurs le percolât a été recueilli et sa quantité mesurée. Trois campagnes ont été réalisées en respectant une période de repos de trois jours permettant au sable de sécher avant la campagne suivante.

Le suivi de la percolation a permis de montrer que l`écoulement du percolât dure 3 à 4 jours occasionnant ainsi une déshydratation de près de 30%. Ce taux d`élimination est le même dans les serres que sur les lits nus. Par contre, l`évaporation est plus élevée dans la serre que sur les lits nus. En effet, la serre augmente la température interne entrainant ainsi une forte évaporation. L`humidité piégée dans la serre est alors éliminée par les extracteurs, ce qui entraine un meilleur séchage des boues dans la serre que sur les lits nus.

Ainsi, Les résultats montre en outre que la serre n`influe pas sur la percolation mais agit plutôt sur l`évaporation. Le séchage des boues est plus rapide et plus élevée dans les serres.

MOTS CLÉS : assainissement, boues, séchage, biotechnologies, valorisation, serres, percolât.

PHYTOTOXICITY EFFECT OF OLIVE MILL WASTEWATER (OMW) AND ASSESSMENT OF IT PHENOLIC EXTRACTS GENOTOXICITY WITH VICIA FABA MICRONUCLEUS TEST

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ABSTRACT

In Morocco, management of Olive Mill Wastewater (OMW) produced by factories poses problems to both producers and the authorities because of the absence of detoxification systems. Several components of OMW, particularly polyphenols, have been shown to have phytotoxic effects on plants and soil microorganisms. Whilst OMW is anecdotally known to restrict plant growth, there are many rigorous studies that have been performed to date. Furthermore, although OMW is currently a waste stream requiring management, it may be considered a potentially valuable resource if phytotoxic compounds and other adverse chemical characteristics can be readily removed and/or counteracted. Wastewater reuse in agriculture has the potential to both treat a waste product at the same time as harnessing a valuable water source. The ability to reuse OMW would be of significant benefit to the Olive Oil industry, as it could potentially be a cost-effective method of wastewater management, whilst at the same time providing a valuable water resource. The aims of the present study is to evaluate the performance of three laboratory phytotoxicity assays; (1) Barley (*Hordeum vulgare*), (2) Lucerne (*Medicago sativa*) and (3) Maize (*Zea mays*). The Olive Mill Wastewater concentration was varied (0 %, 10%, 20%, 40%, 60%, 80% and 100%) and pH was corrected for crude OMW. The tolerance of the three cultivated plants species to OMW was studied through biomass, emergence of seeds and Germination Index. The *Vicia faba* micronuclei test was used to evaluate the genotoxicity of phenolic compounds. The results of these tests revealed that the effluent was highly toxic with effective concentration, $(EC50)_{-14}$**j** inhibition values, as low as 21.7%, 27.9% and 46.6 respectively for Maize, Barley and Lucerne. The pH variation of OMW increased the Germination Index at pH neuter by 4.5 fold. OMW was genotoxic at a 10% OMW concentration. The RP- HPLC identification of phenolic extracts revealed the presence of the major phenolic compounds that are responsible for the genotoxicity effect. Results showed an increase in micronucleus frequency and a decrease in Mitotic index when the concentration of OMW polyphenols increase. Finally, *Vicia faba* micronucleus test seems to confirm the genotoxicity in vivo of phenolic extracts.

KEY WORDS: Olive mill waste water; phytotoxicity; Genotoxicity; Micronucleus assay; *Vicia faba*; Phenolic Compounds.

SURVIVAL AND PATHOGEN LOADS IN AFRICAN CATFISH (CLARIAS GARIEPINUS) CULTURED IN TREATED WASTEWATER IN KUMASI, GHANA

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ABSTRACT

This study was conducted to assess the survival and pathogen loads in African catfish (*Clarias gariepinus)* cultured in the final maturation pond of a series of waste stabilization ponds used for the treatment of municipal wastewater. For a period of 24 weeks, the fish were culture in reused water fed pond (WFP) and a surface-water-fed pond (NWFP) which served as a control. Fish in NWFP were fed with formulated commercial catfish feed (Raanan) at 2% body weight while fingerlings in the WFP were not fed but were allowed to scout for their own food in the pond environment throughout the experimental period. Biweekly samples of water, sediments and fish samples were collected for microbiological analysis. The water and sediments samples were analysed for total coliform, *E. coli*, *Salmonella* and helminth egg population counts. All fish in the ponds were also harvested, counted and the average weight calculated to determine the survival and growth rates over the period. The pathogen loads in the gut, skin and flesh of three randomly selected fish from both treatments (WFP and NWFP) were determined. All microbiological analyses were carried out using standard methods. The *E. coli* and *Salmonella* populations in the sediments and water from the WFP exceeded the maximum permissible limit by 2 -3 log units. However, the levels in the NWFP were within the set standards. Significantly ($P \leq 0.05$) higher levels of pathogen contamination were detected in the gut and skin of fish from the WFP than the NWFP. Mean *E. coli* populations in the skin and gut of fish from WFP were 4.17×10^5 cfu/10g and 3.61×10^4 cfu/10g, respectively. There were no *E. coli* or Helminth eggs in muscles of fish from both sources but total coliforms were present in all fish tissues. The results also indicated that pathogen load in both NWFP and WFP was in the decreasing order: sediment>water>fish. From the findings, catfish from WFP may be a potential health hazard to consumers and fish farm workers and it therefore requires precautionary measures such as depuration and efficient processing methods, prior to fish consumption.

KEY WORDS: Pathogenic bacteria, Helminth eggs, Africa catfish: *Clarias gariepinus*, Waste stabilization pond

TREATMENT OF FAECAL SLUDGE BY UNPLANTED DRYING BEDS: MONITORING OF TREATMENT PERFORMANCES AND DRYING EFFICIENCY ACCORDING THE ALIMENTATION MODES AND THE LOADING

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ABSTRACT

In most of the large cities of developing countries like Dakar, large amounts of faecal sludge are daily withdrawn and they have serious consequences on the environment and the population health. Thus, in Senegal a project was initiated by the National Office for Wastewater (ONAS) and the Sandec, in order to implement low-cost biotechnologies for the treatment of faecal sludge. For this present study an experimental facility was built in order to evaluate the effectiveness of the solid/liquid separation on unplanted drying beds under different loads.

The experiment was conducted over three beds, which were fed by batch following two modes. According the first mode N°1, the second feeding was applied before the end of the run of the percolation of the first one. While in the second mode N°2, the feeding was made at the end of the run of the percolation of the first one. These operating modes were used to test the influence of the loads and the power supply on the clogging, the treatment efficiency and the dryness.

The hygienic quality of the leachate, the dried sludge and the sludge stored for 30 days were also monitored. The results showed that the mode N°2 of supply, reduced beds clogging. According to the physicochemical parameters, the effluents were less concentrated. However, the concentrations exceed the limits of the Senegalese standard values for the wastewater discharge in the environment. The influence of the loads and the feeding mode on the treatment performances was significant for TS but slightly significant for nitrogen and COD contents. The reduction of coliforms was around 1 logU and the eggs and the larvae of helminths were reduced at about 100 % in the leachate. For the sludge dehydration, 2 to 9 days were necessary for a dryness of 80 % of SM with nominal loads from 13.7 to 122 kg/m^2.year. The results showed that the dryness was only influenced by the load. Dried sludge are very low concentrated with Faecal Coliforms around 10^4 UFC/100g with a reduction of 3 log U). For helminths eggs, no reduction was observed in the dried sludge and in the sludge stored for 30 days. It appears in this study that for further valorisation and use, the by-products of the sludge must be treated more.

KEY WORDS: Sludge, biotechnologies, drying, feeding, clogging, performance, dryness.

TOPIC 2

Requirements and practical experiences in water treatment and re-use in Africa

WASTEWATER TREATMENT PRACTICES IN AFRICA - EXPERIENCES FROM SEVEN COUNTRIES IN WATERBIOTECH PROJECT

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ABSTRACT

In this paper, existing wastewater treatment practices in 7 African countries, i.e. Algeria, Burkina Faso, Egypt, Ghana, Morocco, Senegal and Tunisia, are reported. Data were collected by questioning wastewater treatment plants managers as well as treated wastewater users in 2012. This study showed that 0.2 to 63 L/d/person of wastewater are treated in these countries, with the higher levels obtained for North Africa. Technically, treatment plants (mostly activated sludge and waste stabilization ponds) deal with high organic loads, uncontrolled input, power cuts and increasing wastewater flow rates. Poor operation and maintenance (O&M), in part caused by the lack of funds, high energy costs and lack of re-investments, is also a serious reported issue. Consequently, treatment plants often deliver insufficient effluent quality, which negatively affects the environment and acceptability of stakeholders towards the treated water. Other challenges, such as water availability, long-term impacts, financial and social constraints, affecting the reuse, are also discussed.

KEY WORDS: wastewater treatment practices, African countries, operation, maintenance, financial and social constraints.

ACKNOWLEDGMENT: The work was funded by WATERBIOTECH coordination and support action ("Biotechnology for Africa's sustainable water supply", Contract No.265972- KBBE; duration: 1.08.2011 – 31.01.2013) funded within the EU 7th Framework Programme.

THE CLARA SIMPLIFIED PLANNING TOOL – A TOOL TO FIND THE MOST COST-EFFECTIVE SOLUTION FOR WATER SUPPLY AND SANITATION SYSTEMS

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ABSTRACT

The CLARA project

Experiences from the EU FP6 research project ROSA (http://rosa.boku.ac.at/) showed that besides the required adaptation of technologies to local conditions especially soft factors are of importance for successful implementation of sanitation systems. These soft factors include:

- participation of all stakeholders from the beginning (as described in a number of sanitation planning approaches, e.g. the Household-Centred Environmental Sanitation approach),
- capacity building to raise awareness on sanitation issues,
- creating demand for products from sanitation systems for reuse (liquid and solid fertilizer),
- consideration of operation and maintenance from the beginning, and
- combining excreta and solid waste management schemes.

Additionally, we found that knowledge about planning in general and practical knowledge on strategic planning in particular is lacking in African communities. Therefore one main objective of the FP7 project CLARA (Capacity-Linked water supply and sanitation improvement for Africa's peri-urban and Rural Areas) is to develop a simplified planning tool for integrated water supply and sanitation systems for small communities and peri-urban areas that incorporates the key factors for successful implementation, i.e. operation and maintenance issues and reuse potential, from the beginning of the planning process, and that can be tailored to available local capacities. This simplified integrated CLARA planning tool shall then be tested and evaluated in different geographical African regions to incorporate different economic, cultural and social boundary conditions.

The CLARA project started in March 2011 with duration of 3 years. CLARA is coordinated by BOKU University, Austria, and has 15 partners. Besides BOKU there are 3 more European partners that have been all partners in ROSA and/or NETSSAF: TTZ Bremerhaven, Germany

(the coordinator of NETSSAF), EcoSan Club Austria, and BIOAZUL, Spain. The African partners cover 4 geographical regions: Eastern Africa (Ethiopia and Kenya), Southern Africa (South Africa), Western Africa (Burkina Faso) and Northern Africa (Morocco and Tunisia).

The CLARA simplified planning tool

In CLARA we do not aim to define a new overall planning approach, however, the CLARA simplified planning tool aims to provide the missing link for the technical part of the overall planning process by supporting local planners to find the best solution for water supply and sanitation in the planning objective. By using the tool it will be possible to compare the real costs of various alternatives of water supply and sanitation systems. Environmental, social and health aspects will not be considered explicitly since it is assumed that these aspects are already considered in the framework conditions, i.e. it is assumed that all systems fulfilling the legal requirements benefit environment and health and are socially appropriate. That means that the tool cannot be used to compare a solution that fulfils legal requirements with e.g. the solution "no sanitation facilities" as these 2 alternatives do not have the same impact. However, the tool can be used to compare e.g. water-borne and dry sanitation systems.

With this assumption the comparison of alternatives can justifiably be reduced to comparing the costs of the alternatives, i.e. for investment, operation and maintenance, and re-investments over a specific project period (e.g. 50 years). Net present values of all costs are calculated and used for comparison.

The user of the CLARA simplified planning tool - the planner - is responsible for developing appropriate alternative solutions. Technologies are grouped in functional groups as defined in the Sustainable Sanitation and Water Management (SSWM; *http://www.sswm.info*) toolbox. These functional groups include: Water sources, Water purification, Water distribution, Water use, Waste collection and transport, Waste treatment, and Reuse. Technologies in the functional groups have to be compiled to systems, i.e. for using any wastewater treatment technology the treatment sludge has to be included as well.

The draft version of the CLARA simplified planning tool has been presented to the partners during the last consortium meeting in Morocco in March 2013. The partners now have to assess the design assumptions for the technologies implemented in the tool if they are in line with the local legal requirements. After feedback from the partners country specific versions of the CLARA simplified planning tool will be prepared to be tested during the planning process that is carried out in the 5 pilot communities in Burkina Faso, Ethiopia, Kenya, Morocco and South Africa, respectively.

In the presentation we will introduce the CLARA simplified planning tool as well as the results from testing the tool in the CLARA pilot communities in Ethiopia and South Africa.

KEY WORDS: CLARA, sanitation, simplified planning tool, water supply.

ACKNOWLEDGEMENTS: The work is carried out within the project CLARA (Capacity-Linked water supply and sanitation improvement for Africa's peri-urban and Rural Areas; Contract # 265676; duration: 1.3.2011 – 28.2.2014, http://clara.boku.ac.at/), a Collaborative Project funded within the EU 7th Framework Programme, Theme "Environment (including Climate Change)". The CLARA team is grateful for the support.

WASTEWATER TREATMENT IN MOROCCO BETWEEN COMMITMENT AND CONSTRAINTS

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ABSTRACT

For over a decade, the Moroccan political on sewage has allowed to several Moroccan cities and centers to have their own wastewater treatment plants. There are currently more than a hundred different types of STEP varying from simple natural lagoon to complex systems such as activated sludge.
In addition to their spatial heterogeneity, these systems are faced to different organizational and functional problems affecting removal efficiencies and the basic objectives of the sewerage.
In this work, we try to list the different systems, the problems faced and the prospects for proper operation.

KEY WORDS: PNA-treatment plant-reuse –purification- operation.

LIFE CYCLE COST BASED PLANNING FOR WATER SUPPLY AND SANITATION TECHNOLOGIES, CASE STUDY OF BAHIR DAR, ETHIOPIA

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ABSTRACT

Providing sustainable and improved water supply and sanitation service for those who have not access is one of forefront issue stated by Millennium Development Goal. To facilitate the achievement of this goal, it is essential to overcome the traditional way of planning, development and service delivery of water supply and sanitation systems, which barely assure the system sustainability. This paper presents the approach of Life cycle cost (LCC) analysis for water supply and sanitation systems in the vicinity of Bahir Dar to shift planner's and decision maker's historically from narrow approach of least investment cost to a wider scope of approach based on system life cycle planning . LCC approach assists planners and decision makers to identify and understand economical factors for sustainability of water supply and sanitation, and it supports to compare and choose economically best water supply and sanitation alternatives based on life time expense. Identifying already constructed water supply and sanitation technologies at the study region and collecting their design documents were conducted in 2013 and then their bill of quantities (BOQ) for construction and financial information for operation and maintenance were reviewed to build-up costing database. The collected major design parameters for each technologies and corresponding cost data were regressed and sensitivity analysis were conducted in order to identify responsive input variables to develop technology's cost functions for the main life time cost components: initial investment cost, annual operation and maintenance cost, replacement costs and revenue if any. Net present value (NPV) estimation approach was chosen to merge recurrent and one time investment costs in to a single value to compare one alternative among others. Cost functions developed from the study will be used as financial decision support tool for regional planner and decision maker in addition to its importance to validate the performance of CLARA simplified planning tool for Ethiopian situation. The simplified tool has been developed to estimate aggregate LCC of integrated water supply and sanitation alternatives and to make economical comparison among various technological options.

KEY WORDS: Life cycle cost; water supply technology; sanitation technology; cost functions.

ACKNOWLEDGEMENTS: The authors wish to sincerely thank Austrian Development Cooperation (ADC) and the CLARA project for providing financial and technical supports.

IDENTIFICATION OF DESIGN FORMULAS FOR REED BED FILTERS OF A WASTEWATER TREATMENT PLANT IN SMALL COMMUNITY IN MOROCCO

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ABSTRACT

The study was conducted on a pilot treatment plant located in Draga community near of Agadir city in south of Morocco (30 ° 25 '01" N, 9 ° 36' 00" W). In order to improve the integrated management of water resources in Sous Massa basin, the U.S. Agency for International Development (USAID) in collaboration with the Moroccan government jointly funded a project called "P.R.E.M" (Sustainability of Water Resources in Morocco) to perform the pilot treatment plant and recycling of wastewater from the Drarga city whose main activity of the municipality Drarga is agriculture.

This study focuses on the removal efficiency of the physicochemical parameters of the pilot treatment plant in Drarga, which is designed specifically for tertiary wastewater treatment by reed bed filters for reuse in agriculture. The reeds have shown a very high level of pollution removal, such as physicochemical parameters, for a period of three years. Buy the way; we conducted a comparative analysis of five design reed beds filters methods in order to choose the appropriate and adapted method to Moroccan climate and socio-economic context.

KEY WORDS: Micro-organisms, physicochemical parameters, reed bed filters, rhizosphere, wastewater.

SAFE USE OF ECOLOGICAL SANITATION PRODUCTS IN AGRICULTURE - IMPLEMENTATION OF DEMONSTRATION GARDENS - EXAMPLE OF DAYET IFRAH

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ABSTRACT

Ecological sanitation is a new holistic paradigm in sanitation, which is based on an overall view of material flows as part of an ecologically and economically sustainable wastewater management system tailored to the needs of the users and to the respective local conditions. It does not favour a specific sanitation technology, but is rather a new philosophy in handling substances that have so far been seen simply as wastewater and water-carried waste for disposal. Ecological sanitation introduces the concept of sustainability and integrated, eco-system oriented water and natural

Plants need 17 nutrients called "essential elements". Each of these elements contributes in different functions that allow the plant to grow and reproduce. Nitrogen is the factor that limits the performance initially, but after the nitrogen is provided, potassium determines performance.

An adult can produce about 400 liters of urine per year, containing 4 kg of nitrogen, 0.4 kg phosphorus and 0.9 kg of potash. The total amount of feaces produced per person per year is 25 to 50 kg, containing up to 0.55 kg of nitrogen, phosphorus 0.18 kg and 0.37 kg of potash. The majority of nitrogen and potassium leaves the body with the urine. Phosphorus is more balanced between the urine and feces. Human waste should be recycled instead of being rejected, to showcase their contained of nutrients necessary for the growth and development of plants.

Under the Pilot project of ecological sanitation in the rural area of Dayet Ifrah. 4 UDDT facilities were constructed; the present study aims to assess the effect of the application of sanitation product (urines and feaces) on agricultural output. for this, a testing and demonstration garden was developed in the Dayet Ifrah village.

Before using ecological sanitation products in crop fertilization, it is required to analyze them to determine their nutrient content (NPK) and microbiological composition especially pathogens. The results of chemical analyzes showed that the urine samples contained 5.6 g / l of nitrogen, 0.36 g / l of phosphorus, 1.09 g / l of potassium, 2.52 g/l of sodium and 0.32 of calcium. The microbiological analysis of urine samples showed an absence of fecal coliforms and fecal streptococci. The results of analyzes of the faeces (stored for one year in dry conditions) show an absence of all indicators of fecal pathogens sought in three fecal samples (absence of fecal coliforms, fecal streptococci, Salmonella, helminthes eggs (Ascaris), Clostridium, Rotavirus, Escherichia coli). Microbiological analyzes, after a year of treatment of faeces dehydration, revealed no trace of viable pathogenic including helminthes eggs (Ascaris),

We promote a flexible multi-barrier approach, developed by WHO for managing the health risks associated with the use of excreta in agriculture. This multibarrier concept contains a series of measures/barriers along the entire sanitation system from ‘toilet to table’. Each of the barriers has a certain potential to reduce health risks associated with the excreta use and it is

recommended by WHO to put in place several of these barriers in order to reduce the health risk to an acceptable minimum.
The application of urine and faeces showed a significant improvement in agricultural yields of the tested crops.
A conducted a household survey in the village to assess the acceptability and sustainability of the practice reveals that 95% of the populations surveyed are willing to sell the urine (buying and selling) and agricultural products.
Our work shows that Ecosan can succeed in very poor populations. It is particularly relevant as locomotors of agricultural economics.

KEY WORDS: ecological sanitation, urine reuse, multibarrier concept, UDDT, Ecosan.

REMOVAL OF SULFUR COMPOUNDS ON MODIFIED ACTIVATED CARBON: APPLICATION TO A TREATMENT OF REFINERY WASTEWATER

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ABSTRACT

In order to protect environment and to recover caustic soda solution, adsorption on modified activated carbon technology was used to remove sulfide and organics from refinery sulfidic spent caustic wastes. The performance of the adsorption was investigated and the capacity of modified activated carbon (MAC) to adsorb refractory sulfur compounds of H2S from refinery sulfidic spent caustic was evaluated in terms of their textural and chemical characteristics.
Experiments were conducted to evaluate the activated carbon adsorption of sulfur compounds contained in the caustic waste after its use in the washing of the LPG. Was investigated adsorption kinetics of COD , S^{2-} and S, from petroleum refinery wastewater on activated carbon after adjustment of the parameters influencing the system, such as the adsorbent dosage , initial concentration, contact time and the surface chemistry of carbons using heat treatment, oxidation by H_2O_2 or by HNO_3. The adsorption equilibrium and kinetics data were determined for three treatments of AC (oxidation by H_2O_2 and HNO_3 and calcinations at 500 °C). The data were adjusted to several adsorption isotherms and kinetic models. Freundlich model gave the best fit isothermal equilibrium than Langmuir. While the kinetic data are best fitted by the second-order kinetic model. Several parameters have shown their influence on the adsorption and various characterization techniques phenomenon have been identified.

KEY WORDS: Adsorption, isotherm, Sulphur removal, treatment, wastewater.

PERFORMANCE STUDY OF NANOFILTRATION PROCESS IN THE REMOVAL OF HEAVY METALS

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ABSTRACT

The use of treated wastewater has become a necessity and an integral part of the current strategy to mobilize all available resources. Pollutant loads contained in wastewaters have various origins. The five main categories of polluters are industry, agriculture, households, transport and urbanization. Particularly industrial wastewater containing heavy metals must be treated before being discharged into the natural environment or in sewage treatment plants. The presence in the environment of these toxic metals is an increasing danger to human health and to the balance of ecosystems. The incorporation of membrane technology in the effluents treatment process loaded with metal ions has emerged. The membrane processes (microfiltration, ultrafiltration, nanofiltration and reverse osmosis) were then used for this purpose with various effectiveness and selectivity.

This study describes the rejection of heavy metal ions (Cu(II), Cd(II),Zn(II) and Mn(II)) using a commercial nanofiltration membrane DK. The effect of transmembrane pressure, pH and metal concentration on the metal rejections and permeate flux was explored. The results showed that for optimal pH (pH = 1) and in the case of single heavy metal, the maximum rejection was obtained for □P = 5 bar for all studied heavy metals. The rejections of Cu, Cd, Zn and Mn were 86, 79, 94 and 94%, respectively when the concentration of each heavy metal was fixed to 500 ppm and were 92, 92, 94, and 96% respectively when the concentration was increased to 900 ppm.

The treatment of different mixtures containing Cu(II), Cd(II), Zn(II) and Mn(II) metals by nanofiltration using DK membranes was also studied at optimal conditions of pH and transmembrane pressure. The experimental results show that similar values of retention rates and permeate fluxes were obtained in the case of mixtures than those previously observed in the case of single heavy metal.

KEY WORDS: Nanofiltration, heavy metals, rejection, membrane, permeate flux.

ELABORATION OF AN ASYMMETRIC CARBON MICROFILTRATION AND ULTRAFILTRATION MEMBRANES: APPLICATION TO THE TREATMENT OF TEXTILE INDUSTRY WASTEWATER

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ABSTRACT

With the development of global economy, the lack of water resource is becoming an increasingly crucial problem. Membrane separation technology, such as ultrafiltration (UF) or microfiltration (MF) now has been becoming an important way in the treatment and the recycling of wastewater.
Many efforts to achieve economical and efficient membranes for various uses have resulted in a selection of new materials, an improvement in membrane preparation techniques and an increase in the number of applications. At present, the interest is derived toward inorganic membranes due to their superior permeability–selectivity combination and suitable performance for high temperature or corrosive environment compared to polymeric membranes.
Different studies on carbon membranes have shown that they can successfully compete with polymeric membranes and other porous inorganic membranes,
This works describe the preparation of an asymmetric carbon ceramic microfiltration and ultrafiltration membranes using mineral coal powder and phenolic resin. These membranes possess high chemical and mechanical resistances and are designed for the treatment of wastewaters and the purification of highly corrosive industrial chemical solutions.
A Tunisian mineral Coal was used as the main carbon material source for preparing carbon membrane. It is a kind of anthracite with high carbon content, low ash content and moderate volatile component. According to the previous study where it was found that the average pore size of carbon membrane decreases with decreasing of coal particle size, the average particle size of 100µm and 1.76µm were selected for the preparation of the support and microfiltration layer respectively. These powders were prepared from crushing-sieving of a raw mineral coal rocks which then was ground in a planetary crusher at 300 rpm during 30 min and15 hours to obtain respectively the two different powders having average particle size respectively equal to 100µm and 1.76µm.
The second source of carbon used in this work is a phenolic resin marketed by the company Irons Resins S.A, Spain (Sumitomo Bakelite co). It is sold in powder form soluble in the ethanol containing 7 % of hexamine as curing agent. Previous studies showed that the carbon content in the resin represents 25% (reached at 700°C under nitrogen atmosphere) of its total molecular weight. Besides its role of carbon precursor, resin acts also as binder and porosity agent. Others organic additives as ethylene glycol, amijel and methyl-cellulose are used respectively as lubricants and plasticizers or to enhance the total porosity of the final material, as Starch, since it sublimate during carbonization.

The coal powder with average particle size of 100µm was dry mixed with the different organic additives and then an alcoholic solution of phenolic resin was added to obtain a plastic paste.
The paste was extruded into a tube (OD/ID = 10mm/8mm) under pressure of 30 to 40 bars. After curing at 150°C at ambient atmosphere, the tubular green bodies were carbonized under nitrogen atmosphere up to 700 ◦C at a rate of 2°C/min and held for 1 h.
The obtained carbon support had a pore volume of 38% and a mean pore diameter of 9µm.
The intermediate microfiltration layer was deposited by slip casting process on the inner face of the obtained support. The elaborated suspension was made of carbon powder (1.76µm average particle size) suspended in alcoholic solution of phenolic resin (Resin/Ethanol = 15/85 wt %). The suspension is subject to ultrasound exposure at a power of 180 W for maximum 10 minutes to avoid the risk of resin cross linking since and then casted for 6min. After carbonized under nitrogen stream (1ml/min), the intermediate microfiltration layer presents a pore diameter of 0.6µm and a thickness around 22µm.
The ultrafiltration layer was prepared also by slip casting process. Viscous carbon slip prepared with different concentrations of an alcoholic solution of phenolic resin mixed with commercial carbon powder which have an average particle size of 44nm. The slip was deflocculated by magnetic stirring followed by ultrasound exposure then it was casted onto the inner surface of the intermediate layer using different casting times. The obtained samples were directly cured at 150°C for 4hours under oxygen atmosphere and then carbonized under inert atmosphere following the same temperature program used to prepare the microfiltration layer. This protocol provides an optimized layer of a high degree of homogeneity with an average pore diameter of 2.4nm and a thickness of 8.34µm.
The application of membranes separation processes on textile wastewater treatment shows an interesting retention of polluting substances expressed in term of COD and salinity respectively of 50% and 30% with microfiltration membrane and 70 and 45% for ultrafiltration membrane. A great retention of turbidity and color were achieved in the two cases.

KEY WORDS: Carbon membrane, Microfiltration, Ultrafiltration, phenolic resin, carbonization, textile effluent.

ASSESSMENT OF PHYSICO-CHEMICAL AND MICROBIOLOGICAL QUALITY OF DRINKING WATER FROM DISINFECTED WATER SOURCES POINTS TO HOUSE HOLD WATER CONTAINERS IN SELECTED COMMUNITIES OF AKAKI-KALITI SUB CITY, ADDIS ABABA CITY ADMINISTRATION

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ABSTRACT

Though ground water is much better than surface water in terms of biological quality, lack of source protection and inefficient treatment, waste management and sewerage system problem, poorly designed pit latrines and poor hygienic practice at the households affect the quality of the water. Therefore, assessment of physico-chemical and microbiological quality of drinking water from disinfected water sources points to house hold water containers in selected communities of Akaki-kaliti sub city, Addis Ababa City Administration were conducted.
Methods: This study was conducted from September 2006 to January 2007. A survey of 72 triplicate water sample and sanitary surveys were conducted in 3 chlorinated, 35 pipe water and 35 randomly selected households' storage water containers. The water samples presumptive test of TTC and FS were examined using membrane filtration method.
Result: Temperature at all three disinfection points were above permissible limit of 15 oC. Turbidity at CTR and FSC were meet the acceptable level of WHO and National standard limit of potability < 5 FAU and above the recommended limit at the TDR.. The pH values at all the three points were within the recommended limit (6.5 -8.5). The free chlorine residual were 0.67, 0.6, 0.68 mg/l at CTR, TDR and FSC respectively which are lass than to average value of the recommended limit of WHO (>0.8mg/l). All sample sources were contaminated with TTC and FS having cfu >1 per 100ml and this was found out to be above WHO and National standards (cfu/100ml=0).
Only 1(2.9%) of pipe water samples were <15 oC whereas others above the limit of 15 oC. The average temperature of pipe water was in the range of 14.5-22.5 oC which was warmer as compared to the standard temperature (15oc). This favors the regrowth of some indicator organisms like TTC in distribution systems. Out of the examined sampling sites 34.3% of them were below the range of acceptable chlorine residual limit (0.2-0.5 mg/l) and 17.1% were above the recommended level (0.5 mg/l). In all pipe water samples, pH values were within the recommended limit. In the pipeline, only 17.1% and 31.4% of sampling sites were found acceptable based on WHO and National standard for TTC and FS counts, respectively. The overall risk-to-health classification at pipe water (N=35) were 19(54.29%) in intermediate and 16(45.7%) in low classification range for FS whereas for TTC, 19 (54.29%), 8(22.88%) and 8(22.88%) were in intermediate, high and low risk to health matrix score, respectively.
For water samples at the household, only 14.3% was within recommended free chlorine residual level. 8.6% and 17.1% of sample sites (N=35) were above the recommended limit of temperature (<15oC), and turbidity (<5FAU), respectively and only 1 (2.9%) was acceptable for both TTC and FS cfu levels. The health matrix classifications for bacteriological indicators (TTC and FS) were found to be 65.7% and 20% with in the high risk and medium risk score, respectively.

Conclusion and recommendation: Uncontrolled physico-chemicals parameters such as temperature, turbidity, pH and inefficient chemical chlorine dosing, which led to low chlorine residual at distribution and household water containers were the major factors that contributed the occurrence of high bacterial numbers. Moreover, the water pipe lines and sewerage lines arrangement was also another factor that contributes for bacterial growth in the distribution system, there by compromising the quality of water at the point of use. Bacteriological load was greater at the household samples due to poor hygienic practice. Therefore, the management of water sources, appropriate treatment of the raw water sources, at home, control of physico–chemical parameters at disinfection points, and promoting good hygienic practices are important to make the water quality acceptable in the study area. Moreover, installation and utilization of highly efficient technology is recommendable for production of high potable water

KEY WORDS: disinfection points, pipe water, households drinking water, physico-chemical parameters, thermotolerant coliforms, Faecal streptococci, source protection and sanitary survey.

BRACKISH WATER DESALINATION USING AN EFFICIENT MULTI-STAGE STILL

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ABSTRACT

There is a vital need for fresh drinking water in many arid and isolated regions in Algeria. Moreover, many people in rural areas have not access to fresh water. Several processes can be used to have clean potable water of high quality among them the distillation technique. Distillation system is a process that relies on evaporation to purify water. It can effectively remove salts and many contaminants from water, including bacteria, inorganic and many organic compounds. For various reasons, purification of water supplies is extremely important, specifically desalination of brackish waters using multi-stages distillation to produce fresh, potable water.

The present work proposes a new multi-stage distillation system that was designed in UDES center with the objective of increasing its productivity and improving its efficiency. Different effects engineering and design parameters can be affected the performance of the multi-stage system such as water depth in the evaporator, energy, temperature difference between the water in the boiler and bottom side of the tray, material of the tray and its inclination angle. In this investigation, we have studied the effects of cooling water temperature and water boiler temperature on each tray yield in order to optimize their influence on the yield of the multi-stage distillation process for the first four trays. The preliminary results showed a significant improvement of the overall productivity. Indeed, the total productivity of the multiple stages still is strongly affected by the increase of the cooling water flow rate on top of the tray. The results that permit the determination of each tray yield for a given evaporator temperature are also presented in this work. Distillate output was measured for each stage during carrying out tests. The experimental results of tests show that the first tray of the system produces about 33 liters of fresh water per day and the temperature of the evaporator efficiency is fixed at 96°C. It was found that the average daily distillate output of multi-stages still is more significant than a conventional still. Therefore, it can be concluded that the cooling water temperature on top surfaces of the trays and the integration of the splits between the trays which favor vapor transfer to the upper trays increase production and improve many more the system yield. The analysis control of the distilled water showed that its quality was within the international standards (World Health Organization guidelines).

The aim is to develop a multi-stage solar still simple, economic, reliable and robust to produce fresh water for domestic and socio-economic uses from brackish water that are abundant in many remote areas and the Sahara Algerian. Although, we notice that a distillation system is most effective in removing inorganic compounds such as metals, nitrate and particulates from a contaminated water supply.

KEY WORDS: Distillation, Desalination, Multi-Stage still, Solar, Energy.

APPLICATION OF BIOSORPTION TO TANNERY WASTE WATER FOR CHROMIUM REMOVAL

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ABSTRACT

The manufactures of leather has been an important activity since antiquity; it is a transformation process animal hides into leather involving various chemical and mechanical operations to clean the skin of meat, fat and hair. However this tanning process poses a threat to the environment because they carry variety of organic and inorganic chemicals.
In Marrakech city, traditional and industrial tanneries have a great environmental hazard, because they discharged these wastewater into the environment without previous treatment.Their harmful effects derive largely from their content chromium highly toxic and capable of disrupting the biodegradation of effluents when it's discharged into biological treatment plant, The chromium concentration are around (≈40 tons/year) **(**Tiglyene et al, 2005).
In this regard, the main objective of this work is to study the effectiveness of the removal of chromium from these releases by applying a treatment processes economically cheaper and operational, notably bioadsorption.
To evaluate the bioadsorption test, various bioadsorbents are tested mainly Eggshell, sawdust, cactus, avocado peel…etc. In this step, only bioadsorbent which gives a best removal capacity of chromium from this effluent will be chosen. After that, we will study the effect of various operating parameters and optimal experimental conditions will be determined (the initial pH, the initial concentration of chromium, the dose of bioadsorbent and time contact) using the biosorbent the most effective in terms of chromium removal from aqueous solutions, in the sense, to understanding more the mechanism of the biosorption treatment.
The first results demonstrate that the Eggshell has had a high capacity of removing chromium with a 71% of reduction, comparatively to the other biosorbents tested. In the other hand, results of the experiments launched with the aqueous solutions demonstrated that the eggshell tested has an optimal capacity of removing chromium with a pH of around 5, a bio-adsorbent dose of 0.2 g in 50 ml, an initial concentration of 600 mg / l and a contact time of 4 hours.

KEYWORDS: tannery wastewater; chromium; natural biosorbents; aqueous solutions.

TOPIC 3

Operation and maintenance related to biotechnologies for water treatment and re-use

PRACTICAL EXPERIENCE IN OPERATION, MAINTENANCE AND COST EVALUATION OF MBR SYSTEM FOR INDUSTRIAL WASTEWATER TREATMENT

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ABSTRACT

Industrial wastewater is one of the most polluting sources to water bodies in larger cities around the world. To date, several interesting solutions for treatment, for example ultrafiltration and reverse osmosis, anaerobic digestion in UASB reactors and aerobic treatment with rotating biological contactors have been proposed. Most promising, however, appears to be the use of vertical reactors characterized by good oxygen transfer and a high biological conversion capacity. The current demand is that efficient and cost effective systems be developed, as environmental issues became a critical factor for the industrial competitiveness.

Literature revels that membrane bioreactors (MBR) – combinations of common bioreactors and membrane separation units for biomass retention – offer new possibilities for bioprocesses and wastewater treatment according to the particular goal and demands of the process. The membrane is a physical barrier that allows certain compounds to pass through, depending on their physical and/or chemical properties. Bioreactors differ from conventional reactors as living organisms present in the reactors operate under milder conditions of temperature and pressure. MBRs combine the benefits of high biomass concentrations to increase removal rates or volumetric productivity with the possibility to run a continuous process at controlled biomass retention e.g., by individual control of hydraulic and biomass residence times, production or degradation kinetics. Membrane filtration can be a very efficient and economical way of separating components that are suspended or dissolved in a liquid.

A large scale industry (beverages) was selected in order to run practical experiments through MBR technology. The wastewater produced is around 146m^3 per year or 405,55 L per day considering that every season lasts 12 months (this amount could be higher of lower depending on the year). The average COD content of the wastewater could be set in 6,5gCOD/L. Thus the average COD production per day (on a year basis, 12 months and 30days per month) will be 2.632,5 gCOD/d. The pilot scale MBR system of 2280 L provided with an immersed membrane ultrafiltration was built and installed in the winery. The plant has been designed for minimizing maintenance and clean installations extend the work life of the system. A proper operating and maintenance procedure was developed which clearly explain how to start, run and maintain the system.

The Organic Load Rate (OLR) was varied between 0.1 gCOD/L.d – 0.8gCOD/L.d with a COD concentration in the influent of 18 g/L, but the system had to stop due to low temperature i.e -14°C, the average permeate flow given by the system is 0,6 L/min or 777,6 L/d, taking in to account that the suction pump has a relaxation time of 1 minute every 10 minutes. This volume flow is also higher than the average wastewater production per day. The F/M ratio was around 0,15. Nevertheless, it must be remarked that these calculations have been made considering one year to treat the total volume of wastewater produced during one

production season (September – January). The COD removal efficiency was between 95% to 99% independently of the OLR applied with values in the permeate COD lower than 100mg/L, during the whole experiment except when there was some disturbance in the system. The Suspended Solids concentration kept stable between 4-5g/l. The effects of some physico-chemical parameters, including pH, aeration rate and temperature, on treatment performances were also investigated.
The resulting permeate could be disposed via the sewage system but without paying additional fees, it could be reused for irrigation purposes, reused for cleaning operations (e.g. for floors) or it could be directly discharged into natural water bodies. Due to the ultrafiltration membrane, treatment the water is bacteria-free, but drinking water quality was not reachable.
The cost evaluation results showed that if we let the system run at least 40% of its total capacity for 6 months /year, the system can treat around 750 m^3 wastewater per year and In 10 years 50.200 € can be saved from avoiding disposal fees. The results of this pilot plant running and operation can be adapted and used to implement MBR treatment technologies, effectively as well for other less complex kinds of effluents, such as municipal wastewater .

KEY WORDS*:* MBR, industrial wastewater treatment, operation, maintenance, cost evaluation, irrigation, reuse.

COST CONSIDERATIONS FOR THE IMPLEMENTATION OF INNOVATIVE BIOTECHNOLOGIES FOR WASTEWATER TREATMENT IN AFRICA

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ABSTRACT

Functional water supply and wastewater treatment lead to fundamental health and environmental benefits for the society but cause significant costs for installation, operation and maintenance as well as for renewal. During the investigation of existing water treatment practices in countries of Northern and Sub-Saharan Africa within the WATERBIOTECH project, cost information on several wastewater treatment plants has been collected. The aim of this paper is to give an overview on the cost analyses results and their relevance for future improvements.

As the data showed, cost documentation and cost control is weak in most cases leading to the fact that only rough estimations could be made. However, the results showed that the specific costs for the technologies vary strongly within and between the different countries. The data also showed that operation and maintenance costs including all necessary cost components are lacking in many cases. Currently, many malfunctions of treatment systems are at least partly related to problems with cost coverage. The main cost related problems identified are:

- Donors emphasize on the investment stage and often provide insufficient support for long term coverage of operation.
- Dependence on expensive imported equipment for technical systems leads to high operation costs.
- Dependence on expensive imported spare parts leads to non-replacement of broken equipment and machinery.
- Costs for power supply cannot be covered by O&M budget.
- Low wages for O&M personnel lead to low motivation.
- Local communities cannot cover O&M and re-investments.
- Benefits cannot be utilized efficiently to reduce costs.
- Training of personnel is not covered by O&M budget.

Also for future improvements, cost arguments will remain decisive for project development. In order to allow cost efficiency, variant analyses can be based on sole cost comparison presumed that all variants comply with health related legislation and environmental ordinances. In this case, those ordinances define technical and non- technical requirements and are therefore crucial for implementation costs. If variant analyses have to cover more than the sole cost factors, multi criteria decision support is needed which complicates the process and might reduce the transparency of decisions. In any case, incorrect cost analyses can make projects fail – even already at the planning stage. The paper gives simple examples to show

the importance of parameter setting (life span, discount rate) for net present value calculations that should be considered already at the conceptual stage. As WATERBIOTECH aims on fostering innovative biotechnological treatment processes, the cost component is an important part of the projects dissemination and training activities to achieve this goal.

KEY WORDS: water supply, sanitation, cost comparison, CBA, net present value, biotechnologies.

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PILOT PROJECT OF ECOLOGICAL SANITATION AND RAINWATER HARVESTING IN THE CENTRAL SCHOOL OF DAYET IFRAH VILLAGE

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ABSTRACT

The Lack of infrastructure for drinking water and / or sanitation in 70% of satellite primary schools in Moroccan rural area, has a large deficit in infrastructure which is reflected by the negative impact on schooling girls (low enrollment nearly 22% against 52% for boys), the impact on the health of students and teachers (infectious diseases due to lack of good hygiene practices) and the impact due of environment pollution in and around schools.

The main objective of an ecological sanitation system is to protect and promote human health by providing a clean environment and breaking the cycle of disease. In order to be sustainable, a sanitation system has to be not only economically viable, socially acceptable, and technically and institutionally appropriate, it should also protect the environment and the natural resources.

The objective of the Pilot project of ecological sanitation and rainwater harvesting in the central school of Dayet Ifrah village, is: ensured Low cost treatment of wastewater in order to promote the reuse of treated wastewater and the capture and use of rainwater. The landscaping of the entire facility has created a space dedicated to sustainable development education and awareness of rural communities for the protection of water resources.

Ecosan systems studied are implemented in a small rural area in Morocco called "Dayet Ifrah" near the town of Ifrane. Dayet Ifrah is a high mountain wetland classified as "Site of Biological and Ecological Interest

To convince the local population to adopt and accept the concept, several awareness sessions were conducted during the development of the diagnostic study, where the JMAA (village council) has been closely involved.

To ensure the replicability of the project, the realization of facilities was made during a workshop for the construction of ecological sanitation facilities Dayet Ifrah, 14-25 June 2010, in favor of the population and local labour force, representatives administrations concerned with sanitation

The sewage treatment system is via a constructed wetland planted with reed (*Arundo donax*) with a horizontal subsurface flow for the treatment of black waters of the central school and the mosque of village. In a climate zone characterized by a cold and rainy winter and marked by frost and snow. A biogas digester with hemispherical dome is used for the pretreatment of sewage to liquefy solids (faeces, paper, and waste) and to pre-digest the organic matter. An

underground irrigation system allows the drainage and valorization of treated wastewater by biomass production.

The rainwater harvesting is done by a catchment area consists of a catchment area formed by the roof of one of the classrooms and the roof of the tank, galvanized gutters and masonry stone tank. The rain water collected is used both for irrigation of green spaces and the flush toilets

The landscaping of facilities at the school for educational purposes, has allowed isolating the technical area without hidden it. The organic shapes of the various components of the schoolyard define a sieving system, which let perceive without allowing access.
Our work has demonstrated that the development of a concept of integrated management and utilization of unconventional water in rural areas is possible.
The users are satisfied with the ecosan approach to treat their wastewater. Our work shows that ecosan can succeed in very poor populations. It's particularly relevant as locomotors of Sustainable development.

KEY WORDS: ecological sanitation, Sustainable development, constructed wetland, rainwater harvesting, treated wastewater reuse.

ONCOLOGIC WARD WASTEWATER TREATMENT BY MEMBRANE BIOREACTOR: BIOMASS ACCLIMATION AND PHARMACEUTICAL REMOVAL

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ABSTRACT

Introduction
Hospitals are considered as an important source of pharmaceutically active compounds release into the environment and as a specific source for some compounds such as antineoplastic drugs. Hospital wastewater (HWW) is currently co-treated with urban wastewater resulting in a dilution of different discharges and does not provide a segregation/separation of pollutants. Only few studies have investigated anticancer drugs probably due to their low environmental concentration (below ng.L-1). However, antineoplastic pharmaceuticals are different from the other pharmaceutical classes as they are designed to damage cells and not to regulate them. Anticancer drugs have a potential impact on the environment because of their cytotoxicity, genotoxicity, mutagenicity and teratogenicity properties.

First biomass acclimation
This study presents two biomass acclimation periods of a membrane bioreactor (MBR) pilot treating a part of the wastewater of the oncological ward of a hospital. The MBR pilot was operated in the external configuration (eMBR) for the first biomass acclimation. The biomass growth is very slow, from 2.5 g.L-1 at day 40 to 4.6 g.L-1 at day 160, indicating that the acclimation to hospital wastewater (HWW) is difficult but remains possible (Figure 1). This slow biomass growth on a long-term period could indicate an inhibitory effect of the HWW to the activated sludge. A dilution of half of the pharmaceutical load from day 100 by synthetic wastewater did not result in a faster biomass growth.
Degradation kinetics of easily biodegradable substrate in presence of antineoplastic and antibiotic pharmaceuticals showed a total inhibition of non-acclimated activated sludge coming from a municipal wastewater treatment plant. On the contrary, activated sludge from the MBR source treatment was only partially affected by the presence of pharmaceuticals and was able to normally degrade low substrate loads. Therefore, activated sludge of the MBR source treatment is in a semi-acclimated state after 160 days of operation.
The most used antineoplastic drug 5-fluorouracil was almost systematically detected in the HWW from 49.6 to 1287 µg.L-1. 5-fluorouracil removal efficiency by the MBR source treatment was always higher than 86.8 %. 5-fluouracil was also efficiently removed by non-acclimated activated sludge coming from a municipal wastewater treatment plant. However, the specific removal velocity of 5-fluorouracil was increased by 18 % by the MBR source treatment indicating that source treatment is beneficial to remove pharmaceutical residues.

Second biomass acclimation
The second acclimation campaign is currently in the process since 90 days (Figure 2). The MBR pilot configuration was switched to submerged membrane in an external module

(sMBRe) since this MBR configuration is known to be operated at gentler hydrodynamic conditions than MBRe configuration.
No significant biomass drop-off was observed after the inoculation in this MBR configuration. However, no biomass growth on the long term period has yet been observed but biomass concentration seems to stabilise around 4.5g.L-1. The F/M ratio is currently increased from 0.1 to 0.2 kgCOD.kgMLVS-1.d-1 by regular increments in order to obtain biomass growth.

Conclusion

Both campaigns show the difficulty of activated sludge acclimation to oncological ward wastewater. However, the slight biomass growth obtained during the first campaign proves that the acclimation to this HWW is possible. In addition, the semi-acclimated biomass of the MBR pilot was more efficient than the non-acclimated biomass to degrade COD in presence of pharmaceuticals and to remove the antineoplastic 5-fluorouracil. This proves the benefit of the source treatment to the efficiency of pharmaceutical removal.
5-fluorouracil was almost systematically detected in HWW at very high concentrations, sometimes above 1 mg.L-1. 5-fluorouracil is the 2nd most used antineoplastic in the oncological ward. Its concentration range in HWW indicates that other pharmaceutical widely used in the oncological ward (ifosfamide, cyclophosphamide, ticarcillin, amoxicillin) might be present in HWW at very high concentrations as well. The very high pharmaceutical concentrations in HWW could be the explanation of the difficulty to achieve a significant biomass growth in the MBR pilot.

KEY WORDS: pharmaceutical, membrane bioreactor, hospital wastewater.

EQUILIBRIUM AND KINETICS STUDY OF REACTIVE DYE REMOVAL FROM AQUEOUS SOLUTION BY ADSORPTION ON POWDER ALFA FIBRE

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ABSTRACT

Synthetic dyes are extensively used in the textile industry. Due to inefficiencies of the industrial dyeing process, some of the used dyes are lost in the effluents of textile units, rendering them highly coloured. Current studies show that adsorption is one of the most promising techniques for quick lowering of the concentration of dissolved dyes from aqueous solutions.
The aim of this study was to determine the equilibrium and kinetics adsorption separately of reactive red 45 dye and reactive blue 19 dye from aqueous solution with powder Alfa fibre as an adsorbent obtained from leaf of Stippa Tenacissima L crushed and screened with a particle size < 2mm. The initial concentrations of dye were selected at 50 mg/L. The target adsorbent was prepared in laboratory conditions and washed with a solution of NaOH 1 mol/L by soxhlet for 4 hours.
All the adsorption experiments were carried out by batch technique. The kinetic adsorption studies were performed at different doses of adsorbent, pH, temperature and dye concentrations. The experimental data were analyzed with Langmuir, Freundlich and Temkin isotherm models.

KEY WORDS: Watershed Oum Erbia, crude surface water, water quality monitoring.

IMPROVEMENT OF ANAEROBIC REACTION IN A NEW SEQUENTIAL REACTOR

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ABSTRACT

If the method of the aerobic treatment is widely used in wastewater treatment, it remains that the anaerobic process has been a resurgence of interest for several reasons, including a very low consumption energy, low sludge production and mainly the formation of a biogas (CH_4, H_2S, CO_2, etc.).
Anaerobic digestion is a process by using a complex microbial community, compound of four syntrophic populations, resulting in four successive metabolic processes (hydrolysis, acidogenesis, acetogenesis and Methanogenesis). However, it is confronted by a number of constraints that may reduce its kinetics: production of hydrogen-producing bacteria forced hydrogen generating hydrogen, the accumulation of which leads to the cessation of acetogenesis by bacteria OHPA (Obligate Hydrogen Producing Acetogens). Furthermore, the formation of hydrogen sulfide is a constraining factor for bacteria generally and for methanogens especially.

This work was part of a national doctoral thesis which aims to study the anaerobic biological treatment using synthetic solutions containing glycerol in a batch reactor in low temperatures. The solution is subjected to a special sequential reactor, using sequenced recirculation whose frequency is fixed by means of a computer-controlled pump. The recirculation retrieves the biogas regularly by stripping. The recirculation allows extract regularly the gaz generated by fermentation by stripping.

The first trials were carried out on synthetic solutions without sulfate to evaluate the kinetics of biological degradation in the absence of the toxic effect of H_2S. Despite low temperatures (average of 16.5 ° C) less than that required for mesophilic fermentation (35 ° C), the initial results were conclusive. The removing efficiency of the organic matter (initial COD concentration 900 mg / L) was 45%, 46% and 32% respectively for recirculation rate of 100%, 50% and 25%, after 20 hours.

These results show that the effect of recirculation under anaerobic conditions has an important role in the reduction of COD, probably due to the removal of gas from the fermentation by stripping, especially hydrogen. The recirculation rate significantly influences the removal

efficiency remains, however, comparable to the rate of 100% and 50%. Also, it is wise to work with 50% for energy saving considerations.
To highlight the impact of sulfate-reducing reaction on the kinetics of anaerobic biodegradation, a second series of tests in the presence of increasing doses of sulfate is in progress.

KEY WORDS: anaerobic reaction, sequential reactor, bacteria OHPA, toxic effect of H_2S, recirculation.

TOPIC 4

Energy efficiency in wastewater treatment

MODELLING ENERGY CONSUMPTION IN MEMBRANE BIOREACTORS FOR WASTE WATER TREATMENT IN NORTH AFRICA

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ABSTRACT

Two pilot-scale membrane bioreactor systems were operated alongside a full sized activated sludge plant treating domestic waste water in Tunisia, in order to compare specific energy demand and treated water quality. Energy consumption rates were measured for the complete membrane bioreactor systems and for their different components, *e.g.* pumps, blowers, *etc*. Specific energy demand was measured for the membrane bioreactor systems and compared with the full sized activated sludge plant, which operated around 3kWh.m^{-3}. A model was developed for each of the membrane bioreactors based on both dynamic and steady-state mass balances combined with microbial kinetics and stoichiometry, and the energy balance. Energy consumption was evaluated as a function of various operating parameters such as the mixed-liquor suspended solids concentration, net membrane permeate fluxes, and the resultant treated water quality. The model demonstrated that modifying one of the membrane bioreactors would provide treated water suitable for unrestricted irrigation, with energy consumption lower than the activated sludge plant. This work demonstrates the potential for using MBRs in decentralised domestic water treatment in the North African region, at energy consumption levels similar or lower than a conventional activated sludge system, with the added benefit of producing treated water suitable for unrestricted human crop irrigation.

KEY WORDS: Membrane bioreactor, Energy consumption, Specific energy demand, decentralised domestic waste water treatment.

USE OF SLUDGE FROM WASTEWATER TREATMENT PLANT AS ALTERNATIVE ENERGY

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ABSTRACT

The rising worldwide demand for energy is one of the contributing factors to the increasing greenhouse gas emissions. In the next century, it will become even more limiting due to intensification of economic activities, increased population, urbanization, and climate change. Furthermore, climate change should also be seen in the context of sustainable development in both developing and developed countries**.** Unfortunately, the exact amount of greenhouse gas emissions in the world is not known. However, it is estimated that global carbon-dioxide (CO2) emissions from fossil-fuel combustion reached a record high of 31.6giga tonnes (Gt) in 2011, according to preliminary estimates from the International Energy Agency (IEA). The generation of huge amounts of waste and environmental conditions which result is considered as a challenge to sustainable development. It is possible to recover and use waste gases from waste to produce electricity supply industries fuel and heating buildings. Recovery and use of these gases have great advantages for greenhouse gas emissions. Among the waste, the handling of sewage sludge is one of the most significant challenges in wastewater management. Like developing countries, most of wastewater is discharged into the environment without treatment. In Algeria 138 Sewage treatment plants are operating at the national level, estimated 800 million cubic meters of water produced annually according to the Ministry of Water Resources, thus production of sewage sludge in Algeria will continuously increase. The disposal of huge quantities of sewage sludge is a major environmental problem. This represents a considerable potential resource that is generally underutilized. Indeed, decades of landfill gas toxic to the environment evaporate into the atmosphere. The methane released is toxic and causes 25 times more greenhouse gases than carbon dioxide. In Mediterranean and developing countries the biogas technology (anaerobic digestion) is little known and those who know the technology often do not have the technical and financial capacity to raise and manage a biogas project.
To remove pollutants resulting from industrial processes, wastewater treatment before it is discharged to environment is extremely important. Hence the necessity to consider
as National wastewater program research. Treatment of wastewater from municipal treatment plants is removing the majority of the organic matter, and a part of the organic matter is in the form as sludge. In general, Sludge is considered as an expensive and problematic byproduct of the wastewater treatment process. However, recovery of sludge for energy rapidly takes place as clean-up process applied to the treatment of effluents including wastewater treatment plants. Several channels exist for the disposal of sewage sludge but some of them are only limited by their cost effectiveness: whether the choice is to burn it, dump it or bury it, the process is costly, time intensive and laden with contingent liabilities both immediate and future. Energy recovery (biogas as a source of heat and electricity) and biological recovery are green technology to transform the sludge into high-value products while minimizing the risk of pollution.

The present study tries to develop the sewage sludge to biogas by digestion process. The sewage sludge is used to produce biogas by degradation of organic matter in waste treatment plants. This biogas is generally produced by anaerobic digestion. Biogas contains 65% methane and 35% carbon dioxide and minor amounts of hydrosulphurous. If this technique does not ensure the complete removal of sludge, it nevertheless contributes significantly to reduce the volume, and it consider as a source of renewable energy which can be converted into any form of useful energy as heat, electricity .... The biogas production is considered as an economic solution, and environmentally friendly for the sustainable development. Biogas is formed when microorganisms, especially bacteria, degrade organic material in the absence of oxygen. It permits to produce a combustible gas called biogas, which is essentially methane composed, and can reduce half of organic matter. The aim of this study was to assess the effectiveness of sludge as a source of energy in Algerian context and the current state of the existing sewage treatment plants through the national territory.

KEY WORDS: wastewater /energy/ climate change /biogas/digestion.

MEMBRANE FILTRATION PROCESS ADAPTED FOR WATER TREATMENT OF AERATED SEWAGE LAGOONS

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ABSTRACT

The aim of this project is to apply the Membrane technology in a aerated sewage lagoon in submerged conditions. This new wastewater filtration treatment will benefit rural areas subject to chronic water shortages by reusing this water for irrigation of green areas. For this purpose, the membranes developed in this project without support are immersed in aeration well and work in suction mode. The development of the membrane without support is approached by CFD (Computational Fluid Dynamics) in order to provide the best compromise between pressure drop / flow velocity, permeate flux and dimensions.

KEY WORDS: Membrane, aerated lagoon, numerical simulation, new membrane module, spacer.

DEGRADATION OF PHARMACEUTICAL POLLUTANT IN WATER BY TIO2 ASSISTED PHOTOCATALYTIC PROCESS

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ABSTRACT

The consumption of pharmaceutical derivatives is in constant increase. We count about 4 000 active molecules used to relieve various affections. A big part of these active compounds is excreted and meet in the worn-out waters. Unfortunately, most are not biodegradable and are not eliminated completely by waters purification systems using biologic way. Other processes of purification as the ozonolysis or the chlorination drive to the formation of deterioration products whose toxicity is identified well or little known but that meets also in the waters of rivers[4]. The photocatalysis is a technique that already gave its proofs on the deterioration of organic molecules in water.

Antibiotics are the most successful family of drugs so far developed for improving human health. Besides this fundamental application, antibiotics have also been used for preventing and treating animals and plants infections as well as for promoting growth in animal farming. All these applications made antibiotics to be released in large amounts in natural ecosystems.

The residues of these drugs and their metabolites may be accumulated in soil and will disturb the balance of the soil ecosystem. One potential adverse effect is to have harmful impact on some non-target organisms utilizing the excrement. Only in the recent years more attention has been paid to the discharge, presence and potential adverse effects of veterinary drugs in the environment.

Photocatalytic decomposition of spiramycin was carried out in a closed circulation system by using a helical glass reactor with double streamer of 2 m length and volume of 0.8 L. Reservoir of 2 Litters was used, in which the spiramycin solution was introduced. Oxide particles in different amounts were constantly dispersed by a magnetic stirrer. The samples were irradiated from the center of the reactor. A Phillips ATLD 24W lamp (λmax = 365 nm), was used as the UV light source. The suspension was recycled at different flow rates by means of a peristaltic pump.

The photocatalytic oxidization of spiramycin has been valued in maintaining a flow rate of 3.787 mL/s and differents initial concentrations of pollutant: 5; 10; 20 and 30 mg/L. The obtained results show that the deterioration of spiramycin is very fast that its concentration decreases quickly. The rate constant is reversely dependent on the initial concentration of spiramycin in the solution: it is the highest for the lowest concentration and decreases with increasing concentration. As mentioned before, the degradation is faster for lower spiramycin initial concentration.

This study was conducted to investigate the efficiency of a photocatalysis oxidation system for pharmaceutical pollutants treatment. Oxidative degradation of spiramycin by hydroxyl radicals (OH°) was studied in aqueous medium using suspended forms of TiO_2 (Degussa P-

25) under UVA (365 nm) irradiation light. The results showed that the degradation of spiramycin was affected by many factors. The optimum rate of photodegradation was obtained with a flow rate and a catalyst coating equal to 3.78 mL/s and 0.05 g/L respectively. And the rate of photodegradation was found to increase when the Spiramycin concentration decreases from 30 to 5 mg/L. In addition, it was shown that the Spiramycin degradation followed the first-order kinetics and the reaction rate was well fitted with Langmuir–Hinshelwood model. The removal ratio of Spiramycin was 99 % in less than 60 minutes. Thus, the UV/TiO_2 photocatalysis process is very efficient and can be suggested for the degradation of Spiramycin in aqueous solution.

KEY WORDS*:* Advanced oxidation, photocatalysis, TiO_2, UV, Spiramycin, pharmaceuticals pollutants.

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.

TOPIC 5

Water Treatment Policies

WATER TREATMENT POLICIES: CASE OF PESTICIDE

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ABSTRACT

During the land use intensification process seen globally thus far, pesticide use per hectare has generally increased more than proportionally with crop output per hectare. Pesticides are a common cause of water pollution. Regarding the new legislation, this article updates the information concerning the water treatment policies and it reviews the new studies about pesticides and policies in surface water, drinking and groundwater. Overuse or underuse of pesticides may depend on the specification itself but also on the application to different crops. the indirect effects of pesticides can enable the development of environmental and health standards because pesticides are considered as carcinogenic or endocrine disrupting chemicals.

KEY WORDS: Water, drinking, pesticide, environment, policies.

CURRENT STATE OF TREATMENT PLANTS AND SEWAGE REUSE IN ALGERIA

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ABSTRACT

According to the World Bank, the water deficit increases today to 50 Bm^3 per year. It will reach 150 to 240 Bm^3 2050. The most affected countries by water scarcity are those located in the MENA region (14 of the top 20 in the world).
Algeria has long been facing huge problems in water. Overloading of coastline, the disparities between rural and urban areas, drought and increasing pollution are all factors that destabilize the precarious balance of the environment. Population and economic growth in some regions of Algeria have led to a growing demand for water and a negative impact on the ecosystem in general and especially water resources.
The Algerian government has launched several large-scale programs to eradicate the problem of drinking water shortage and irrigation water. These include the implementation, by 2014, of 13 seawater desalination plants produce 2.3 million m^3/day fresh water and the mobilization and transfer of 600 million m^3/year of water from underground aquifers to deficit areas by 2040.
Algeria is divided into five areas bounded by river watersheds; four of them are located in the North and one in the South. This last area is suffering from water discharge and salinity rising where the sanitation solutions those need to be made.
The average volume of drinking water produced annually was estimated at 2800 hm^3 in 2009 and will reach 3500 hm^3 in 2020 with the national mobilization of resources. The annual volume of wastewater was estimated at about 1200 hm^3 in 2010.The average volume of drinking water produced annually was estimated at 2800 hm^3 in 2009 and will reach in 2020, 3.500 hm^3 with the national mobilization of resources. The annual volume of wastewater was estimated at about 1.200 hm^3 in 2010.
Indeed, today there are 123 operational wastewater treatment plants in Algeria. A net increase has resulted in the volume of the treated water which reached 700 million m^3 per year. Unfortunately, a little of this treated water is reused either in the urban area for washing or irrigation, agriculture and industry.
In this paper, an overview of wastewater treatment plants in Algeria will be presented highlighting the used technologies, the problems encountered in the collection of wastewater and the solutions provided by the Algerians authorities in sanitation.

KEY WORDS: wastewater, water treatment, desalination, water reuse, Sanitation.

CONTROLE DE LA POLLUTION DE L'EAU EN TUNISIE (COPEAU)

Mohamed. Ben Hassine

RESUME

La Tunisie a un climat semi-aride, caractérisé par de fortes variations de la pluviométrie dans le temps et dans des lieux différents. La protection des ressources en eau est une priorité nationale en Tunisie. La protection de ces ressources contre toutes les formes de pollution et de contamination est essentielle pour assurer la qualité de l'approvisionnement en eau. Cependant, lors du lancement du projet, la qualité de l'eau en Tunisie était dégradant en raison de la pollution diffuse de l'utilisation agricole des pesticides et des engrais, rejets d'eaux usées urbaines et industrielles non traitées dans les lacs, les rivières et les oueds, et la contamination par les déchets solides déversés près de l'eau. Cette pollution des ressources en eau représente un risque important pour la santé publique. La Tunisie a déjà eu un cadre juridique pour lutter contre la pollution de l'eau. Cependant, son application et l'exécution était encore faible. Ceci est principalement en raison d'un manque de surveillance et des capacités institutionnelles des autorités tunisiennes et des normes inapplicables. Il n'y avait pas d'évaluation des sources de pollution et aucun cadre pour la coordination et l'échange d'informations entre les autorités compétentes. L'objectif principal du projet COPEAU était de renforcer la capacité de l'Agence nationale de protection de l'environnement de Tunisie (ANPE) dans le contrôle de la pollution de l'eau, notamment les capacités institutionnelles et techniques pour intensifier l'échantillonnage et l'analyse des eaux et le traitement des données en vue de l'amélioration de l'approvisionnement en eau et la réduction des risques pour la santé.

Le projet COPEAU a réussi à renforcer la capacité de l'ANPE pour protéger la qualité de l'eau en Tunisie. Il a établi un cadre commun pour tous les acteurs de la protection de l'eau pour surveiller la qualité de l'eau, en renforçant la surveillance même dans les régions éloignées du pays et fournir une référence pour la protection de la qualité de l'eau dans l'ensemble de la région. Un manuel complet de procédures d'échantillonnage et d'analyse a été également élaboré, y compris le traitement et l'évaluation de l'information. Avec le soutien du programme LIFE pays tiers et le gouvernement tunisien, l'équipe du projet a acquis trois laboratoires mobiles, ce qui a considérablement amélioré la capacité de l'ANPE pour mener les analyses systématiques des eaux souterraines et de surface dans les toutes les zones de la Tunisie. Le projet a permis de fournir un cadre de référence commun et des procédures au sein duquel les différentes techniques et juridiques des agents de protection de l'eau pourrait travailler de manière plus cohérente et avec succès.

A cet effet, 138 milieux récepteurs ont été contrôlés avec un total de 896 points de mesures et de 11764 analyses effectuées depuis le 1er janvier 2007. Il est à signaler qu'en 2006, l'ANPE ne contrôlait que 7 milieux récepteurs, avec un total de 1618 analyses effectuées sur 12 mois. Cette augmentation est à mettre à l'actif des bénéfices tirés du projet COPEAU L'ANPE a publié les résultats de ses analyses de l'eau dans les bulletins d'information réguliers et de façon plus détaillée dans son rapport annuel. Le projet COPEAU devraient également fournir un bon exemple pour la région d'Afrique du Nord.

MOTS-CLES : lutte contre la pollution, gestion des ressources en eau.

POSTER PRESENTATIONS

TOPIC 1

Biotechnologies for water treatment and reuse in the African context

NEW CONCEPTION OF MULTI-SOIL-LAYERING (MLS) METHOD TO WASTEWATER TREATMENT IN MOROCCAN SMALL COMMUNITIES

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ABSTRACT

Wastewater effluent disposal is a serious problem in Moroccan rural area. The lack of sewerage network for wastewater collection, the absence of control and of environmental sensitivity are the important factors creating spreading diseases, gradually environmental degradation and contaminating surface as well as underground waters. Consequently, the on-site treatment of wastewater in this rural area provides one solution to this problem. Among the decentralized wastewater treatment technologies that could be used in rural areas, the multi-soil-layering (MSL) method constitutes a promising technology. According to literatures, the MSL method has showed its efficiency to remove organic matter and nutrients from wastewater in Asian countries and Hawaii. However, there has been no study in dry area and no study on removal efficiency of pathogens by the MSL method. So, the aim of this study is to investigate the feasibility of the use of MSL method for wastewater treatment using local materials and to examine the performance of this system to remove organic matter, nutrients and pathogens under climatic conditions of Morocco.

Treatment efficiency of wastewater by MSL system was evaluated using laboratory-scale MSL system, which was set up in 36 cm (length), 30 cm (width) 65 cm (height) plastic boxes enclosing 'soil mixture layers' alternating with permeable gravel layers. The soil mixture layers were composed of local soil, sawdust, iron metal and charcoal at the ratio of 70%, 10%, 10%, and 10%, respectively, on a dry weight basis. The MSL pilot plant was alimented continuously by domestic wastewater with an hydraulic loading rate (HLR) of 200 l/m^2/day. The physico-chemical parameters measured at the inlet and outlet of the MSL pilot plant were biochemical oxygen demand (BOD5) , chemical oxygen demand (COD), ammonium (NH^+_4-N), nitrites (NO^-_2-N), nitrates (NO^-_3-N), total Kjeldahl nitrogen (TKN), total nitrogen (TN), orthophosphates (PO^-_4-P) and total phosphorus (TP). The microbiological analysis has focused on germs indicators of fecal pollution which includes total germs (TG) at 22°C and 37°C, fecal coliforms (FC), total coliforms (TC), *Clostridia* (Sulphite-reducing-anaerobes), *Streptococci* D (SD), *Escherichia coli* (EC) and intestinal enterococci (IE) and pathogens such as *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *salmonella* sp.

The results showed that the MSL system after 5 months operation could remove 92 % of total suspended solids, 88 % of total BOD5, 81 % of COD , 86 % of NH^+_4, 58 % of NO^-_2, 68 % of NO^-_3-, 82 % of TKN, 82 % of TN, 79 % of PO^-_4-P and 79 % of TP. The average removal of bacteria obtained by the MSL system reached 1.23 Log units. The high removal efficiency

was achieved for *Pseudomonas aeruginosa* and *Clostridia* (1.39 Log), however the lowest removal efficiency was found for *E. coli* which is about 0.97 Log.
In general, the MSL system demonstrated a good performance for removal of organic matter, suspended solids, N and P but its performance to remove feacal coliforms and pathogens still moderate under the experimental conditions used in this study. This is mainly due to the high porosity level and course pore spaces of the substrate in the permeable gravel layers.
Based on these preliminary results, wastewater treatment by MSL system showed a high adaptability to Moroccan wastewater and climatic conditions. As a low cost wastewater treatment method with fewer constraints for exploitation, the MSL system could be an effective solution for decentralized domestic wastewater treatment in Moroccan rural areas.

KEY WORDS: domestic wastewater treatment, multi-soil-layering (MSL) method, nitrogen, organic matter, pathogens, phosphorous, suspended solids.

A PRELIMINARY STUDY TO AN INTEGRATED PROCESS MANAGEMENT OF OLIVE MILL WASTEWATER (OMW) TREATMENT USING DILUTION BY SUGAR MILL LIMING AND BIO-COAGULATION PROCESS

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ABSTRACT

The variety of organic pollutants released by the ever increasing number of industries is the direct cause of environmental and health-related problems that have detrimental effects on living beings. However, among of them like sugar mill liming that can be used in the treatment of some effluents. This study evaluated the beneficial effects of combining coagulants with dilution by sugar mill liming to remove turbidity and dark color, and proposed conditions for proper operation of a coagulation process. Initially a pretreatment using dilution by sugar mill liming was carried out to decrease the COD of Olive mill wastewater (OMW) effluent, which showed color removal of 33% and turbidity reduction of 63% at a dilution of 67%. The coagulation treatment processes using natural organic coagulants (NOC_{505}) was investigated as secondary treatment. Preliminary test showed an effective coagulation was achieved in which the olive mill wastewater was partially decolorized and 90% of turbidity content eliminated.

KEY WORDS: Olive Mill Wastewaters (OMW), Natural Organic Coagulants (NOC_{505}), sugar mill liming, dark color, Turbidity.

EFFECT OF WET HYDROGEN PEROXIDE CATALYTIC OXIDATION PRE-TREATMENT ON OMW ANAEROBIC DIGESTION

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ABSTRACT

Biogas is considered as a valuable source of renewable energy. Biogas results from the anaerobic digestion of organic matter (domestic waste, purification water treatment sludge, agricultural effluents …). In previous works on the anaerobic digestion of unmodified OMW, many problems such as the high toxicity the low biodegradability and the acidification of reactors were studied. Advanced Oxidation Processes (AOP) constitute a promising alternative for the pre-treatment of OMW, basing on oxidative reactions. Recently, in our previous studies, we have proved the efficiency of aluminium-iron pillared montmorillonite ((Al-Fe)PILC) catalyst for OMW photo-oxidation in presence of H_2O_2.
The aim of this study is to evaluate the pre-treatment process of OMW catalysed by (Al-Fe)PILC in presence of H_2O_2 at 323K and atmospheric pressure coupled to biomethanisation.
The clay samples were characterised by XRD, BET surface area and chemical analysis. Preliminary experiments were performed on real F3 OMW phenolic fraction (<8kDa). After the addition of the catalyst and the desired quantity of H_2O_2, small samples of the reaction solution were analyzed by HPLC, TOC analyzer and spectrophotometer. Results indicate that the use of (Al-Fe) PILC allows colour reduction, significant abatement of total organic carbon and reduction of phenolic compounds.
The anaerobic conditions in filling operation were maintained by continuously flushing with nitrogen gas. The bottles were then incubated at the temperature of 37°C and magnetically stirred. At regular intervals, the volume of biogas produced was measured by a displacement method. The microtoxicity test is based on the inhibition of the bioluminescence of *Vibrio fischeri*. COD was determined according to Knechtel standard method.
The biomethanisation process was found to be stable during 60 days of operation. The biodegradability enhancement of the treated effluent may be attributed to the reduction of the total phenolic compounds concentration of the waste and of the associated toxicity, which facilitates the anaerobic digestion of the OMW. This result opens promising perspectives since its conception as a fast and cheap pre-treatment prior to conventional anaerobic digestion.

KEY WORDS: Anaerobic digestion; Catalytic wet peroxide oxidation; Olive mill wastewater; Pillared montmorillonite.

OLIVE MILL WASTEWATERS TREATMENT BY COAGULATION-FLOCCULATION PROCESS

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ABSTRACT

Olive mill wastewaters (OMW) are a significant source of environmental pollution, especially in important olive oil producing countries such as Spain, Italy, Greece, Tunisia, Morocco, Turkey, Lebanon, Syria and Portugal. When discharged into the environment, olive mill wastewaters create serious environmental problems, such as colouring of natural waters, alteration of soil quality, phytotoxicity and nuisance odours.

Several methods have been reported for the removal of pollutants from these effluents. These technologies can be divided into three categories: biological, chemical and physical. Physical-chemical treatment is well known and has yielded promising results. Several authors have tested coagulation-flocculation techniques using different coagulants, such as aluminium sulphate, ferric chloride, ferric sulphate and lime, but there are few studies that have investigated the combined effect of a mixture of coagulants.

The objectives of this work were to carry out a complete characterization of the raw and decanted olive mill wastewater, resulting from a modern unit located in the Marrakesh region, and to study the reduction in organic load and suspended matter (SM) content achievable by coagulation-flocculation using two different coagulants (lime, aluminium sulphate) and their combination.

Coagulation tests were realized using jar test equipment in a series of six flasks. One flask corresponded to a control suspension without adding any coagulant. The other suspensions were treated with increasing coagulant concentrations of lime or aluminium sulphate, used separately (concentrations varying from 0 to 30 g/L and from 0 to 3 g/L, respectively) or in mixture. All solutions were stirred first for 3 min at 130 rpm, and then after the coagulant addition for 20 min at 30 rpm, followed by 1 h settling. The supernatant was separated from the precipitate for analysis.

OMW are also highly saline (electric conductivity 17 mS/cm), due to the salting practiced to preserve olives during trituration. These effluents contain also high loads of Chemical Oxygen Demand (COD of 271.17 g/L) and SM (36.17 g/L).

Coagulation-flocculation tests showed that the application of aluminium sulphate without correction of the pH caused a small decrease of the pH from 4.79 to 4.63. The optimal elimination of the COD (66.35 %), and SM (34%) was obtained with an amount of 1.5 g/L. However, the application of lime in a range amount shown that 15 g/l is the optimal quantity to remove better COD (35.41 %) and SM (53 %).

The successive addition of lime to 1.5 g/L of aluminium sulphate, starting from an amount of 5 g/L, and induced a removal of COD (76.61 %) and SM (60.46 %) at only 10 g/L of lime.
All in all, the best coagulation-flocculation was obtained by the combination of 1.5 g/L of aluminium sulphate and 10 g/L of lime, which gave a better elimination of the colloidal particles, a good reduction of the organic matter causing colour and the toxic polyphenols.

KEY WORDS: olive mill wastewater treatment, organic load, suspended matter, coagulation-flocculation, aluminium sulphate, lime.

ELECTROCHEMICAL TREATMENT AND BIODEGRADATION OF OXAMYL IN AGRICOLE EFFLUENTS

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ABSTRACT

For several decades, pesticides were used for the protection of crops and human health; however, their excessive use and misapplication resulted in environmental contamination. In fact, since a small fraction of the applied pesticide in agricultural use is directly involved in the pesticidal action, most of these compounds find their ways, as ''residue", into the environment and accumulate to exert adverse ecotoxic effects. Some of these chemicals share structural similarity with natural substrates of bacteria. Herein, a range of bacterial strains was checked for their potential biometabolization of these pesticides and the efficient ones were retained. The biodegradability was assessed using chromatographic techniques. Several strains were able to detoxify agricultural effluents containing pesticide residues with a yield of about 70 to 90%. Moreover, the biological detoxification was compared to the electrochemical approach, the experiments were based on the kinetic of the electrochemical degradation of aqueous solutions containing pesticides, including Oxamyl Nematicide. The chemical oxygen demand (COD) measurement during the processing showed that the electrochemical process permitted removing the pesticide from agricultural aqueous wastes. This work allowed to set-up a cleaning process combining biological and electrochemical approaches.

KEY WORDS: Detoxification; Oxamyl; Electrochemical degradation; Bioremediation; GC-MS.

THE ELECTROCHEMICAL DEGRADATION OF PESTICID IMAZALIL AND PYRIMETHANIL ON BORON-DOPED DIAMOND ELECTRODE

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ABSTRACT

The electrochemical oxidation of mixture pesticides imazilil and pyrimethanil pesticides has been studied on boron doped diamond (BDD) electrodes on acid medium by bulk electrolysis. The influences of current density, conductive electrolyte, pH, and concentration of pesticide were investigated. GC and chemical oxygen demand measurements were conducted to study the reaction kinetics of pesticides mineralization. The best obtained conditions for COD removal on the BDD anode to degrade imazalil and pyrimethanil solutions include operating at 50 mA cm^{-2} and 25 ± 3 °C. The experimental results showed that the electrochemical process was suitable for almost completely removing COD, due to the production of hydroxyl radicals on the diamond surface (OH•) and other electrogenerated oxidants (Cl^-, ClO^-).

KEY WORDS: Electrochemical oxidation, Pesticide, Direct electro-oxidation, Boron-doped diamond, fungicide.

EXPERIMENTAL STUDY ON THE ELIMINATION OF COLOUR BY IMMOBILIZED ENZYMES-EFFECT OF DIFFUSIONAL LIMITATIONS

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ABSTRACT

Enzymatic treatment of waste waters is a simple, innovative, efficient and low cost technology for removing recalcitrant compounds such as azo dyes. The technique could be well adapted in the treatment of coloured waste waters generated by dyeing methods, traditionally used in African countries. In this study, we investigate the removal of Congo red (CR), a model azo dye molecule, by immobilized plant peroxidase from turnip "*Brassica rapa*". Partially purified turnip peroxidase (TP) was immobilized by entrapment in spherical particles of calcium alginate and was assayed for the discoloration of aqueous CR solution. Experimental data revealed that pH, reaction time, temperature, colorant and H_2O_2 concentration play a significant role in dye degradation. Maximum CR removal was found at pH 2.0, constant temperature of 40 °C in the presence of 10 mM H_2O_2 and 180 mg/L of CR. More than 94% of CR was removed by alginate immobilized TP after 1 h of incubation in a batch process under optimal conditions. About 74% removal efficiency was retained after four recycles. Diffusional limitations in alginate beads such as effectiveness factor η, Thiele modulus Φ and effective diffusion coefficients (D_e) of Congo red were predicted assuming a first-order biodegradation kinetic. Results showed that intraparticle diffusion resistance has a significant effect on the CR biodegradation rate.

KEY WORDS: Congo red; diffusion; immobilization; discoloration; peroxidase.

NANOTECHNOLOGY IN NATURAL MATERIAL: A NEW PROCESS TO IMPROVE THE LOW COST WATER TREATMENT.

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ABSTRACT

The diffusion of a wide range of pollutants in water has become a critical issue in the world, due to demographic growth and industrialization development. The heavy metals, is the persisting pollutants in water, whose their release into the environment is very harmful to human health and ecological environment. Consequently, the contaminants removal has become necessary.

Influencing the physical and chemical properties of molecules, nanotechnology is a unique technical that independently helps in water treatment. It's the production and utilization of a diverse array of nanocomposite (NNs) with the size ranging from 1 to 100 nm materials.

Due to the heterogeneity of their large surfaces, clays attract attention for use as material to adsorption and more, they have the ability to sorb ions and release them later, when the conditions change. Also, until now, it has one of the low-cost materials used for water treatment. More than that, natural clays are abundantly available, low-cost natural resource and environmentally friendly adsorbents of several contaminants from water. In addition, it has been shown that the clay particles could be electrospun easily with many polymers for various applications.

The aim of this study is the:

i) Fabrication and Surface engineering of electrospun nanofiber/ Clay composites.
ii) Optimization of the electrospinning parameters for the fabricated nanocomposite materials.
iii) Testing the fabricated nanocomposite for removal of the multi-metal polluted water.
iv) Evaluation of the photoctalysis potential of the nano-clay fiber to demean the organic matter like pesticide and bacteria.

A general view of the composite showing the two materials with complete different textures: the PAN flat surface and the clay aggregate. All elements of the clay particles were exposed in the surface of the fibers, who's demonstrate that the clay electrospinning in a polymer increase their exfoliation.

The adsorption of Pb, Cu, and Zn from aqueous solutions on the PAN–natural clay-NNs showed that this clay fiber could adsorb an initial concentration (10 mg/l) at less than 2h. In addition, the equilibrium kinetics for metals adsorption shown that the maximum equilibrium adsorption capacity (Qe) of the fiber for adsorbing the studied metals reached 10 mg/g in a maximum value (500 mg/l) of the equilibrium metals concentration (Ce).

The photocatalysis of the studied pesticide (10 mg/l) and bacteria like clostridia spore (10^3 UFC /L) under UV show that only one hour is sufficient to demean about 95% of the pesticide and all bacteria spore.
The adsorption mechanism of heavy metals in the synthesized fiber adsorbent was based on ion exchange between hydrogen ions of ion oxides in clay-NNs adsorbent and metals ions in solution, and electrostatic force between this heavy metals and this adsorbent.
This study proved that the nanocomposite fiber by natural clay was unselectively adsorbed with any metals, which could be adsorbed in high significant amount from aqueous solutions.

KEY WORDS: Nanocomposite, Natural clay, Electrospening, Water treatment.

TECHNOLOGIES FOR BIOREMEDIATION OF WATER AND SEDIMENT CONTAMINATED BY POLYCYCLIC AROMATIC HYDROCARBONS IN BIZERTE LAGOON (TUNISIA)

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ABSTRACT

Microcosm experiments were conducted in which the surface of marine sediment was contaminated with phenanthrene and subjected to either of three different bioremediation schemes, i.e., biostimulation (BS) by supplementing with addition of nitrogen and phosphorus fertilizer or mineral salt medium, bioaugmentation (BA) by inoculating with three bacterial isolates, namely *Acinetobacter* sp. (S1) , *Bacillus megateruim* (S2) and *Stenotrophomonas maltophilia* (S3) , were enriched from Bizerte sediments and had shown a good PAH degradation potential in liquid culture medium within 20 days of incubation, and combination (CB) of BS and BA. Bacterial biomass in water and sediment was estimated using flow cytometry. Phenanthrene analysis in the sediment was conducted by gas chromatography (GC).

Bioremediation stimulated the microbial population and increased PAH biodegradation. Interestingly, bioremediation treatments strongly enhanced bacterial biomass in the water column, at the interface and in the sediment, as compared to control and contaminated microcosms. Biostimulation with mineral salt medium (CBS2) strongly enhanced phenanthrene degradation, with up to 98 ± 0.2% whereas Phe degradation was minimal in CBS1 when nitrogen and phosphorus fertilizer were used (76 ± 0.4%). Bioaugmentation with inoculation of different PAH-degrading bacterial consortium (S1 and S2) enriched from Bizerte sediments enhanced phenanthrene degradation as compared to *Stenotrophomonas maltophilia* (S3). Combination of both treatments did not significantly enhance PAH degradation relative to the biostimulation and bioaugmentation protocols. The results suggest that biostimulation with ecologically competent pollutant-degrading bacteria is an ecologically promising bioremediation scheme. This finding opens exciting possibilities for future studies needed to evaluate the potential impact of mixture of PAHs and bioremediation treatments of water and sediment on microbial biomass, activity, and community structure.

KEY WORDS: Water, Sediment, Phenanthrene, Degradation, Biostimulation, Bioaugmentation, Heterotrophic bacteria, Microcosms.

BIODEGRADATION OF PHENOL BY FREE AND IMMOBILIZED TURNIP PEROXIDASE

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ABSTRACT

This paper is a comparative study of phenol biodegradation by free and alginate entrapped turnip peroxidase.
The effects of relevant factors on the process such as pH, temperature, concentration of H_2O_2, phenol concentration and enzyme activity were evaluated in order to optimize the conditions for removal of phenol.
Results showed that the obtained average yield is 93% for phenol concentration of 80 mg /l with free enzyme and 46 g/l with immobilized enzyme. The process duration is 3 hours. The reaction is conducted in aqueous medium under optimal pH between 7 and 8 respectively and temperature of 40 °C.

KEY WORDS: Phenol, Optimization, Biodegradation, peroxidase, immobilized.

REUSE OF TREATED WASTEWATER AND ITS IMPACT ON ALFALFA AND FABA BEAN GROWTH AND ANTIOXIDANT

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ABSTRACT

The scarcity of water is a common concern in many arid and semi-arid areas of the world. To preserve the quality of water bodies and reduce withdrawals from the natural environment, it is necessary to look for alternative resources. The reuse of treated wastewater, or REUE, may be one of such alternative. The effort invested in water reuse will preserve the fresh water for other uses.

The purpose of this study is to investigate the possibility to use the treated wastewater, supplied by wastewater treatment plant(WWTP) using stabilization pond of Chichaoua city (Morocco), in irrigation of alfalfa and faba bean (both local cultures in the region). A bacteriological and physico-chemical characterization was performed biweekly for the waters at the inlet and outlet of the WWTP, and compared with irrigation standards.

Seeds of alfalfa and beans were disinfected and germinated in Petri dishes at 25 ° C in dark conditions. After germinations, the young seedlings were transferred into plastic pots filled with sterile sand and peat at ratio of 4/5 and 1/5, respectively. The experiment was conducted under greenhouse conditions and the plants were submitted to three irrigation regimes: purified wastewater, raw wastewater and well water as control. At flowering stage, the plants were harvested and some agro-physiological and biochemical parameters were assessed. The aspects of oxidative metabolism in leaves of alfalfa and faba bean, the degree of emergence of oxidative stress in these organs of plants by analyzing the state of the membrane integrity of the leaves through the assessment of the level of peroxidation membrane lipids (MDA), the rate of hydrogen peroxide and the analysis of the activity of peroxidase (PO), polyphenols oxidase (PPO) and catalase (CAT) were studied.

Data analysis showed that the performance efficiency of the WWTP of chichaoua city (Anaerobic+facultative pond) has reached respectively 79%, 84%, 84% and 75% of SS, COD, BOD_5 and TKN, with discharge concentrations of 161 ± 16.5 mg / l COD, 110.75 ± 11.5 mg / l BOD_5, 84.63 ± 5.3 mg / l SS and 52.7 ± 7.03 mg / l TKN. The bacteriological analysis showed a reduction of fecal bacteria and pathogens efficiency close to 68%.

Table1: Biochemical's parameters of Alfalfa and Faba bean irrigated by the three studied regimes

	ALFALFA				FABA BEAN			
	PO	**PPO**	**MDA**	**CAT**	**PO**	**PPO**	**MDA**	**CAT**
Control	2,879	15,405	0,014	4,817	2,585	8,695	0,015	3,974
Treated wastewater	7,215	16,575	0,098	6,768	3,227	11,657	0,164	4,451
Raw wastewater	7,309	18,995	0,132	8,362	4,267	15,27	0,179	5,521

The results for the irrigated plants showed that the growth parameters (plant height, leaf, dry biomass and nodulation) increase for plants irrigated with treated wastewater compared to the control. Thus, higher antioxidant activities in leaves of plants irrigated with raw sewage in comparison with those recorded in leaves irrigated by treated wastewater and control plants. In addition, under these treatments, we found increases in the activities of antioxidant enzymes such as PO, PPO and catalase involved in the scanning of reactive oxygen species such as H_2O_2.
The behavior of the faba bean and alfalfa plants irrigated with three types of water showed that the growth was improved when the plants were irrigated with the treated water, comparatively to control plants.
In general, irrigation with treated wastewater has enhanced the contribution of fertilizer material and especially mineral nitrogen which promotes plant growth in terms of dry weight, which reflects the production of plant material.

KEY WORDS: Treated wastewater, lagoons, faba bean, alfalfa, growth, reuse, arid climate.

FEASIBILITY OF DOMESTIC WASTEWATER REUSE IN AGRICULTURE: EXPERIMENTAL STUDY ON THE TREATED WATER OF CHLEF PURIFICATION PLANT

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ABSTRACT

Wastewater treated can be considered as a non negligible water spring to be reused by man in different application like irrigation or industry. This practice can be considered as a best solution to decrease the most use of conventional water that limited and badly distributed on the earth and therefore, to protect rivers, plans of water and even the underground waters. In Algeria agriculture knows serious difficulties. water destined for irrigation becomes more and more limited and the reuse of treated wastewater in agriculture becomes very necessary. Since few last years, a rich program for the reuse of domestic treated wastewater in agriculture has been adopted in Algeria. The reused volume was estimated at 17 Millions m^3/year in 2011 and will be evaluated around 200 millions m^3/year in 2014. The number of purification plants concerning by the reuse will pass from 14 plants in 2011 at 25 plants in 2014. The aim of this work is to study the possibility reuse of domestic treated wastewater coming from CHLEF plant (North Algeria) in agriculture. At present, these waters are directly rejected in nature without any valorization. Physico-chemical and microbiological analysis have been done, during one month and few days, on the treated wastewater in order to justify the feasibility for the reuse of this resource in agriculture. Some parameters of water pollution have been analyzed in this work. These include: pH, conductivity, total dissolved salt (TDS), suspended matters, biochemical oxygen demand (BOD), chemical oxygen demand (COD), nitrates and bacteriological analysis. The results showed that all of the parameters measured were under the national and the international limits values fixed in the guidelines for the reuse of wastewater in agriculture.

KEY WORDS: Water purification plant, wastewater, reuse, irrigation, water resources, Chlef.

THE TOLERANCE OF MAJOR CROPS IN ARID LAND FOR SALINITY

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ABSTRACT

The research aimed to study the tolerance of major crops in arid lands for salinity in different suitability classes according to the degree of limitation and yield's productivity, so here eight major crops that can be growing in arid land were selected (Cotton, Alfalfa, Millets, Mango, Banana, Tobacco, Guava and Avocado) and evaluated for salinity.

By collecting the data of soil salinity level for any area in the world soil of any arid land and comparing the data with the crop's requirement and applying calculation and methodology according to the soil suitability classification system for specific crops, produced by FAO and adopted by SyS (1980). We could deduce wish crops are more tolerant for salinity more than the other.

By applying the above mentioned systems of evaluation we have concluded the following results:
1-The most tolerant crops for salinity are: Cotton, Alfalfa, Millets and Mango
2-The medium tolerant crops for salinity are: Banana, Tobacco and Guava
3-The least tolerant crops for salinity are: Avocado

ARTIMIA SALINA LIFE CYCLE AND IT'S RELATION TO GHABER AWOON LAKE PRODUCTIVITY

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ABSTRACT

Artemia Salina belongs to the Subphylum, Crustacea. Class, Branchiopoda. Order, Anostracea. Live in saline lakes, coastal marshes and used as food for many fish and crustaceans larvae.
This study was conducted on Lake Ghaber Awoon which located in Southern Libya, during the spring and early summer of 2012. The study addressed the life cycle of *Artemia Salina* and its relation to Lake Ghaber Awoon productivity.
The study showed that Ghaber Awoon Lake is desert lakes with high nutritional productivity. The Lake scored the highest level of productivity in the spring session on the surface of the western bank, Sacs, larvae and Sub-adult existed in March to the surface of the western Bank and disappeared in June in the middle and bottom level of the Lake except Sub-adult where only one found in the middle and bottom of the Lake.
Direct proportion found between the Sacs, larvae and Sub-adult and between larvae and Sub-adult. Direct proportion where also found between the Sacs and the Lake productivity. Sacs, larvae Sub-and adults existed on the surface of the western side of the bank in March, most of the productivity concentrated in the middle of the western bank in April, which means these animals live in the vicinity of productivity area not in the same region of the productivity

TOPIC 2

Requirements and practical experiences in water treatment and re-use in Africa

INFLUENCE OF PYROLYSIS TEMPERATURE ON ACTIVATED CARBON PREPARED FROM HIGH DENSITY AMAZON WASTE WOOD (IPE)

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ABSTRACT

Sawdust residues from Amazon wood industries can be considered as an excellent precursor material for the production of activated carbon, which is material widely used for wastewater treatment. Nevertheless, wood from amazon region generally presents high density property probably due to its chemical composition, particularly its high extractives content, which may reduce the interest to produce activated carbon. The present work is focus on the production of activated carbon by physical activation prepared from high density tropical wood precursors.

The objective is to assess the effect of the pyrolysis temperature, as pretreatment step, on activated carbon characteristics. Amazon sawdust residue used in this study was *Tabebuia serratifolia (Vahl) Nichols spp*. (Ipe) with density of about 1 $g.cm^{-3}$. The chemical composition of wood was determined according to brazilian standard ABNT NBR 2003 and ABNT NBR 2010. The elemental analysis of both sawdust and activated carbons including carbon, hydrogen, nitrogen, sulfur and oxygen components has been determined.

Approximately 20 g of Ipe sawdust was pyrolyzed at three different temperatures (500°C, 600°C and 700°C) in an oxygen-free atmosphere laboratory muffle furnace with a heating rate of $100°C.h^{-1}$. Charcoal activation was carried out in a laboratory tubular reactor at 850°C with CO_2 as activating agent at a constant flow 150 $ml.min^{-1}$ during 60 min. For wood chemical analysis, the average composition was respectively 33.47 wt.% lignin, 10.50 wt.% extractives and 69.05 wt.% holocellulose (i.e., cellulose and hemicellulose fractions). The elemental analysis of wood indicated carbon content higher to 51 wt.%, with ash content lower than 0.65 wt.%. Carbon content of the intermediate charcoal produced after the pyrolysis pretreatment was in the range of 77-82 wt.% depending of the temperature of pyrolysis.

Textural characterization of activated carbons was carried out by N_2 adsorption–desorption isotherm measurements at 77 K using a Quantachrome Instruments Autosorb-1C. The results indicated that surface areas were in the range of 455–750 $m^2.g^{-1}$ showing the influence of the pyrolysis temperature in the pretreatment step. Secondly, the pore size diameters distribution was predominantly microporous, with nevertheless a significant volume of mesopores.

Kinetic adsorption of both methylene blue and phenol solutions exhibit a short adsorption period (less than 15 min) with an equilibrium time close to 60 minutes for all activated

carbons. The removal of both adsorbates was very high in all cases (almost 100%) with a maximum adsorption capacity higher to 900mg.g^{-1} and 280 mg.g^{-1} for methylene blue dye and phenol respectively. The results indicate that increasing the pyrolysis temperature between 500 °C and 700 °C negatively influence the textural characteristics of the activated carbons prepared from high density tropical wood. Nevertheless, activated carbons prepared with the pyrolysis temperature of 500 °C present very promising properties with elevated surface area, high adsorption capacity and fast kinetic law.

KEY WORDS: activated carbon, physical activation, pyrolysis pretreatment, tropical wood.

OPTIMIZATION OF ACTIVATED CARBON PREPARED FROM AGRICULTURAL BY-PRODUCT AVAILABLE IN THE NORTH AND CENTRAL OF AFRICA AND IT'S USE IN THE WATER TREATMENT

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ABSTRACT

In this work, the activated carbons derived from abundant waste materials in Africa, such as oil palm shells wastes, olive cakes wastes and Argane shells have been prepared by different activation process (physical and chemical activation). The methodology of experimental design (MRE) was used to optimize the preparation conditions. The activated carbons so prepared were characterized: by Infrared analysis, the titration of functional groups, the determination of pH of zero point charge (pHpzc), the specific surfaces areas and the scanning electron microscopy. BET surface area varied between 1030 m^2/g and 2320 m^2/g. Microspore volumes were obtained from DR equation applied to N_2 and CO_2 adsorption data and their values ranged between 0.38 and 0.54cm^3/g.

The activated carbons prepared were applied on the removal of pollutant from water particularly iodine, methylene blue, phenol, 4-Chlorophenol and 2-nitrophenol. The experimental data were well described by the Langmuir isotherm. The result shows higher adsorption capacity of these pollutants onto activated carbons ranger from 1000mg/g to 2000mg/g; 500mg/g to 1000mg/g, 200mg/g to 600mg/g 120-200mg/g, 200-250 mg/g respectively of iodine, methylene blue, phenol, 4-chlorophenol and 2-nitrophenol.

KEY WORDS: Activated carbon, Adsorption, Oil palm shells wastes, Olive cakes waste, Argane shells, Water treatment.

PRELIMINARY TEST OF EVALUATION OF THE ABILITY ADSORPTION OF ANIMATED POLYACRYLONITRILE NANOFIBER INTO CHROMIUM

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ABSTRACT

Recently, membranes made up of nanofibers have received considerable interest. This is Attributed To Their amazing characteristic: such as very large surface area to volume ratio and superior mechanical properties Compared with traditional membranes (L.S. Wan et *al.* , 2006).
Nanofiber electrospinning process is a technical training that can be used for a wide variety of polymer. Polyacrylonitrile fiber is the most used fibers because of its low cost and good stability in aqueous media at prolonged times. To obtain nanofibers, it is significant to control the process conditions and the solution properties, one of the Most Important parameter is the solution viscosity (N. Khenoussia , 2009). In fact, this technique has been used by many researchers to address pollution, including metal pollution in aquatic environments (J. Wang et *al* , 2012; . S. Deng et *al*, 2003).
In this context, the Chromium is a metallic element used in many industrial and therefore generated in large amounts in wastewater of these industries. The Analyzes of wastewater from tanneries show that concentration of chromium can reach 7g / l; much greater than that recommended by the World Health Organization (WHO), which requires that the chromium concentrations should not exceed 0.1 mg / l in aquatic ecosystems , and 0.01 mg / l in drinking water. This work is a preliminary test which aims to evaluate the adsorption capacity of the aminated polyacrylonitrile towards chromium. The results show that the use of PAN aminated has an important power adsorption of Cr. The adsorption capacity of the nanofiber may exceed 180 g / g. These preliminary results require applying this technique in the treatment of raw sewage from tanneries.

KEY WORDS: Nanofiber, Aminated polyacrylonitrile, Electrospinning, Chromium, Adsorption.

WATER QUALITY OF LEACHATE DISCHARGE FKIH BEN SALAH IN MOROCCO AND PROPOSED TREATMENT

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ABSTRACT

Wastes from domestic and industrial activities are being dumpsite. This is a risk of contamination of the groundwater in the region Fkih Ben Salah. This made it necessary to study the issue of discharge.

Threatening groundwater area Fkih Ben Salah, the real risk of pollution by leachate infiltration, we were aiming to achieve this work is based on the analysis of leachate - by qualitative characterization of the functions that will be input-purification system, quantify, search and determine the best means of treatment. This work is first on a physico-chemical and bacteriological water characterization of waste leachate to choose the right technology for leachate treatment.

Different physico-chemical parameters of the leachate (pH, electrical conductivity, chemical oxygen demand (COD), biochemical oxygen demand (BOD5), total suspended solids (TSS), total Kjeldahl nitrogen (TKN), the total hardness (DT), the total phosphorus (TP) and total organic carbon (TOC)), are determined by the standard (AFNOR 1996) methods and Rodier (2009). Germs studied are of two types: the pollution indicator bacteria (Total coliforms, Fecal coliforms, E. coli, Streptococci D, Intestinal enterococci) and pathogenic bacteria (*Clostridium perfringens, Pseudomonas aeruginosa, Staphylococcus aureus* and *Salmonella sp.*) (Standard Moroccan, 2006).

The results have shown that the organic material is the most dominant mass , with a percentage (78 %) , a very acidic pH of 3.6 , the electric conductivity is in the range of 2.930mS / cm , the application chemical oxygen demand (COD) was measured to 39.93 g / L, when the biochemical oxygen demand of about 0.355 g / L , this indicates the presence of the organic material consumed by the microorganisms. The BOD5/COD ratio is 0.00088 indicating that leachate at a very low biodegradability because leachate is very young and acid Kjeldahl nitrogen is of the order of 4.900 g / L, while the material slurry is 66 mg / l . The hardness value is the total of 0.441 g / l, while the leachate is considered very hard, and the total organic carbon is 42.97 %, which results in a percentage of 74.08 % of the organic matter. Analysis of the results obtained on the pathogens studied showed the presence of indicator bacteria pollution and pathogenic bacteria.

Based on these results, we consider a method of treatment by electro-coagulation technique for rejection meets Moroccan standards for discharge into the natural environment. It has been proven that this technique offers the simplicity, efficiency, environmental compatibility, safety, selectivity, low cost, especially when this technique is compared to the biological and physico-chemical treatment.

KEY WORDS: Characterization of leachate; Electrocoagulation, Moroccan discharge Standards, Processing method.

CONTROL QUALITY OF SPRING WATER IN TANGER-TETOUAN REGION

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ABSTRACT

Water is essential to human life, but this vital need can be associated with a diverse set of risks that need to be better controlled, hence the importance of monitoring the quality of water consumed. This monitoring is defined by "WHO" as the assessment vigilant in terms of public health safety and acceptability of drinking water test. Routine monitoring should be performed for all water resources including water sources whose consumption has become necessary.

A water quality study of some sources was performed in the Tangier-Tetouan region, located north-west of Morocco. The peninsula Tingitane is characterized by a structural entity that is the Rif area, which the local population uses this water sources for own consumption.

In this context our study focuses on the evaluation and determination of physico-chemical, heavy metals and bacteriological properties of 11 springs in the Tangier-Tetouan region, according to the standard water analysis.

The results for the analyzes of the physico-chemical parameters have shown that the Tangier-Tetouan region has generally a good water quality with the exception of a single source (Source Agla) that reveals a high contamination especially in the iron (0.7 mg/l) and manganese (0.25mg/l) elements (exceed the guideline value for drinking). As for heavy metals, it appears that all sources have a good quality because it was found in the concentrations of trace metals very low than limit of drinking.

Assessment of bacteriological contamination shows that the degree of contamination in the study area varies from one source to another. Levels of the most important contamination for different microflora studied (*E. coli*, coliform bacteria and intestinal enterococci) are met for five sources (Glaoui, Nakhla, Hamma, Sidi Talha and Gaznaya) during the raining period (March to May). Indeed, bacterial contamination appears due to the phenomenon of bacterial infiltration from sewage and waste of the local population activities. This bad microbial quality makes this water not potable, because it can lead to a high risk of waterborne infections in this user population.

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KEY WORDS: Quality Control, spring water, physico-chemical, microbiological and heavy metals.

PRESENT AND FUTURE VISION ON WATER ISSUE IN EGYPT

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ABSTRACT

The main objective of the present article is to highlight the water issue: resources, pollution and protection at present time. About 97% of Egypt's water resources are from the Nile River. The rest is from the non-renewable ground water aquifers and the rare winter rain falls. Industry, human activities and agriculture are the main responsible of water resources pollution and deterioration of water quality. The present paper discusses the water issue in terms of water quality and man-made water pollution problems in Egypt. Water pollution control, management and protection to preserve our water resources are also goals of this paper. Based on the present status, the future water status in Egypt is expected.
The future vision refers that with the increase in water demand as a result of population growth, agricultural expansion, industrial development and the rise of standard of living, water crises is expected because the available water resources are limited. Egypt has been listed among the ten countries that are threatened by want of water by the year 2025. Water uses, maximization the benefits from the available water, attention to non-conventional water resources (rain harvesting and sea water desalination) and research that cut costs, the institutional and legislative frameworks of water management , and the strategies and policies to rationalize water use and to augment water supply will be discussed. The controlling factors of water utilization and management in Egypt will be analyzed and discussed. The possible future water scenarios for year 2020 which reflects alternative programs to develop the water systems and to rationalize the water uses will be present and discussed.

KEY WORDS: Pollution control and challenges, Water issue in Egypt, Water quality, Water resources

GROUNDWATER IN AFRICA

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ABSTRACT

Groundwater in Africa could form an important part of a strategy to cope with an expected sharp increase in demand for water as the continent's population increases that Africa is the world's second-largest and second-most-populous continent. There is also an increasing interest in the use of groundwater for irrigated agriculture as the climate becomes more variable. Groundwater is the water located beneath the earth's surface in soil pore spaces and in the fractures of rock formations. A unit of rock or an unconsolidated deposit is called an aquifer when it can yield a usable quantity of water.

Recent studies mapped the aquifers, or groundwater, across African continent and the amount they hold and estimate that reserves of groundwater across the continent are 100 times the amount found on the its surface.

Studies helped in division of Africa into five major regions: North, East, West, Central, and Southern Africa so, across much of central, western and eastern Africa, where the climate is wet or seasonally wet and basement geology predominates, natural groundwater-levels are generally shallow – approximately 0-25 mbgl. Shallowest groundwater-levels (<7 mbgl) are estimated to be adjacent to perennial rivers. Deepest groundwater levels (>250 mbgl) are mapped in the major sedimentary basins in north Africa where average annual rainfall is low and aquifers are generally hundreds of meters thick. Also studies estimated largest groundwater volumes are found in the large sedimentary aquifers in the North African countries Libya, Algeria, Egypt and Sudan.

A case study of groundwater in Africa could be demonstrated in South Africa that despite its relatively small contribution to the total water supply (~13%), represents an important strategic water resource. Owing to the lack of perennial streams in the semi-desert to desert parts, two-thirds of South Africa's surface area is largely dependant on groundwater. Although irrigation is the largest user of groundwater, groundwater provides the water supply to more than 300 towns and smaller settlements.

Sustainable development of the groundwater resource is not a trivial task and depends crucially on an understanding of the hydrogeology and people with the skills to make informed decisions on how groundwater can best be developed and managed in a sustainable way.

KEY WORDS: Groundwater Africa.

TOPIC 3

Operation and maintenance related to biotechnologies for water treatment and re-use

DRINKING WATER TOXICITY IN HEALTH AND DISEASES

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ABSTRACT

The quality of the drinking water is a universal health concern. This paper is an attempt to clarify concerns about the quality and safety of drinking water quality both tap and mineral on health of the people living in Dakahlia Governorate – Egypt. Drinking water samples were collected from 14 different locations of Dakahlia Governorate representing 73 samples and 7 samples of mineral water. These samples were analyzed for physicochemical and bacterlogical parameters. The found values of physicochemical and bacterlogical parameters were compared with the World Health Organization (WHO) and Egyptian Minstry of Health (EMH) water quality standards.
Study of all these characteristics and correlation studies indicate that in some of the studied areas water was polluted and not suitable for drinking purpose. The drinking water of these areas needs some degree of treatment before consumption and prevention steps to be taken from contamination.

KEY WORDS: Drinking water; physicochemical parameters; bacterlogical parameters; Atomic Absorption Spectrophotometer (AAS).

INFLUENCE OF WATER QUALITY OF THE DISTRIBUTION OF THE BENTHIC MACROINVERTEBRATE OF TAFNA RIVER (NORTH WESTERN OF ALGERIA)

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ABSTRACT

Tafna River is located in the north-western of Algeria. The samples were carried out during the spring period 2013 on nine (09) stations along the river.
Our results showed the variations in abundance and diversity of benthic macro-invertebrates identified in the various stations. The diversity decreases from upstream to downstream of the river and it is under the influence of notable disturbances such as organic pollution. Any alteration of the environment has consequences on the diversity of the environment.
The parameters indicative of physico-chemical quality have shown middle to bad state of the upstream to downstream of Tafna. This influence on the benthic macrofauna which hosts: its distribution, its sensibility to the pollution and thus its behavior and its requirement with such a degree of pollution.

KEY WORDS: water quality, benthic macro-invertebrate, distribution, sensibility, Tafna River.

WASTES IMPACT ON THE EGYPTIAN WATER RESOURCES AND THE NEED FOR DEVELOPMENT OF WATER TREATMENT TECHNOLOGY

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ABSTRACT

Water resources in Egypt are estimated by billion m^3/year (BCM/yr) as: Nile River (56.8), precipitation (1.8), fossil groundwater extraction (1.0), and seawater desalination (0.1) with sum of 59.7 BCM/yr. The use of spilled water resources (BMC/yr) are: renewable groundwater extraction (2.3), wastewater reuse (2.9), agriculture drainage reuse (7.5) with sum of 12.7 BCM/yr. It is forecasted that in year 2025 the population will increase from about 75 million in 2008 to 95 million, leading to a decrease in per capita water available from 800 to 600 m^3/ yr. The main water-using sector is agriculture, followed by municipal (53 Km^3, 8%) and industrial uses (4.0 Km^3, 6%). Water resources receiving large amount of untreated or inadequately treated wastewater, industrial wastes and agriculture wastes so, water quality in the Nile River deteriorates along the course of the river. Furthermore, climate change is likely to affect water quality through the expected sea level rise in the Nile Delta. Lake Nasser has good water quality with only small organic substance concentration. In 2007 average organic loads in River Nile water at 11 governorates remained below the allowed limits of 5 mg/l of BOD. This is because the high self purification processes in the river. However, in the same year COD was between the allowable limit of 10 mg/l in 7 of the governorates. A detailed study was undertaken in 2002 ranked water pollutants according to their severity to public health and the environment. Pathogenic microorganisms are ranked first, followed by organic compounds. Pesticides and heavy metals are ranked third. Nitrogen fertilizers present another source of pollution. Salinity is another important water quality issue. Drainage return flows to the Nile result into an increase in salinity of water. Lakes also receive a lot of pollutants that make fish unsafe for human consumption. Groundwater is contaminated by nitrogen and nitrate from fertilizers and subjected to the impact of pesticides and herbicides use. Shallow aquifers, in particular in Nile Delta are often heavily contaminated. Health impact of different pollutants and control of water pollution as the main challenge for the sustainability of water resources will be discussed.

Since all water uses require that water quality falls within a range specific to that use. Thus the present rate of deterioration of quality will certainly increase the severity of the water scarcity problem or add to the cost (i.e., treatment requirements of using water at levels expected in 2020. The present traditional water treatment processes will be insufficient to remove the pollutants to produce safe drinking water. Such advanced technologies as hybrid filtration systems, photo-catalytic systems, ozone and UV disinfection, activated carbon and innovative mixtures for removing dissolved metals are necessary and will be discussed to be applied. Also, low-cost technologies to provide safe water for rural area as well as other developing countries population will be presented.

KEY WORDS: Developments required for water treatment, Low-cost water treatment, Sources of water pollution, Water in developed countries, Water pollution. control, Water resources in Egypt.

INOCULATION BY TOLERANT RHIZOBIA STRAINS IS AN EFFICIENT SOLUTION TO WATER ECONOMIZATION IN ALFALFA IRRIGATION

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ABSTRACT

Alfalfa (*Medicago sativa L.*) is a widespread and cultivated forage legume in the world thanks to its high nutritional value, its high protein content and its effects on soil fertility (Huyghe, 2003). In Morocco, alfalfa occupies more than 100,000 Ha, or about 22% of the total area under forage crops (Bouizgaren et al., 2011).

Water deficit is an abiotic factor that affects the agricultural production with high frequency and intensity, influencing aspects related to plant development, and stability of the crops (Araus et al., 2002). Due to its ability to form root nodules in association with rhizobial strains that fixe atmospheric nitrogen N_2, the inoculation by tolerant rhizobial strains have shown positive effects on plants growth under this abiotic stress (Farissi et al., 2013). This study carried out to assess the effect of rhizobial strain (Rh9) inoculation on growth and some physiological parameters in 2 Moroccan alfalfa (*Medicago sativa L.*) populations (Tata and Tafilalet) under water deficit conditions in order to minimize the utilization of water in irrigation.

The experiment was conducted in greenhouse at 32/22 15 °C d / n, 50-80% of relative humidity and a photoperiod of 16 h. seeds of alfalfa were disinfected and germinated in petri dishes at 25 ºC under dark conditions. Seedlings were transferred to plastic pots filled with sterile sand and peat at 4/5 and 1/5 ratio respectively and inoculated or not separately with the suspension of rhizobial strain Rh9 (10^{8} Cells / ml) that were isolated from nodules of *Medicago sativa L* grown in soils of South-East region of Morocco (Latrach et al 2012) and previously tested and selected for its tolerance to water deficit induced by different PEG 6000 concentrations in petri dishes, after that the seedlings were grown under 2 irrigation regimes, 80% of field capacity (control) and 40% of field capacity (Water deficit). The water deficit was applied for thirteen days and some agro-physiological and biochemical parameters related to water deficit tolerance were assessed at the flowering stage.

The obtained results showed that water deficit has significantly reduced the growth parameters (height of plants, leaves area, dry biomass and nodulation). Plants inoculated with rhizobial strains Rh9 have shown close values to well watered plants compared to non-inoculated.

This constraint has also negatively affected the relative water content, membrane permeability, chlorophyll content and stomatal conductance of leaves significantly. The comparison among the non-inoculated and inoculated alfalfa plants which received the half of

water quantity showed a significant difference in their behavior under this abiotic stress. The plants inoculated with the rhizobial strain Rh9 were more tolerant to water deficit conditions. The impact of drought can be reduced through the selection and characterization of water deficit legumes tolerant symbiotic combinations, their tolerance was associated with the maintaining of adequate levels in terms of physiological and biochemical parameters studied and may constitute a biotechnological way to improve water use economization for irrigation.

KEY WORDS: alfalfa, growth, nodulation, water deficit, tolerance, water economy.

ETUDE COMPARATIVE ENTRE DEUX SYSTEMES D'EPURATION DES EAUX USEES DANS UN ECOSYSTEME ARIDE

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RESUME

Les eaux usées non traitées ou traitées de façon inadéquate et déversées dans les plans d'eau sont considérées depuis plus de 30 ans comme une source de pollution et d'eutrophisation des milieux aquatiques.
Historiquement, les installations effectuant le traitement des eaux usées en provenance des résidences isolées ont été conçues afin d'effectuer un traitement bactérien des eaux, dans une perspective de protection de la santé publique.
De nos jours, on constate qu'elles génèrent des apports en phosphore dans les milieux aquatiques, et ce, d'autant plus si elles sont inadéquates ou non conformes.
Pour cela, plusieurs procédés d'épuration des eaux usées ont été créés pour minimiser ce danger, mais quelle technique choisi-t-on?
Notre étude consiste à comparer entre deux procédés d'épuration des eaux usées, à savoir le lagunage aéré et l'épuration à boue activée (STEP classique).

MOTS CLES : eaux usées, lagunage aéré, STEP classique, écosystème aride.

TOPIC 4

Energy efficiency in wastewater treatment

SOLAR PHOTO-FENTON USING PERSULFATE/PEROXYMONOSULFATE FOR PHARMACEUTICAL RESIDUES REMOVAL FROM DOMESTIC WASTEWATER

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ABSTRACT

Domestic wastewater treatment plants (WWTPs) effluent reuse has emerged as one of the most viable approaches for crop irrigation and to alleviate water stress. However, its wider acceptance is hampered in part by the occurrence of pharmaceutically active compounds (PhACs) and others organic micropollutants, which are slightly transformed or even unchanged during current biological water treatment. Advanced oxidation processes (AOPs) based on the generation of the highly oxidative hydroxyl radical (HR) such as solar photo-Fenton technologies have turned out to be one of the promising and competitive technologies for the abatement of various bio-recalcitrant PhACs. However, HR based AOPs proceed through unselective multistep pathways which limit its efficiency in complex environmental matrices, natural organic matter (NOM) and carbonate / hydrogenocarbonate anions being among the main HR scavengers in wastewaters. To avoid in part these limitations, sulfate radical anion ($SO_4^{\bullet-}$, SRA) has been regarded as a promising alternative to HR even though less is known about its reactivity in aqueous media. SRA has demonstrated absolute kinetic rate constants with PhACs equivalent to those with HR but reacts more selectively than HR mainly through one electron oxidation mechanisms limiting the scavenging effect of NOM and inorganic ions (Mahdi-Ahmed et al., 2012). Generation of SRA can be achieved through peroxydisulfate (PDS) or peroxymonosulfate (PMS) activation by UV/Vis irradiation leading in the former case to two SRA moles and in the latter case one mole of HR ad one mole of SRA. This work aims at decontaminating biologically treated domestic wastewater effluent from PhACs by SRA based homogeneous photo-Fenton involving persulfate (PDS) or peroxymonosulfate (PMS) as an oxidant, ferrous iron (Fe(II)) as a catalyst and simulated solar irradiation as a light source. This is the first time that the beneficiary use of solar energy in PDS/Fe(II)/UV-Vis system was evaluated by using several probe compounds (diclofenac, sulfamethoxazole, carbamazepine and ciprofloxacin). For instance, in wastewater, carbamazepine was fully degraded in 30 min for an initial CBZ concentration of 50 µM and an optimal PDS:Fe(II) molar ratio of 2:1 thanks to the high selectivity in reactivity of SRA in complex matrices. By-products were identified using liquid chromatography-high resolution-mass spectrometry allowing for the establishment of degradation pathways. PhACs first underwent degradation through one electron transfer oxidation processes due to SRA reactivity followed by hydroxylation processes through HR formed by Fe(III) photoreduction. The sequential generation of SAR and HR has made PDS/Fe(II)/UV-Vis a kinetically effective process in removing PhACs from wastewater without the accumulation of toxic intermediates and opens new economical feasible remediation strategies for tertiary treatment in domestic wastewater treatment plants.

KEY WORDS: Sulfate radical; wastewater; solar photo-Fenton; pharmaceutical; transformation pathways.

HIGH RATE ALGAL PONDS PERFORMANCE FOR BIOGAZ PRODUCTION TREATING DOMESTIC WASTEWATER

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ABSTRACT

Low cost wastewater treatment technologies, such as high rate algal ponds (HRAP) are possible alternative solutions for arid and semi-arid regions, where small communities suffer from water shortage. Furthermore, this system could provide water reuse and bioenergy generation through anaerobic digestion. The performance of a pilot high rate algal pond treating domestic wastewater was evaluated under Mediterranean climatic conditions in Barcelona (Spain) over a period of one year. The main objectives of this study were to determine the wastewater treatment efficiency of this system, to investigate the microalgal productivity and to evaluate biogas production. The results showed the efficiency of this system in removing organic (over 80% COD removal) and nutrient contents (over 95% removal) of the municipal wastewater. Biomass productivity was influenced by seasonal variations, reaching the highest productivity on the months of April to June 2013 (17 $g/m^2 \cdot d$). Dynamics of microalgae species also showed a high variation during the campaign. However, *Monoraphidium* sp. and *Nitzschia* sp. were generally predominant. Accordingly, the variation in microalgal biomass determined the anaerobic digestion performance evaluated in lab-scale reactors. Microalgae methane yield ranged between 0.08-0.21 L CH_4/g COD, with highest performance when HRT was raised from 15 to 20 days (100-150% increase).

KEY WORDS: Biogas; Biofuel; Photobioreactor; High rate pond; Microalgae; Wastewater

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REMOVAL OF TYLOSIN FROM AQUEOUS SOLUTIONBY ACTIVATED CARBON SYNTHESIZED FROM WHEAT BRAN

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ABSTRACT

Water pollution due to antibiotics compounds has been a major cause of concern for chemists and environmental engineers in recent years, it occupies an important place due to the high amounts consumed in both veterinary and human medicine. Their presence and accumulation in natural waters constitutes an emerging pollution leading to the disruption of ecosystems and increased malfunction in the reproduction of aquatic species such as fish. Activated carbon has been widely used in water treatment to remove organic and inorganic pollutants because of its high adsorption surface area, high amount, rate of adsorption and specific surface reactivity.

The aim of this work is to study the effectiveness of the tylosin adsorption from wastewater onto activated carbon. Tylosin is one of antibiotics used in veterinary medicine as a macrolide antibiotic and as an antibacterial agent for better assimilation of food and accelerating weight gain.

Activated carbon was prepared from wheat bran by chemical activation using sulfuric acid. The adsorption of tylosin onto activated carbon synthesized from wheat bran was investigated as a function of initial pH(1-7), stirring speed (100-1000 rpm), initial tylosin concentration(10 mg/l) and the amount of adsorbent (0.2-1 g/l).Preliminary tylosin adsorption tests were performed gives us a removal rate of more than 60% in 3 h, it was found that the adsorption increased with increasing the amount of adsorbent, a stirring speed and pH of around (400 rpm) and (3-4) respectively.

KEY WORDS: tylosin**,** adsorption, activated carbon, wheat bran.

TREATMENT OF DAIRY EFFLUENTS BY COAGULATION–FLOCCULATION WITH OPUNTIA FICUS INDICA

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ABSTRACT

The *Opuntia ficus-indica* cactus indigenous to Mexico is being tested as a flocculating agent to dairy effluents. The performance and the quality of treated Effluent were evaluated by measuring the residual turbidity. The results showed the effectiveness of different solutions of Opuntia with the best removal of 20 NTU for the most turbid effluent, by using 5 mg/L of Opuntia concentration. It may be possible to recycle the treated water for some industrial uses. This study concludes that the potential of mucilage extracted from the Opuntia spp as a flocculation agent to turbidity removal in the treated dairy effluents.

KEY WORDS: Coagulation–flocculation, Dairy Effluents, Opuntia, Turbidity.

PARAMETRIC STUDY OF METHYLENE BLUE DEGRADATION USING IMMOBILIZED TiO_2 UNDER SUNLIGHT

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ABSTRACT

About 15% of the total world production of dyes is lost during the dyeing process and is released in the textile effluents. The release of those colored waste waters in the ecosystem is a dramatic source of non-aesthetic pollution, eutrophication and perturbations in the aquatic life. As international environmental standards are becoming more stringent (ISO 14001, October 1996), technological systems for the removal of organic pollutants, such as dyes have been recently developed. Among them, physical methods, such as adsorption, biological methods (biodegradation) and chemical methods (chlorination, ozonation) are the most frequently used. Among the new oxidation methods or advanced oxidation processes (AOP), heterogeneous photocatalysis appears as an emerging destructive technology leading to the total mineralization of most of the organic pollutants. Photocatalytic processes in water by oxidation using a catalyst have been the subject of several researches recently. The mostly investigated photocatalyst for the degradation of organic pollutants is TiO_2. TiO_2 is remarkably photocatalytically active, cheap, non-toxic, chemically stable over a wide pH range, and is not subject to photocorrosion.

It can be used in mobilized or immobilized status, but its consumption is less in immobilized form and its process is economical. The use of TiO_2 in suspension is efficient due to the large surface area of catalyst available for reaction and due to the absence of mass transfer limitations. However, the need for a solid-liquid separation step to retrieve the catalyst after the reaction is a severe and expensive disadvantage of this system compared to the application of an immobilized TiO_2 system. On the other hand, the penetration depth of light is limited in slurries and the immobilized photocatalyst shows an inherent decrease in the specific surface area available for reactions. Assessing all the advantages and disadvantages for the different methods it can be said that the immobilized system shows more advantages mainly due to the cheaper running costs.

The goal of this paper is to test the effectiveness of immobilized TiO_2 for degradation of Methylen Blue which is an organic dye reference. Immobilization is used to stabilize TiO_2 particles on reactor surfaces. Two different methods were applied and their coating properties were compared. The first one was direct deposition of TiO_2 on cement surface; the second was by incorporated during the preparation of the cement base. This process is more stable than direct deposition method and its regeneration is simpler. Moreover, it can be applied on non-glass surfaces. Other advantages of this method are water and chemical resistant, UV resistant, mechanical stability, chemical inactivity, and cost effective.
Preliminary results of this study showed that the second method to immobilize TiO_2 is more effective. Its surface preparation is very critical in order to increase the stability of catalyst

and its life time. The conditions of process and critical parameters have been delineated. Different experiments have been done, such as effect of initial concentration of MB, pH of solution and quantity of TiO_2.

KEY WORDS: TiO_2 photocatalyst, ciment, Methylene Blue, wastewater treatment, solar irradiation.

IMPACT ASSESSMENT OF DEFICIT IRRIGATION ON YIELD AND FRUIT QUALITY IN PEACH ORCHARD

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ABSTRACT

The aim of the work was to assess if the irrigation target and frequency when using Regulated Deficit Irrigation strategy (RDI) does affect peach trees (*Prunus persica* (L.)) in terms of crop water uptake, water use efficiency (WUE) and Physiological responses like yield and fruit quality. Six treatments were applied: the control (T0) and five RDI treatments. The control received 100% of the crop water requirements (ETc) with 0.8mm per irrigation supply, whereas RDI100-0.4mm, RDI75-0.8mm, RDI75-0.4mm, RDI50-0.8mm, RDI50-0.4mm were respectively irrigated at 100%, 75%, and 50% of ETc. New technologies have been used to help on decision making for irrigation such as meteo-stations, Soil moisture sensor, Pulse flow meter and Telemetry system.

Higher yield and good quality could be obtained with less irrigation water and adequate frequency (RDI75-0.4mm). The actual work recommends adopting RDI50-0.4mm in the early stages, and RDI75-0.4 during fruit development, although, just before maturity we can use RDI50-0.4 to accelerate the fruits maturity.

KEY WORDS: Peach, Irrigation, WUE, RDI, Fruit quality.

TOPIC 5

Water treatment policies

WATER REUSE IN EGYPT

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ABSTRACT

Several regions in our world have been suffering water stress. Approximately, 436 million people living in 29 countries suffer water scarcity. These figures are expected to increase three to fivefold by 2050. Water deficit is the result of burgeoning population, unequal access to water resources by various social classes, growth in different sectors of the economy, practices that degrade --rather than conserve-- water quality, and the lack of institutions capable of managing water deficit and degradation. Egypt covers a very arid region situated between the Sahara and Arabian deserts.

Egypt is extremely dependent on the River Nile, being the most downstream country in the Nile basin. 97% of the population lives on 4% of the land of Egypt, around the river Nile. The most pressing challenge facing water resources development in Egypt are rapid growth and unbalanced distribution of the population, rapid urbanization, water quality deterioration, government‘s policy to reclaim new land, and unsustainable water use practices. Now Egypt is reaching its limits of available water and this will not be possible anymore and Egypt will have to face variable supply conditions.

The research aims for capturing wastewater for reuse in order to reduce the gap between an ever-growing water demand and a rigid supply.

KEY WORDS: wastewater, reuse, water security, water quality.

NANO COMPOSITES OF POLYSTYRENE DIVINYLBENZENE RESIN BASED ON OXIDIZED MULTI-WALLED CARBON NANOTUBES

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ABSTRACT

In this work, we synthesized two cation exchange resins from poly styrene divinyl benzene (PS-DVB) and such copolymer with oxidized MWNCTs (Nano Composites). The prepared cation exchange resins were characterized using infrared spectroscopy, thermal stability analysis, X-ray diffraction, and field emission scanning electron microscope. Also, the ion capacities of prepared cation exchange resins were determined by titration. Based on the experimental results, it was found that the thermal stability of prepared nanocomposites in presence of oxidized MWNCTs increased up to 622°C. The X- ray pattern texture of PS-DVB copolymer exhibit amorphous pattern structure with indication peak at 20°, whereas, the nanocomposite exhibit two indication peaks at 20°, and 26° for the copolymer and MWCNTs, respectively. The cation exchange capacity increased from 225.6meq/100g to "323meq/100g", for copolymer PS-DVB and its Nanocomposites resins, respectively.

KEY WORDS: grafting, CNTs, oxidized Multi-Walled Carbon Nanotubes, suspension polymerization, resin.

PHYSICAL AND CHEMICAL CHARACTERIZATION OF THE WATERS OF LAKE DAM GHRIB (W. AIN DEFLA, ALGERIA)

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ABSTRACT

The Ghrib dam is one of the largest Algerian reservoir with a maximum storage capacity of 145 million m3. It controls a catchment area of 2800 km2. It was created on the Oued Chéliff, which is located in the province of Ain Defla in the southwestern part of Algiers, and downstream the Boughzoul dam which serves as a settling pond to it. The waters of this restraint are intended to supply drinking water to the city of Algiers and Medea Berrouaghia and to irrigate the plains of Upper and Lower Chellif.
The fish fauna of the dam is represented by six species of Cyprinidae against a species of Percidae. Our goal is to assess the impact of the fish fauna on the water quality of the dam to monitor the evolution of the water quality of the dam. For this purpose, monthly water samples were carried out between 2010 and 2011. The physico-chemical analyzes of water from the Ghrib dam show that they are hard and slightly alkaline. The lake can be classified as a hot monomictic lake. The distribution of Ca2 + and Mg2 + ions shows that the chemistry is strongly linked to the lithology of the water, following the dissolution of carbonate formations and gypsum formations. In addition, it appears that the waters of the reservoir were well oxygenated throughout the study period.

KEY WORDS: Physico-chemistry of water, fish fauna, dam Ghrib, Algeria.

ESTIMATION OF PHYSICO-CHEMICAL AND BACTERIAL QUALITY OF THE WATER OF LAKE RÉGHAÏA (NORTHERN MITIDJA, ALGERIA)

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ABSTRACT

The lake Réghaïa represents a real coastal biotope for numerous living beings. Permanent waters of this natural reserve, classified a Ramsar site in 2003, are mixed directly with urban, industrial and agricultural waste and are receiving daily (about 80,000 m^3 of polluted water/ day and without pre-treatment).
Our objective is to estimate the physicochemical and bacterial pollution of this hydrosystem subjected to various types of wastes. During our study, analyses were monthly carried out from surface and depth in different stations: (two stations) upstream, one in the middle and the latest one downstream.
The physicochemical analyses reveal high concentrations in organic matter, nitrate and phosphate, these elements are responsible for environmental degradation. However, bacteriological analysis show that the lake Réghaïa is contaminated by fecal streptococci, especially in stations selected upstream, coliforms are present but at lesser degree. Finally, the absence of pathogens such as salmonella and vibrio is reassuring. This form of contamination is indicative of a real fecal risk necessarily require strict control without which water for irrigation will be bad.
Faced with this situation, it would be interesting that socioeconomic authors engage in a rigorous management of treatment stations and sewage.

KEY WORDS: Physicochemical and bacteriological quality of water, lake Réghaïa, Algeria.

THE APPLICATION OF BIOLOGICAL PROCESSES IN INDUSTRIAL WASTE WATER TREATMENT

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ABSTRACT

Water is critical source for industrial plants and waste water treatment makes up an important component of many management strategies. Industrial firms seek possibilities of reuse wastewater and process water as water availability becomes scarce to provide environmentally sustainable wastewater treatment while reducing compliance costs and maintaining value for their business. The application of the biological waste water processes are sustainable and environmental friendly to environment and also cost saving. The contribution deals with biological processes used for the treatment of industrial waste water. There are described aerobic and anaerobic biological processes, which utilise the microorganisms to reduce organic compounds and simultaneously some inorganic compounds, heavy metals, etc.

KEY WORDS: biological process, waste water treatment, microorganism, efficiency, environment.

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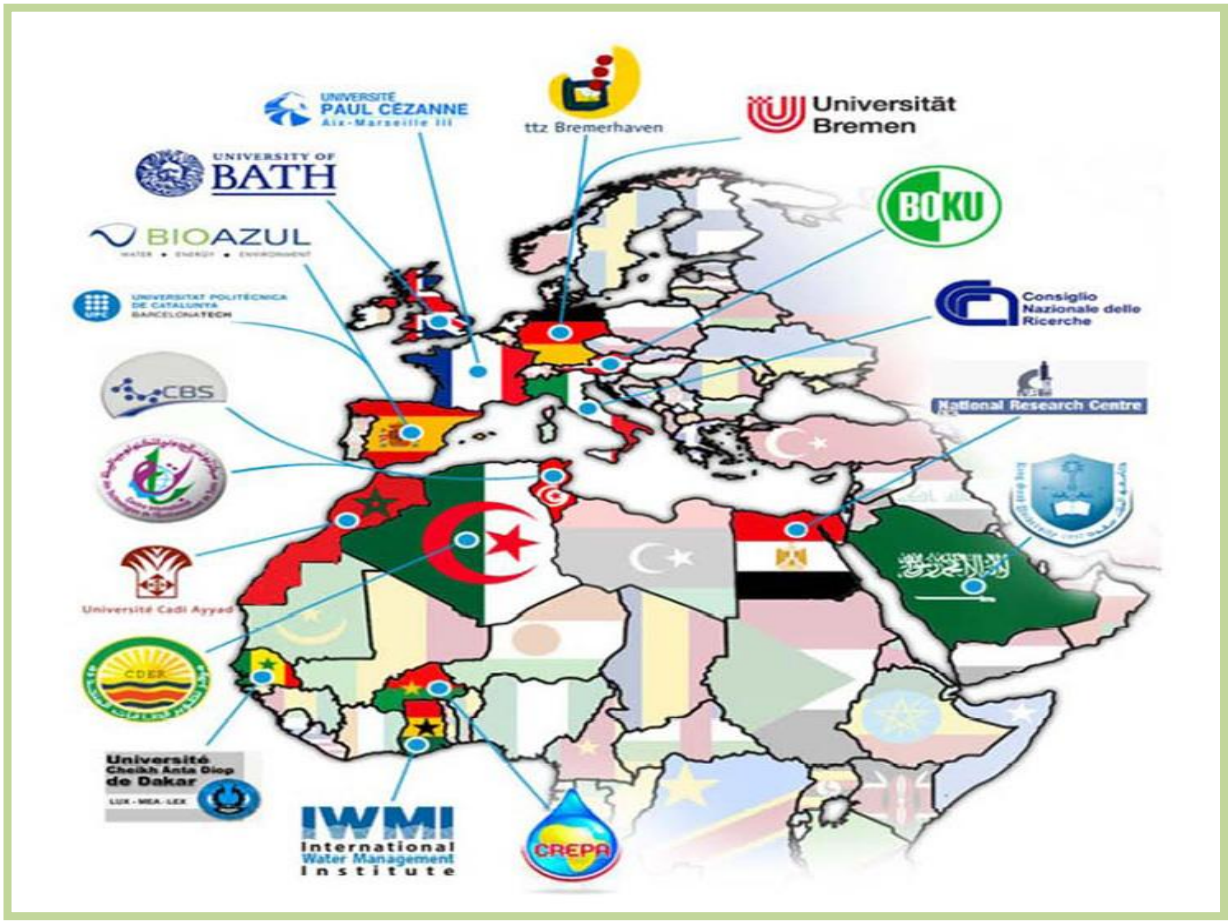

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