CMTDE
2022

BOOK OF ABSTRACTS

8th Maghreb Conference on Desalination and Water Treatment

19 - 22 December 2022

Sol Azur Beach Congress Hotel 4*, Hammamet, Tunisia

Organized by

الجمعية التونسية لتحلية المياه
TDA
Tunisian Desalination Association

Laboratoire de Recherche
"Dessalement et Traitement des Eaux"
LRDTE
Code : LR18ES01
Université de Tunis El Manar
Faculté des Sciences de Tunis

With the collaboration of

European Deasalination Society

U T M
جامعة تونس المنار
UNIVERSITÉ DE TUNIS EL MANAR

Professor Béchir HAMROUNI

Chairman of the CMTDE 2022

Guest Editor, Desalination and Water Treatment Journal

President of the Tunisian Desalination Association

On my behalf and on the behalf of the organization committee we welcome you to the 8th edition of The Mahgerb Conference on Desalination and Water Treatment. I would like to thank Professor Moez CHAFRA, President of the University of Tunis El Manar and Professor Noureddine AMDOUNI, Dean of the Faculty of Sciences of Tunis, for agreeing to honor us by presiding over the opening ceremony of our event.

Professor Miriam BALABAN has always honored us with her presence, we express our gratitude to her for the continued support.

A big thank you to our speakers who accepted our invitation to make us benefit from their experiences.

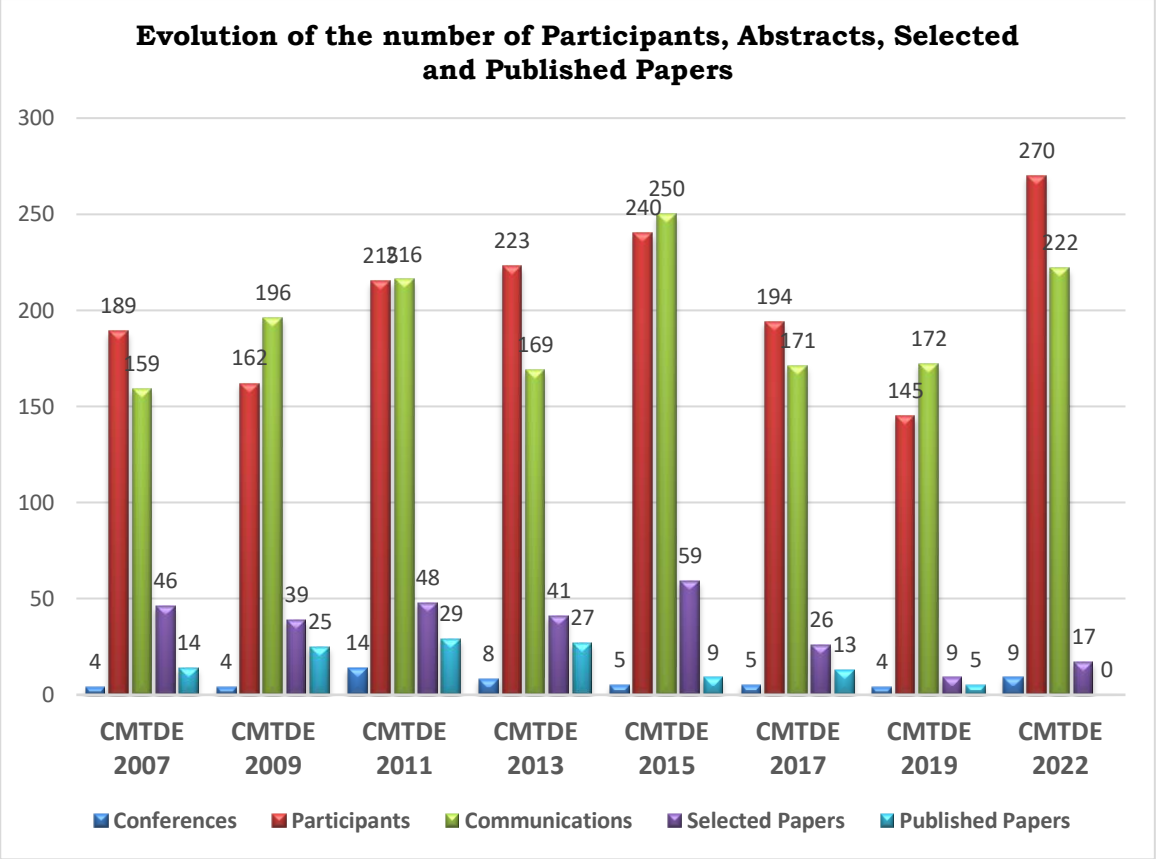
The increasing scarcity of freshwater sources and the global demand for water is expected to grow in the oncoming decades which urge the need to develop alternative water supplies, including seawater desalination, reuse and recycling of wastewater. That is why the Maghreb Conference on Desalination and Water Treatment was initiated in 2007 by the Tunisian Desalination Association and Desalination, with the support of the European Desalination Society. CMTDE is the unique Conference organized in the field of desalination and water treatment. It is held every two years and has become a successful platform to discuss advances and share experiences in desalination processes, water and wastewater treatments. In each edition, selected papers are published, after peer review, in Desalination and Water Treatment Journal.

Here, we express our sincere thanks to Professor Miriam Balaban, editor-in-chief of this journal, for her help, encouragement and for making special issues possible. We also thank the reviewers for their availability and quick responses.

Conference topics were varied including membrane and thermal desalination processes, pretreatment, post-treatment of desalinated waters, wastewater treatment and reuse, economic and environmental aspects of desalination, renewable energy.

This conference offers you 9 plenary Conferences, 222 communications (for oral and poster presentations) and a panel session on innovation opportunities for the future and on improving the status of the Tunisian Desalination Association.

Since the first edition of CMTDE, the evolution of the number of participants, communications, selected papers and published papers is summarized in the following histogram:



Homage to Professor Miriam BALABAN

The successful organization until today without interruption of eight edition of the CMTDE was made possible thanks to the help of Professor Miriam Balaban Secretary General of the European Desalination Society and Editor-in-Chief of the journal desalination and water treatment.

With our greatest appreciation, the University of Tunis El Manar and the Tunisian Desalination Association honor Professor Miriam BALABAN for her collaboration for the development and dissemination of research on Desalination and Water Treatment.

For more than half a century, Prof. Miriam BALABAN has been a pillar of the global desalination community. The focus of Balaban's research career has been desalination. In 1966, Balaban founded Desalination, the first international journal for desalting and purification of water, serving as its editor-in-chief from 1996 to 2009. In 2009 Balaban established and became editor-in-chief of the monthly Desalination and Water Treatment

Journal, to accommodate the expanding field. She has reviewed and edited more than 20,000 papers and several books from over 100 countries. She is the editor and publisher of the Desalination Directory. The international online database connects over 30,000 individuals and 5,000 academic and government institutions and companies involved in desalination and water conservation.
Balaban has been a member of the International Desalination Association since 1975 and has served as a board member and officer. She is a member of the Scientific Program Committee for the International Desalination Workshop.

Since 1993, Balaban has been the secretary general of the European Desalination Society (EDS), located at the Università Campus Bio-Medico, Rome, Italy. Balaban organizes international courses, conferences and workshops in desalination, traveling and speaking internationally. She has been referred to as "the soul of the European Desalination Society".

She received recognition for her work from different parts of the community. On our side, today, taking advantage of the opening ceremony of the 8th edition of the CMTDE, the University of Tunis El Manar and the Tunisian Desalination Association are pleased to honor Professor Miriam BALABAN.

Looking forward to seeing you in Hammamet.

Tunis, December 19, 2022

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Professor Enrico Drioli

Enrico Drioli Emeritus Professor at the School of Engineering of the University of Calabria. Founding Director of the Institute on Membrane Technology, CNR, Italy. Since 2018 Distinguished Visiting Professor at Nanjing Tech University, College of Chemical Engineering. Since 2018 Guest Professor of School of Marine Science and Technology of Harbin Institute of Technology, Weihai, P.R.China. Since 2012 Distinguished Adjunct Professor, CEDT King Abdulaziz University, Jeddah Saudi Arabia; 2010-2020 WCU Distinguish Visiting Professor, at the Hanyang University, Seoul Korea. Currently Chairman of the Section on "Membrane Engineering" of the European Federation of Chemical Engineering and coordinator of EU-EUDIME Doctorate School on Membrane Engineering. He has been coordinator of several international research projects. He is Honorary President of European Membrane Society (1999) and is involved in many International Societies, Scientific Committees, Editorial Boards, and International Advisory Boards.

He is the recipient of various Awards and Honours, ex. “Richard Maling Barrer Prize” of the EMS, Academician Semenov Medal of Russian Academy of Engineering Science, MIAC International Award for his contributions in the field of Membrane Science and Technologies, etc. He is author of more than 970 scientific papers, 24 patents and 32 books on Membrane Science and Technology.

Progress in integrated membrane systems for fresh production and minerals recovery from the sea

Enrico Drioli[1, 2, 3]

[1] Institute on Membrane Technology (ITM–CNR), c/o University of Calabria, Italy
[2] University of Calabria - Department of Environmental and Chemical Engineering, Rende, Italy
[3]State Key Laboratory of Materials-Oriented Chemical Engineering, College of Chemical Engineering, Nanjing Tech University, Nanjing, 211816, China

Abstract

Membrane engineering is one of the disciplines most involved in the technological innovations necessary to face the problems characterizing the world today and in future such as water shortage, raw material depletion, and energy consumption. In desalination and wastewater treatment purification and recycle, in biomedical application, in food and beverage production and in various other strategical area, integrated membrane operation have a strategic central role.

Important progresses have been achieved in industrial applications and in the recent years.

Redesign on the mining industry introducing membrane systems in the recovery of minerals from sea and brackish water, contributions on space engineering and redesign agrofood for the growth of membrane engineering, are typical examples.

P. Ing. Hervé BUISSON

Hervé BUISSON is a citizen of France, Canada, and USA. He is graduated from Lycee Thiers (MathSpe M') in Marseille, France and ENSIACET (ex ENSIGC, Chemical Engineering) in Toulouse, France, with MSc specialisation in biotechnology and material sciences at Ecole Polytechnique of Montreal and McMaster University in Canada.
Herve Buisson is the author of numerous papers, publications, patents, a list of which can be given upon request.
Recognized global expert in Water and Wastewater Treatment and reuse/recycling with 30+ years in Industry, Hervé Buisson has held various senior technical and innovation positions including: Program Manager Membrane Processes / Pulp and Paper and Food and Beverage at the Waste Water Technology Centre of Environment Canada (Burlington, Ontario). Manager of Veolia's Corporate Research Centre in Maisons-Laffitte (France). Vice- President Process Engineering, Veolia Water Technologies Americas (Cary, NC, USA), Senior Advisor – Innovation and Technologies (Veolia Water Technologies - Saint Maurice-France).

He has acted as a technical advisor for various public and private institutions (European Commission, Environment Canada, AWWARF, WERF, Duke University, Singapore SCELSE project….), and is a frequent invited speaker on water and filtration related topics. Fluent with all aspects of water and wastewater treatment, his specialized expertise and specific focus lies in membrane processes and their integration into novel water cycle management schemes, as well as novel nanotechnologies based solutions.

Hervé Buisson most recent additional focus is on developing efficient and cost-effective innovation engines, effective ideation, open innovation, interactions between academia, public-private research.

"Translation of Innovation to Industry: An Industrial Perspective in Desalination and Reuse"

Hervé BUISSON,

P.Eng., Veolia Water Technologies – Design Centre
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Abstract

Over the years desalination plants have benefitted from many innovations; some incremental and some disruptive. Indeed, the mega RO plants of today are quite different from the MSF plants of the 60s-70s! Over time, RO designs have become more standard and commoditized, around the current polyamide 8"x40" SWRO module, with some local adaptation, notably of pretreatment and post-treatment. With such standardization and volume increase, prices have gone down significantly, with sea water desalination projects producing fresh water at a cost

below 1 euro/m3, even down to 40cts/m3 with some local conditions! Today's dominant design for RO desalination plants is very strong, even representing a barrier to the introduction of new processes, new membranes or new designs, (a good illustration of this point being the well know "failure" of the 16" or 18" modules).

Yet, market drivers are fast evolving since the early 2000 fueled by water scarcity, and the impact of climate change in some parts of the world. Energy considerations, CO_2 and environmental footprints, water recoveries are more important than ever, so is the need for find new more energy and water efficient ways to produce fresh water out of seawaters, brackish waters and wastewaters. At the same time material science, and our understanding of microbial ecology has also progressed a lot.

So the time has probably come to innovate again and bring better systems to the market fast.

From new very high permeability RO membranes with artificial channels, to digital smart and adaptative control , to a better toolkit to fight biofouling and scaling, and an increased focus on lower energy consumption wastewater reuse schemes, many innovation pathways exist today to shape tomorrows plants. The presentation will introduce some of them and focus on the challenges and opportunities to bring those to market fast, with some illustrations from recent projects done by Veolia and others.

Dr. Núria FIOL

Dr. Núria FIOL has the Chemical Engineering Degree and Degree in Chemistry. Doctor by University of Girona (Spain) in environmental technology. She is professor and Director of Chemical and Agricultural Engineering and Agrifood Technology Department at University of Girona (Spain). She is specialized in analytical chemistry, materials characterization, and removal of contaminants by sorption processes.

She has participated in 18 research project and 4 educational projects related to new learning methodologies. She has published more than 50 articles and participated in congress worldwide. Since 2001, she supervises UdG, Erasmus and PhD students in their degree, master and doctoral thesis.

Elimination of metal ions by microalgae: a research and learning project

Dr. Núria Fiol

Department of Chemical and Agricultural Engineering and Agrifood Technology.
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Abstract

New teaching methodologies are changing the educational approach to increase academic performance among students. In the recent years, universities and schools are progressively embracing the Project-Based Learning (PBL) methodology that **allow students to acquire key knowledge and skills through the development of projects that respond to real-life situations. It is considered a much-appropriated** method for the teaching sciences when it comes to training students. Projects based on water contamination and water treatment are relatively easy to carry out and arouse great interest among the sciences students.

Water quality issues are a major challenge that humanity is facing in the twenty-first century. Emphasis is placed on chemical pollution, particularly on inorganic and organic pollutants including toxic metals and metalloids. Inorganic pollutants are not subject to degradation like many of the organic pollutants and can accumulate in human beings through the consumption of contaminated water and food. During the last decades, researches has been studied the way to find a sustainable and environmentally friendly remediation approach to eliminate metals from aqueous solutions, and remediation by algal species has recently emerged as an appealing technique.

Humans have used algae as food for hundreds of years and nowadays, thanks to the development of marine biotechnology, algae are being cultivated and used for different purposes such as production of food, biocompouds source or water treatment. Biological removal of metals is possible by both living and non living algal biomass and plenty of research studies have been published concluding the

optimal conditions for the removal of metal ions by different algae species. Microalgae have recently attracted considerable interest worldwide, due to their ability to convert atmospheric CO_2 to useful products such as carbohydrates, lipids, and other bioactive metabolites and its potential use for wastewater treatment and energy production.

Based on recent literature that demonstrate the capacity of some microalgae species to adsorb and bioadsorb metals, a learning and research experience based on PBL was designed to be applied in vocational and training studies in analytical chemistry and pharmaceutical products. One of the mains objectives of this project is the use of microalgae as sorbents for the treatment of wastewater that students generate in their own laboratories. The project requires knowledge and skills for cultivation microalgae, sorption experimentation and chemical analysis that will be acquired through applied methods. Literature related to these subjects will be the grounding base of the theoretical part of the PBL experience. The project will be carried out during two academic years in three Spanish secondary education centers: IES Costa Teguise (Canary Islands), IES Politècnico Las Palmas (Canary Islands) and IES Montilivi (Catalonia). The centers have the scientific support of the Spanish Algae Bank of the University of Las Palmas de Gran Canaria (Canary Islands) and the Department of Chemical Engineering of the University of Girona (Catalonia) and is funded by the Spanish Ministry of Education.

The initial part of this PBL project will be devoted to select the most suitable microalgae for its future application. For this, it will be necessary to characterize the wastewater generated in laboratories. After that, microalgae will be cultivated in the educational centers under the necessary conditions for their growth and production (nutrients, light conditions, temperature) with the support and advice of the Spanish Bank of Algae. After microalgae harvesting, the study to eliminate contaminants from waters will be carried out with the scientific advice and analytical equipment form the University of Girona.

All educational centers will work together according to PBL methodologies, including different competences, transversal skills and promoting communication between the students from the centers participating in the project to exchange ideas, problems and solutions.

Acknowledgement

This project was funded by the Spanish Ministry of “Ministerio de Educación y Formación Profesional” (PROYECTO ALGAS 2021).

Prof. Philippe HABERSCHILL

Philippe HABERSCHILL (70 ans) est maître de Conférences émérite depuis début 2017 au Centre d'Énergétique et Thermique de l'INSA de Lyon. Il a enseigné notamment la thermodynamique générale, les mesures physiques et le Froid Industriel pendant plus de 20 années. Son domaine de recherche est l'étude expérimentale et la modélisation dans le domaine de la réfrigération et des pompes à chaleur. Sur ces thèmes il a supervisé une trentaine de thèses et participé à la rédaction de plus de 100 publications et communications lors de congrès. C'est un membre reconnu de la communauté française du froid, à ce titre il est membre du comité de rédaction de la Revue Générale du Froid et titulaire de la médaille C. Tellier de l'AFF.

Intérêt des générateurs thermodynamiques pour le dessalement

P. Haberschill

Univ Lyon, INSA Lyon, CNRS, CETHIL, UMR5008, 69621 Villeurbanne, France

Abstract

Dans le conteste de réduction des consommation d'énergie, nous nous sommes intéressés à l'utilisation des machines thermodynamiques (machines frigorifiques et pompes à chaleur) pour le dessalement de l'eau de mer. Ces machines permettent la production de froid comme de chaud aussi elles peuvent être employées comme source thermique des systèmes de dessalement par ébullition comme par congélation de l'eau. Nous ferons un tour d'horizon des systèmes de ce type en en précisant leurs caractéristiques. Les nouvelles générations de machines, à haute température notamment seront évoquées, leur intérêt pour le dessalement mis en évide.

Prof. Hamza ELFIL

Pr. Hamza ELFIL is the Head of Laboratory Desalination and Natural Water Valorization (LaDVEN) in CERTE. In 1999, he obtained his PhD in Process Engineering – Water Treatment - from INSA Toulouse, France. His main research interests are related to water desalination, water quality and scaling phenomena in natural water. He offers many activities and lectures about water desalination and qualities and related topics for the public to make science more attractive and understandable**.**

Desalination of irrigation water: Added values and disadvantages

Pr. Hamza Elfil
Head of Desalination and Valorization of Natural Water Laboratory
Water Research and Technologies Center (CERTE)

Abstract

Salinity is a common problem for irrigators in arid and semi-arid climates, due to soluble salts in irrigation water. High salinity lowers crop yields and causes soil salinization.

Desalination of brackish irrigation water could be a solution to reduce salt stress as well as agricultural water stress. Results on agricultural land have shown that irrigation with water produced by desalination process increased considerably the yield of tomatoes and peppers and ameliorated their qualities, compared to those grown with raw water. The gain calculated, based on real price of desalinated water (about 1.1 DT/L), was much higher than that obtained by saltwater irrigation. Desalination also provides to select the best water salinity for the agricultural product required.

The main disadvantage of water desalination, in the agricultural field, lies mainly in the brine discharges with a salinity of up to 4 times that of raw water. The investment cost is considered particularly expensive for the farm

Prof. Sadok BEN JABRALLAH

Sadok BEN JABRALLAH, born in 1958, is a Professor of Physics-Energy at the Faculty of Sciences of Bizerte, University of Carthage. He is a member of the Laboratory of Energy, Thermal and Mass Transfers of Tunis (LETTM-FST) in which he leads a research team "Transfers, Flows and Energy Efficiency (TF2E)".

His research work first focused on solar desalination and then extended, within the framework of several supervised theses, to the vast field of energy. He is the coordinator of a Professional Masters (which he created) “Climate Engineering and Energy Management”.

Sadok BEN JABRALLAH is a member of the scientific committee of the National Agency for Energy Management (ANME).

Evaporation in desalination processes : Mechanisms and recent scientific progress

Abstract

Evaporation is an important phenomenon in the water cycle, but also in desalination processes. Indeed, evaporation occurs as a main step in thermal processes, and in the water discharge treatment phase for membrane processes (evaporation pond). Understanding the mechanisms of evaporation makes it possible to control this phenomenon and optimize its performance: this is the subject of this presentation.

Depending on the desalination process studied, there are several configurations of evaporation systems. We can cite:

• The evaporation of a streaming liquid film,

• The evaporation of a water horizontal film,

• The evaporation of a drop of liquid.

We present the issues of each type of evaporation and the recent scientific progress as well as the issues related to it.

Prof. Moncef GUEDDARI

Moncef GUEDDARI is Professor at the Faculty of Sciences of Tunis, University of Tunis El Manar. He holds a 3rd cycle doctorate from Paul Sabatier University in Toulouse and a Doctorate Es-Geological Sciences from Louis Pasteur University in Strasbourg. His research focuses on inorganic geochemistry in continental and marine aquatic systems and on environmental geology. He Participated in several national and international research projects and supervised numerous doctoral and master projects. He published more than 130 papers in international ISI journals;

Water salinization in Tunisia: causes, effects and remediation

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Abstract

Previously, the risks of water salinization resulted mainly from a natural hazard of geological or meteorological origin. Today, it is above all society that creates risk, mainly in relation to agricultural practices, industrial activities as well as climate change. Actually, it is of great importance to reduce occurrences and confer the lowest level of residual risk. To do so, three steps are to be considered: identify the risk, fix the possible consequences and make a plan to manage the risks of the future.

The salinization of surface waters, which is particularly problematic in arid and semi-arid regions, is linked, among other, to the increase in the intensity of the chemical weathering of the rocks of the watersheds, to the modification of the land use, farming practices and climate change.
Regarding groundwater, salinization is one of the main causes of the degradation of their quality. The mode of salinization depends on the geographical (continental, coastal, etc.), geological (lithological nature of the aquifer) and climatic context. The main vectors involved in the salinization of groundwater are marine intrusion linked to overexploitation and sea level rise, mixing with ancient brines and the dissolution of evaporitic formations.
Tunisia is endowed with water resources estimated at 4.85 km^3/year, of which 2.7 km^3/year constitute average runoff and 2.15 km^3/year form groundwater flow. Surface water resources are not always usable. Salinity and pollution can be a serious limit to their exploitation. In northern Tunisia, some rivers such as the Mellègue wadi and the Tessa wadi, tributaries of the Medjerda, and the Jerabï wadi, a tributary of the Miliane, carry water whose salinity can exceed 3g/L. In the center, the base flows of the Zéroud wadi have the highest degree of salinity (6g/L). In the South, the basic intakes have a salinity of 4 to 5g/L. Nearly 30% of all surface water resources have a salinity above 1.5g/L.

The waters coming from the deep aquifers have a salinity which often varies between 1.5 and 3g/L, but which can reach 5g/L, and even 7 g/litre.

Groundwater, especially coastal aquifers, because they are easily exploitable and difficult to control, explain a state of massive overexploitation. This results in a large drop in the piezometric level. This phenomenon, in addition to the rise in sea level, promotes the risk of marine intrusion and water salinization.

In Tunisia, nearly 81% of water resources are intended for irrigation. The excessive use of moderately to highly saline water for irrigation affects the level of crop yield and could irreversibly degrading irrigated soils. It is estimated that 60% of soils in public irrigated areas are affected by sodicity and alkalinization, due to secondary salinization.

The situation of Tunisia's water resources, which already reflects water stress, will involve the development of green water potential and the optimization of water flows to ensure food security, the gradual use of non-conventional water (desalination, reuse of treated water) and will require the improvement of irrigation performance, and the modernization of water management which will involve a significant cognitive evolution.

Prof. Abdeltif AMRANE

Abdeltif AMRANE (57 years old) Professor – Exceptional class, UMR CNRS 6226 ISCR, University of Rennes 1. (Google Scholar: h-index: 56; citations: 12357 // Scopus: h-index: 46; citations: 9080). Since more then 15 years his research is entirely devoted to the development of combined processes for the removal of organic pollutants in effluent wastewater and gaseous emissions within the CIP team.

He has managed and co-managed 29 PhD theses as thesis director and 9 are in progress. He has been involved as a manager or a participant in several national and international projects, as well in international collaborations. He has published more than 430 international papers including 15 papers in press. He is the co-Editor of three books (Elsevier). He has also published 12 chapter books and has about 130 international and 20 national oral communications.

The coupling of an electrochemical process and a biological treatment for the removal of recalcitrant organic compounds – Case study: nitroimidazole antibiotics family

Arwa Abou Dalle[1,2], Imen Saidi[1,3], M. Zaghdoudi, Florence Fourade[1], Hayet Djelal[4], Aymen Amin Assadi[1], Florence Geneste[1], Abdeltif Amrane[1]

1. Univ Rennes, Ecole Nationale Supérieure de Chimie de Rennes, CNRS, ISCR – UMR6226, F-35000 rennes, France
2. Laboratoire de Biotechnologies Appliquées, Centre AZM pour la recherche en biotechnologies et ses applications, Université Libanaise, Tripoli, Liban.
3. Unité de recherche de Catalyse d'Electrochimie de Nanomatériaux et leurs applications et de didactique CENAD, Institut National des Sciences Appliquées et de Technologie (INSAT), Tunis, Tunisia
4. Ecole des Métiers de l'Environnement, Campus de Ker Lann, Bruz, France

Abstract

The large accumulation of emerging pollutants in continental and marine natural waters is the consequence in part, of industrial development on a large-scale. Partly responsible for this pollution, low volumes containing high concentrations of persistent organic pollutants can result in large polluted volumes very weakly concentrated which are difficult to treat. One solution would be to treat the considered pollution on site, as intended in this project. Among the destructive processes available to treat recalcitrant compounds, such as pharmaceuticals coming from industrial effluents (concentrations and COD higher than 1 and 10 g L^{-1} respectively in some pharmaceutical effluents) (Mansour et al. C. R. Chim. 18, 39–44, 2014), combined processes have been widely studied (Scott and Ollis, Environ. Prog. 14, 88–103, 1995; Oller et al. Sci. Total Environ. 409, 4141-4166, 2011), including several studies performed by the ISCR teams, owing to their high efficiency to eliminate biorecalcitrant compounds and to their lower cost

compared to physico-chemical mineralization. Different electrochemical processes were tested as pre-treatment to demonstrate at a lab-scale level the feasibility of these coupled processes for the removal of pharmaceuticals pollutants. The objective is to improve the biodegradability of the effluent, avoiding its complete mineralization which is not economically viable. On the one hand, a subsequent biological treatment, involving for instance a wastewater treatment plant can be considered to complete effluent mineralization. To demonstrate the feasibility and the interest of the combined process, some recalcitrant compounds were considered.

Prof. Guiliana MAGNACCA

Guiliana MAGNACCA is PhD in Chemistry and Associate Professor of Physical Chemistry at the Chemistry Department of Torino University.
I am teacher of many courses of first, second and third level related to physical chemistry and material science and I am involved in outreach activities related to the organization of scientific activities for schools and non-specialized audience, as representative for the Chemistry Department.

My scientific interests concern the physico-chemical characterization of materials (oxides, mixed oxides, perovkite-like, hybrid organic-inorganic, and so on) that can be applied in energy and environmental fields and I collaborate with several groups worldwide (Italy, Spain, Denmark, Canada, Argentina and Tunisia) to develop projects also financed by the European Commission.

I presented several conference talks in national and international meetings in the field of Physical Chemistry, Surface Science, Catalysis, Materials Science, Water Treatment, I am co-author of 144 publications on high impact factor journals and co-author of several book chapters and my h-index is 32.

A Heterogeneous biocatalyst for wastewater depollution: the system Soybean Peroxidase @ Al_2O_3

Giuliana Magnacca, Enzo Laurenti

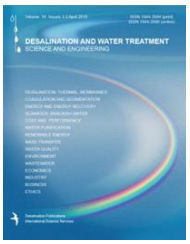
Abstract

Among the possible strategies to abate pollutants in water bodies (adsorption, membrane-based processes, photocatalysis and/orchemical oxidation),biological methods cover an important role [1]. Biological treatment of wastewaters can be achieved exploiting the whole organisms, which are usually sensitive to harsh conditions and easily degraded, or simply enzymes that are less sensitive to deactivation and offer high activity and selectivity in biocatalytic conversion of water soluble compounds, even presented in traces. Among enzymes, oxidoreductases, for instance laccases and peroxidases, are the most commonly used for environmental application such as abatement of Contaminants of Emerging Concern. Enzymes drawbacks include high costs and additional procedure for recovery after use, but these aspects can be overcome immobilizing them on a proper support that guarantees an easy reuse together with a physical protection to denaturation processes. Although several procedures of immobilization are reported in the literature, not all of them preserve the activity of the biocatalyst, as in some cases the interaction enzyme/support can cause unfolding and deactivation of the active site. This study is about preparation, activity tests and physico-chemical characterization of a biocatalytic handleable system Soybean

Peroxidase/Al_2O_3 and the strategy applied to unveil the causes of an unexpected lack of activity of the supported enzyme [2].

[1] Free and immobilized biocatalysts for removing micropollutants from water and wastewater: Recent progress and challenges, Jakub Zdarta , Teofil Jesionowski, Manuel Pinelo, Anne S.Meyer, Hafiz M.N.Iqbal, Muhammad Bilal, Luong N.Nguyen, Long D.Nghiem, Bioresource Technology, 344(B), 2022, 126201, https://doi.org/10.1016/j.biortech.2021.126201

[2] Characterization methodology to evaluate the activity of supported soybean peroxidase, Sadraei R., Murphy R.S., Laurenti E., Magnacca G., Ind.Eng.Chem.Res., 58, 2019, 19082-19089, 10.1021/acs.iecr.9b03495



Selected papers at CMTDE 2019 published after peer review in Desalination and Water Treatment Journal

1- ***Zakaria TRIKI, Zineb FERGANI, Mohamed Nadjib BOUAZIZ***

Exergoeconomic and exergoenvironmental evaluation of a solar-energy-integrated vacuum membrane distillation system for seawater desalination.

Desalination and water treatment, (2021), 225, 380-391.

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Desalination and water treatment, (2021), 225, 430-442

Desalination and Water Treatment
www.deswater.com
doi: 10.5004/dwt.2021.27144

225 (2021) 380–391
June

Exergoeconomic and exergoenvironmental evaluation of a solar-energy-integrated vacuum membrane distillation system for seawater desalination

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Received 7 February 2020; Accepted 15 January 2021

ABSTRACT

In this paper, exergoeconomic and exergoenvironmental analyses of a solar vacuum membrane distillation (VMD) desalination system were performed to evaluate the cost of exergy destruction and the environmental impact of each component of the desalination system. The analysis permits the identification and evaluation of inefficiencies in the plant as well as the determination of the most environmental friendly process components and opportunities for design improvements. The results showed that the solar collector has the largest irreversibility and cost of exergy destruction. Therefore, it is a very important component for improving solar VMD plant performance. In addition, it will be profitable to reduce exergy losses in the membrane module even at the expense of increased investment costs since the dominant factor in the total cost rate for this component is the cost of exergy destruction. Whereas, it would be advantageous to reduce capital costs in the condenser since it has a relatively high exergoeconomic performance. On the other hand, exergoeconomic factor and exergy efficiency for the heat exchanger are found to be 49.02% and 96.59%, respectively, indicating that the exergy and exergoeconomic performance of this component is satisfactory. Finally, the results revealed that the largest potential for reducing the overall environmental impact of the solar VMD system is associated with the solar collector, the membrane module, the condenser, and the heat exchanger.

Keywords: Seawater desalination; Vacuum membrane distillation; Solar energy; Exergoeconomic; Exergoenvironmental analysis; Efficiency

* Corresponding author.

Desalination and Water Treatment
www.deswater.com
doi: 10.5004/dwt.2021.27142

225 (2021) 402–412
June

Treatment of landfill leachate from Fez City by combined Fenton and adsorption processes using Moroccan bentonite clay

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Received 24 December 2019; Accepted 4 January 2021

ABSTRACT

This work deals with the study of the feasibility of landfill leachate treatment (Fez city, Morocco), using sequential processes combining Fenton and adsorption onto natural local bentonite clay. Thus, the operational conditions of the Fenton process were firstly optimized with 2,000 mg L^{-1} of Fe^{3+} and 2,500 mg L^{-1} of H_2O_2 at pH = 3, which removed 73% of the chemical oxygen demand (COD) and 92% of the color from the raw leachate. Then, raw Moroccan bentonite was characterized by nitrogen adsorption–desorption, scanning electron microscopy-energy dispersive X-ray analysis, X-ray diffraction, and Fourier transforms infrared spectroscopy. The results indicate that the bentonite is characterized by a heterogeneous surface with irregular particle sizes and the presence of the montmorillonite as the major component. The bentonite presented characteristics of mesoporous material with Brunauer–Emmet–Teller (BET) surface area and total volume of pores of 51.7 $m^2 g^{-1}$ and 0.11 $cm^3 g^{-1}$, respectively. The natural bentonite clay was used as an adsorbent for the pretreated leachate (PL). The effect of adsorbent dosage, effluent pH, contact time, and temperature on the adsorption efficiency was investigated. Pseudo-second-order and Freundlich were the most suitable models to fit the experimental kinetic and the isotherm data of the adsorption, respectively. Therefore, 73% of COD and 96.5% of color removal were observed in Fenton treatment alone. The application of the Fenton process (2,500 mg L^{-1} of H_2O_2, 2,000 mg L^{-1} of Fe^{3+}, pH 3, and 1 h of contact time) coupled with adsorption (3 g L^{-1} of bentonite dosage, pH 5 and 5 h of contact time, and T = 35°C) has achieved a total COD and color removal of 84% and 98%, respectively. This indicates that the combination process that involves Fenton followed by the adsorption process onto natural bentonite adsorbent would be an ideal option for leachate treatment.

Keywords: Landfill leachate; Fenton; Adsorption; Natural bentonite; COD

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Desalination and Water Treatment
www.deswater.com
doi:10.5004/dwt.2021.27143

225 (2021) 413–421
June

Effect of ultrasound on biosorption kinetics of Acid blue 25 from aqueous media by using cycads palm bark as novel biosorbent

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Received 3 February 2020; Accepted 29 January 2021

ABSTRACT

In this work, the cycads palm bark (CPB) was tested as a novel biosorbent for the removal of acid blue 25 (AB25) from aqueous media in the absence and presence of ultrasonic irradiation. Batch biosorption studies were conducted to study the effects of different parameters such as initial pH solution, biosorbent dose, initial dye concentration, and ultrasonic power on AB25 dye biosorption in order to explain the influence of ultrasonic irradiation on biosorption kinetics. Ultrasonic irradiation and initial pH solution played a key role in the removal of acid dye. The amount of AB25 biosorption is markedly increased in the presence of the ultrasonic field and reduces of equilibrium time for biosorption. The biosorption kinetic data were found to be well-represented by the pseudo-second-order rate equation, both in the absence and presence of ultrasound. The activation energy (E_a) of biosorption has also been evaluated with the pseudo-second-order rate constants. The values of E_a for AB25 on CPB in the presence and in absence of ultrasound, respectively, are 20.14 and 25.80 kJ/mol, which confirm that the process is physical nature (E_a < 40 kJ/mol) both with and without the assistance of ultrasound. This was further confirmed by the values of ΔH° obtained. Additionally, the biosorbent surface was characterized by surface-specific area, isoelectric potential (pH_{zpc}), surface functional groups, and scanning electron microscopy.

Keywords: Ultrasonic irradiation; Biosorption; Cycads palm bark; Acid blue 25; Kinetics; Characterization

* Corresponding author.

Desalination and Water Treatment
www.deswater.com
doi: 10.5004/dwt.2021.27146

225 (2021) 422–429
June

Recovery of nickel ions by supported liquid membrane (SLM) using D2EHPA as carrier

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Received 16 March 2020; Accepted 29 January 2021

ABSTRACT

This research is dealing with the liquid–liquid extraction and the facilitated transport through a supported liquid membrane (SLM) system of nickel ions. Di(2-ethylhexyl) phosphoric acid (D2EHPA) was used as a carrier dissolved in chloroform. The effect of critical parameters such as the amount of D2EHPA (in membrane), the initial concentration of nickel as well as feed phase pH which affect the transport of nickel(II) through the SLM system, were investigated. Experimental results revealed that Ni(II) flux across the membrane tends to increase with the concentration of these metal ions. The optimum conditions for Ni(II) transport are: feed phase pH of 5, stripping phase of 0, 5 M HNO_3 and 30% D2EHPA (v/v). At optimal conditions, the transport of Ni(II) was achieved with an efficiency of about 60% within 24 h and 100% within 3 h for initial nickel concentration of 2.5 and 0.25 mM, respectively. A concluding aging test was carried out to check the stability of the membrane and the evolution of the percentage of nickel transported in the function of time.

Keywords: Nickel; Extraction; Supported liquid membrane; D2EHPA; Transport

* Corresponding author.

Desalination and Water Treatment
www.deswater.com
doi:10.5004/dwt.2021.27145

225 (2021) 430–442
June

Low-cost biosorbents from pines wastes for heavy metals removal from wastewater: adsorption/desorption studies.

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Received 24 January 2020; Accepted 21 December 2020

ABSTRACT

The use of inexpensive materials such as agricultural by-products and industrial waste has received considerable attention because of their high efficiency for heavy metal retention, low cost and availability. This study aimed to investigate the technical feasibility of residual biomass from pines (cones and leaves) for Cr(VI) and Cu(II) removal from aqueous solutions. The effect of various parameters, such as pH, metal concentration, contact time, temperature and biosorbent/solution ratio was examined. Biosorbents were characterized using scanning electron microscopy combined with energy-dispersive X-ray spectroscopy and Fourier-transform infrared spectroscopy. The specific surface area was evaluated by the Brunauer–Emmett–Teller isotherm. The equilibrium data showed better fitting to the Langmuir model, indicating the monolayer adsorption behavior. The Langmuir model predicted a maximum adsorption capacity of 27.78 mg g^{-1} of Cu(II) on pine cones and 64.04 mg g^{-1} of Cr(VI) on pine leaves. The kinetic study revealed that the pseudo-second-order model fitted the experimental data. The thermodynamic study showed that the biosorption process was endothermic for Cu and exothermic for Cr(VI). The biosorbent can be reactivated with 0.1 mol L^{-1} HNO_3 allowing the recovery of the metals and the recycling of the biosorbent. These results showed that pine waste materials can be used as efficient, economic and eco-friendly biosorbent for Cu(II) and Cr(VI) recovery from contaminated effluents.

Keywords: Biosorption; Desorption; Langmuir isotherm; Pine biomass; Chromium; Copper

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CMTDE 2022_205 Ion Exchange Equilibrium between DOWEX 50X8 Resin and Electrolyte Solution: Selective Removal of Copper (II) ions from Wastewater.
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CMTDE 2022_211 Separation of nickel and copper ions using supported liquid membrane and ion-exchange resin.
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CMTDE 2022_212 Characterization of Electrocoagulation Sludge from Phosphate Treatment Using Aluminum Electrodes.
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CMTDE 2022_213 Comparative Study of the Elimination of Fluoride, Sulfate and Phosphate Ions by Electrocoagulation: Application to Natural Waters.
CHIBANI Amel, NCIB Sana, BARHOUMI Afef, , ELALOUI Elimame, BOUGUERRA Wided

CMTDE 2022_214 Photo-catalytic processes for efficient reduction of an inorganic pollutant under different light sources
Mohamed Amine DJILALI*, Mounir MELLAL, Elhadj MEKATEL, Salim BOUDIAF, Billal BRAHIMI.

CMTDE 2022_215 Study of seawater desalination brine by Electrolysis process
NOUBIGH Ichrak, KHLEIFIA Naima, ABIDI Houda

CMTDE 2022_1

Studies of Congo Red photodegradation with synthesized $ZnAl_2O_4$

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Abstract

The spinel $ZnAl_2O_4$ was successfully used for the photo-degradation of Red Congo (RC), a hazardous and recalcitrant dye. The spinel was prepared by nitrate route and characterized by X-ray diffraction XRD, SEM/EDS and TEM. The electrical conductivity augments exponentially with the inverse of absolute temperature and activation energy of 0.19 eV was computed. n-type conduction is evidenced from the anodic photocurrent at the semiconductor/electrolyte junction, thus improving the separation of electron /hole (e-/h+) pairs by the interfacial electric field. The quenching experiments were carried and the results demonstrate that the radical OH• is the responsible active specie for the RC photooxidation. The solar photocatalysis over the $ZnAl_2O_4$ exhibits an increased performance in the CR degradation due to activation by the UVA part of the solar light. An elimination conversion of 95% was obtained after 4 h at room temperature for a RC concentration of 20 mg/L.

Keywords : Spinel $ZnAl_2O_4$; Nitrate route; Photo-oxidation; Congo Red; Solar light.

CMTDE 2022_4

Evaluation of organochlorine pesticides in surface water from Madjerda river Tunisia

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Abstract

In recent years there has been growing environmental concern, especially regarding the use and discharge of toxic substances. Many organic pollutants are detected in aquatic ecosystems such as pesticides. Because of their large-scale production and usage, toxicity, bioaccumulation, and persistence in the environment, they cause harmful effects to organisms and human health. The Mejerda River is one of the major rivers in Tunisia and several studies dealt with the importance of this river in terms of ecology, geochemistry, and sociology. The organochlorine pesticides **(**OCPs) were investigated in surface water samples from eight sampling stations in the Mejerda River. The extraction of water samples was performed by liquid-liquid extraction in the tube with hexane. Gas chromatography coupled to the masse spectrum (GC-MS) was used to perform qualitative and quantitative determinations. The levels of OCPs in water varied between 4.41 ng g^{-1} and 29.04 ng g^{-1}. The Hexachlorobenzene (HCB) and ∑DDT are the most dominant compounds in different sampling sites. Distribution of HCB, ∑DDT, and other OCPs are different indicating different sources of contaminations. The concentrations of OCPs in water pose no threat to human and aquatic living species.

Keywords : OCPs, Distribution, Water, Madjerda River, GC-MS.

CMTDE 2022_6

Conceptual DFT elucidation of the reaction mechanism in polysulfone PSF and polyethylene glycol PEG membranes

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Abstract

Polysulfone-based ultrafiltration membranes [1] had been the subject of several research areas. In this work, we carried out a theoretical study of the synthesis mechanism of these materials [2]. In this study the mechanism of the chemical reaction between polysulfone (PSF) [3] as a membrane matrix and polyethylene glycol (PEG) as an additive [4] using was elucidated by means of DFT conceptual derived indices. Our calculations were carried out using Gaussian 09 software. Hartree-Fock (HF) method and functional density theory (DFT) were used to obtain the optimized molecular structures of the PFS and the PEG. Obtained results, show that PEG plays the role of electrophile and PSF plays the role of nucleophile during the reaction reaction. It was also found that PEG reacts with oxygen from the extremities while polysulfone reacts with C28 carbon regardless of the number of units per chain. Our results show also that DFT derived indices are directly correlated with the number of units per chain. Mots clés Polysulfone PSF, polyethylene glycol PEG, membrane, Hartree-Fock (HF), functional density theory DFT.

CMTDE 2022_7

Public landfill leachate characteristics and treatment by ozonation for the removal of pollutants

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Abstract

The waste production nation wide is increasing every year, on account of the rapid urbanization and growing populations, also consumption modes. Algerian political authorities have chosen Technical Landfill Centres (TLC) as a competitive and safe technique of waste management. However, storing these wastes in a bad way poses several environmental challenges, especially in the Department of Saïda, the latter have significant groundwaters.

The analysis of the results showed a high concentration of easily biodegradable organic matter. The pollutant load is of the order of 4676.40 mg/L of the chemical oxygen demand (COD), 288.75 mg/L of the biochemical oxygen demand (BOD_5), and shows an average content of nitrates (NO_3^-=30 mg/L). This mineral pollution is caused by a high electrical conductivity, which reaches an average value of 10.8 mS/cm, and a low concentration of heavy metals in the raw leachate such as lead (Pb = 0.551 mg/L) and Zinc (Zn = 0.159 mg/L). The ozonation treatment allows for the successive biodegradation of 98% of the BOD_5, and 97% of the COD, 83% for lead, and 64% for zinc. In this study, ozonation treatment represented an effective treatment for the organic and metallic leachate pollutants of this landfill.

Keywords : Public landfill, Leachate, Characterization, Contamination, Ozonation treatment.

CMTDE 2022_8

Structural study and biological properties of new triazole-based ligands and their Silver complexes.

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Abstract

In this work, we conducted a study on a family of organic compounds: Schiff bases, and their complexes. Since the 2000s, we have recorded an increase in the number of studies relating to the biological activity of Schiff bases and their metal complexes [1,4].
A comparative study between the biological activity of Schiff bases and their metal complexes, made by Gangadhar and al. (2008) [5], shows that metal complexes are more active than free ligands.
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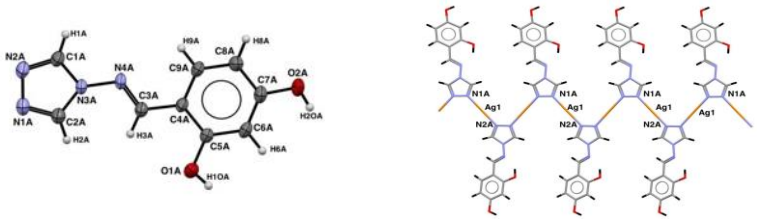

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[5] B. Gangadhar, Bagihalli, S. Prema, A. Sangamesh. Journal of Enzyme Inhibition and Medicinal Chemistry, (2009), 24, 381–394.

CMTDE 2022_9

Determination of pore size distribution (PSD) using the adsorption isotherms on the activated carbon of the RES adsorbate

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Abstract

To describe the internal structure of activated carbons as well as other amorphous microporous adsorbents, we frequently resort to a pore size distribution (PSD). Thus, it assumes that the complex internal structure of the adsorbents may be described in terms of an equivalent collection of regular model pores. The role of

PSD is to determine pore volume accessible to a molecule of a given size. According to the plot, the adsorbent is macroporous since the size of the activated pores is between 60 nm and 80 nm. The rise in temperature causes the distribution to shift towards the larger rays, which could be due to an expansion of the size of the pores under the effect of thermal agitation.

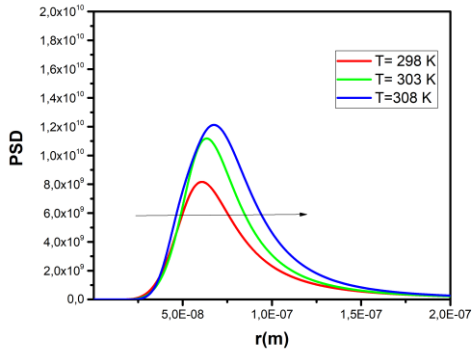

Figure: Pore size distribution of activated carbon from avocado seeds at different temperature values

Keywords : PSD; Effect of temperature; Adsorption.

CMTDE 2022_10

Experimental study of a coupled unit for space cooling and water desalination

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Abstract

The waste heat recovery from condenser of air conditioning for seawater desalination is attractive because of its great energy and environmental value. This paper experimentally investigated a modified air conditioner with a desalination unit that operates in the space-cooling and seawater distillation. The experimental investigation is used to study the performance of the system for water distillation, the flow rate of the potable water and the amount of energy saving during the desalination process. The results showed that the temperature in the tank is 72°C; with continuously used air conditioning this value may

become better. According to these results, the maximum coefficient of performance (COP) of the air conditioning was around 6.11. In the integrated system, the potable water production rate was 730 mL/h. The proposed system provides the possibility to save energy which would lead to low cost of fresh water as well as GHG emissions is reduced.

Keywords : Heat pump, COP, Energy saving, Condenser length optimization, Seawater desalination

Graphical abstract

CMTDE 2022_11

Electrochemical treatment in aqueous solution of oxytetracycline by electroFenton using an activated carbon doped by zinc oxide

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Abstract

The degradation of oxytetracycline (OTC) in aqueous solution has been studied by an heterogeneous electroFenton (HEEF) process using granular activated carbon (GAC) doped by zinc oxide (ZnO) nanoparticles. ZnO has been used as catalyst loaded on the nickel foam (Ni) as a cathode. The composite GAC-ZnO was synthesized by an easy method then was characterized by Scanning Electron Microscope (SEM), X-ray Diffraction (XRD) and Transformer Forrier Infrared Spectroscopy (FTIR). The results show that the morphology and the chemical composition of activated carbon have been changed after the zinc oxide grafting. SEM result confirms that ZnO was doped onto activated carbon surface. The prepared (Ni+GAC-ZnO) exhibited a high degradation (99% within 24 h) and a mineralization efficiency of OTC (70% after 24 h). The effects of operating parameters such as the anode type and changing the ElectroFenton catalyst were also investigated.

Keywords : Activated carbon, Zinc oxide, Oxytetracycline, Heterogeneous ElectroFenton, Activated carbon doped by zinc oxide.

CMTDE 2022_12

Immobilization of heavy metals in wastewaters by apatitic calcium phosphate

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Abstract

Heavy metals are defined as comparatively-high density metallic elements that can cause toxicity even at low intaking doses. Nowadays, water sources become more and more menaced by the continuous increase of urbanization, industrial activities, and the excessive use of chemicals all over the world. The industrial contaminants commonly include ionic species of cadmium (Cd), lead (Pb), zinc (Zn) and copper (Cu). When released into the water systems above the permissible limits, these hazardous pollutants are of potential threat to the surrounding environment and to the aquatic organisms.

This study aims to investigate the effect of the operating conditions on removing a series of heavy metal ions from simulated wastewaters using apatitic calcium phosphate subjected to heat treatments within the temperature range of 100–900°C

Among various heavy metals, cadmium was selected to study the efficiency of the adsorption process since it is the most frequently available is wastewater. Subsequently, the main operating conditions were applied to treat Pb^{2+}, Zn^{2+} and Cu^{2+} in single and multi-component systems.

Keywords : Heavy metals; Wastewaters; Apatitic calcium phosphate.

CMTDE 2022_15

Structural study and biological properties of new triazole-based ligands and their Silver complexes.

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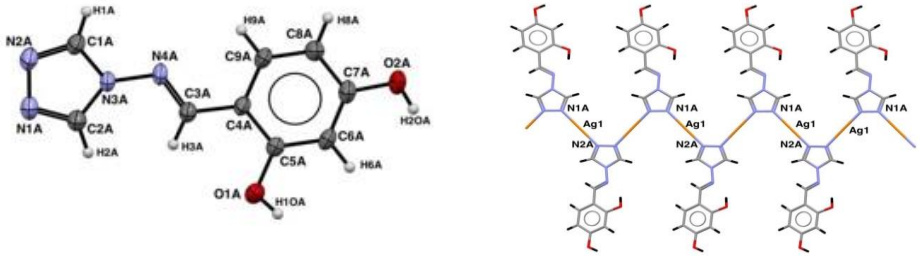
Abstract

In this work, we conducted a study on a family of organic compounds: Schiff bases, and their complexes. Since the 2000s, we have recorded an increase in the number of studies relating to the biological activity of Schiff bases and their metal complexes [1,4].

A comparative study between the biological activity of Schiff bases and their metal complexes, made by Gangadhar and al. (2008) [5], shows that metal complexes are more active than free ligands. At the end of this bibliographical study, we note that in some cases, that these compounds and their metal complexes exhibit a greater inhibitory power than that of standard antibiotics. We will also present in this contribution, a study of the compound of Schiff bases and their complex. The condensation reaction of 4-amino-1,2,4-triazole with 2,4-dihydroxybenzaldehyde under a condition of low variation synthesis, as well as complexation of the ligand with Ag $(NO_3)_2$ with an equimolar ratio resulted to the crystallization of the two compounds in the same space group: P21/n. The two compounds were characterized by infrared and UV-Vis spectroscopy as well as by single crystal X-ray diffraction studies.



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CMTDE 2022_16

Kinetic study of degradation of antraquinonic dye, C.I. acid blue 25, in aqueous solution by hydrogen peroxide using dawson-type heteropolyanions as CATALYSTS

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Abstract

This study presents an evaluation of catalytic performances of $P_2W_{17}MoFeO_{62}$ for the degradation water advanced treatment through homogeneous Fenton-like. The $H_2O_2/P_2W_{17}MoFeO_{62}$ system has been utilized to decompose hydrogen peroxide to reactive hydroxyls for the degradation of Acide blue 25. The influence of dye assisting inorganic acids such as H_2SO_4, HNO_3, HCl and H_3PO_4 on catalytic degradation has been investigated. The catalytic activity was examined in view of the effects of various parameters, pH value, catalyst mass, hydrogen peroxide concentration, and temperature of solutions. The best pH value for the following experiments of AB25 degradation was chosen to be 2.5. The best catalytic activity and stability was achieved for an optimal catalyst dose of 0.05g. A high degradation efficiency of 96.24% was obtained for a H_2O_2 concentration equal to (157.31 mg/L). A higher temperature facilitated the diffusion of AB25 in the solution, which increased the degradation efficiency.

Keywords : Degradation, Advanced oxidation process, Acid blue 25, Wastewater, Treatment.

CMTDE 2022_17

Optimization of separation phases of activated carbon by hydrocyclone process on using response surface methodology

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Abstract

The aim of this study is to build an efficient hybrid treatment process for the depollution of mixed and highly polluted industrial textile wastewater. The proposed system consists of an effective coupling between adsorption by activated carbon and a phase separation by a hydrocyclone. The response surface methodology using the Box–Behnken experimental design was applied and explored in order to optimize the most influencing factors. The experimental results showed that the decolorization efficiency (CR%) by activated carbon for Novacron Blue 4R (NB4R) dye was 87.15% under optimal treatment conditions with a pH of 11, a concentration of carbon of 12.42 g/L and an initial dye concentration of 62.50 mg/L. The optimization study of separation of activated carbon by the hydrocyclone allowed a separation efficiency (ES%) about 88.74%. The cited efficiency was ensured in the optimal conditions which were a volume flow rate of 81.83 L/min, a carbon concentration of 12.42 g/L with a size of 0.5 m. The proposed hybrid process is shown to be more efficient in terms of treatment efficiency and recovery of the carbon particles. In addition, big improvements were reached especially in the term of the final wastewater quality after adsorption/hydrocyclone combination when compared with the current conventional treatment method in the concerned industry.

Keywords : Hydrocyclone; Activated carbon; Optimization; Response Surface Methodology; Industrial Wastewater

CMTDE 2022_18

Performance evaluation of the "MD ORYX" autonomous desalination solar-driven membrane distillation plant in Kairouan, Tunisia

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Abstract

A small-scale stand-alone solar-driven membrane desalination unit was installed at the Mechanical Department site of Kairouan University. The desalination plant is intended for autonomous operation in remote regions with a lack of electricity and drinkable water but with high solar irradiation. The desalination energy is supplied entirely by 3 solar thermal collectors offering a total area of 6 m² and the electrical auxiliary energy is supplied by a 4 PV panel, ensures the production of 1 kW with the ability to store energy generated from 2 batteries. The membrane used in this study was of the spiral wound design, which allowed for a compact arrangement besides effective internal heat recovery. The plant was tested and prepared for long-term testing in the weather conditions of Kairouan, Tunisia. The plant has been continuously operated producing as high as 15.92 L/m2 with an approximate distillate conductivity of 1865 S/cm. The thermal energy y required by the process was in the range of 90 and 310 kWh/m^3.

Mots clés : Membrane distillation, Solar collectors, Photovoltaic cells.

CMTDE 2022_19

Sulfonated polyether sulfone octyl sulfonamide / Montmorillonite clay composite for electrodialysis application

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Abstract

Sulfonated Poly Ether Sulfone Octyl Sulfonamide (S-PESOS) / Montmorillonite (MMT) hybrid membranes were elaborated to evaluate their potential for use as electrodialysis (ED). The S-PESOS/MMT hybrid membranes were prepared using a solution casting and evaporation method, and the MMT content in the composite membranes was controlled at 1, 3 and 6 wt percent based on the S-PESOS. Three novel hybrid membranes were fabricated and called SPMT11, SPMT13 and SPMT16. The performances of the hybrid membranes for electrodialysis in terms of their thermal properties, water uptake, proton conductivity, transport number and morphology were investigated. The thermal properties of the hybrid membranes were improved with introduction of the MMT. The SPMT11 composite membrane showed increased proton conductivity compared with the non-modified S-PESOS membrane under the 100 % relative humidity condition. As the MMT content decreased, the proton conductivity increased and the water uptake increased due to the monovalent ions located between the MMT layers. This property makes hybrid membranes potential candidates for ED applications.

Keywords: S-PESOS membrane, Ion conductivity, Montmorillonite, Hybrid membrane, Electrodialysis.

CMTDE 2022_20

Analysis of the exergy efficiency of a solar humidification-dehumidification desalination unit

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Abstract

Tunisia, like its neighbouring countries, is facing a problem of lack of fresh water. Desalination of seawater and saline water could be the major source of drinking water for arid and semi-arid areas and for industrialized areas. Conventional desalination processes require large amounts of energy in the form of thermal energy (MED and MSF) or electrical energy (RO). Most desalination plants using these technologies work with fossil fuels, hence the sensitivity to price and availability of oil. To deal with these problems, desalination technologies based on renewable energies are highly desirable.

Some technologies have not been developed at commercial level yet because the major drawback of these systems is that they are energy-intensive and inefficient in terms of the amount of fresh water produced. In this work, we are interested in humidification - dehumidification technology coupled with a simple solar still. The proposed installation includes solar still coupled with an air bubbling system.

The unit presented is designed to provide high quality drinking water in remote coastal areas with low infrastructure and without connection to an electrical network. The designed installation is completely autonomous; indeed, the only energy source is the sun.

An energy study made it possible to estimate the electrical energy required for the operation of the ventilation system. We have taken into account the losses of air charges in the pipes and the losses within the diffuser immersed in the solar still. The power of the various pumps supplying the solar basin and the circulation of cold water at the dehumidifier were calculated. The daily energy requirements of the entire installation were estimated at 5.6 kWh.

The aim of the exergy study is to characterize the efficiency of the system. This study makes it possible to determine the distribution of the energy degradation on all the organs of the installation; this will make it possible to propose improvements aimed at the energy efficiency of the system. The average exergy efficiency varies from 6% (cover) to 36% (absorber), moreover the overall exergy efficiency of the solar basin is around 21%.

The exergy study carried out confirms that the interaction between the sun and the absorber produces the greatest irreversibility (exergy destroyed). Moreover, the rate of irreversibility in salt water and air can be neglected compared to the irreversibility of the absorber. These results suggest that efforts should be directed towards better absorber designs, solar still cover materials, evaporation-condensation studies.

CMTDE 2022_21

Study of the productivity of a vacuum membrane distillation system coupled to different types of solar collector

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Abstract

Desalination using solar energy coupled with membrane technology is considered an attractive alternative for the production of drinking water especially in rural and arid areas. Membrane distillation is a relatively new and promising process. This method uses hydrophobic porous membranes to physically separate the brine. In this article, we propose to estimate the potential of vacuum distillation seawater using a solar membrane coupled with solar energy. We compare the performance of a desalination system that combines a membrane module with three different solar technologies: a flat solar collector, a cylindro-parabolic collector and a solar pond. Figure 1 summarizes the different coupling possibilities studied. Each point of intersection represents a configuration of a solar desalination system studied.

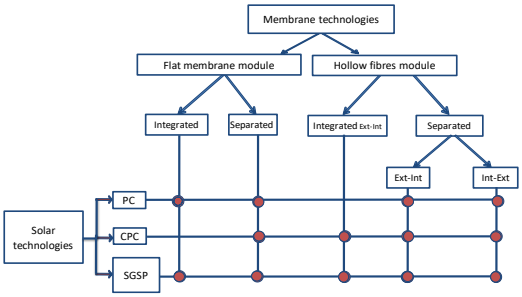

Figure 1: Possibilities of coupling the VMD with solar energy

A model describing working with three solar technologies has been proposed. The model was developed based on material and heat balances. From this model, we have developed a simulation program that evaluates and compares the performance of different configurations. The models developed make it possible to determine the evolution of the temperature and the flow of distillate over time and for each day of the year. A comparison of the performance of the different configurations studied revealed that the CPC is the most efficient solar collector.

Integration of the module in the collector has made it possible, in all the cases studied, to improve productivity. This study also showed that the internal-external arrangement of fibres is better than the external-internal arrangement. Following this study, we have chosen to realize a 100% solar installation where the membrane module is separated from a field of flat solar collectors. The average daily production of this facility is estimated at 432 L of distilled water with a unit cost of around 11.7 $/m^3.

CMTDE 2022_22

Improving the productivity of a simple and hybrid solar still using nanoparticules

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Abstract

This paper aims to study, theoretically and experimentally, the effect of the integration of nanoparticles of Al_2O_3, Cu_2O, TiO_2 and FeO, at different concentrations (0.01%, 0.0075% and 0.005%), in water. of sea for a hybrid solar still equipped with a heat pump in order to improve its production. The theoretical study is summarized in the development of a theoretical model based on the balances, of energy and matter, described at the level of each organ constitutes this distiller. The experimental study shows that the temperature as well as the production of the distiller increase with the addition of nanoparticles in seawater, in a first step, and with the increase in the concentration of nanoparticles, in a second step. The Cu_2O nanoparticle is proven as the most efficient nanoparticle with an efficiency of 67% instead of 34% for the solar still with seawater only. The results of the simulation show that the thermal conductivity of the nanofluid increases with the increase of the concentration of the nanoparticles, it is that explains well the experimental results of the temperature. The validation of the established model is made by comparing the results of the simulation with those of the experiment. This comparison shows a good agreement between the results found.

Keywords : Hybrid solar still, Nanoparticles, Nanofluid, Production, Thermal conductivity.

CMTDE 2022_24

Study of the retention capacity of Algerian bentonite clay with respect to chromium (VI) for its elimination

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Abstract

The objective of this study is to examine the retention powers of Algerian bentonite clay with respect to chromium (VI) with a view to its elimination. The structural properties of the clay surface have been studied by different techniques namely, XRD, SEM, EDS and BET. Different reaction parameters were considered and varied. Thus, the influence of the temperature, the mass of the introduced bentonite, the initial chromium contents and the pH were observed on the chromium (VI) elimination yields. Appreciable elimination rates of 40 and 70% were obtained and adsorption capacities ranging from 4.20 to 7.25 mg/g. Langmuir and Freundlich models were used in the equilibrium isotherm studies and it has been found that Langmuir model is well representative. First-pseudo, second-pseudo orders and intra particle diffusion kinetic models were used and the results showed that the pseudo-second-order model followed well the experimental data. The positive value of thermodynamic parameter $\Delta H°$ showed an endothermic chrome (VI) adsorption process.

Keywords : Adsorption; Chrome (VI); Bentonite; Isotherm model; Kinetic; Thermodynamic.

CMTDE 2022_25

Somatic coliphages : indicators of viral and fecal contamination for water reclamation and index of wastewater treatment process

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Abstract

Due to steep population growth, emerging waterborne infectious pathogens, water scarcity and climate change, water management is becoming increasingly challenging mainly in developing countries. Water reuse would be a sustainable solution to overcome water demand especially in agricultural fields. The aim of wastewater treatment is producing an effluent of a quality suitable for either disposal or reuse purposes by removing physical, chemical and microbiological contaminants. The goal of wastewater treatment facilities is to safeguard the quality of the aquatic environment and to conserve water resources as well as the control or the elimination of waterborne diseases. Indicators microorganisms have been used to assess water quality and the functioning of wastewater treatment processes. Therefore, they are used to ensure compliance with environmental standards and assist in the planning of wastewater treatment. The presence of fecal indicator bacteria (FIB) in water may indicate fecal contamination and possible association with enteric pathogens. Nevertheless, FIB is not always adequate as indicators for waterborne diseases caused by viruses or parasites. Both the viruses and the parasites present different behaviours to the resistance to water treatments and to the environmental persistence. For this reason, currently national and international regulations and directives on water quality are progressively including other indicators extensively studied in the last few decades that complement the FIB.

Studies conducted on fate and effectiveness of different water treatments on bacterial and viral indicators showed that FIB doesn't reflect the behaviour and the resistance of waterborne pathogenic viruses. Results corroborate the fact that somatic coliphages seem good candidates as indicators of enteric viruses in wastewater and as index to evaluate the efficiency of wastewater treatment process. In fact, different removal processes were evaluated regarding bacterial indicators and somatic coliphages. FIB inactivation by biological treatment based on activated sludge, UV irradiation and E-Beam irradiation treatment of wastewater was not as much effective against somatic coliphages which persists longer than FIB once outside the gut. For instance, the abatement of FIB by biological treatment is ranging between 2 to 4logs. Meanwhile, abatement of somatic coliphages is ranging between 1 and 2 logs. Consequently, somatic coliphages are considered as promising indicators of fecal and viral contamination and a useful index of water treatment process prior to water reclamation.

Keywords : Wastewater treatment, Treatment process, Somatic coliphages, Fecal indicator bacteria.

CMTDE 2022_26

Application of response surface methodology for the removal of cationic and anionic dyes by adsorption onto activated biosorbent

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Abstract

The removal of cationic and anionic dyes was performed onto a bio-adsorbent. A methodology of surface response was used, this kind of design estimate the coefficients of a quadratic polynomial mathematical model, whose essential interest is to be able to predict at any point of the experimental region, the values of the response. The effect of adsorbent dose, the effect of initial concentration, the effect of pH and temperature were investigated. A preliminary study was conducted in order to indicate the experimental region. Then a full factor design was performed to determine the effect of the main parameters and their mutual interaction for the adsorption process. Using the experimental results, a linear mathematical model representing the influence of the different parameters as well as their interactions was obtained.

Keywords : Adsorption, Dyes, Activation, Competition, Optimization.

CMTDE 2022_27

Behavior of reverse osmosis membrane for removal of dye pollutants from wastewater

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Abstract

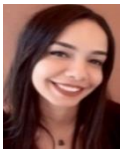
The industrial effluents discharged by some industries often have a high pollution load hardly biodegradable and highly detrimental for the environment. One of the most significant issues related to water contamination is the multiplicity and the discrepancy of industrial sewage containing organic compounds especially dyes. Many methods have been used to remove dyes from wastewater such as adsorption, electrocoagulation and membrane processes. In the present study the removal of two dyes such as cationic dye (methylene blue) and anionic dye (methyl orange) was investigated using a polyamide thin film composite reverse osmosis denoted HWS from Osmonics company. The influence of main operating

conditions (feed concentration, transmembrane pressure, pH, recovery and ionic strength) on the retention was evaluated in order to follow the behaviour of HWS membrane. The retention behaviour of the selected membrane was investigated. The surface charge and the mechanism of transport were determinate. The results show that this membrane has a residual charge that is highly pH dependent and the retention of ionic species is due to a mechanism based on electrostatic interactions between membrane loads and ions. The retention of dyes was in the order of 90% and 96 % for methyl orange and methylene blue, respectively. It relatively depends on feed concentration, ionic strength, pH and applied pressure.

Keywords : Wastewater treatment, Reverse osmosis, Methylene blue, Methyl orange.

CMTDE 2022_29

Study of chromium removal by adsorption on activated carbon synthesized from pomegranate peels



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Abstract

Wastewater contamination by chromium becomes an important problem due to its widespread applications in industrial processes such as metallurgy, tanning industries, refractories and foundries. Chromium is harmful for environment and threatens the human health as it is a carcinogen element. The World Health Organization defined an upper limit of 0.05 mg L^{-1} in drinking water. Different studies were carried out on the efficiency of low-cost natural adsorbents for heavy metals removal. This work focuses on the efficiency of chromium hexavalent removal by the biochar synthesis from pomegranate peels by chemical modification with phosphoric acid H_3PO_4. Fourier transform infrared spectroscopy (FTIR), pH of zero charge, BET, Scanning Electron Microscopy (SEM) and elemental analysis were used to characterize the biochar.

The characterization of the adsorbent revealed that the pH of zero charge is equal to 4.2, the specific area is about 2057 m^2 g^{-1} and the total pore volume is equal to 1.20 cm^3 g^{-1}.

A preliminary study of the influence of the contact time and temperature was carried out. The results obtained show that equilibrium is reached after 90 minutes. The best elimination is obtained at 45°C.

The thermodynamic parameters ΔH° and ΔG° confirmed that the adsorption processe is endothermic and spontaneous.

Keywords : Biochar, Adsorption, Pomegranate peels, Chemical modification, Phosphoric acid, Hexavalent chromium removal.

CMTDE 2022_30

Comparative assessment of ionizing radiation technologies applied for inflammatory drugs degradation in the environment

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Abstract

The degradation of main persistent pharmaceutical compounds in aquatic system namely, ibuprofen, diclofenac, ketoprofen, and 2.6-dichloroaniline was investigated based on the use of ionizing irradiation process (gamma and electron beam irradiation). The pharmaceutical selected in this study occurred in the aquatic environment due to their high usage and their presence in wastewater.

An optimization of the operating parameters was studied by experimental design methodology. The effects of the initial concentration of the treated pollutants, the applied dose of irradiation, the reactor system parameters and the addition of oxidants were investigated. The synergistic effect of the ionizing radiation coupled to an oxidant such hydrogen peroxide and persulfate was determined. For each compound tested, the influence of operating variables was established, and first-order rate constants were determined for characterization of radiolytic reaction. Under both irradiation technologies, the degradation efficiency was evaluated and it was slightly higher for some compounds treated by gamma irradiation than treated by EB. The results confirmed that the ionizing technology can remarkably reduce the COD. Furthermore, the degradation efficiency of the selected compounds was enhanced by the addition of H_2O_2 (at the appropriate addition amount) and PS. However, the methanol as radical scavenger reduced the degradation efficiency

The addition of ionizing irradiation treatment, a suitable method, among the AOPs, to the traditional water treatment techniques seems to be a promising alternative. In the future, the use of EB as innovative process to the treatment of wastewater could play an imperious role at commercial scale for very large volume of real industrial water treatment.

Keywords : Pharmaceuticals, AOP, Gamma irradiation, Electron beam irradiation.

CMTDE 2022_31

Evaluation of effectiveness of electrocoagulation : heavy metals and organic matter removal

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Abstract

The harmful effects of industrial wastewater on the environment and human health with a continued rise in high water demand quality requires the development of modern and cost-effective technologies for water treatment to remove different types of pollutants. One of these techniques is the electrocoagulation (EC) process. The purpose of this study was to study the efficiency of the EC process using aluminium sacrificial anode, in the removal of organic matter (humic acid (HA)) and heavy metals (copper II (Cu^{2+}), Nickel II (Ni^{2+})). This study focuses on the effect of several operational parameters: initial pH (pHi), current density (j), electrolyte dose ([NaCl], [Na_2SO_4]) and electrolysis time tEC. Experimental results obtained showed that optimal removal was achieved for : pHi of about 5 for Cu and Ni and 4 for HA, j=1.388 $mA.cm^{-2}$, tEC(Cu,Ni) of 30 min, tEC(HA) of 10 min and [NaCl](Cu) =1g L^{-1}, [NaCl](Ni=1.5g L^{-1},[Na_2SO_4](HA)=0.15 g L^{-1}. Under the optimum conditions, EC performance was evaluated for Cu, Ni and HA removal and efficiencies of 89.93, 70,28 and 93.18 % were respectively obtained. The energy consumption was found to be 0.07, 0.065 and 0.033 $kWh.m^{-3}$. This investigation proposes an effective wastewater treatment and a promising method for heavy metal and organic matter removal.

Keywords : Electrocoagulation, Heavy metals, Humic acid, Removal efficiency, Energy consumption.

CMTDE 2022_32

Removal of naproxen from aqueous solutions by orange peel and activated carbon

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Abstract

The adsorption of an anti-inflammatory drug in aqueous solution was tested by orange peel and its synthesized activated carbon. Activated carbon samples and raw material were characterized by BET, Boehm titration, XRD, FTIR. This study is focused on the study of isotherm adsorption of anti-

inflammatory medicaments. The thermodynamic study of the adsorption on orange peels and its activated carbon (AC) gives maximum adsorption capacities in the range of 40 and 126 mg/g for biomass and AC for respectively. The experimental curves obtained were then fitted by Langmuir, Freundlich and Temkin models. The Langmuir model is the most suitable for this objective. The estimation of the thermodynamic parameters; ΔG, ΔH and ΔS show that the biosorption of anti-inflammatory drugs by the two adsorbents is spontaneous, physical and endothermic.

Keywords : Activated carbon; Adsorption; Anti-inflammatory; Biomass waste; Characterisation; Isotherms; Modelling.

CMTDE 2022_33

Adsorption of naproxen from aqueous solution using lemon peel waste

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Abstract

Lemon peel waste was tested for the adsorption of an anti-inflammatory agent in aqueous solution.
Raw material was characterized by BET, Boehm titration, XRD, FTIR. This study is focused on the adsorption isotherms of anti-inflammatory drugs. The thermodynamic study of adsorption on lemon peel has been conducted to obtain a maximum adsorption in the range of 45 mg/g. The experimental curves obtained were then fitted by the Langmuir, Freundlich and Temkin models. The Langmuir model is the most suitable for this aim. The estimation of the thermodynamic parameters; ΔG, ΔH and ΔS indicate that the biosorption of anti-inflammatory drugs by the tested biomass is spontaneous, physical and endothermic.

Keywords : Adsorption; Anti-inflammatory; Biomass waste; Characterisation; Isotherms; Modelling.

CMTDE 2022_34

Effect of inorganic anions and temperature on natural iron oxide/Oxalate mediated photocatalytic degradation of organic compound under UV and solar irradiation

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Abstract

Advanced oxidation processes (AOPs) are considered as effective technologies for the removal of organic and inorganic wastewater pollutants with high stability and/or low biodegradability. These processes are mainly based on the generation of highly reactive radical species, among which the most common one is the hydroxyl radical •OH. Fenton (Fe^{2+}/H_2O_2) or photo-Fenton ($Fe^{2+}/H_2O_2/UV$) processes, the most conventional homogenous AOPs, can be used either to lower toxicity of wastewater or to decontaminate wastewaters to allow for their drainage to water bodies. As an alternative technique to the homogenous photo-Fenton reaction, iron oxide and oxalate under UVA illumination can form an iron oxide – oxalate complex to enhance the photo-Fenton-like reaction. Fe-based catalysts have been widely used for the environmental remediation because they are abundant and environmentally friendly. This work studies a heterogeneous photo-Fenton-like system in presence of natural iron oxide (NIO) and oxalate. The effect of temperature and inorganic anions on the performance of the AOP process was investigated. The common inorganic anions (Cl^-, SO_4^{2-}, HCO_3^- and CO_3^{2-}) usually present in groundwater were used. Inorganic anions influence the rates of the decomposition of formed hydrogen peroxide and the oxidation of 2,6-dimethyphenol (2,6-DMP) as a model pollutant. From the obtained results, the degradation of 2,6-DMP was slightly inhibited by HCO_3^-/CO_3^{2-}anions at low concentrations and was considerably inhibited in presence of high concentrations. The pH variation in NIO-Oxalate system is a determining parameter in the degradation of 2,6-DMP in presence of HCO_3^-/CO_3^{2-} anions. However, an accelerating effect of the photo-Fenton-like process upon addition of Cl- and SO_4^{2-} was obtained. This effect is probably due to the oxidation reactions involving the inorganic radicals formed. It was also observed that 2,6-DMP degradation remarkably enhanced with the rise of temperature. The accelerating affect was in the following order: 50°C (100% after 4h) > 40°C (100% after 5h) > 30°C (100% after 6h) > 20°C (80% after 6h). This work provides an efficient metal-based photo-Fenton-like natural catalyst with strong anti-interference ability to practically treat wastewater.

Keywords : Natural iron oxide, Oxalate, Photo-Fenton-like, Inorganic anions, Temperature.

CMTDE 2022_35

Mechanisms fluoride removal from Métlaoui tap water by electro coagulation

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Abstract

Due to the dissolution of phosphate rocks which contain fluoride, underground water in Gafsa region (Metlaoui, Omlarayes and Redayef) contains high concentrations of fluoride ions, around 2 to 4 mg/l. Thus, a concentration of fluorine more than 1.5 mg/L; the value required by the World Health Organization (WHO), causes dental and bone diseases. In the present work, we are called upon to study the treatment of fluoride ions existing in the tap water of Métlaoui polluted with 3.53 mg/L fluoride ions by three removal techniques: electrocoagulation, chemical coagulation and adsorption using $Al(OH)_3$ flocs formed upstream by electrocagulation in NaCl-distilled water. For each of the three methods, we have optimized the main parameters influencing the efficiency of the treatment in order to have the best yield. Two mechanisms of fluoride removal by electrocoagulation are proposed by many authors: Chemical adsorption and co-precipitation but without justification. In this work, we prove experimentally the existence of these two mechanisms. By comparing electrocoagulation with chemical coagulation and electrocoagulation with adsorption in $Al(OH)_3$ flocs, we concluded that co-precipitation mechanism is more dominant than adsorption.

Keywords : Fluoride removal, Electrocoagulation, Coagulation, Adsorption

CMTDE 2022_36

Apport en polluants organiques persistants (HAPs, PCBs) des rejets telluriques au proche littoral d'Annaba, Algérie

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Résumé

Les rejets anthropiques au Golfe d'Annaba sont multiples et très diversifiés. Ils ont pour sources principales, les rejets domestiques, industriels et agricoles. Ce flux terrigène est principalement véhiculé vers la mer par les oueds Bouhamra et la Seybouse ou déversé directement dans le littoral via les effluents liquides du complexe, d'engrais phosphatés, Fertial. La connaissance des caractéristiques physico-chimiques de ce flux anthropique est indispensable pour la préservation et la gestion rationnelle et durable des eaux du Golfe.
Un suivi saisonnier de la qualité de l'eau et des sédiments des principaux effluents urbains a été réalisé. Les résultats révèlent une contamination des eaux et des sédiments par les HAPs et les PCBs. Dans l'oued Bouhamra, les HAPs sont présents toute l'année, dans l'eau et le sédiment et leurs concentrations dépassent les normes. Tandis que les PCBs ont été détectés que dans le sédiment de l'oued. Le plus grand nombre de HAPs a été trouvé dans l'eau de l'oued Seybouse avec des concentrations relativement élevées. Les PCBs sont aussi présents dans le sédiment de la Seybouse. Les effluents de Fertial, principalement les eaux du bassin annexe sont chargées en HAPs et PCBs. La majorité des effluents présentent un mauvais potentiel biologique. Ces micropolluants persistants sont essentiellement d'origine pyrolytique.

Mots-clés : Pollution organique – HAPs – PCBs - Eaux et sédiments- Baie d'Annaba (Algérie).

CMTDE 2022_38

Recovery of uranyl ions from aqueous solutions by adsorption process on the synthesized zeolite Mazzite

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Abstract

The nuclear industry generates many radioactive effluents that must be treated before being released into the environment. The presence of radionuclides in natural waters has an extremely serious negative impact on the environment and on human health. Various techniques have been developed for the removal of radionuclides from the environment. One of these techniques is adsorption, in which the adsorbents used for the elimination of radionuclides must have a high retention capacity and be resistant to radiation, such as zeolites. The elaboration of the microporous adsorbent mazzite was carried out by hydrothermal process from a gel with the following molar composition: 3.35 Na_2O: 1 Al_2O_3: 9.17 SiO_2: 125 H_2O: 1.24 (TMA)Br: 0.66 Al_2 SO_4 with a heating time of 168 hours and a temperature of 100°C. The elaborated material was the subject of a characterization by various techniques namely, optical microscopy, X-ray diffraction, scanning electron microscopy, Fourier transform infrared spectroscopy and differential thermogravimetric analysis. The synthesized adsorbent was used for the recovery of uranium (VI) from a synthetic solution using the static mode. The effect of varying operating parameters such as pH, contact time, solid/liquid (S/L) ratio and concentration was studied. The results show that the adsorption capacity of uranyl ions by mazzite was 39 mg/g under optimal conditions with pH of 3.0, contact time of 300 min, temperature of 20°C, ratio (S/L) 10 g/L and initial concentration of 150 mg/L. The uranyl ion adsorption isotherm data on the material correlated better with the Langmuir model than the Freundlich model, showing that the uptake of uranium by the elaborated Mazzite was of chemical type with a monolayer distribution on the surface.

Keywords : Mazzite zeolite; Sorption; Uranium.

CMTDE 2022_39

Synthèse par voie sol-gel et caractérisation de sulfure d'étain : Application à la photocatalyse

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Abstract

Cette étude est consacrée à la synthèse de nanoparticules de SnS (non calcinées et calcinées) par voie sol-gel en utilisant le $SnCl_2$ et $CS(NH_2)_2$ comme précurseurs en variant le solvant. Les échantillons obtenus sans calcination ont été caractérisés par la spectroscopie infrarouge a transformé de fourrier (FTIR) et la microscopie électronique à balayage (MEB) et les échantillons calcinés à 500°C ont été caractérisés par diffraction des rayons X (XRD), photoluminescence (PL) et UV–Spectromètre de Vis (UV-Vis). La spectroscopie FTIR des poudres confirme la présence de la liaison Sn-S. Les images MEB, nous a montré des formes sphériques avec la formation des agglomérats. Les résultats XRD ont indiqué la formation de sulfure avec la phase orthorhombique et hexagonale comme mode de cristallisation. Les spectres PL ont montré des émissions centrées autour de 414 nm, 530 nm et 646 nm. Comme application le pouvoir photocatalytique du SnS a été examiné par la dégradation de la Rhodamine B (RhB). Les résultats du test photocatalytique obtenus montrent la bonne performance du SnS dans la dégradation de RhB.

Mots clés : Sol-gel, Nanoparticules, SnS, RhB, Dégradation photocatalytique.

CMTDE 2022_40

Adsorption of cationic dye methylene blue using chert

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Abstract

The use of raw and purified natural chert as adsorbent for wastewater treatment was investigated for the removal availability of textile dyes from aqueous solutions. For this purpose, the adsorption of cationic dye Methylene Blue (MB) onto raw (CH-br) and purified Chert (CH-p), were investigated through batch adsorption experiment. The cherts were characterized through chemical analysis by X-ray fluorescence (XRF), X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM) and liquid nitrogen adsorption-desorption analyses by measuring the specific surface area (BET Method). The effect of parameters such as pH, adsorbent weight and initial dye concentration were studied. The adsorption Kinetic followed pseudo-second-order kinetic model. Maximum dye removal was observed at pH 2. The results showed that natural chert can be used effectively for the removal of cationic dyes from aqueous solutions and that CH-p can be used adequately to adsorb MB more efficiently than CH-br.

Keywords : Adsorption, Methylene Blue, Dye, Natural Chert, Purified Chert

CMTDE 2022_42

Treatment of water contaminated by a pharmaceutical residue, by adsorption, on a bio material

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Abstract

Hospital effluents and the pharmaceutical industry are the main sources of pharmaceutical residues in the environment and particularly in water sources. The presence of these drug substances, their persistence in aquatic environments, and their biological interest create concerns for the health of living species and their ecosystems.

This study allows the removal of a selected antibiotic, which is amoxicillin, from water by adsorption on sawdust as a biosorbent. An optimization of certain parameters influencing the adsorption process, the contact time, the quantity of adsorbent involved, the pH of the medium, the temperature, and the ionic strength, was carried out in order to improve the retention rate of this emerging pollutant. The study of thermodynamic parameters showed that this process of depollution is exothermic. The application of Langmuir, Freundlich, Temkin, Dubinin-Radushkevich, and Toth models allowed to describe correctly the adsorption isotherms. The external diffusion step was the determining step in the process of Amoxicillin adsorption by sawdust.

Keywords: Pharmaceutical residues; Adsorption; Amoxicillin; Sawdust; Biosorbent.

CMTDE 2022_44

Manufacture and characterization of hydrophobic membrane based on recycled polymers

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Abstract

In this study, a hydrophobic membrane has been prepared by thermally induced phase separation for the brackish water distillation using recycled polymers and old reverse osmosis membranes, which have been discarded in huge quantities in nature, by consequently we win economically and ecologically.
Membrane morphology and performance were tailored by acting on the casting solution composition, more specifically on the presence and the concentration of different polymers and alumina as pore former agents. The obtained membranes were characterized in terms of morphology, thickness, porosity, contact angle, mechanical resistance, pore size and pure water permeability (PWP). The resulting data indicated as both the additive and the polymer concentration in the casting solution played a role for the final membrane structure and properties. The results show that the porosity reaches 82% and the pure water permeability (PWP) in the range of 2960 l/m2h-1 with the presence of alumina. VMD tests showed as the prepared membrane with a pore size comparable to the commercial polypropylene (PP) membrane, exhibited promising results in terms of permeate flux which opening new perspectives in the sustainable membrane technology.

Keywords : Hydrophobic membrane, Recycled polymers, Characterization, Brackish water distillation.

CMTDE 2022_48

Treatment of wastewater by coagulation-flocculation process using the cactus Opuntia as a bio- coagulant

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Abstract

Urban wastewater is a major source of environmental pollution. In recent years, a great deal of work has been devoted to finding less costly methods of pollution control. Several biomaterials have recently been explored for use in the bio-sorption and bio-coagulation-flocculation of wastewater pollutants. In this study, the potentiality of Opuntia Cactus, as a coagulant for the treatment of wastewater (collected at the inlet of the primary clarifier of the CHOTRANA WWTP) in terms of chemical oxygen demand (COD), suspended solids (SS) and turbidity, was investigated. The physico-chemical properties of this bio-coagulant were characterised by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and zeta potential analysis. The optimal conditions for the application of the Opuntia Cactus were identified by performing jar test experiments. The parameters tested were chemical oxygen demand (COD), suspended solids and turbidity. The results of this work indicate that Opuntia Cactus is an effective bio-coagulant, which can remove 40% of COD and 80% of turbidity and suspended matter. From this study, it can be deduced that Opuntia has a great potential to be used as a low-cost bio-coagulant for wastewater treatment.

Keywords : Urban wastewater, Cactus Opuntia, Coagulation-floculation, Turbidity, COD, Suspended solids.

CMTDE 2022_49

Application du procédé d'échange ionique à l'élimination d'un colorant synthétique

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Résumé

À l'origine de près de 2,6 millions de décès chaque année [1], l'eau polluée est devenue le fléau le plus dévastateur de notre époque. La pollution aquatique est le résultat du déversement volontaire ou accidentel de différentes catégories de substances exogènes dans le milieu naturel (colorants, détergents, produits phytosanitaires, médicaments…). Les colorants synthétiques représentent aujourd'hui un groupe important de ces substances, leur production mondiale étant estimée à plus de 700.000 tonnes par an, dont 10 - 15 % sont rejetées dans les effluents au cours des différentes étapes d'application [2]. L'évacuation directe de ces effluents dans l'écosystème représente une source dramatique de perturbation de la vie aquatique et présente un danger potentiel de bioaccumulation qui peut affecter l'homme par transport à travers la chaîne alimentaire. Comme les standards internationaux de protection de l'environnement deviennent de plus en plus stricts, la décoloration des effluents colorés a reçu ces dernières années l'attention des scientifiques. Ainsi, plusieurs méthodes biologiques, physiques et chimiques sont développées pour l'élimination des colorants, avec une efficacité plus ou moins importante, nous citons à titre d'exemple : Les procédés de sorption, regroupant l'adsorption et l'échange ionique. Ce dernier est le procédé au moyen duquel les ions d'une certaine charge (positive ou négative) contenus dans une solution sont éliminés et remplacés par une quantité équivalente d'autres ions de même charge émis par un solide (l'échangeur d'ions). Ainsi, les substances nocives ou précieuses, peuvent être récupérés et remplacés par d'autres ions moins nocifs ou sans valeur. L'avantage majeur de ce procédé réside dans la possibilité et la facilité de régénération, ce qui permet d'une part de réutiliser l'échangeur et d'autre part de récupérer la substance éliminée de l'effluent, sous forme de concentrât pouvant être réutilisé. L'échange ionique semble donc être un outil bien adapté au traitement des eaux usées comprenant des colorants synthétiques ayant une charge électrique tels que les colorants azoïques anioniques, connus pour leur toxicité. Dans le but d'enrichir nos connaissances sur ce sujet, nous nous sommes intéressés dans le présent travail à l'élimination de l'Acide Orange 10 (AO10), colorant synthétique choisi comme un modèle de molécules appartenant à la classe précitée, par fixation sur une résine échangeuse d'anions commerciale, Amberlite® IRN78. Les résultats obtenus mettent clairement en évidence la capacité de cette résine à fixer l'AO10, via un mécanisme d'échange ionique. La fixation est sensiblement affectée par la concentration du colorant, la dose de la résine, la température et la présence d'anions compétiteurs (Cl^- et SO_4^{2-}). La nature du contre ion de la résine (Cl^- ou OH^-) n'a cependant aucun effet sur la rétention de notre colorant. La régénération de la résine est faisable et facile, en utilisant l'acide chlorhydrique comme réactif de désorption en présence de méthanol. La résine régénérée pourrait efficacement être réutilisée pour d'autres cycles de sorption/désorption.

Mots clés : Echange ionique, colorant azoique anionique, fixation, AO10, IRN78.

CMTDE 2022_50

Parametric study of photocatalytic ceramic membrane for colored wastewater treatment

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Abstract

Hybrid membranes are currently developed to find the membrane with good chemical and thermal resistance. Therefore, this research highlights the preparation of hybrid flat membrane from clay/TiO_2 using a dip-coating process. Three parameters have been studied, which are TiO_2 concentration, immersion time and calcination temperature. After membrane preparation, the use of these membranes to treat colored wastewater was done. The results show that the addition of titanium dioxide (TiO_2) improves the hydrophilicity of the membrane and the contact angle decreases from 33.7° to 6.31° when TiO_2 concentration increases from zero to 21 g/L. In addition, the porosity of the membrane decreases to reach the value of 19.66% for TiO_2 concentration of 21 g/L. For the case of methylene blue rejection, a decline from 70.23% to 57.11% can be remarked with an increase of TiO_2 concentration from 11 to 21 g/L. Furthermore, on the retentate side, the best rejection of methylene blue is attributed to the membrane coated with one g/L with TiO_2. In addition, when the calcination temperature increases from 300°C to 600°C, the contact angle remains around 7°, and the porosity increases by 36%. As a result, at 300°C, the high value of methylene blue rejection is 79% and 77% on permeate and retentate sides, respectively. With the increase of immersion time from 0.5 h to 12 h, the methylene blue rejection increases to reach the value of 68%.

Mots clés : Ceramic membrane, Characterization, TiO_2, Wastewater, Treatment.

CMTDE 2022_51

Insights into the physicochemical properties of Sugar Scum as a sustainable biosorbent derived from sugar refinery waste for efficient cationic dye removal

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Abstract

The objective of this study was to determine the ability of sugar scum (SS), an industrial waste, as a novel biosorbent for the removal of Basic Blue 41 (BB41) from aqueous solutions. The biosorbent was characterized by SEM/EDS, BET, FTIR and pHpzc measurements, respectively. To reach a maximum adsorption capacity of 26.45 $mg \cdot g^{-1}$, impacting operational factors such as pH, biosorbent dose, contact duration, starting dye concentration and temperature were adjusted, when the removal efficiency reached 84% during 60 min at pH 10, 1.5 $g \cdot L^{-1}$ of biosorbent and C_o= 10 $mg \cdot L^{-1}$. The experimental data were modelled by various isotherm models, whereas the best fit was found for Freundlich with a high correlation coefficient (R^2 = 0.991). Others kinetic models including pseudo-first and pseudo-second order models were tested to fit the kinetic data. The biosorption of BB41 onto SS was spontaneous ($\Delta G° < 0$) and exothermic ($\Delta H° < 0$), and the reuse test demonstrated that SS could be regenerated after four successive runs. Furthermore, this study revealed that sugar scum is an underutilized bioresource in Algeria, with the potential to provide low-cost environmental removal of additional contaminants in the wastewater treatment domain.

Keywords : Sugar Scum (SS); Basic Blue 41 (BB41) dye; Biosorption; Isotherms; Kinetic.

CMTDE 2022_52

Adsorption of Heavy Metals from Aqueous Solutions on Synthetic Zeolite

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Abstract

The objective of the present study is to investigate the removal of heavy metal ions Cu^{2+}, Zn^{2+}, Cd^{2+} and Ni^{2+} from aqueous solution using synthetic zeolite type Faujasite. The adsorption studies were carried out in the single and binary component system. Sorption experiments were performed in batch at pH (5–6), adsorbent dosage (0.15g). The single-ion equilibrium adsorption data were fitted to three isotherm models: Langmuir, Freundlich, and Dubinin-Radushkevich. Results showed that the Langmuir isotherm fits sorption data better than the Freundlich equation. The obtained R_L (separation factor or Langmuir parameter) values were in the range of 0–1 indicating that sorption was favorable. The obtained mean free

energy value for adsorption of Ni^{2+}, Zn^{2+}, Cu^{2+} and Cd^{2+} were in the range of 8–16 kJ/mol, indicating that ions were up taken through an ion exchange process.

Keywords : Adsorption, Heavy Metals, Synthetic zeolite, Langmuir, Freundlich, Dubinin-Radushkevich.

CMTDE 2022_54

Study of heat transfer phenomena of a passive solar still

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Abstract

The paper reports a study of heat transfer for a single solar still, concerning a typical summer day in Gabes region.
Influences of humid air temperature and pressure on heat and mass transfer are studied.
It was found that the increase of water vapor partial pressure and humid air temperature improves the solar still productivity.

Keywords: Solar still, Humid air temperature, Heat transfer.

CMTDE 2022_58

Adsorption of dyes by adsorption onto activated biosorbent: isotherm and kinetics studies

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Abstract

In this study, the removal of dyes by adsorption on activated biosorbent was investigated and the results were fitted to Langmuir, Freundlich, Dubinin-Radushkevich, and Temkin adsorption models at various temperatures. The constants of each model were evaluated depending on temperature. Thermodynamic parameters for the adsorption system were determined at 25, 35, 45, 55 and 65°C. The obtained values showed that dyes adsorption is a spontaneous and endothermic process. The kinetic process was evaluated by first–order, second–order and Elovich kinetic.

Keywords : Adsorption, Dyes, Activation, Isotherm, Kinetic, Thermodynamic.

CMTDE 2022_59

Application of the ultrafiltration membrane for treatment of dye wastewaters discharge from textile industries

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Abstract

The textile industry is a large water consumer. As regulations become stringent and the cost of freshwater increases, reclamation of wastewater becomes more and more attractive. Ultrafiltration process is investigated as a possible alternative to remove dye from aqueous synthetic solution. This work presents a comprehensive study towards a better understanding of dye retention mechanism during ultrafiltration (UF) processes. Thus, Removal of methylene blue and methyl orange was studied using a polyethersulfone ultrafiltration membrane denoted PWS from Osmonics company. The influence of the most important operating variables (feed concentration, pressure, pH, recovery and ionic strength) on the retention of the selected compounds was discussed. There was a gradual increase in the removal efficiency with an increase in pH and feed concentration. However, increasing pressure is accompanied with increasing retention of methyl orange and decreasing retention of methylene blue, indicating that membrane-solute interactions were found to play an important role during the process.

Keywords : Wastewater treatment, Ultrafiltration, Methylene blue, Methyl orange

CMTDE 2022_60

Reactive dyes rejection and textile effluent treatment study using nanofiltration processes. Study of fouling and antifouling

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Abstract

The textile wastewater treatment by membrane processes presents some limitations such as membrane fouling which causes a rapid flux decline. In fact, the membrane processes efficiency can be affected by membrane pore blocking or/and cake formation. In order to limit the effect of membrane fouling caused by plugging particles in textile effluent, nanofiltration process were used to treat synthetic reactive dyes aqueous solutions and a raw textile effluent. In fact, Dye concentration had a significant effect on flux values. Under the fixed NaCl concentrations the flux decreased with increasing dye concentrations. This study allowed us to develop the phenomena that coexist during the frontal filtration of the solutions containing a mixture of "salt dyes". Three theoretical models for studying the phenomenon were compared and a regeneration efficiency index made it possible to optimize the optimal conditions in this study.

***Keywords** : Nanofiltration, Reactive dye, effluent textile, fouling, antifouling*

CMTDE 2022_62

Preparation and characterization of an activated carbon based on PVC plastic waste. Application in the recovery of Cu^{2+} ions

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Abstract

The objective of this work is to develop an adsorbent based on waste from PVC plastic type cables for the elimination of heavy metals, mainly copper (Cu^{2+}) which is found in industrial waters with a content exceeding the eligible limits. To achieve this goal, high temperature PVC pyrolysis (700°C) and chemical activation (KOH) were chosen as synthetic methods. The obtained activated carbon product in the raw state was characterized by different techniques, X-ray diffractio (XRD), Energy Dispersive Spectroscopy (EDS), Fourier transform infrared spectroscopy (FTIR), Scanning Electron microscopy (SEM) and thermo gravimetric analysis (ATG/ATD). After the analysis, adsorption tests of Cu^{2+} ions were carried out on the activated carbon produced in aqueous solutions in discontinuous mode. The effects of different parameters such as the initial concentration of Cu^{2+} ions, the exchange temperature, the pH of the solution and the solid/liquid ratio were studied to determine the optimal parameters of the applied process. According to the obtained results, a removal efficiency of 60% and an adsorption capacity of 20 mg/g were recorded.
Several models were used namely the linear models of Langmuir, Freundlich and Dubinin - Radushkevich (D-R) to test the experimental data obtained. It seems that the Langmuir model is the most suitable. The pseudo-second order kinetic model showed a better fit. The themodynamic parameters have been also determined.

Keywords : Adsorption; Copper ions; Plastic PVC waste; Activated carbon; Pyrolysis.

CMTDE 2022_66

Treatment of aqueous solutions polluted by Fe^{2+}, Zn^{2+}, Cu^{+2} ions by ion exchange process using a zeolite type A

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Abstract

This work involves the use of a zeolite type A for the recovery of zinc (Zn^{2+}), iron (Fe^{2+}) and copper (Cu^{2+}) from a hetero-system synthetic prepared aqueous solution. The recovery process used is that of ion exchange in batch mode.

The zeolite A was previously characterized by different techniques, XRD, SEM, ATD, TG and FTIR. The exchanged sodium ions existing in the zeolite A were measured by the atomic absorption technique in a multi-compound system. A parametric study concerning the initial concentration of ions, the contact time, the exchange temperature, the pH of the solution, the nature of the cation exchanged and the solid/liquid ratio was carried out. The results obtained show the efficiency of the zeolite A in the recovery of the studied ions Fe^{2+}, Zn^{2+} andCu^{+2} with very appreciable exchange rates. The Freundlich and the Langmuir models have been applied and the adsorption kinetics followed both adsorption isotherms. Kinetic, equilibrium and thermodynamic studies were also carried out. A comparison of kinetic models applied to the adsorption of iron, copper and zinc ions onto the zeolite was evaluated for the pseudo first-order and the pseudo second-order kinetic models. It seems that these models were found to correlate the experimental data. Intra particle diffusion model was also used. The thermodynamic parameters namely the enthalpy $\Delta H°$, entropy $\Delta S°$ and free energy $\Delta G°$ of adsorption of Fe^{2+}, Cu^{2+} and Zn^{2+} ions on zeolite A were determined.

Keywords : Ion exchange; Characterization; Copper; Zinc; Iron; Zeolite A; Equilibrium; Thermodynamic; Hetero-system.

CMTDE 2022_68

The removal of phosphate by adsorption onto alginate /activated carbon

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Abstract

Phosphate manufacturers cause considerable amounts of water pollution. Phosphate is frequently present in groundwater and urban/industrial wastewater. Phosphorus is an important element for agricultural and industrial products. It is an essential nutrient in the aquatic environment, but excessive concentrations of phosphate in surface waters can lead to eutrophication. Therefore, the removal of phosphates from wastewater can be an effective method to control eutrophication. During the last decades much research has focused on phosphate removal techniques such as physical, chemical and membrane processes. Our interest is focused on adsorption which is an easy and very effective technique. Alginate, a natural polysaccharide extracted from brown algae is the most commonly used for the formation of powder/alginate composite beads. The alginate appears to be of interest for its property of forming the gel in the presence of divalent cations, in particular calcium ions. The adsorption and gelling properties of alginate make it possible to consider the combination of adsorbents by encapsulation and the production of materials that can be used in water treatment processes. The removal of phosphate from solution by adsorption onto alginate/ activated carbon beads has been studied. A preliminary study was investigated according several parameters such as the initial concentration of phosphate, pH, adsorbent dose and temperature.

Keywords : Phosphates, Adsorption, Alginate, Activated Carbon.

CMTDE 2022_69

Removal of Nitrate by Biosorption using Eucalyptus Leaves

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Abstract

The presence of Nitrate in water has double-edged effect, since nitrate plays an important role in the natural nitrogen cycle that affects all plants and animals, but at high concentration in water it disturbs the ecologic equilibrium and deteriorate the quality of water. Indeed, the presence of nitrate in water increase constantly due to of excessive contributions urban, industrial, and especially agricultural waste. According to the

World Health Organisation, the concentration of nitrate in drinking water should not exceed 50 mg/L. Several techniques have been used to remove nitrate from water such as biological denitrification, reverse osmosis, electrodialysis, ion exchange and adsorption. The adsorption has been recognised as the most efficient and easy to removal any type of pollutants.
The present study focuses on the removal of nitrate by bio-adsorption using eucalyptus leaves as a low-cost adsorbent. A preliminary study was carried out to determine the optimal operating conditions for nitrate removal using eucalyptus leaves. The isotherms models were applied in order to explain the adsorption process, then a kinetic study has been conducted. The thermodynamic parameters were determined to indicate the nature of adsorption process. Finally, to show the effectiveness of eucalyptus leaves as a low-cost adsorbent to remove nitrates, a well water from Menzel Bouzalfa was treated.

Keywords : Nitrate, Eucalyptus leaves, Biosorption, Isotherm, Kinetic, Thermodynamic.

CMTDE 2022_70

Oward a primary measurement procedure for pH in seawater : Comparison of mean activity coefficients in saline aqueous matrixes

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Abstract.

This study allowed us to establish a procedure for determining the pH of seawater by the primary method using cell without junction (Harned cell) in artificial seawater without sulfate (ASW-SO4) which is taken as a reference buffer solution featuring the natural seawater at salinity 35 and anionic strength equal to 0.6731 mol / kg. The determination of the coefficient average activity (γ ±HCl) of HCl was taken from two approaches (1) an experimental approach in which we introduced the potential standard value (E°) calculated in dilute media (2) a second approach in which we developed the Pitzer model in function of the temperature (15, 25 and 35°C) taking into account all the parameters of the solution in ionic interactions and we demonstrated its feasibility for the solutionASW-SO4.

Keywords : pH, artificial seawater traceability, potentiometry, Pitzer model, TRIS

CMTDE 2022_71

Study of textural, structural and adsorbent properties of aerogel and xerogel nanostructured zirconia: defluoridation of drinking water

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Abstract

The present investigation reports the effect of the evacuation mode of solvent in the adsorbent properties of aerogel and xerogel ZrO_2 materials in the removal fluoride from water. Aerogel and xerogel zirconia were prepared in one-step by the sol–gel method. Aerogel is obtained by drying under supercritical conditions of solvent and xerogel is obtained by ordinary drying in an oven.

The characteristic properties of those solids were investigated using Fourier Transform Infrared Spectroscopy (FT-IR), X-ray diffraction (XRD), Rietveld refinement of XRD patterns, Physisorption of N2 (BET), Scanning Electron Microscopy (SEM) and energy dispersive X-ray spectroscopy (EDS). Experimental conditions such as adsorbent dose, contact time, initial fluoride concentration and pH value were investigated.

Crystallite size showed that all crystalline xerogel and aerogel zirconia samples were of nano-crystalline nature. Textural analysis reveals the mesoporosity of all adsorbents. FTIR spectra spectroscopy show the important role of superficial hydroxyl groups in the defluorination process. Xerogel zirconia removed more fluoride than aerogel zirconia.

The selected zirconia adsorbent was used successfully to remove fluoride from contaminated natural water below 1.5 mg/L, even in complex matrix.

Keywords : Fluoride Adsorption, Zirconia, Mesoporous, Xerogel, Aerogel, Natural water.

CMTDE 2022_72

Removal of Oxytetracycline an Emerging Pollutant from aqueous solution by Electrocoagulation

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Abstract

Oxytetracycline (OXY) is one of the most consumed antibiotic drug all over the word. This medicine is classified as emerging contaminant, due to its wide application, high solubility in water, high residual toxicity and an absence of biodegradability that conventional wastewater treatment technologies are unable to successfully eliminate. In this study, we describe the successful degradation and mineralization of OXY aqueous solution through metal hydroxides generated during electrocoagulation process. Experiments were carried out in a batch electrochemical reactor using aluminum electrodes. Effects of pH, concentration and current densities on removal efficiencies were carried out and studied. Six pH conditions (pH =2; 3; 4; 5; 7 and 9) were applied. Obtained results show that the higher removal efficiency has been obtained at pH =9. In addition, the effect of current density and concentration indicated that the degradation efficiency increases with increasing current density and concentration. Thus, the % DCO removal obtained reaches 95 % indicating quasi- total mineralization. Furthermore, spectrophotometric analyses argued in favour of a pseudo-first order degradation kinetic. The resulting apparent rate constant value is equal to k = (0.078±0.03) min-1.

Keywords *: Electrofloculation process, Oxytetracycline, DCO, kinetic study.*

CMTDE 2022_73

Gliding arc plasma pre-treatment for the biodegradation of a pharmaceutical pollutant

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Abstract

As a result of urbanization and industrial and agricultural development, water is contaminated with various types of inorganic and organic pollutants. Among these pollutants, pharmaceutical compounds and their residues are a large source of non-biodegradable products leading to perturbations in the environment and the ecosystem. Consequently, several studies have focused on the degradation or elimination of

pharmaceutical pollutants. Advanced Oxidation Processes (AOPs) such as plasma process, are increasingly used for the degradation and mineralization of recalcitrant pharmaceutical pollutants through the in-situ formation of strongly oxidizing species including hydroxyl radicals OH°. However, AOPs have the disadvantage of being large consumer of energy which considerably increases the cost of treatment. Thus, the coupling between the different types of process seems adequate and necessary to establish an efficient and economical treatment system. In this context, this study reports on the use of gliding arc plasma process as pre-treatment for biodegradation to degrade a pharmaceutical pollutant. After an optimization of the experimental conditions of degradation by plasma, an evaluation of the biodegradability of the treated solutions was carried out. All the results showed the feasibility and efficiency of the plasma process as a pre-treatment step for biodegradation.

Keywords : Pharmaceutical pollutant, Coupling, Plasma, Biodegradability.

CMTDE 2022_74

Removal of cationic and anionic dyes from aqueous solution : Degradation of an emerging pharmaceutical contaminant by new bio adsorbent

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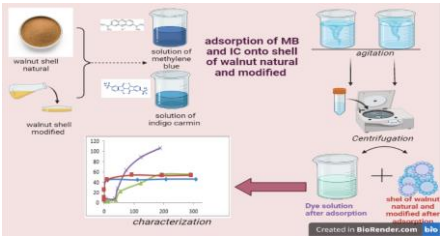
Abstract

The aim of this work is to study a novel, low cost and eco-friendly bioadsorbent which are the walnut shell natural and modified basic with the sodium hydroxide, to remove two types of dyes cationic and anionic: the methylene blue and indigo carmin. The walnut shell was characterized by the determination of dry matter, humidity, ash content, volatile matter, pH_{PZC} and FT-IR. The phenomenon of adsorption capacities varies, depending on the initial dye concentration, pH of the solution, contact time, and process temperature. Increasing pH resulted in an increase of percent of adsorption of methylene blue while the increasing of pH resulted the decrease of percent of adsorption indigo carmine and the mechanism of adsorption was occurred by the electrostatic attraction for the methylene blue and repulsion for the indigo carmine between the charges of adsorbent surface and dyes molecules. After applying adsorption kinetic models such as the pseudo-first-order and pseudo-second-order. The highest suitability was out to be the pseudo-second order kinetic model. Langmuir and Freundlich's models were used in this study but eventually, Freundlich was the most suitable model in this study due to the higher R^2 obtained. The maximum dye adsorption capacity was found to be 53.33 mg. g^{-1} and 45.88 for methylene blue by the shell of walnut natural and shell of walnut modified basic respectively and 55.55 mg. g^{-1} and 101.21 for Indigo onto shell of walnut natural and shell of walnut modified basic respectively. The thermodynamic parameters ΔG^0 (KJ. mol^{-1}), ΔH^0 (KJ. mol^{-1}) and ΔS^0 (kJ. mol^{-1}. K^{-1}) indicated the endothermic nature of biosorption and the increased randomness at the solid-solution interface during adsorption respectively. The results showed very clearly the effectiveness of walnut shell in the decolorazation of methylene blue and especially the indigo carmine which is the most toxic.

Keywords : Adsorption, Shell of walnut, Methylene blue, Indigo carmin.



Graphic abstract: removal of methylene blue and indigo carmine by walnut shell natural and modified.

CMTDE 2022_75

Degradation of an emerging pharmaceutical contaminant by Glidarc plasma

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Abstract

Every year, thousands of tons of pharmaceutical compounds are used in human and veterinary medicine to treat symptoms, diseases and infections. These molecules detected in groundwater and drinking water have an adverse effect on human health and the environment. They are therefore considered as emerging contaminants. To face this worrying situation, many works are oriented towards the degradation of these emerging pharmaceutical contaminants by several treatment processes. In this context, we are interested in the study of the degradation of this type of organic pollutants in water by an advanced oxidation process, GLIDARC. The study of the degradation of an emerging pharmaceutical contaminant was initiated by an optimization of the experimental parameters such as the effect of the concentration of the pollutant and the effect of the distance between the two electrodes and the solution. This optimization was followed by a kinetic study of the degradation reaction. The determination of the biochemical oxygen demand (BOD) and the chemical oxygen demand (COD) was carried out. The biodegradability of the treated solution was also evaluated. The obtained results confirm the effectiveness of the GLIDARC plasma for the treatment of emerging pharmaceutical contaminants.

Keywords : Emerging pharmaceutical contaminant, Plasma, Glidarc, Degradation

CMTDE 2022_78

Dégradation de la côte Est de Bizerte (Région de Ghar El Melh) par erosion et intrusion marine : Application du SIG

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Résumé

Les zones littorales sont caractérisées par l'apparition des intrusions marines qui peuvent être liées soit à un changement climatique global et planétaire, régional et/ou local, soit à l'action anthropique tel que le cas de la région de Korba. Ce travail consiste à déterminer les dégâts causés par l'intrusion marine dans au niveau de la nappe de Ghar el Melh et ses environs immédiats. Pour se faire, l'approche utilisée est la méthode paramétrique combinée avec les techniques de SIG (méthode dite GALDIT).

La région de Ghar el Melh et ses environs se trouvent au Nord-Est de la Tunisie (Cap-Bon). Ils sont caractérisés par leur climat méditerranéen à hiver modéré et été chaud. Ici, les séries géologiques affleurantes sont le plus souvent meubles (argiles et sables) d'âge Mio-Pliocène et Quaternaire.

La carte de vulnérabilité à l'intrusion marine de la nappe de Ghar el Meleh et l'indice GALDIT ont été obtenues grâce aux données analytiques du ministère de l'agriculture et ceux effectuées à l'INAT (laboratoire de pédologie). Ces données analytiques ont été traitées et cartographiés à l'aide du logiciel Arc Gis 10.1.

En déterminant les six paramètres sur lesquels est basée la méthode GALDIT on peut dire que : 1) le paramètre G, indique que la nappe de Ghar el Melhest semi captive ; 2) le paramètre A, montre que sa conductivité hydraulique est faible ; 3) le paramètre L, désigne sa hauteur par rapport au niveau de la mer. Cette hauteur est faible autour de la lagune de Ghar el Melh et à proximité d'Oued Mejerda; elle est faible à moyenne à l'Est de la nappe et élevée à l'Ouest; 4) le paramètre D représente les distances 500, 750 et 1000 m par rapport au rivage; 5) le paramètre I concerne l'impact de l'état actuel de l'intrusion marine montre une conductivité électrique et une teneur en chlorure et un ratio Cl^-/ ($HCO_3^- + CO_3^{2-}$) élevées, avec des zones négligeables de moyen et de faible ratio; 6) le paramètre T qui évalue l'épaisseur de la nappe montre qu'il s'agit d'un aquifère épais.

L'indice GALDIT de la nappe de Ghar el Melh est égal à 6,1, correspondant à une vulnérabilité moyenne. En revanche, la carte de vulnérabilité montre d'importants dégâts tout le pourtour de la lagune de Ghar el Melh. En s'éloignant de la lagune, la vulnérabilité devient moyenne à proximité de l'Oued Mejerda et fable partout ailleurs.

CMTDE 2022_79

Removal of tramadol hydrochloride, an emerging pollutant, from aqueous solution using NF270 nanofiltration membrane

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Abstract

Tramadol hydrochloride (TRAH) is an analgesic widely used in recent decades. This medicine is classified as an emerging contaminant, responsible for environmental damage and aquatic toxicity, that conventional wastewater treatment technologies are unable to successfully eliminate. This study focuses on the application of NF270 nanofiltration membrane treatment for removal of TRAH, an emerging pollutant, from aqueous solution using a dead-end stirred-cell filtration system. The effects of operating pressure, feed concentration and pH solution on the permeate flux rate and TRAH rejection were investigated. Influence of operating pressure was studied at different values (2 - 12 bars) at initial concentration of 20 mg/L and pH of 6.65. Results showed that the permeate flux increased linearly with the transmembrane pressure. On the other hand, it was observed that TRAH rejection increases with pressure until a constant and steady rejection of 82.5% at 8 bar. Regarding the effect of concentration, the experimental results indicate that the permeate flux decreases and the rejection of TRAH increases when the initial feed concentration increases. Finally, the permeate flux increases slightly with initial pH solution and TRAH rejection increased significantly from 49.0% to 89.4% by moving the solution pH from 3.2 to
9.0. Steric hindrance effect seems to be the most significant mechanism in terms of reaching a TRAH rejection percentage of about 83%.
Based on the overall results, the removal efficiency of TRAH by NF270 was influenced by operating pressure, feed concentration, and pH solution.

Keywords : Tramadol hydrochloride, Emerging pollutant, NF270, Nanofiltration.

CMTDE 2022_81

Synthesis and characterizations of Carbon Xerogels from Resorcinol and formaldehyde and modeling

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Abstract.

The sol-gel method consists on obtaining very pure products from selected precursors. Indeed, synthesizing very pure activated carbon (> 99% carbon) using organic precursors containing only carbon and oxygen as hetero atoms to form a polymeric resin by pyrolysis. The proposed synthesis reaction is a polycondensation of resorcinol with formaldehyde in two different media (water and acetone) in the presence of two catalysts (acetic acid and sodium carbonate). By varying the following parameters: solvent, nature and quantity of catalyst, 16 samples were obtained. By the method of factorial design (2k): an optimization is realized by following three characteristics of nanoxerogels prepared: the density, the gel time and performance. The results indicate the best conditions for the synthesis of a carbon nanoxerogel: the lowest quantity of acid catalyst in aqueous media (A5).

Keywords : Resorcinol, Formaldehyde, Carbon Xérogel, Gels ; Factorial design.

CMTDE 2022_82

Fabrication and characterization of a novel Lysine-PVA electrospun fibers for gold nanoparticles extraction from water

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Abstract

Metallic nanoparticles have received great interest in different industrial and medicinal fields due to their unique properties: optical, electrical, magnetic, high surface to area ratio, small size and different shapes. Despite these advantages, their short and long-term toxicity is a critical issue. The huge production of these nanomaterials will increase their release in the environment (soil, water and atmosphere) and cause a higher risk to the ecosystem and human health. Therefore, the focus on reducing the release of nanoparticles is urgently needed. The aim of this work was the fabrication of new lysine loaded PVA electrospun fibers to extract gold nanoparticles (AuNPs) from aqueous environment. The produced fibers were characterized by scanning electron microscopy (SEM), fourier transform infrared spectroscopy (FTIR), thermogravimitric

analysis (TGA), elemental analysis, BET surface area and pH of zero charge. The catalytic performance of AuNPs adsorbed onto fibers was evaluated through the reduction of 4-nitrophenol.
These fibers have shown high efficiency in AuNPs extraction from water, reaching 95% at pH equal to. The reduction of 4-nitrophenol to 4-aminophenol using AuNPs-PVA-Lysine fibers as a catalyst was achieved within 60 min. The recyclability test of these fibers as catalyst showed that the reduction process was completed with more than 99% of 4-nitrophenol removal yield after 5 cycles.

Keywords : PVA, Lysine, Fibers, Gold nanoparticles, Removal, Catalysis, Recyclability

CMTDE 2022_83

Kinetics of hydrolytic degradation of carbamates pesticides

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Abstract

Water is a very stable compound but also very reactive, is an excellent solvent in the liquid state. It is ubiquitous on earth and in the atmosphere, in its three states, solid (ice), liquid and gaseous (water vapour). Water is also a natural resource whose management is the subject of strong environmental issues. The chemical formula of pure water is H2O. Hydrolysis is a chemical reaction in which a covalent bond is broken by the action of a water molecule. Basic hydrolysis is a hydrolysis reaction. But, contrary to classic hydrolysis, the water is generally replaced by sodium hydroxide or any other solution containing hydroxide ions. Basic hydrolysis is slow at room temperature but rapid in hot solution. A pesticide is a substance used to control harmful organisms. It is a generic term that brings together insecticides, fungicides, herbicides and parasiticides designed to have a biocidal action. The chemical fight has existed since millennia, the use of sulfur for example dates back to ancient Greece. In this research work, the parameters that influence the kinetics of the hydrolytic degradations of Isoprocarb or 2-isopropylphenyl-N-methylcarbamate and Promecarb or 3-isopropyl-5-methylphenyl-N-methylcarbamate and their degradation mechanisms have been studied in details. From the kinetic results obtained on these N-methylated carbamate insecticides, we were able to attribute to Isoprocarb as well as to Promecarb a hydrolytic degradation of the E1cB type. Indeed, the positive values of the variations of the entropies of activation ($\Delta S\neq = + 21,78$ $Jmol^{-1}K^{-1}$) and ($\Delta S\neq = + 66,82$ $Jmol^{-1}K^{-1}$) respectively for Isoprocarb and Promecarb are in favor of E1cB mechanisms for the hydrolysis of each insecticide. The rate constants of hydrolytic degradation of two pesticides were determined following a first order kinetic model. The reactions kinetics have been investigated using UV spectrophotometry and HPLC chromatography. These results are confirmed by the correct positioning of the points corresponding to Isoprocarb (pKa = 10,89) and Promecarb (pKa = 10,47) on the Hammett and Brönsted lines proposed by Williams for the hydrolysis of a series of N-methyl carbamic acid esters. Therefore, study of hydrolytic degradation behavior is utmost important while considering performance of

phytosanitary products. Pesticides undergo hydrolytic bond cleavage to form water soluble degradation products that can dissolve in an aqueous environment. In this context, degradation is a chemical phenomenon. During hydrolysis, 2-isopropylphenol is the main degradation product of Isoprocarb. It gives evidence for the significant reactivity of this insecticide in alkaline solution. For Promecarb, 3-isopropyl-5-methylphenol has been identified as one of the hydrolysis products at the temperature and pH of the aqueous medium. These reactions can sometimes be catalyzed by the own hydrolysis products. The phenomenon in which hydrolysis mainly occurs in the reaction medium. On the other side, in recent years, among parameters that influence states of degradation are catalysts. However, the impacts of these parameters that increase or decrease the degradation rate are clear. It is known that hydrolytic degradation proceeds with a higher rate constant in the hottest solution.

Keywords : Pesticide, Degradation, Carbamate, Kinetics, Aqueous medium, HPLC chromatography

CMTDE 2022_84

Mineralization and degradation of carbamates pesticides by electro Fenton process and the study of their biodegradation

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Abstract

Its ions are decomposable when a solution contains a chemical substance and a solvent is added to it. The applications of electrolysis are numerous, it is used to study the degradation of a chemical compound. Scientists subsequently know that chemical reaction takes place with measurable change in concentration. When electric current flows through a conductive liquid, chemical transformations then occur. Electrolysis is a method that allows to carry out chemical reactions through electrical activation. It is also involved in the classification of chemical bodies. An electrical potential difference is applied between two electrodes in this solution. The generator positioned between the anode and the cathode delivers a continuous current. Indeed, chemical compounds can react to the electrodes. Pesticides are substances whose chemical properties contribute to the protection of cultivated plants. A part of this compound represents the active structure and determines the effectiveness of the product. A number of natural states of water exist. Water differs from most liquids in that it becomes less dense as it freezes. Highly reactive radical intermediates (•OH) make it possible to efficiently oxidize organic compounds such as pesticides by the electro Fenton process. This advanced oxidation process is used to treat insecticide solutions. This research work concerns the study of the mineralization in aqueous medium of Isoprocarb and Promecarb by electro Fenton process. The production of H_2O_2 was thus carried out by in situ production in an open electrochemical reactor with a plug flow from the reduction of molecular oxygen on a volume cathode consisting of a fixed bed of carbon graphite grains. The investigation of solutions of the two insecticides by electro Fenton process shows that the evolution of organic carbon measured in terms of TOC increases with increasing of the reaction time. Percentages of mineralization by this process exceeded 40% for Isoprocarb and 50% for Promecarb for a current intensity of 800 mA and an electrolysis time of 3 hours. Kinetics of degradation is largely influenced

by the experimental parameters. An augmentation in the electrolysis current leads to an increase in the rate of degradation under the operating conditions of the electrolyser. The absolute rate constants kabs determined are 3,32 × 109 M^{-1} s^{-1} for Isoprocarb and 10,88 × 109 M^{-1} s^{-1} for Promecarb. Several aromatic by-products of the electrochemical degradation of the two insecticides have been identified by LC/MS. Biodegradability is the property of a biodegradable substance. In clay and under the action of living organisms, we have concluded that Isoprocarb and Promecarb are biodegradable. The biochemical oxygen demand or BOD5 of solutions treated by the electro Fenton process is a parameter that measures their abilities to be decomposed in clay. It involves a purely chemical oxidation reaction, in which light energy does not directly intervene.

Keywords : COT, Eectro Fenton process, Mineralization, Isoprocarb, Promecarb, Biodegradation.

CMTDE 2022_85

Study of the behavior of innovative materials based on NaY zeolites doped with CuO, Fe_2O_3 and ZnO semiconductors in the adsorption and reduction of Cr(VI) from aqueous solution

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Abstract

The objective of this study is to examine the adsorption and reduction powers of innovative heterogeneous materials based on CuO, ZnO and Fe_2O_3 semiconductors and NaY-type zeolite of chromium (VI) by adsorption and of photo catalysis. This work consists first in the preparation and structural characterization of the surface of these heterogeneous materials by XRD and FTIR. All the interreticular distances and the relative intensities of the diffraction peaks obtained were compared with the respective ASTM files thus showing that all the prepared semiconductors were impregnated in the structure of the NaY zeolite support. It has been shown that the introduction of the CuO semiconductor into the NaY structure modifies its water character. Indeed, the infrared absorption band attributed to water molecules is almost absent and of very low intensity, which gives a hydrophobic character to the heterogeneous CuO/NaY material. Various reaction parameters were studied such as the influence of the mass of heterogeneous materials, the initial concentration of chromium (VI) and the pH. The results of the Cr^{6+} ion adsorption tests on these materials showed that the adsorption rates vary as follows: CuO/NaY(82%) > ZnO/NaY(75%) > ZnO(63%) > Fe_2O_3/NaY(60%) > Fe_2O_3 (36%) > NaY(35%) > CuO(5%). On the other hand, the reduction rate varies as follows: CuO/NaY(97%) > Fe_2O_3/NaY(95%) > Fe_2O_3 (82%) > ZnO/NaY(80%) > ZnO(80%) > CuO(59%).

Keywords : Adsorption; Reduction, Chrome (VI); CuO; ZnO; Fe_2O_3; Semiconductor; NaY zeolite.

CMTDE 2022_92

Inhibition of $CaCO_3$ scale formation in hard water using magnetic fields

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Abstract

Scaling is one of undesirable problems of natural hard water, which causes enormous technical and economic consequences by the formation of compact and adherent deposit on pipe and industrial or domestic installations. The present work examines the effect of magnetic water treatment on the $CaCO_3$ precipitation. Scaling tests were performed using the fast-controlled precipitation (FCP) and the chronoamperometric method (CA). The FCP results showed that increasing the magnetization time leads to a delay in the formation of $CaCO_3$ in solution, ranging from 51 min to 86 min after 18 hours of treatment (the efficiency was about 60 %). In addition, it was found that magnetic field creates a memory effect. On the other hand, the CA results showed that when the applied magnetic field intensity increases, the scaling time and the inhibition efficiency increase. For example, for a magnetic field applied for 18h of 0.33T and 0.70 T, the tE is 178 min and 341 min respectively. Under these conditions, the inhibition efficiency is 65% and 85%. The morphology of $CaCO_3$ crystals formed was characterized and analyzed by scanning electron microscopy (SEM) and X-ray diffraction (XRD).

Keywords : Scaling, Magnetic field, Fast controlled precipitation, Chronoamperometric method, Memory effet, Inhibition.

CMTDE 2022_93

Effet de la minéralisation sur l'élimination de la matière Organique azotée par adsorption sur charbon actif

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Résumé

Depuis quelques années, les traiteurs d'eau portent une attention toute particulière à l'élimination de la matière organique naturelle (MON). Cette dernière présente dans l'eau brute est source de nombreux désagréments : couleur, goût ou encore odeur. L'élimination de la MON est donc essentielle pour minimiser les risques sanitaires et la dégradation du réseau de distribution (Lemarchand ,1981 ; Mazet et al, 1991 ; Achour, 2001).

Les essais d'adsorption ont permis de suivre la variation des rendements d'adsorption de l'histidine et de la Tyrosine en fonction de la variation du temps de contact. Nos résultats ont montré que la réduction de la tyrosine et de l'histidine par adsorption sur charbon actif en poudre et en grains, augmente avec l'augmentation du temps de contact aussi bien en eau distillée qu'en eaux minéralisées.

Le taux de fixation de la Tyrosine et de l'Histidine est très important aussi bien en eau Distillée qu'en eaux Minéralisées respectivement sur Charbon actif en poudre et en grains. Cette élimination varie de 68 % à 99,80 % sur charbon actif en poudre (CAP) et de 64 % à 96.67 % sur charbon actif en grains (CAG).

Les meilleures capacités d'adsorption sont obtenues avec le charbon actif en poudre et les faibles ont été obtenus avec les eaux fortement minéralisées tels que les eaux de forage pour le CAP et le CAG. Globalement On a trouvé que le temps de contact adéquat se trouve au-delà de 30 minutes.

Mots clés : Tyrosine, Histidine, Charbon Actif en Poudre (CAP), Charbon Actif en Grain (CAG), Adsorption, Minéralisation.

CMTDE 2022_94

Valorisation cyclique des eaux grises

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Résumé

La réutilisation des eaux grises traitées (EGT) pour l'irrigation est apparue comme une ressource alternative pour répondre à la demande croissante d'eau pour le secteur agricole et réduire la pression sur les ressources

en eau douce qui sont très limitées. Cependant, cette réutilisation nécessite une gestion adaptée afin d'éviter les risques environnementaux et sanitaires. Dans ce travail, le traitement des eaux grises (EG) a été étudié à partir d'un système de traitement cyclique que nous avons conçu et mis en œuvre dans la serre de l'INRGREF. Ce système est composé de trois niveaux de traitement (EGT 1, EGT 2 et EGT 3). Chaque niveau est constitué par une série de pots en graviers et sol sablonneux. L'utilisation des eaux grises a été modérée en fonction de la qualité chimique et microbiologique obtenue. Différents prélèvements de sols et des EGT ont été réalisés et analysés pendant 14 cycles d'irrigation. Les EGT ont montré que les paramètres physico-chimiques comme le pH, la conductivité électrique (CE), la demande chimique en oxygène (DCO), la demande biologique en oxygène (DBO_5) dans la plage de 7,35-7,91, 1,69-5,03 dS/cm, 102,6-54,2 mgO_2/l et 31,33-15,74 mgO_2/l, respectivement. Le traitement cyclique des eaux grises a entraîné une réduction de la charge polluante avec un effet significatif sur les trois niveaux de traitement, cependant une augmentation de la salinité a été observée au cours de tous les cycles d'irrigation. Les résultats microbiologiques ont montré l'efficacité du traitement des eaux grises avec un faible risque sanitaire sur les sols irrigués. La qualité des EGT est conforme aux normes tunisiennes autorisées (NT106.03) et convient à la réutilisation non potable.

Mots clés : Eaux grises traitées, Irrigation, Traitement cyclique, Sols, Paramètres physico-chimiques, Paramètres microbiologiques.

CMTDE 2022_95

Extraction synergique du cobalt (II) par l'acide di-(2-ethylhexyl) phosphorique (D2EHPA)

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Résumé

L'extraction liquide-liquide du cobalt (II) à partir d'un milieu sulfaté par l'acide di- (2-éthylhexyl) phosphorique dans chloroforme à 20 °C est étudiée avec les deux paramètres suivants : le pH et la concentration de l'extractant en présence et en absence de l'agent synergique le 1-octanol.
La stœchiométrie des complexes extraits a été déterminée par la méthode des pentes. Le complexe organométallique extrait du cobalt (II) dans la phase organique est $CoL_2 2HL$
L'efficacité de l'extraction augmente avec l'augmentation du pH et la concentration de l'extractant.
Les données spectrales de l'infrarouge et d'UV-VIS réalises en présence et en absence du 1-octanol viennent pour confirmer que la géométrie d'espèce extrait est un mélange entre une géométrie octaédrique et tétraédrique.

Mots clés : Extraction liquide-liquide, Synergie, Cobalt (II), Acide di(2-éthylhexyl) phosphorique.

CMTDE 2022_96

Photomineralization of 2,5-dihydroxybenzoique acid: formation of light induced secondary oh• (lis-oh•) precursors

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Abstract

The removal of organic micropollutants from ground water and wastewater is one of the critical and urgent topics in the environmental researches. Solar light can potentially induce the phototransformation of aqueous light absorbing chemicals in the absence of any added oxidant or photocatalyst. Such "unassisted" photolysis can accomplish partial or total removal of the target pollutant and of its light absorbing photoproducts. Complete mineralization is assumed to be unreachable as it is generally considered that the mixture stops evolving after the removal of absorbing photoproducts. However, it was recently demonstrated that phenol and its derivatives, pollutants of high concern due to their widespread occurrence in surface water, induce their own mineralization upon irradiation. These findings suggest the possibility for these compounds to generate OH• radicals, highly oxidant species supposed to be exclusively produced in so-called advanced oxidation processes (AOPs) which require either costly energy or the addition of oxidants.

The goal of our work was to investigate this phenomenon more deeply. For this, we studied the fate of 2,5-Dihydroxybenzoique acid (DHBA), a phenol derivative, when it is irradiated using simulated solar light. TOC analysis indicated that significant mineralization occurred. Measurement of OH• radicals using terephtalic acid as a probe showed that these species were generated with an average rate of 7×10^{-9} M s^{-1} and a total cumulated concentration of 10^{-3} M. These findings are consistent with the formation of light induced secondary OH• (LIS- OH•) precursors, which may also take place in the aqueous photodegradation of other substituted phenols.

Keywords : Phenol; Irradiation; Photomineralization; OH• radicals; Phototransformation ; LIS- OH•

CMTDE 2022_97

Study of leaks with piezometric analysis of the Beni Haroun dam

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Abstract

The majority of dams worldwide are confronted with the problem of water leaks through banks and foundations. The study of this phenomenon turns out of a very big importance, because he can put in danger the stability of the dam and reduce his useful capacity. This is the case of the Beni Haroun dams.

The dam lake develops in two branches, one fed by the Endja wadi to the west-southwest, the other by the Rhumel wadi to the south-east. These two wadis meet about 3.5 kilometers upstream of the dam to form the El Kébir wadi which then progresses for about 50 kilometers towards the north northwest through the massif of the small Kabylie before joining the Mediterranean Sea at halfway between the towns of Jijel and Collo.

The dam is located at the upstream end of the limestone-marly gorge of Beni Haroun and about 4 km from the confluence of Oued Rhumel and Oued Endja.

The present study is based on the analysis of the variation of the piezometric levels and the leakage flows according to the coast of the lake as elements of auscultation and monitoring of the dam.

Indeed, the study has made it possible to highlight the existence of privileged directions of water circulation within the limestone massif with a spatial variation in the degree of cracking. The study of the relationship piezometric level-coast of the reservoir has highlighted the existence of a very important relationship between the reservoir and the various piezometers.

Keywords : Leak, Limestone, Piezometry, Dam, Fissured medium, Beni Haroun.

CMTDE 2022_98

Kinetic study of degradation of antraquinonic dye, C.I. acid blue 25, in aqueous solution by hydrogen peroxide using dawson-type heteropolyanions as catalysts

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Abstract

In several industrial sectors, the usage of dyes has generated a very important hazard for environmental and biological living organisms in water bodies and on the ground. In order to decontaminate these toxic dyes, it is necessary to develop effective, feasible and low-cost processes. In this regard, this work is intended for the study of the elimination of anthraquinonic dye, C.I. Acid Blue 25 (AB25), in aqueous phase by an advanced oxidation process in the presence of iron-substituted heteropoly anion catalyst. The $H_2O_2/P_2W_{17}MoFeO_{62}$ system has been utilized to decompose hydrogen peroxide to reactive hydroxyls for the degradation of Acid blue 25. The influence of dye assisting inorganic acids such as H_2SO_4, HNO_3, HCl and H_3PO_4 on catalytic degradation has been investigated. The catalytic activity was examined in view of the effects of various parameters, pH value, catalyst mass, hydrogen peroxide concentration, and temperature of solutions. The best pH value for the following experiments of AB25 degradation was chosen to be 2.5. The best catalytic activity and stability was achieved for an optimal catalyst dose of 0.05g. A high degradation efficiency of 96.24% was obtained for a H_2O_2 concentration equal to (157.31 mg/L). A higher temperature facilitated the diffusion of AB25 in the solution, which increased the degradation efficiency. Furthermore, the results demonstrated that the AB25 degradation could be significantly inhibited due to the existence of inorganic anions. The catalytic degradation of AB25 in the presence of nitrates and sulfates is rapid and leads to a very high degradation, which indicates the low interaction between these anions and the $^{\bullet}OH$ radicals. The lowest reaction rate was observed in curve of phosphate ion. Halides ions (Cl^-, Br^-) create competition between $^{\bullet}OH$ radical and organics, inhibiting the oxidation and slow down the degradation rates. The obtained results showed an interesting effect of real water matrices.

Keywords : Degradation; $H_2O_2/P_2W_{17}MoFeO_{62}$ system; Hydroxyl radical; Acid blue 25, Inorganic anions; Complex matrices.

CMTDE 2022_99

Electrochemical oxidation of Allura Red AC in low and high solution conductivity using SPE system and conventional flow cell by borne doped diamond electrode

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Abstract

In this work, synthetic wastewater contaminated with Allura Red AC is treated by anodic oxidation using a boron-doped diamond in both conventional cells (which requires the addition of supporting electrolyte) is compared with a cell setup based on solid polymer electrolyte (SPE) cell (avoids the addition of supporting electrolyte). The impact of current intensity, flow condition, and supporting electrolyte, is determined on dye and organic matter removal on both cells. The results show both systems are able to achieve full dye removal, but the SPE-system provided better performance. Adding 2 mmol NaCl or $NaClO_4$ boosted the color removal rate regardless of the electrolysis cells. 100% of color removal and 16.29 kWh m^{-3} of energy consumption is achieved after 120 min of electrolysis using conventional cell under optimal condition: I = 0.5 A, flow rate = 300 dm^3 h^{-1}, 2 mM of NaCl or $NaClO_4$ + 50 mM Na_2SO_4 mixture solution as a supporting electrolyte. On the other hand, 100% color removal and 14.79 kWh m^{-3} of energy consumption after 45 min of electrolysis and are achieved using SPE cell under the optimal condition: I = 0.75 A, stirring rate = 850 rpm, the addition of 4 mM of sodium chloride.

Keywords : Anodic oxidation; BDD electrode; Solid Polymer Electrolyte (SPE); Low conductive solution; Food dye.

CMTDE 2022_100

Scénario d'optimisation des effluents textiles

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Résumé

Les effluents textiles posent un grave problème sur l'environnement en raison de leurs extrêmes variabilités de composition. Ils sont chargés en sels, éléments traces métallique (ETM), agents stabilisants et colorants non biodégradables. Le rejet de ces effluents affecte les eaux de surface et souterraines, les organismes aquatiques, le sol et les plantes. De ce fait, différents procédés de traitement sont envisageables pour dépolluer ces eaux et atténuer leurs effets néfastes sur l'environnement. Etant donnée que le secteur agricole est le domaine le plus consommateur d'eau, le traitement des effluents textiles et leurs valorisations peut être une meilleure alternative pour pallier le manque d'eau. Dans ce contexte, les effluents textiles (ET) issus d'un traitement biologique (TB) ont été soumis à deux procédés membranaires (Ultrafiltration (UF) et Nanofiltration (NF)). Ainsi, des couplages d'eau ont été faites afin d'améliorer la qualité des effluents traités biologiquement. Dans ce cadre, une expérimentation a été menée pour évaluer l'effet de différentes qualités d'effluents textiles traités sur le sol. Les résultats ont montré que les ET issues du TB sont caractérisés par une conductivité électrique (CE) et pH élevés et sont chargés en ions sulfate. De faibles niveaux d'ETM sont enregistrés. Cela a provoqué une augmentation du pH et de la CE du sol. Les traitements membranaires et les couplages d'eau ont contribué à réduire la CE et les teneurs élevées en ions sulfate.

Mots clés : Effluents textiles, Réutilisation des eaux, Traitements membranaires, Couplage eau, Caractérisation des sols.

CMTDE 2022_101

Application of response surface methodology for chromium removal by adsorption on date stalks

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Abstract

In this study, we investigated the chromium removal by adsorption on date stalks. Adsorption process was influenced by various parameters such as pH of the solution, initial chromium concentration, mass, stirring speed, contact time and temperature were studied. In order to optimize the operating conditions of chromium elimination, the response surface methodology was used by means of the experimental design. According to the desirability function, the maximum response of 99.59% was predicted for chromium removal at a pH equal to 2, a mass of adsorbent of 1.3 g, a temperature of 45 ° C and a stirring speed equal to 125 rpm. Adsorption model and thermodynamic parameters were studied.

Keywords : Chromium removal, Adsorption model, Factorial design, Optimization, Response surface methodology

CMTDE 2022_102

An effective standalone solar air gap membrane distillation unit for brackish water desalination. A case study of Ghardaïa region

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Abstract

Several drinking water production techniques are being established to meet the needs of the growing population. Air gap membrane distillation (AGMD) appears to be an attractive solution for water desalination. This thermal process is characterized by its potential to provide drinking water at low energy costs when combined with solar energy. In this paper, the performance of an AGMD brackish water desalination unit coupled with solar energy was investigated. A case study of Ghardaïa region has been considered in this work. A mathematical model using MATLAB software was developed to predict the permeate flux based on heat and mass transfer. In addition, a solar flat plate collector (SFPC) was used to heat seawater using free solar energy. The model of a flat solar collector made it possible to determine the instantaneous evolution of the collector outlet temperature as a function of the flow rate and the feed water temperature. The obtained results showed that the solar AGMD process can produce water with a maximum permeate flux of 8 $kg.m^{-2}.h^{-1}$ achieved at a feed temperature of 68°C. Moreover, Gained Output Ratio (GOR) of the solar desalination unit was found to be about 4.6, which decreases with increasing hot water flow and temperature.

Keywords : Brackish water desalination; Air gap membrane distillation; Solar energy; Flat plate collector; Performance.

CMTDE 2022_104

Energy and exergy analyzes of a PWR type nuclear power plant coupled with ME-TVC-MED desalination

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Abstract

This work deals with the energy and exergy analysis of a cogeneration plant for electrical power generation and water desalination using real operational data. The power side is a pressurized water reactor (PWR) nuclear power plant (NPP), while the desalination side is a multi-effect distillation (MED) system with a

thermo-vapor compressor (TVC) plant coupled with a conventional multi-effect plant (ME-TVC-MED). The exergy analysis was carried-out based on the second law of thermodynamics to evaluate the irreversibility of the plant and the subsystem. In this study, the components of the sub-system were analyzed separately to identify and quantify the component that has high loss of energy and exergy. According the energy and exergy analyses, the highest source of irreversibility occurs in the core of a reactor (50% of the total exergy destruction). However, turbines, steam generators, and condensers also contribute to energy loss. Besides, the thermodynamic efficiency of the cogeneration plant was obtained as 35.38% which is more effective than others systems. In the ME-TVC-MED desalination unit, the main sources of energy losses are located in the effects and the thermo-compressor of about 50% and 36%, respectively. Moreover, the exergetic efficiency of the ME-TVC-MED unit was found to be low at 6.44%, indicating a high degree of technical inefficiency in the desalination process. Therefore, a lot of opportunities exist to improve the performance of the system.

Keywords : Nuclear power PWR; ME-TVC-ME desalination; Cogeneration plant; Energy study, Exergy

CMTDE 2022_105

Prévalence des *Legionella* dans les réseaux d'eaux chaudes sanitaires et les tours aéroréfrigérantes de quelques établissements en Algérie

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Introduction

Les *Legionella spp.* appartiennent aux principaux agents étiologiques responsables de pneumonies communautaires sévères. Elles sont responsables de ce qu'on appelle communément légionelloses. Ces dernières représentent 0,5 à 10% des cas de pneumonies dans le monde, et sont mortelles dans 10 à 30 % des cas. Depuis que les tests rapides de diagnostic (détection d'antigènes urinaires) ont été introduits dans notre pays, des cas de légionelloses sont diagnostiqués chaque année.

Les légionelloses peuvent être prévenues par contrôle et élimination de la bactérie des sources de contamination c'est-à-dire des installations sanitaires (douches, robinets.) et des dispositifs de climatisation (TAR…), car c'est à partir de ces écosystèmes que se produit la contamination humaine par inhalation d'aérosols contaminés.

Dans le cadre de la prévention des légionelloses dans notre pays, nous avons réalisé la présente étude.

Matériels et Méthodes

Notre étude a été réalisée dans 19 établissements des 2 régions d'Alger et d'Oran.1607 échantillons d'eaux ont été analysés de 2007 à 2012. 1443 provenaient des réseaux d'eaux chaudes sanitaires (ECS), 164 de tours aéroréfrigérantes (TAR).

Pour la recherche et le dénombrement des *Legionella* dans les eaux nous avons utilisé la norme AFNOR NF T90-431. Il s'agit d'une méthode par ensemencement sur milieux spécifiques (après concentration par

filtration ou centrifugation et décontamination) d'un prélèvement d'eau d'un litre avec lecture des boites à 3, 7 et 10 jours.

L'identité des souches isolées a été déterminée grâce à un test d'agglutination qui permet avant tout de faire un diagnostic d'espèce (sérotypage). Ce test permet la détection de *L. pneumophila* sérogroupe 1, *L. pneumophila* sérogroupes 2-14 ainsi que 7 autres espèces de légionelles.

36 souches identifiées comme *Legionella pneumophila* sérogroupes 2-14 ont été testées vis-à-vis des antisérums de lapin anti *Legionella pneumophila* sérogroupes 2 à 15 (identification par immunofluorescence puis agglutination).

3 souches Lp1 ont été analysées par électrophorèse en champs pulsé (ECP).

Résultats

Le taux de prélèvement positifs est de 5%, ce qui n'est pas négligeable. 90,7% des concentrations obtenues sont supérieures au seuil d'alerte qui est de 10^3 UFC/L.

Nous avons réussi à isoler 86 souches de légionelles :

27 appartiennent au sérogroupe1 (*Lp1)*, le plus incriminé en pathologie humaine.

59 sont des *Legionella pneumophila* sérogroupes 2-14 (*Lp*2-14).

L'identification des Lp2-14 pour 36 souches a montrée une prédominance des sérogroupes 6 et 3 (41,67%,) suivis respectivement par les sérogroupes 14,13 et 10.

Parmi les 3 souches Lp1 analysées par ECP, il y a une souche endémique Paris.

Conclusion

La situation en Algérie, quant aux légionelles, reste peu ou mal connue. Une surveillance environnementale et clinique sérieuse devrait être mise en place au niveau national pour mieux cerner cette bactérie. Nos résultats devraient interpeller les pouvoirs publics sur la nécessité de mettre en place un outil réglementaire (textes officiels) pour la recherche systématique de cette bactérie dans les installations à risques (TAR et ECS) et les bâtiments recevant du public (hôtels, hôpitaux…).

CMTDE 2022_106

Comparative analysis of various nuclear desalination computation

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Abstract

In this study, various computational techniques have been discussed to conclude technical and economic performance of nuclear energy driven desalination plants. Two specially designed programs from International Atomic Energy Agency (IAEA) named as DEEP and DETOP are being used in various organizations and institutes to assess the techno-economic parameters. These tools have the ability to perform multiple cycle, fuel options and various integrated desalination technologies but inflexibility for

plant configurations is not possible. SEMER code is developed by French Atomic Energy commission and is designed for overall economic estimation including nuclear as well as other fossils plants with various fuel cycle model. However, the code cannot conclude fuel cycle model with no cogeneration option available. APROS is a simulation facility design for nuclear power plants, thermal systems, combustion power, desalination model and solid oxide fuels. The facility includes multiple comprehensive libraries which contains several components such as electrical, thermal and automatic control. It was observed that both DEEP and DETOP can assess the technical and economic parameters of any nuclear and fossils plant whereas SEMER and APROS cannot asses the cogeneration plant for desalination. The main objective of the study is to conclude the best estimate program for nuclear desalination.

Keywords : DEEP, DETOP, SEMER, APROS, Pros and cons, Optimization.

CMTDE 2022_107

Salting-Out Assisted Liquid-Liquid Extraction (SALLE) for the separation of 2-methylaziridine from aqueous stream : Phase equilibrium, solubility and Data Correlation

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Abstract

In this study, the influence of potassium chloride (KCl), Sodium chloride (NaCl), lithium chloride (LiCl), and Magnesium chloride ($MgCl_2$) salts on the performance of extracting 2-methylaziridine (MA) from aqueous solutions using dichloromethane (DCM) as solvent was investigated under conditions of T=298.15 K and ambient pressure of 101.3 kPa. The selected salt amounts in initial aqueous solutions were (5% and 10%). The outcomes demonstrate that salting-out impact of the salts was huge, with the goal that an improvement in the MA distribution coefficient (D_2). In this way, the salting-out impact showed up in the request $MgCl_2$> LiCl > NaCl >KCl under similar conditions, in agreement with the Hofmeister series. The Othmer-Tobias and Hand equations confirmed the consistency of the measured tie-line data. Meanwhile, the well-known the NRTL activity coefficient model was employed to reproduce the measured LLE data and obtaining the binary interaction parameters.

Keywords : LLE data, Experimental, 2-methylaziridine, Salting-out, Activity coefficient models.

CMTDE 2022_108

Performances of constructed wetland system to treat whey and dairy wastewater during a macrophytes life cycle

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Abstract

Industrial wastewaters represent a serious threat to the environment due to their variable and complex composition, particularly the whey and dairy wastewater. Dairy wastewater management is tightly constrained by economics, it is necessary to develop inexpensive and sustainable management practices which require low energy inputs. Constructed wetlands system (CWs) have been proposed as an economical, efficient, and sustainable wastewater treatment technology. The aim of this paper was to provide the first published data on the efficiency of CWs treating dairy wastewater in Tunisia. In most CWs, good organic, total suspended solids (TSS) and nutrient removal was measured.

In order to evaluate the efficiency of this process for industrial wastewater treatment, small-scale wetland containing three horizontal subsurface flow (HSSF) and one free water surface flow (FWS) hybrid system. A mixture of Reeds (*Phragmites australis*), Cattails (*typha latifolia*), and Papyrus (*Cyperus papyrus*) were planted into depth 0.5 m, with pea gravel. Duckweed was put in FWS constructed wetlands.

Several water quality parameters including pH, Electrical Conductivity (EC), Dissolved Oxygen (DO), TSS, Chemical Oxygen Demand (COD), 5-day Biochemical Oxygen Demand (BOD_5), Total Kjeldahl Nitrogen (TKN) and Total Phosphorus (TP) in both raw and treated wastewaters were monitored during a macrophytes life cycle. At the same time, the study monitored the fate of nutrients through the planted microcosms, and the growth rate of macrophytes.

The average influent characteristics, for 20% of whey, were as follows: TSS (3040 mg/L), COD (5060 mg O_2/L), BOD_5 (3020 mg O_2/L), TKN (79 mg N/L) and TP (32,2 mg P/L). Removal efficiency of 99.6% for TSS, 80% for COD, 97% for BOD_5, 90.4% for TKN and 99.6% for TP was observed. Results reveal a temporal variation in the system's performance depending on the macrophytes growth rate. Reeds, Cattails and Papyrus start their life cycle at the beginning of the winter and continue their development during summer. The effluent pH, TSS, COD, BOD_5 , TKN and TP concentrations were complying with both irrigation reuse regulations as well as discharge regulations.

Keywords : Organic matter; Reeds; Cattails; Papyrus; Removal efficiency; Hybrid constructed wetland.

CMTDE 2022_109

Sol, Eau et Agriculture « Cas de la Medjerda »

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Résumé

Le sol joue un rôle important pour la sécurité alimentaire et La lutte contre le changement climatique. A l'instar, d'une part favoriser le stockage du carbone dans les sols et la réduction concomitante des niveaux de dioxyde de carbone atmosphérique, et d'autre part, améliorer l'enrichissement des sols en matière organique » est liée par leur fertilité. Pour ce faire, la détermination des besoins en eau des cultures dépende des conditions climatiques, et du stock d'eau et de la capacité de stockage du sol. Cette étude vise à déterminer la réserve utile (RU) qui est la quantité totale d'eau du sol utilisable par une culture « Blé » cas de la région de la Medjerda. Elle dépend de la nature du sol mais aussi de la profondeur du sol colonisée par les racines et de la charge en cailloux. Une analyse granulométrique (a été réalisée par un laboratoire) a permis de caractériser un sol selon sa texture et de connaître sa capacité de réserve en eau (RU). Cette consommation en eau de cette culture dépend de différents éléments climatiques : la température, l'humidité de l'air, le vent et l'ensoleillement. Ces données climatiques ont été utilisées pour une période allant de 2010 à 2020, afin de quantifier l'évaporation du sol et la transpiration des plantes.

Mots clés : Eau-RFU- Amélioration des Sols- Evaporation- Climat -Agriculture.

CMTDE 2022_110

Extraction par nanofiltration de mélange "Fer+Cuivre" : Optimisation du procédé

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Résumé

Ces dernières années, certains pays ont mis en place des réglementations régissant les décharges. Dans une optique de développement durable, les industriels recherchent des technologies de traitement des eaux usées pour contrôler leurs rejets. La nanofiltration semble particulièrement adaptée aux caractéristiques de séparation qu'il permet vis-à-vis de la taille des molécules cibles. La pollution par les terres rares et les

métaux lourds affecte les eaux souterraines et les eaux de surface. Cela a changé la qualité de l'eau et l'a rendue dangereuse à utiliser. La pollution de l'eau est un gros problème, compte tenu de la diversité des sources et des caractéristiques des espèces polluantes, les principales étant industrielles, urbaines et agricoles. La grande difficulté étant que les métaux lourds ne sont pas biodégradables et ont tendance à s'accumuler dans les organismes vivants (poissons, mollusques, légumes, etc.) consommés par l'homme. Pour ces préoccupations, les lois environnementales sont devenues plus sévères. Pour cela, le traitement des effluents aqueux est devenu important. On peut conclure que la chimie de séparation et de purification est un domaine de recherche thématique dans ce domaine. Les rejets provenant de l'industrie contiennent des métaux lourds (chrome, cuivre, zinc, nickel, fer, cobalt, cadmium, plomb, …) qui sont nocifs pour la santé humaine, la faune et la flore.
Cette étude est accès sur la nanofiltration pour le traitement des eaux usées industrielles. L'élimination de deux métaux lourds en milieu aqueux a été étudiée avec la membrane de nanofiltration en polyamide SNTE NF270-2540. Les résultats ont montré que la rétention des ions fer est totale (100%). Selon les conditions expérimentales, la rétention des ions de cuivre variait de 82 % à 94 %. Il a été observé que le pH n'a pas d'influence sur la rétention du fer. La rétention des ions par la nanofiltration a été réalisée par effet Donnan (répulsion électrostatique) et effet volume contre-ion (exclusion stérique).

Mots clés : Nanofiltration, Extraction, Fer, Cuivre, Membrane.

CMTDE 2022_111

Extraction of heavy metals by clay intercalated by crown ethers

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Abstract

Since clays are abundant materials in the earth and are with various crystal structures, many laboratories around the world have paid great attention to the study of these materials. In this work, the crown ethers: DB-14-C-4$(NO_2)_2$, DB-14-C-4$(NO_2)_2(Br)_2$, DB-14-C-4$(Br)_4$ and DB-14-C-4$(COOH)_2$ were intercalated between the smectite layers saturated by Na+. The obtained complexes were characterized by DRX, IR spectroscopy. After intercalation of crown ethers, the basal spacing's of the smectite were determined by DRX. These modified clays were studied for their ability for binding heavy metals.

Key words : Crown ethers, Montmorillonite, Intercalation, Depollution.

CMTDE 2022_112

Characterization and treatment of open-dumped solid wastes at Hammam Jedidi barite mine, northern Tunisia

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Abstract

A vast pile of solid wastes has been deposited near the Hammam Jedidi barite mine a, northern Tunisia. These wastes were by-products of mining-refining activities of the mine industries and now open-dumped in barren fields without any protection or barrier. According to the chemical analysis of potentially toxic elements (PTEs), the mine wastes contain various PTEs of hydro-thermal origin and Cr, Cu, Zn, As, Cd, Sb, Hg, and Pb are abnormally high in comparing with natural background. Water solubility (mobility) of Pb is hazardous level based on Environmental Quality Standard. The result of mineralogical investigation using X-ray diffraction and optical microscopy indicates that these PTEs are not presented as major constituent elements of mineral contained in the mine wastes, but they are presented as impurities, substitutions, and/or bonding with fine particles, which might be relatively easily mobilized and migrate into the nature. Thus, appropriate isolation measure of the mine wastes is required for future environmental protection.

Keywords : Mine waste, Fluorite, Barite, Hydro-thermal alteration, Mercury, Heavy metal.

CMTDE 2022_115

Cadmium retention by Nigella Sativa Magnetised

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Abstract

Heavy metal contaminations in the environment prompt further research for the fabrication of new adsorbents. Here, efficient removal of cadmium (Cd) in aqueous solution achieved using a new material, which was made from the seeds of Nigellasativa (NS) and magnetized by a ferrofluid.

The biosorption of Cd^{2+} by magnetized NS was studied by varying some parameters: pH, biosorption time, stirring speed, initial concentration of Cd^{2+}, quantity of biosorbent and temperature.

The results showed that the efficiency of the biosorbent on Cd^{2+} was better at a pH of 4.11. The Cd absorption capacity reached in an equilibrium time of 5 min was 162.74 mg/g. The Cd^{2+}biosorption rate

was found to best fitted the pseudo-second-order equation. Our results showed a better correlation with the isotherm models of Langmuir and Sips. This suggests that the adsorption took place through physical interactions as well as the presence of functional groups at the surface of our biosorbent, which was confirmed by analysis by Fourier transform infrared spectroscopy.
The present study demonstrated that magnetically rendered NS seeds could be used as a very promising potential biosorbent to remove Cd^{2+} from water.

Keywords : Biosorption, Cadmium, Nigella sativa, Ferrofluid.

CMTDE 2022_116

Comparison between four different $Al(OH)_3$ coagulant processing for the treatment of the outlet water of urban wastewater treatment Chotrana I plant for agriculture purposes

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Abstract

Tunisia has been suffering from drought for several years, which requires good management of water resources. For this reason, the reuse of urban wastewater for the irrigation of certain forage or vegetable crops represents one of the solutions. It is in this context that this work fits. In fact, the outlet water of urban wastewater treatment Chotrana I plant must be treated to be used for agriculture purposes. Initial turbidity of 49 NTU must decrease below 5 NTU to have a clear water. Four types of aluminum hydroxide coagulant Al(OH)3preparations for the treatment of this water were studied and compared.
The first type is water treatment by batch electrocoagulation. Current density (i=30 mA/cm^2) and treatment time (t=25 min) for Al/Al electrodes have been optimized. Hence, turbidity decrease to 3 NTU.
The second type is to inject sulphate aluminium in solution with the same Al amount than that dissolved by electrocoagulation ((0.45mg/800 mL). Turbidity remains higher than 5 NTU. Only by adjusting pH to 6.5 that is possible to have turbidity less than 5 NTU.
The third type is to prepare $Al(OH)_3$ coagulant before by electrocoagulation process in NaCl-distilled water and to inject it in the water to treat. Turbidity remains higher than 5 NTU even if we adjust Nacl-distilled water pH after electrocoagulation. Only if initial pH solution is adjusted to 6.5 that is possible to decrease turbidity to 3 NTU.
The forth type is to use $Al(OH)_3$ coagulant prepared by electrocoagulation process in NaCl-distilled water as a filter membrane on Büchner filter. Turbidity is less than 5 NTU.
With the four treatments, DCO, DBO5 and MES initially higher than NT 106.03 standards become less than standard concentrations.
Electrocoagulation treatment is better than the three others because it is the cheapest process and there is no need to adjust pH.

Keywords : Electrocoagulation, Coagulation, Filtration, Turbidity.

CMTDE 2022_117

Synthèse et caractérisation d'un charbon actif produit à partir des coquilles de noix : Application au traitement d'une eau polluée par un résidu médicamenteux

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Résumé

De très nombreux matériaux sont développés pour traiter les eaux polluées par les résidus médicamenteux. Dans cette étude, un charbon actif a été synthétisé à partir des coquilles de noix et activé par l'acide phosphorique. Les limites d'adsorption d'une substance pharmaceutique, le diclofénac ont été déterminées. La synthèse de cet adsorbant a été optimisée par les différents paramètres tels que : la variation de la masse, le pH initial, la concentration initiale, la variation de la vitesse d'agitation, la température et le temps de contact. Les indices d'iode et de bleu de méthylène ont été considérés comme le paramètre de performance des mésopores, micropores et macropores de cette synthèse. Après caractérisation des charbons actifs (CAs) préparés, des tests d'adsorption ont été réalisés sur le diclofénac sodique. Les résultats de synthèse ont montré que les propriétés physico-chimiques optimales du charbon actif ont été observées à 25°C avec de l'acide phosphorique à différentes concentrations notées CA20%, CA35%, CA40%, CA60%, CA75% et CA85%. Dans ces conditions optimales, les charbons actifs des coques de noix présentaient respectivement une adsorption d'iode et de bleu de méthylène optimale pour CA35% de 3784,6 mg/g et 1990,67 mg/g. Le charbon actif préparé était un excellent adsorbant pour l'élimination de la substance pharmaceutique étudiée. Les données expérimentales d'adsorption suivaient l'isotherme de Langmuir et le pseudo modèle cinétique du premier ordre. Cependant, l'efficacité variait en fonction de la nature de l'adsorbat et le rapport adsorbat-adsorbant était le principal facteur limitant du processus d'adsorption. Une élimination optimale supérieure à 93 et 99,66 % pour tous les CAs a été constatée avec le CA35% pour un temps de contact de 60 min, une concentration initiale de 110mg/L et un pH initial égal à 2 pour le diclofénac sodique. Il a été observé que l'efficacité d'élimination du polluant n'était pas définie par la constante de vitesse d'adsorption mais par la réactivité avec l'adsorbant.

Mots clés : Eau polluée, Diclofénac, Coques de noix, Charbon actif, Agent activant, Adsorption.

CMTDE 2022_118

Impact of chlorine-based disinfectants on PEHD water pipes performance

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Abstract

Various disinfection techniques such as ozonation, ultraviolet radiation, chlorination (HOCl), the addition of chloramines, and chlorine dioxide (ClO2) have been used for decades to eliminate disease-causing microorganisms in potable water. Moreover, chlorine-based disinfectants are the most widely used in drinking water treatment as a secondary disinfectant due to their high effectivity against various pathogens and remarkably lower implementation and operation cost. The benefit is that many human lives are saved. The negative consequence is that chlorine-based disinfectants create a strongly oxidative environment, materials in contact with such media may deteriorate by oxidation and consequently reduce the performance of pipes.

In this study, an accelerated laboratory aging of pipe materials in chlorinated water was performed. For this purpose, samples prepared with two new high-density polyethylene (HDPE) water pipe grades (PE100 classification) were immersed in chlorine solutions (400 ppm and 4000 ppm of sodium hypochlorite (NaOCl)) with a pH level of 6.5 at room temperature. For comparison, control samples were exposed in non-chlorinated distilled water. After one week of conditioning, the surface analysis with differential scanning calorimeter (DSC) revealed that antioxidants, initially present in the polymer matrix, were totally consumed by chlorine. Molecular characterization (FTIR-spectroscopy, melt flow rate (MFR)) of aged samples indicated oxidation of polyethylene layers in contact with chlorinated water after 6 weeks of exposure. This led to deterioration of mechanical properties (specially the plastic behavior of materials) as shown by tensile testing results. Nevertheless, materials aging in 4000 ppm chlorine concentration was found to be much faster than in 400 ppm.

Keywords : Disinfection, Chlorine, aging, HDPE water pipes.

CMTDE 2022_119

Removal heavy divalent metals from aqueous solution using polymer supported schiff bases 4-(5-mercapto-1,3,4-thiadiazol-2-ylimino) pentan-2-one

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Abstract

This work describes the preparation of a novel chelating from mesh chloromethyl polystyrene crosslinked with divinylbenzene. The first part treats the synthesis, characterization and sorption studies of a novel polystyrene-supported 4-(5-mercapto-1,3,4-thiadiazol-2-ylimino) pentan-2-one Schiff bases from 5-amino-1,3,4-thiadiazole-2-thiol and acetylacetonechloromethylated polystyrene, this MNPs were characterized by elementary analysis, infra-red spectra trans-mission electron microscopy, and thermogravimetric analysis. The second part explores the ability of the polymer chelating for removing heavy metal ions (Cu^{2+}, Mn^{2+}, Ni^{2+} and Zn^{2+}) in aqueous solutions was studied by means of batch equilibration technique, and compared the adsorption capacity of resin. We investigated the adsorption capacity of polymer chelating at different parameter: contact time, pH, mass of resin, concentration of metal ions and temperature, and determination of M(II) by flame atomic absorption spectrometry (FAAS).

Keywords: Polymer-supported; Schiff bases; Heavy metal ions; Adsorption.

CMTDE 2022_120

Compréhension de la variation du chlore dans deux points d'eau : cas du barrage Chorfa et eau de dessalement

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Résumé

L'eau du robinet est produite à partir d'eau prélevée par un captage dans une nappe souterraine ou dans une ressource d'eau superficielle douce ou d'eau de mer. Selon la qualité de l'eau prélevée, différentes étapes de traitement peuvent être nécessaires pour rendre l'eau potable et maintenir sa qualité dans les installations de stockage et dans les réseaux de distribution, jusqu'au robinet du consommateur.

L'eau de dessalement de Ain T'émouchent - réservoir 2000 m^3 - et l'eau du barrage «Chorfa » représentent les ressources les plus importantes pour l'alimentation en eau potable pour les habitants de la wilaya de Sidi Bel Abbes, afin de suivre la variation du chlore de la quantité initiale qui est de 1.5mg/L jusqu'à son arrivé chez le consommateur nous avons effectué une étude qui consiste à quantifier le chlore dans nos deux sources d'eau cité précédemment on se basant sur les paramètres suivants: température, PH, conductivité, turbidité.

Les résultats obtenus démontrent que la quantité de chlore est liée très étroitement à certains paramètres et également à la nature de l'eau (superficielle ou dessalée).

Mots clés : Eau superficielle douce, Eau de mer, Variation du chlore, Consommateur, Température, PH, Conductivité, Turbidité.

CMTDE 2022_121

Adsorption and optimisation of a basic dye methylene blue on a NaX zeolite

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Abstract

The elimination process by adsorption is one of the most important separation technologies today. This study focused on the adsorption of a basic dye (methylene blue) on a NaX zeolite in order to determine the optimum points of a few physico-chemical parameters. The study of the influence of physico-chemical parameters (contact time, initial concentration of dye in solution, pH and mass of adsorbent, temperature) on the adsorption capacity of BM on NaX zeolite showed that dye adsorption equilibrium time is reached in less than 30 min and the adsorption capacity increases with the increase in the initial concentration of MB. In order to establish the best-fitting isotherm, the experimental equilibrium data were analyzed using several models of multi-parameter isotherms. The models used are Langmuir, Freundlich, Temkin and Elovich. The results show that the Langmuir model has a better correlation coefficient. Adsorption kinetic data was also examined with various kinetic models. The pseudo-second-order model was found to best predict the experimental data. The thermodynamic study shows that the adsorption is exothermic. In order to reduce the number and the cost of the tests, a parametric optimization of the adsorption of BM on NaX was carried out by using a complete factorial plan with two levels. Overall, these results show the interesting adsorption capacity of NaX zeolite with respect to methylene blue. This can play an important role in the depollution of colored effluents.

Keywords : Adsorption, Experimental design, NaX zeolite, Isotherms.

CMTDE 2022_122

Study of the adsorption of a basic blue cationic dye 41 on raw clay

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Abstract

The purpose of this study is to propose an effective, profitable and ecological treatment for the treatment of textile effluents loaded with BB41 by raw clay. The adsorbent was characterized and identified by X-ray diffraction (XRD), scanning electron microscopy (SEM). The chemical compositions were determined by energy dispersive spectroscopy (EDS). The dimensions of the grains of the clay were determined by the

technique of laser granulometry. Then, the effect of some physico-chemical parameters such as the pH of the solution, the solid/liquid ratio, the initial concentration of dye (BB41) and the temperature were investigated the best interpretation of the experimental data was obtained by the Langmuir isotherm, i.e. the molecules of BB41 are adsorbed in a monomolecular layer. Kinetic data were examined using pseudo first order and pseudo second order models. The results show that the data correlates well with the pseudo second order kinetic model. The free energy (ΔG°), enthalpy (ΔH°) and entropy (ΔS°) were evaluated and indicate that the adsorption process is spontaneous and exothermic. The activation energy value obtained during this study of the adsorption of the dye BB41 on raw clay is less than 40 kJ/mol, which shows that the adsorption process is physical in nature.

Keywords : Adsorption; Raw clay; Isotherm model; Kinetic; Thermodynamic; Intra-particle diffusion.

CMTDE 2022_123

Fabrication and test of an autonomous solar photoreactor applicable for water treatment using $BiFeO_3 - Bi_2O_3$

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Abstract

Industrial dyes are among the most environmentally threatening materials, so we thought of inventing a solar-powered device to get rid of the dyes using photocatalytic materials that we made locally in the lab, which means that the two phenomena are powered by solar energy; the working pump and the chemical phenomenon. It is a small device that can be expanded as a local industrial project, especially since our great country, with its vast territory and the long days that the sun offers us, can be exploited to preserve the environment. In this research, the properties of a binary composite oxide $BiFeO_3 - Bi_2O_3$ synthesized by three different methods, namely: sol-gel, sol-gel combustion and self-combustion, have been studied and characterized by various techniques including: XRD, FTIR, TGA-TDA and UV-Vis. The obtained results confirm the formation of the composite mixture $BiFeO_3 - Bi_2O_3$. The photocatalytic properties of the above-mentioned composite have been investigated throughout the photodegradation of methyl orange. $BiFeO_3 - Bi_2O_3$prepared by self-combustion has shown good results. It was found that 89.27% of MO was degraded in the presence of the composite under study.

Keywords: $BiFeO_3 - Bi_2O_3$, Solar-photoreactor, XRD, FTIR, UV-Vis, Methyl orange.

CMTDE 2022_124

Numerical Investigation of Natural convection of non-Newtonian Nanofluid in a Square Cavity Filled with a Porous Medium

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Abstract

The free convection of SWCNT-water non-Newtonian naofluid saturated an inclined square porous medium is numerically investigated. The non-Newtonian fluid behavior described by the Carreau-Yasuda model, where the fluid flow inside the cavity is modeled using the Dupuit- Darcy model to analyses the departure from the linear Darcy situation. The top and bottom walls of the enclosure are kept adiabatic, where the others are differentially heated. The finite difference method has been used to resolve the governing PDE equations of the problem. The obtained momentum equation allowed to present the results for the Newtonian and non- Newtonian behavior of the SWCNT-water nanofluid, the Darcy and the departure from Darcy situation, the base fluid (Water) and SWCNT-water nanofluid. The effects of the Rayleigh number (R_T), ninertial effect parameter (G), the Carreau-Yasuda non-Newtonian parameters $\left(\eta_{nf}, \dot{\gamma}, n, E, s \text{ and } a\right)$ and the inclination angle of the cavity (γ) on the fluid flow and the heat transfer rate are presented through graphs, streamlines, isotherms and apparent viscosity contours. In addition, a scale analysis is presented to show the maximum heat transfer enhancement that can be reached through this study. It is found that the increase of the SWCNT percentage significantly enhances the heat transfer even with the increase of the fluid viscosity. In addition, the increase of the inertial effect parameters inhibits the flow inside the cavity and causes a decrease in the convection rate. The power-law index, n, parameter of the Carreau-Yasuda model has a significant effect on the fluid flow strength and the convection rate inside the enclosure, the more the shear thinning the fluid, the better the rate of convection. The inclination angle of (-30 °C) represents the better angle for maximum convection rate. An enhancement of 8% in convection rate is recorded for the case of Newtonian behaviour, while for the shear-thinning situation the enhancement reaches eight times of that recorded of Newtonian condition.

Keywords : Free convection, SWCNT-water non-Newtonian nanofluid, Porous medium, Carreau-Yasuda model, Dupuit- Darcy model, Shear-thinning fluid.

CMTDE 2022_126

The removal of Rodamine B from industrials effluents by Acid-activated pillar bentonite

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Abstract

Discharges of the tannery industry constitutes enormous nuisance for the environment and are equally harmful to human health. As a result, the use of local clays in the treatment of discharges is of significant economic and environmental interest. The present work aims at the valorization of a clay from western Algeria extracted from the Hammam-Boughrara deposit in Maghnia (Tlemcen). Changes by chemical activation using three mineral acids (H2SO4, HNO3, HClO4) were carried out. The synthesized materials were characterized by x-ray diffraction (XRD) and infrared spectroscopy. On the basis of the results obtained, an intercalation by an iron-based polycation of the clay activated with perchloric acid was carried out. As the activated clay sample (bentClOFe) showed a very high specific surface area of 418 m^2 / g, bentClOFe was successfully applied to the adsorption of rhodamine B from wastewater. The effect of several parameters such as: mass of the adsorbent, the initial concentration of the dye, the pH, the temperature ... were studied. The adsorption efficiency of bentClOFe is 99.95%.

Keywords : Clay, Activation, Intercalation, Bentonite, Wastewater traitment.

CMTDE 2022_127

Comparative study on the efficiency of the desalination process case of the desalination plants of Ain temouchent and Mostaganem - Algerian coast - WESTERN ALGERIA-

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Abstract

The rapid development of desalination applications, and the repositioning of reverse osmosis processes in relation to thermal processes are helping to boost technological and process innovations in this field. Desalination processes are evolving to meet the growing water demand in certain parts of the world subject to water stress, particularly in Algeria, and whose resources are limited in quality and quantity, leading to

the establishment of treatment solutions on brackish water and seawater. The main objectives of the changes are to reduce energy consumption and investment and operating costs: changes in the performance of reverse osmosis membranes, pumping, energy recovery systems, materials and corrosion… The production sectors must adapt to the quality of the water resource, but also to the evolution of the regulations in terms of drinking water and the problems associated with desalination. This study focuses on two seawater desalination stations in Beni Saf, wilaya of Ain-Temouchent and wilaya of Mostaganem. The objective is to assess the effectiveness of the reverse osmosis desalination process on the physico-chemical and bacteriological quality of the water produced.

Keywords : Water stress, Reverse osmosis, Quality of the water, Physico-chemical, Bacteriology.

CMTDE 2022_128

Hopf bifurcation in double diffusion convection through a shallow horizontal layer saturated by non-Newtonian fluid

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Abstract

The onset of transition from rest and steady convective states to oscillatory flows is investigated in a horizontal porous layer saturated by non-Newtonian fluid. The shearthinning behavior of the fluid is described by the Carreau-Yasuda model, which includes the effect of the rheological parameters of the fluid. Neumann thermal and solutal boundary condition types are applied on the horizontal walls of the enclosure, while the vertical walls are assumed adiabatic and impermeable. A new bistability phenomenon arises when the system has two steady-state solutions occurring under the same condition. By considering an infinitesimal perturbation, the linear stability analysis of the diffusive and convective states is conducted based on the finite element method. The linear stability theory is used to predict the critical Rayleigh number for the onset of motion from the rest state as well as the onset of Hopf bifurcation, transition from stationary to oscillatory convection. The effect of varying the parameters of the Carreau-Yasuda model on the bistability region are found to be significant. Overall, the Carreau-Yasuda rheological parameters have a strong influence on the thresholds of convection.

Keywords : Convection, Double diffusion, Porous layer, Non-Newtonian fluids, Bi-stability, Hopf bifurcation, Finite element method.

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CMTDE 2022_129

Satellite imagery as a tool to analyze the brine discharge of the largest Algiers desalination plant

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Abstract

Water scarcity affecting Algeria in the last decades pushed the authorities to launch a program to build large-scale desalination plants along the Algerian coasts. Among them, the HWD (Hamma Water Desalination) plant was designed to produce 200,000 m^3 of potable water per day using the membrane process of reverse osmosis, while rejecting 300,000 m^3/d of hypersaline brine into the Mediterranean Sea. In this work, satellite images provided by the free software Google Earth Pro were used to follow the brine rejected by the HWD plant which interacts with the water surface. Thus, any surface activity detected near the discharge area was tracked and analyzed using image processing tools such as the free software GIMP. Satellite images tracking has shown that the plume horizontal spreading observed near the discharge area was highly dependent on sea state and weather conditions. In other words, when the sea was calm and during the warm months of the year, the interaction between the jet and water surface was important, where the plume spread reached a surface area of about 1800 m^2. While the interaction jet/water surface was weak during the cold months of the year and was hardly visible when the sea was rough. Satellite images of the far field region highlighted interesting surface phenomena, where a part of the plume is drained to the shore mainly through surface circulation. This floating layer is probably due to a sedimentation phenomenon or suspended solids used in the process and mixed with the brine. The observations made during this work underlined an uncommon interaction between the brine jet and the water surface that adversely affects the brine dilution process. Thus, it is recommended to conduct further studies on the impact of the HWD plant on its surrounding environment.

Keywords : Desalination; Brine discharge; Reverse Osmosis; Outfall; Environment.

CMTDE 2022_130

Removal of Ibuprofen from water using an adsorbent prepared from sawdust by zinc chloride activation

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Abstract

The objective of this work is to prepare an adsorbent prepared from sawdust by chemical activation using zinc chloride ($ZnCl_2$). The prepared adsorbent was used to study ibuprofen (IBP) removal from water in batch mode. The study of the adsorption of IBP under different operating conditions (dose of adsorbents, contact time, pH, initial concentration, effect of salts, and temperature) showed that pH was the factor that influences the elimination of IBP and that the optimal pH is equal to 2. The kinetic study of the adsorption showed that the elimination of IBP is rapid and that the model of the pseudo second order is the most adequate. The experimental results at equilibrium adsorption are best described by the Langmuir model, indicating the adsorption of IBP on a homogeneous monolayer on the adsorbent surface of the adsorbent. The chemical and thermal regeneration tests of the adsorbent are successful, and their reuse can reach three cycles.

Keywords : Adsorption, Sawdust, $ZnCl_2$, Ibuprofen.

CMTDE 2022_131

Recovery of plastic waste in the fixing of a methylene blue type textile dye

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Abstract

The main interest of this study is to contribute to environmental protection and sustainable development given the devastating impact of plastic pollution today. The development of highly selective and ecologically acceptable processes is essential to combat the environmental crisis which has become an important problem for current and future generations. This work is an innovative study that focuses mainly on the recovery of plastic waste as an adsorbent for the depollution of wastewater contaminated by textile

dyes of the methylene blue (MB) type in aqueous solutions in batches. The first step concerns the preparation and chemical treatment of plastic waste. The solid products were characterized by various analytical techniques such as X-ray diffraction, infrared spectroscopy, X-ray analysis by energy dispersion and scanning electron microscopy. As for the second step, a study of the adsorption of the methylene blue dye on this material was carried out to optimize the operating conditions for fixing the dye, using the UV spectroscopy technique, several parameters were studied namely the initial concentration, temperature, solution pH and solid/liquid ratio. According to the results obtained, a fixation rate of around 95% was recorded. The results of the kinetic study showed that a relatively steady state is reached after 90 min. The study of MB adsorption isotherms on plastic waste are better represented by the Langmuir model. The pseudo second-order model satisfactorily describes the adsorption of MB on plastic waste. The study of the diffusional mechanisms of the adsorption of BM on the plastic waste and the thermodynamic parameters have been determined.

Keywords : Plastic waste, Adsorption, Dye methylene blue, Environment

CMTDE 2022_133

Bio-dessalement : Perception et Durabilité

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Résumé

Environ deux (02) milliards de personnes, réparties dans quatre-vingt-six (86) pays, vivent en situation de stress hydrique moyen à très élevé. Sur notre planète de plus de 70% d'eau, c'est évident que le problème de l'eau potable et fraiche n'est pas un problème de disponibilité mais d'approvisionnement et de qualité. Pour y remédier, l'humanité à essayer d'imiter les processus qui se produisent dans la nature y'a des milliards d'années : le dessalement de l'eau de mer. Les coûts et les demandes d'énergie associés à différentes techniques de dessalement adoptées actuellement limitent leur utilisation à l'échelle mondiale, contrairement au modèle "gratuit" de la nature. Les scientifiques commencent à s'inspirer de la nature, à imiter les techniques des êtres vivants qui arrivent à s'approvisionner de l'eau et éliminer l'excès de sel dans des milieux salés extrêmes. Aujourd'hui on parle de Bio-dessalement. Dans cette contribution, un résumé sur les différents axes adoptés dans le bio-dessalement ainsi qu'une réflexion sur des démarches perspectives suite à une étude de durabilité préalable des différents axes. L'objectif principal de cet essai est de fournir un aperçue sur les notions traitées et les défis à relever pour un dessalement propre et durable. D'après cette étude analytique quatre (04) pistes doivent être inspecté pour vérifier la durabilité. A savoir : « Energie », « Prétraitement », « Productivité » et « Rejets ». Selon cette analyse la « Bio-distillation » parait l'approche la plus durable. Les approches qui se réfèrent au « Bio-adsorption » représentent des valeurs non durables par déficit pour l'indicateur de « Productivité ». « Biomimétique » est non-durable par excès pour l'indicateur « Prétraitement ». « Bio-fixation de l'NaCl » présente une valeur critique pour l'indicateur « Energie ». En résumé, l'utilisation directe d'organismes vivants est l'approche la plus durable

pour le dessalement de l'eau de mer, L'idée en est encore en phase embryonnaires, bien que quelques rapports récents aient montré l'utilisation potentielle de bactéries et d'algues bleu-vert, l'horizon est plus séduisant : bilan gaz à effet de serre, productivité, rentabilité et économie d'énergie.

Mots clés : Bio-dessalement, Durabilité, Indicateurs de durabilité.

CMTDE 2022_134

Solubilisation of dye using anionic and nonionic surfactants

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Abstract

In this study, the use of surfactants for the solubilization of dyes was studied. The surfactant uses are sodium dodecyl sulfate (SDS) and Tween 80, the dyes use is methylene blue and fucshine. The effect of chemical properties and structure of surfactants and dyes has been discussed. The results show that the duration of a 90 min is sufficient to reach the saturation equilibrium and that the solubilization has to increase in a linear way as a function of the concentration of surfactant, the solubilization in the presence of anionic surfactant is higher to that in the presence of non-anionic surfactant.

Keywords : Solubilisation, Dye, Anionic and non-ionic surfactants.

CMTDE 2022_135

Synthesis and characterization of multilayer ceramic membranes

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Abstract

Separation processes are widely used in industry since the chemical conversions are often incomplete. Membranes technique is one of the most attractive separation methods because of its low cost and high selectivity. Ceramic membranes have advantages in comparison with polymeric membranes. The chemical, mechanical and thermal stability of ceramic membranes are favorable compared to those of organic ones [1-3]. These properties make ceramic membranes interesting candidates for separation. Micro-Filtration (MF) and Ultra-Filtration (UF) are often used to remove particles, microorganisms, and colloidal materials from suspensions [4]. Ceramic membranes normally have with an asymmetrical structure with porous support and active membrane layer. The macro porous support ensures the mechanical resistance while the

active layer functions separation ranging from MF, UF and even Nanofiltration (NF). In this study, Macro porous supports for membranes were prepared from natural materials. The characterization of the raw material and the effect of the sintering temperature on the morphology, pores size distribution and the mechanical properties of supports were studied. For example, a tubular ceramic support fired at 1375°C for 1 h has an average pore diameter and a total porosity ratio of about 7.2 µm and 47 %, respectively. The elaboration of the Clay based top-layer is performed by slip casting method. The heating treatment at 570°C leads to an average pore size of 15 nm. This membrane can be used for Ultra-Filtration (UF); indeed, it showed a good rejection performance of Chromium Cr(III) contaminated water: 80%. It is also suitable for waste water treatment.

Keywords : Ultrafiltration; Membranes; Porosity; Supports; Ceramic membranes.

CMTDE 2022_136

Modelling the full-scale reverse osmosis system using new computational modelling technique

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Abstract

The aim of this work is to use a novel technique named support vector machine (SVM) coupled with very recent optimisation method to tune the hyper-parameters of the model which is dragonfly algorithm (DA). This work was done based on an experimental data done on full-scale reverse osmosis system to treat water for a pharmaceutical use. The data set contains two sets, an input set which includes important parameters that control the reverse osmosis system and the output set which includes the performance of the system. The SVM-DA was trained using 80% of the dataset and tested with 20%. The statistical comparison in terms of regression coefficients and different errors demonstrated the efficiency of the obtained model in comparison to literature. The obtained model can be used to predict the performance of reverse osmosis system without knowing the details of the phenomena via using convivial graphical interface.

Keywords : Reverse osmosis, Support vector machine, Dragonfly.

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CMTDE 2022_137

Modélisation de l'adsorption du chlorobenzène sur la bentonite modifiée

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Résumé

Dans ce travail, un réseau d'anticipation de la fonction de base radiale (RBF) a été utilisé pour prédire la capacité d'adsorption du chlorobenzène (CB) sur la bentonite algérienne modifiée (HDTMA-bentonite). Les paramètres d'entrée utilisés pour la formation du modèle RBF comprennent le temps de contact, la quantité d'adsorbant, le pH et les concentrations initiales de chlorobenzène. La capacité d'adsorption du chlorobenzène sur la bentonite modifiée est considérée comme une sortie du réseau neuronal. Un modèle RBF est utilisé pour prédire le comportement du processus d'adsorption avec l'algorithme de Levenberg-Marquardt (LMA). Le modèle utilise une fonction de transfert linéaire (purelin) au niveau de la couche de sortie et une fonction de transfert sigmoïde tangente (tansig) dans la couche cachée à quatre neurones. Les valeurs du coefficient de détermination (R^2 = 0,984) et de l'erreur quadratique moyenne (RMSE=0,015) ont montré de bons résultats de prédiction. Par conséquent, le modèle RBF en tant qu'outil prédictif a une grande capacité à estimer l'effet des paramètres opérationnels sur le processus d'adsorption.

Mots-clés : Capacité d'adsorption, Réseau de neurones artificiels, Bentonite, Chlorobenzène, Fonction de base radiale (RBF).

CMTDE 2022_138

Etude de l'efficacité de certaines méthodes de désinfection sur une eau contaminée par les légionelles

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Introduction

Les Legionella spp. appartiennent aux principaux agents étiologiques responsables de pneumonies communautaires sévères. Elles sont responsables de ce qu'on appelle communément légionelloses. Ces dernières représentent 0,5 à 10% des cas de pneumonies dans le monde, et sont mortelles dans 10 à 30 % des cas.

Les légionelloses peuvent être prévenues par contrôle et élimination de la bactérie des systèmes d'eau, car c'est à partir de ces derniers que se produit la contamination humaine par inhalation d'aérosols contaminés. Le traitement thermique et le traitement chloré sont les traitements de choix pour la désinfection d'un système d'eau contaminé par les légionelles. En pratique ces deux méthodes sont généralement couplées. En plus de l'accélération des phénomènes d'entartrage et de corrosion cette association provoque une élévation du taux des sous-produits de la chloration, produits nocifs pour l'homme et pour l'environnement. Pour cette raison nous nous sommes proposés d'étudier l'efficacité de certains procédés de désinfection, dits : « plus respectueux de la santé humaine et de l'environnement », sur une eau contaminée par les légionelles. Nous avons à cet effet mené une étude comparative entre quatre méthodes de désinfection qui sont : la microfiltration (1), la photolyse (2), la photocatalyse (3) et les radiations UVC (4).

Matériel et Méthode

L'étude expérimentale a été conduite le 31 juillet 2022, répétée les 04 et 10 août de la même année de 9h30 à 14h 30. Les expérimentations ont été effectuées dans des bancs d'essais montés dans le laboratoire « Epuration et valorisation des eaux de rejet » de l'Unité de Développement des Equipements Solaire de Bou-Ismaïl (U.D.E.S). Les échantillons d'eau avant et après traitement ont tous été analysés selon la norme AFNOR NF T90-43

Pour chaque expérimentation, 11litres (L) d'eau distillée stérile ont été contaminées avec une suspension bactérienne de la souche de référence Legionella pneumophila ATCC33152, Un1erL a été analysé, sans traitement, selon la norme AFNOR NF T90-431dans le but de déterminer le nombre initial de Legionella pneumophila présente dans l'eau contaminée. Un 2ème L a été traité dans le banc d'essai n°1par microfiltration. Le reste de l'eau contaminée a été réparti dans des béchers gradués en verre borosilicaté de 1L. Les béchers ont alors été disposés sur 2bancs d'essais à raison de 6 béchers (pour être traités par photolyse et photo catalyse) pour le banc d'essai n°2 et 3 béchers pour le banc d'essai n°3(pour être traité

par les UVC). 3 boites de milieux de culture pour légionelles ont été ensemencées avec la même suspension bactérienne et soumises aux radiations solaires sur le banc d'essai n°2.

Résultats et Discussion

Pour les quatre méthodes testées les pourcentages d'abattement des légionelles étaient supérieurs à 99,99%, ce qui est plutôt satisfaisant.

Conclusion

Les 4 méthodes que nous avons testées méritent une attention toute particulière, elles pourraient constituer des solutions alternatives pour la désinfection des systèmes d'eau. Des études plus poussées et notamment socioéconomique sont cependant nécessaires. Elles nous permettraient entre autres d'optimiser l'utilisation de ces procédés afin d'obtenir des eaux de qualité et d'intégrer ce qu'on appelle « le concept de développement durable ».

Mots clés : Legionella, système d'eau, Désinfection, Microfiltration, Photolyse, Photocatalyse, UVC, Développement durable.

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Exergy and Economic Analyses of a Novel MED-TVC Distillation System with thermal Vapor Compression System of Al-Jubail Thermal Power Plant

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Abstract

Desalination is the sole proven technique that can provide the necessary fresh water in sufficient quantities and meet the modern needs of a growing world population, and among these technologies is the multi-effect distillation desalination system with thermal vapor compression (MED-TVC). This type of desalination system is one of the most appropriate and economic types of desalination systems for low to high capacities of seawater and brackish water. This research provides a analysis comprehensive exergy and economic in the steady-state conditions for multi-effect distillation desalination system with thermal vapor compression in Al-Jubail thermal power plant in south of saudi arabia (KSA). In addition, the behavior of the MED-TVC system was analyzed for various operating conditions such as the top brine temperature, the number of effects, and the motive steam flow rate. The obtained results confirmed that the major causes of irreversibilities in the MED-TVC system are the effects and thermo-compressor, which account for 50% and 36% of the total exergetic destruction. From an economic perspective, indicate that the proposed cycle has a desirable economic performance, and the results of economic analysis using the Net Present Value (NPV) method and Internal Rate of Return (IROR) show the Payback period in this plan is 3.2 years.

Keywords : Seawater desalination; Multi-effect distillation; Thermal vapor compression; Exergy efficiency; Economic

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Tertiary treatment of secondary wastewater by saturated vertical constructed wetland

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Abstract

In order to treat the secondary treated wastewater received at the site of GDA Sidi Amor and make it suitable for reusing in an aquaponic system following NF desalination, a vertical constructed wetland is implemented with dimensions of 9.5, 2.5, and 1 meter in length, width, and depth, respectively. After covering the tank wall with geomembrane and the bottom with geotextile, the drainage pipelines were installed. The constructed wetland was fed by three gravel layers with different coarse as follows from the bottom: 20 cm with a mixture of 12-20 cm and 25-40 cm of gravel diameter, 10 cm after separation by geotextile with a diameter of 3-5 cm followed by 55 cm of gravel with a coarse diameter of 8-12 cm. Two macrophytes were used for filtration “Juncus maritimus”and “phragmites communis” with a density of 6 plants/m2 for the first and 4 plants/m2 for the second. An impulse feed system supplies the constructed wetland from MBBR reactor with a 127 L every 27 min approximately. An outlet regulation system ensures the regulation of water level at 5 cm from the surface of gravel. The saturated constructed wetland was operated for eight months, starting in october 2021 with the average feed conditions 366 L/h±76.5 for flowrate, 83.9 mgO2/L ±28.29 for COD, 33.06mg NO3/L±29.15 for nitrate and 2.52 ±2.35 mg PO4/L for orthophosphate. The current obtained result for removal rates were 30% ±16.37 for COD, 37%±28.15 for nitrate and 22%±19.18 for orthophosphate. Results were near those obtained in Kenya with Zantedeschia aethiopoca plant and municipal wastewater (35% for COD removal rate and 45% for nitrogen [1]) and low compared to other countries [1]. It can be explained by the small roots of crops at the beginning of test and the significant level of non-biodegradable fraction of COD that was confirmed by a laboratory analysis performed by FIW as well as by anoxic conditions caused by the current configuration (saturated CW). The average daily specific COD loading rate was 11.38 gCOD/m2/d ±9.12. It was low compared to the design criteria in the German standard on constructed wetland systems for treatment of domestic and municipal wastewater (20 gCOD/m2/d) [2].

Keywords : Tertiary treatment, Juncus maritimus, Phragmites communis, Denitrification, COD removal

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CMTDE 2022_141

Fabrication and properties of novel ferric and bentonite ceramic membranes

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Abstract

In this work, the feasibility to elaborate a ceramic membrane from Iron and Bentonite feedstock materials was assessed. A series of ferric and clay membrane formulations with different percentages of raw materials including organic and inorganic additives were synthesized and consolidated by thermal treatment to get ceramic membranes. A kinetic losses process allowed to select twelve membranes potentially eligible since the intervention of organic additives and their contribution to the microstructure of the membranes due to their influence on the qualities of the joints of grain. Density and porosity studies then allowed to choose the best ferric and clay ceramic membrane formulation. Ferric membrane (made from 80 wt% Iron, 6 wt% clay, 4 wt% méthocel, 4 wt% amijel, 4 wt% starch and 2 wt% PVA after sintering at 900°C) presents the highest total porosity of 62.79% and apparent porosity of 61.02%. The selected clay membrane (made from 86 wt% clay, 6 wt% méthocel, 4 wt% amijel, 4 wt% starch after sintering at 900°C) has 64.95% of total porosity and 49.3% of apparent porosity. The regeneration of both types of ceramic membranes was finally assessed. The results obtained show that may the membrane technology is still young however it has great potential for further improvements.

Keywords : Membrane technology, Ceramic membranes, Apparent porosity, Total porosity, Ferric membrane, Density, Clayey membrane.

CMTDE 2022_142

Determination of storm water quality in the algeries area. Physico-chemical characterization. Reutilization

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Abstract

Stormwater is the part of the rainfall that flows down the surface of the soil. The increasing urbanization of territories to modify the natural water cycle and has increased the impacts of stormwater: not only the volumes of water runoff are more important, but the rainwater, already contaminated by air pollution, washes impervious surfaces and loads various pollutants from human activity. Urban stormwater is therefore responsible for flooding and deterioration of the quality of the receiving environments.

In the framework of our work, particular attention is given to rainwater aimed at the recovery and reuse of these recoverable waters as an alternative resource while confirming their heterogeneous nature, these waters are now recognized as a substantial source of pollutants for receiving aquatic environments.

The collection and reuse of rainwater can help fill the water deficit and relieve pressure on water resources. The study conducted on the characterization of the physico-chemical quality of the substances washed and transported by rainwater recoverable from roofs in relation to the possibility of their reuse in irrigation of green spaces. The characterization involved the analysis of physico-chemical parameters such as pH, conductivity, COD, BOD, MES, toxic metals and Orthophosphate, Sulphate, Nitrates, Nitrites, Ammonium, Potassium, Calcium, Magnesium and Sodium ions. Analyses were carried out using UV-Visible spectrophotometry, flame spectrophotometry and atomic adsorption.

The results of the analyses indicate a significant pollution. The latter causes short-term or long-term harmful effects on the different compartments of the ecosystem and even on the human scale. Statistical analysis of the data allowed us, to note that a significant correlation existed between certain parameters and also to identify the distribution of the mineralization of the stormwater and the hydrochemical approach shows that the runoff water has excellent quality for irrigation of the green spaces.

Keywords : Storm water; Pollution parameters; Physico-chemical analysis.

CMTDE 2022_143

Elaboration and characterization of clayey bentonite tubular membrane and its performance in the treatment of an effluent from textile deying industry followed by adsorption using marine waste. Photochemical regeneration of the adsorbent.

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Abstract

Ceramic membranes from bentonite have become a hot research topic because of their low cost and abundance in many countries. This article describes the development and characterization of a microfiltration membrane elaborated using an extrusion method: Each tube was 150 mm in length, with an external diameter of 8 mm and an internal diameter of 5 mm. The membranes obtained were characterized by scanning electron microscopy, mechanical and chemical resistance and water permeability. The synthesized membrane was then used to treat effluent from a textile dyeing industry specializing in washing jeans. The analysis of the filtrates obtained from the tubular membrane shows a decrease in COD from 1400 mg/L to a value of 766 mg/L. In order to improve treatment efficiency, the membrane filtration process was followed by adsorption by marine waste. The analysis of the chemical oxygen demand of the effluent before and after membrane treatment followed by adsorption using a marine compound shows a significant decrease of about 85.6%. A regeneration process was approached in this study in a photochemical way. The results showed a total regeneration of the adsorbent.

Keywords : Bentonite, Effluent, Textile dyeing industry, Tubular membrane, Membrane, Adsorption, Adsorbent, Photochemical, Regeneration process.

CMTDE 2022_144

Caractérisation physico-chimique de l'effluent de la station d'épuration de Tizi-Ouzou.

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Résumé

L'eau est le vecteur privilégié de toute activité humaine. A l'heure actuelle, l'utilisation globale de l'eau, en additionnant les usages domestiques, industriels et agricoles, représente un chiffre impressionnant de 250m^3 par an et par habitant. Ces eaux usées qu'elles soient domestiques ou industrielles, sont collectées

par un réseau d'assainissement complexe pour être traitées dans une station d'épuration avant d'être rejetées dans le milieu naturel. En station, le traitement varie en fonction de la nature des eaux usées et de la sensibilité à la pollution du milieu récepteur [1].
L'objectif principal de notre travail est basé sur le traitement biologique par la dégradation de la matière organique et par les micro-organismes avant que les eaux ne soient rejetées dans le milieu récepteur (Oued). Nous, nous sommes intéressés à la caractérisation physico-chimique des paramètres de pollution à l'entrée de la station de la station d'épuration de Tizi-Ouzou tels que la température, le pH, la DCO, la DBO_5, les ions NO_3^- et PO_4^{3-}. Les résultats des analyses ont montré que la teneur de ces paramètres dépassait largement les normes de rejet [2].
Les résultats physico-chimiques des eaux usées épurées montrent que le suivi de l'évolution des paramètres tels que la DCO, la DBO_5 et les ions PO_4^{3-} a atteint respectivement des rendements d'élimination de l'ordre 82,75, 80,20 et 59,63%.
L'étude statistique multi variée par le biais de l'Analyse en Composantes principales a révélé que la teneur de ces paramètres reste faible dans la station d'épuration.
Le traitement des eaux usées de la station d'épuration par boues activées à un impact positif sur la qualité des eaux rejetées dans le milieu récepteur [3].

Mots clés : Eau usée, Station d'épuration, Micro- organismes, Eaux épurée, Multi-variable linéaire.

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CMTDE 2022_145

Adsorption of malachite green dye from aqueous solutions using nanoparticle loaded on bentonite clay: Kinetics and isotherm study

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Abstract

Industrial effluents (main environmental pollution source) contain highly color dyes with large amount of organic solids. The entrance of such pollutants to different water body cause generation of hazards to aquatic life by their ability to enhance mutagenic and carcinogenic effect. This technique benefits from unique properties such as simple design, using nontoxic and low-cost adsorbents and high efficiency. In this research, a novel adsorbent, nanoparticles loaded on bentonite clay was synthesized by a simple, low cost and efficient procedure. Subsequently, this novel material was characterized and identified by different techniques. The adsorption of malachite green onto bentonite-nanoparticles has been studied. The effects

of contact time, initial pH and initial dye concentration on the malachite green adsorption by the adsorbent have been studied. Four kinetic models, the pseudo first- and second-order equations, the Elovich equation and the intraparticle diffusion equation, were selected to follow the adsorption process. Kinetic parameters; rate constants, equilibrium adsorption capacities and correlation coefficients, for each kinetic equation were calculated and discussed. It was shown that the adsorption of malachite green onto bentonite could be described by the pseudo second-order equation. The experimental isotherm data were analyzed using the Langmuir and Freundlich equations. Adsorption of malachite green onto bentonite followed the Langmuir isotherm. The rapid removal on this novel adsorbent within a short time makes it a promising candidate for waste- water treatment applications

Keywords : Malachite green, Bentonite, Nanoparticles, Adsorbent, Waste water treatment.

CMTDE 2022_146

Low-cost efficient olive mill wastewater treatment

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Abstract

Photo-catalysis with sunlight is a very efficient and low-cost process that ensures wastewater treatment. However, its efficiency depends on solution charges. It is almost applicable for transparent solutions. In this work, we optimized conditions of use of TiO_2 as a photo-catalyst for olive mill wastewater (OMW) treatment. Since Tunisia is one of the top 3 producers of olive oil, it generates great quantities of this type of waste reaching 950,000 m^3 per year [1]. OMW is a dark malodorous liquid and very charged in phenolic compounds. Seeing the difficult-to-treat nature of this wastewater, we started the process by a step of coagulation flocculation using a mix 1:1 in volume of lime solution (30g/L) and cactus mash. This operation permitted to separate the sludge from liquid charged in phenolic compounds.
Solid phase is carbonized and transformed into biochar. Liquid portion is diluted with treated water. Obtained solution is then put in contact with the catalyst and it is exposed to sun light for 24 hours. Results reveal that generated sludge is about 70%. The decolorisation and phenolic degradation is more that 95%.
Final pH of the treated water is about 8.50 and DCO is 7.64 ± 0.02 $gO_2 \cdot L^{-1}$. Phenolic compounds expressed as gallic acid are reduced to 0.2 ± 0.01 10^{-5} mgL^{-1} which is accepted with the Tunisian norms of water rejection.

Keywords : Sunlight, Photo-catalysis, Coagulation, Flocculation, Wastewater.

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CMTDE 2022_147

Reverse osmosis membrane fouling by iron oxides: Prevention and regeneration of fouled membrane

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Abstract

Iron can be found in various forms in water treatment systems. If it is not properly addressed, iron can cause scale buildup in water treatment processes, especially on reverse osmosis (RO) membranes. In fact, if Fe^{2+} is oxidized to Fe^{3+}, insoluble iron compounds such as $Fe(OH)_2$, FeOOH and Fe_3O_4 form and foul the units which represents a major issue for membrane process. Iron fouling in a RO process reduces productivity and increases costs. Therefore, the present experimental work focused on membrane fouling by iron oxides in order to study the influence of pH, initial iron concentration as well as the initial feed water composition. RO membrane fouling was monitored by measuring normalized fluxes drops. Structural characterization of fouled membrane was performed by scanning electron microscopy coupled by energy dispersive X-ray (SEM-EDX) and FTIR analysis. The current results have highlighted the effect of pH of rejected water as a key parameter for fouling occurrence. Cake formation was identified as the primary membrane fouling mechanism responsible for the permeate flux decline. FTIR analysis has revealed that the fouling deposits consist mainly of δ-FeOOH phase. Cleaning strategies for iron-fouled membranes using carboxylic acid were investigated. Interestingly, citric acid presented a good cleaning membrane effectiveness for iron oxides. However, its performance is partially affected by the presence of oxygen.

Keywords : Reverse osmosis; Membrane; Fouling; Iron oxides; Citric acid.

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Diagnosis, monitoring and enhancement of geothermal waters in southern Tunisia (Gabes, Kebili and Tozeur)

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Abstract

The development of the geothermal greenhouse crop sector in southern Tunisia has continued to progress due to the poor management of water resources on the one hand and the effect of climate change on the other. In this context, the present work aims at the analysis and understanding of the physicochemical properties of return water from heating geothermal greenhouses in the governorates of Gabès, Kébili and Tozeur for reuse. These analyzes mainly affected 37 samples during the month of June 2017 and the sampling points vary from one area to another (drilling discharge point, cooler inlet, irrigation basin inlet, etc.).

The results of these analyzes show that the salinity of these waters varies from 0.1 to 6.7 g/l and the SAR from 0.9 to 10.97. In addition, the Langelier Index and the Residual Sodium Carbonate Index highlight the scaling effect of water.

Piper's diagram shows that the return waters have a type of facies: chloride and sulphate calcium and magnesium, which gives us an important idea of the quality of these waters and its impact on the environment.

Finally, these analyzes prove that a treatment of these waters is necessary to preserve the environmental value and to ensure a reuse of these waters as an effective alternative to solve the continuous problem of water scarcity.

Keywords : Geothermal water, Physicochemical analysis, Analysis results, Salinity, Environmental impact.

CMTDE 2022_149

Fluoride removal from wastewater by electrocoagulation

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Abstract

This work investigated the effect of the following parameters: the initial pH, the conductivity, the initial concentration of fluorine, the inter-electrode distance, the current density and the electrolysis time on the removal efficiency of fluoride ions by electrocoagulation (EC). Then, the optimization of working conditions was normalized by a compromise between economically suitable energy consumption and acceptable disposal efficiency.

The results indicated that an initial pH value = 6 and a conductivity of 9 mScm-1 were optimal values for good elimination and moderate power consumption. The study of the effect of the initial concentration showed that the defluoridation yield and the residual concentration of fluorine depend on its incoming value. However, increasing the initial concentration had no significant effect on energy consumption. Moreover, the best active surface was Sa = 448 cm2 and the perfect inter-electrode distance to avoid

delivery of short circuits while maintaining reasonable energy consumption founded was 1 cm. Results suggested a current density J = 1.78 mA cm^{-2} and an electrolysis time t = 20 min as optimal operating conditions to eliminate 86% of the fluoride ions with a moderate energy consumption of 0.16 kWh m^{-3}. Subsequently, the application of the EC process to remove fluoride ions from an industrial waste water sample (ONAS) with an initial fluoride concentration of 12 mg L^{-1} conducted to a residual fluorine concentration of the treated water of 1.8 mg L^{-1}.

Keywords : Electrocoagulation, Eluoride removal, Eptimal operating conditions, Waste water.

CMTDE 2022_150

Removal of Dissolved Organic Matter extracted from Tunisian water by adsorption onto modified activated carbon

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Abstract

Dissolved Organic Matter (DOM) extracted from Kalaat Senan groundwater (Kef-Tunisia) was examined using elemental analysis and FTIR spectroscopies. Total organic carbon (TOC), chemical oxygen demand (COD) and UV-absorbance at wavelength 254 nm (UV254) were also measured. Elemental analysis indicated that groundwater contained a high amount of oxygen but a low amount of carbon. FTIR analyses revealed that polysaccharides were the main compounds present in water. The removal of DOM was studied by adsorbing activated carbon-supported aluminium. The characterization of DOM and activated carbon after adsorption confirms the removal of dissolved organic matter. The decrease of BET surface of adsorbent after adsorption confirms that the pores are occupied by dissolved organic matter.

Keywords : Groundwater; Dissolved organic matter; Adsorption; Activated carbon-supported aluminium; Removal.

CMTDE 2022_151

Evaluation of physico-chemical and bacteriological pollution of Temacine Lake in south east of Algeria

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Abstract

Temacine Lake located in the Oued Righ valley is subject to increasing pressure from various types of degradation (physical, physico-chemical and bacteriological) generated by climatic conditions and anthropogenic activities. The present study was carried out in order to establish a diagnosis of the pollution state of this lake. Thus, representative water samples were collected at lake level during the month of December, March and July of 2014. The analyzes focused on physical (T°, EC), physico-chemical parameters (pH, NO_3^-, NO_2^-, PO_4^{-3}, MES, Dissolved oxygen (DO), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD) and bacteriological analyzes (Total coliforms, Fecal coliforms, Fecal streptococci, Sulphite-reducing anaerobes. Results revealed a significant seasonal variation in most of the pollution indicators studied, with maximum values recorded during the hot period. The highest temperature and EC values were recorded in July (35.12 °C, 27.02 dS m^{-1}), respectively. The highest NO_3^-, NO_2^-, PO_4^{-3} contents were recorded in March (32.12, 0.072 and 20.23 mg L^{-1}), respectively. As for the highest COD and BOD values were recorded in July (125.11 and 28.9 mg L^{-1}), respectively. In contrast, the highest dissolved oxygen saturation (DO) rate was recorded in December (9.23 mg L^{-1}). MIcrobiological results indicated the presence of different groups of faecal bacteria. The high bacterial density in total coliforms, faecal coliforms, and Clostridum sulphito-reducers were recorded in the 3rd water sampling period (July) with 32.4×102, 18.9 ×102, 20.9 ×102 100 mL^{-1}, respectively for the three bacterial groups studied. However, the highest density of fecal streptococci was recorded in the month of March (23.2 ×102 mL^{-1}). These results show the importance of preserving the lake against the risk of anthropogenic pollution, which requires adequate management and good control of wastewater and drainage water discharges into this lake.

Keywords : Physico-chemical properties, Pathogenic bacteria, T°, EC, NO_3^-, COD, BOD, Lake of Témacine.

CMTDE 2022_152

Cyclops dans les barrages d'eau potable, problématique, solutions possibles Cas de la région de Mostaganem, Algérie

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Introduction

Les Cyclops sont des petits invertébrés de 0.5–2.0 mm de longueur, naturellement présents dans plusieurs sources d'eau, C'est un genre qui comporte plus de cent espèces.
Les cyclops en eux même ne sont pas pathogènes pour l'Homme. Outre leur aspect visible à l'œil nu apportant aux consommateurs un sens insalubre, les cyclops constituent un moyen de transmission de plusieurs parasites pathogènes à l'Homme.
La contamination par des cyclops de deux barrages alimentant une grande région de l'ouest d'Algérie, et persistance de la contamination après les différents traitements de potabilisation a déclenché une enquête menée par l'institut pasteur d'Algérie.

Résultats

Les analyses microbiologiques des eaux brutes (barrages) et des eaux traitées ont montré une qualité microbiologique satisfaisante par rapport aux exigences réglementaires nationale.
La recherche des cyclops a montré une concentration de 19 à 32 cyclops / 5 litres pour les eaux brutes (barrages), et de 6 cyclops/5litres après traitement de potabilisation.

Traitement et solutions

1-bassins : A-Chimique : Le produit chimique recommandé par l'OMS est le téméphos du fait de sa faible toxicité, cependant il est utilisé seulement dans certaines circonstances : volume relativement faible (500 m^3 ou moins), Lors des conditions épidémiologiques exceptionnelles.
B-Biologique **:** La propagation des cyclops peut être contrôlée efficacement à une densité d'empoissonnement appropriée de 30 grammes par mètre cube d'eau ; silver carp (*Hypophthalmichthys molitrix*) et bighead carp (*Aristichthys nobilis*) ont montré leur efficacité.
2-Station de potabilisation **:** La mobilité du Cyclops lui permet de pénétrer facilement à travers les filtres pour se trouver dans les réservoirs d'eau potable.
Il est aussi Difficile d'éliminer les cyclops avec les procédés habituels de désinfection à cause de sa résistance à l'oxydation ; leur élimination nécessite des procédés renforcés et adaptés.
Le dioxyde de chlore étant plus efficace contre les cyclops et le permanganate de potassium étant le plus faible dans les mêmes conditions.

Les cyclops sont efficacement éliminés de l'eau par une pré-oxydation notamment avec et dioxyde de chlore ou l'ozone.

Conclusion

Le développement excessif des cyclops dans les sources d'eaux exige de rétablir l'équilibre biologique aquatique et d'adapter les procédés de traitement de potabilisation conventionnels, le traitement chimique ne présente aucun intérêt dans les barrages ayant une capacité importante.

CMTDE 2022_153

Response surface methodology for dyes removal by adsorption onto alginate calcium

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Abstract

The removal of dyes from solution by adsorption onto alginate calcium beads has been studied. A methodology of surface response was used, this kind of designs estimate the coefficients of a quadratic polynomial mathematical model, whose essential interest is to be able to predict in any point of the experimental region, the values of the response. The effects of initial concentration, pH, adsorbent dose and temperature were investigated. A full factor design was performed to determine the effect of the main parameters and their mutual interaction for the adsorption process. Using the experimental results, a linear mathematical model representing the influence of the different parameters as well as their interactions was obtained; it shows that the temperature is the most significant parameter affecting the dyes removal. The effect various experimental parameters and optimal experimental conditions were ascertained by response surface methodology using Doehlert model.

Keywords : Dyes, Adsorption, Alginate, Response Surface Methodology, Doehlert.

CMTDE 2022_154

Response Surface Methodology for Boron Removal by Donnan Dialysis: Doehlert Experimental Design

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Abstract

The removal of boron by Donnan Dialysis from aqueous solutions has been studied according to Response Surface Methodology (RSM). First, a preliminary study was performed with two membranes (AFN and ACS) in order to determine the experimental field based on different parameters such as the pH of the feed compartment, the concentration of counter-ion in the receiver compartment and the concentration of boron in the feed compartment. The best removal rate of boron was 75 % with AFN membrane but only 48 % with ACS membrane. Then, a full factor design was conducted to determine the influence of these parameters and their interactions on the removal of boron by Dialysis Donnan. The pH of the feed compartment was found to be the most important parameter. The RSM was applied according to the Doehlert model to determine the optimum conditions ([B] = 66 mg/L, pH = 11.6 and $[Cl^{-}]$ = 0.5 mol/L) leading to 88.8 % of boron removal with an AFN membrane. The use of the RSM can be considered a good solution to determine the optimum condition for 13.8 % compared to the traditional "one-at-a-time" way.

Keywords : Boron; Doehlert design; Donnan Dialysis; Optimization; Response Surface Methodology.

CMTDE 2022_156

Novel zeolite prepared using Tunisian raw clay: Study of C_3H_6 breakthrough dynamic adsorption onto zeolite material

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Abstract

In this study, Tunisian raw clay (RC) was employed as a low-cost source of Si and Al in the synthesis of Faujasite zeolite (FAU syn) by means of the alkaline fusion method. Optical analysis was performed by means of a Scanning Electron Microscope and showed zeolitic crystals, with well-defined hexagonal morphology. The elemental analysis obtained via energy dispersive X-ray (EDX) proved the presence of principle elements of zeolitic structure (Al, Si, Na, O). The potential effect of bed height (10–18 cm) on the column performance was investigated. A model based on adsorbent pore diffusion, the langmuir isotherm without the axial dispersion was adapted to describe and predict column input. The model was implemented and solved numerically by Comsol Multiphysics software. The predicted breakthrough curve matched well the experimental data (R^2=0.978).). a few degrees discrepancy between the model and experimental data was attributed to the axial dispersion.

Keywords: Adsorption, Clay, Comsol, Modeling, Zeolite.

CMTDE 2022_157

Photocatalytic properties of TiO_2 supported on MCM-41: effect of the incorporation methods

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Abstract

The solar photocatalytic degradation of organic compounds presents in waste water has attracted a great deal of attention thanks to its simplicity, low cost, non-toxicity and the using of a renewable energy.
Supported TiO_2 is a promising material for photodegradation of several types of pollutants since the support allows a greater dispersion of the active sites, an enhancement of the adsorption and a maintain reusability [1].
In this investigation, we studied solar photocatalytic degradation of an anionic dye Methyl orange in water. Nano size TiO_2 particles was supported on porous material (MCM-41) using solid-state exchange (SSE), sol-gel and impregnation methods. We examined the effect of some parameters such as the contentent of TiO2, the time of the reaction and the preparation method. We found that the optimum result corresponds to the solid TiO_2/MCM-41 (SSE).
Based on these results, we can conclud that the loading on MCM-41has an appreciable effect. We reach a degradation rate of 98% after 180 mn. This finding indicates that there is a synergistic effect between adsorption and textural properties of the support and photocatalytic behaviour of semi-conductor which confirms that this material type is a promising support for TiO_2 specially when it is prepared by solid-exchanged method.

Keywords : photocatalysis, nanomaterial, solid-state exchange, sol-gel- impregnation, MCM-41

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CMTDE 2022_158

Performance of a hybrid process integrating coagulation flocculation with membrane filtration for the treatment of Soap industry wastewater : safe reuse purpose

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Abstract

The management of water resources is one of the major priorities in all countries of the world and even more so in developing countries such as Tunisia. The issues of environmental protection, including wastewater treatment, are of great importance for industries especially for soap production ones. This plant generates effluents that must be treated before being dumped into the environment. Hazards created by this activity are due to the presence of considerable concentrations of unsaponifiables (the lipid fraction that cannot be transformed into soap), oil and grease. Membrane separation technologies have broad application prospects in wastewater treatment. Coupling membranes with other water treatment processes is an effective way to improve membrane treatment effect and alleviate membrane fouling. The main objective of the present investigation is to evaluate the use of coagulation/flocculation/sedimentation (CFS) combined with the microfiltration (MF) or ultrafiltration (UF) process for soap manufacturing plant wastewater (SMPW) treatment, focusing on determining the best association of treatments that can generate treated wastewater for reuse purposes. For the first stage of SMPW treatment, several parameters were investigated in terms of turbidity and chemical oxygen demand (COD) removals, as variation of coagulant concentration, flocculent dosage, initial pH, mixing speed and contact time for coagulation and flocculation steps. Response surface methodology (RSM) based on three-level Box–Behnken design (BBD) was used to optimize the response and to design the experiments. The optimum results for chemical CFS were obtained for the use of alum at 2.17 g/L concentration and flocculent at 55.32 mg/L dosage with mixing speed of about 141.4 rpm for coagulation and 28.9 rpm for flocculation steps at contact time of about 4.78 min for coagulation and 33.55 min for flocculation, under initial pH of 5.3, where turbidity was removed by 99% and COD declined to 27% of their initial values. For the second step, the membrane treatment was carried out under Dead End Filtration (DEF) mode in order to select the most appropriate membrane pore size that allows obtaining the best quality of treated water. Different flat microfiltration (MF) and ultrafiltration (UF) membranes have been used. Thus, hybrid CFS-MF treatment of SMPW showed great results, where a 100% and 49% of turbidity and COD removals, respectively, were obtained using the smallest MF membrane pore size of 0.22µm. Combined with UF, the proposed hybrid CFS-UF process seems to be more efficient showing excellent results, where turbidity was removed by 100% and COD declined to 88% of their initial values were achieved using the smallest membrane MWCO of 5 kDa. Thus,

the treated SMPW obtained with this CFS-UF hybrid process presents better quality than the treated SMPW obtained with the conventional CFS treatment. The treated water has a final physico-chemical characterization allowing it to be reused in the soap manufacturing process. Finally, it should be noted that this study can provide a reference for the practical application of combined coagulation-flocculation-sedimentation-ultrafiltration process in soap wastewater treatment.

Keywords : Soap industry wastewater, Coagulation/flocculation/sedimentation, Microfiltration, Ultrafiltration, Hybrid process, Treated water

CMTDE 2022_159

Removal of Fluconazole from Aqueous Solution via Adsorption onto Modified Domestically Waste

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Abstract

Fluconazole was one of most micropollutants which was not designated for disposal in conventional treatment plants; effluents contaminated with this substance must therefore undergo prior treatment. In this study, a simple and effective method was proposed for the removal of fluconazole from water by an adsorbent prepared from domestical waste. Characteristic of prepared biosorbent were investigated using infrared spectroscopy (FTIR), pHpzc, BET measurement, Scanning electron microscopy (SEM) and Thermogravimetric analysis (TGA). Batch studies were used to determine the influences of contact time, solid/liquid ratio and initial fluconazole concentration. The results showed that the equilibrium of retention was depended of initial concentration; fast for low concentration (5 to 10 min) and decaled for 120min to 400 mg/L of Fluconazole with an adsorbent dose 2g/L. Adsorption data were analysed using different isotherm models. The isothermal model with better adjustment to the experimental data was the Temkin- Freundlich model, the kinetics of the adsorption process was studied using pseudo-first-order, pseudo-second-order Elovich, modified Freundlich and intraparticle diffusion models respectively. The experimental data was best described by pseudo-second-order kinetic model.

Keywords : Fluconazole; Adsorption; Kinetics; Wastewaters; Pollution.

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CMTDE 2022_160

Investigation on using electromagnetic water technology for salt leaching and mineral usage in potatoes.

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Abstract

Climate change situation has increased attention paid in the research of efficient techniques of saline water treatment, in respect to soil properties and plant development. It is identified that physical treated saline water may be used in agricultural irrigation, but little is known about the effect of this water on soil ions composition and mineral usage efficiency in plants. This constitutes an important concern in areas served with water salinization. The current research is based on three irrigation treatments (C: ground water, SW: saline water, TSW: treated saline wter) and three potato varieties (Spunta, Bellini and Alaska), planted in factorial-RCBD design under semi-arid conditions. Saline water with 8.5 ms cm^{-1} electrical conductivity (EC) was treated with an Aqua-4D® 60E series device, that serves to circulate water through an electro magnet tube 60E (external diameter 65 mm, passage diameter 1" (DN 25), length 436 mm, maximum flow 60 l min^{-1}, designed for transmitting electromagnetic signals into water and connected to an electro magnet box (Command 60E Pro) pre-programmed to generate electromagnetic signals. Data showed that TSW enhanced the soil humidity (Θs) level as compared to SW. From soil macronutrients results, the highest values of Na^+, SO_4^{2-} and Cl^- were obtained under SW treatment. Though, K^+, Ca^{2+} and Mg^{2+} concentrations were higher in the soil irrigated with TSW. Additionally, TSW can promote salt (Na^+, Mg^{2+}, SO_4^{2-} and Cl^-) leaching from soil and decrease soil salinity. As for plant metabolic behavior, data revealed that usage efficiency of Na^+, Ca^{2+}, Cl^- and NO_3^- were least under SW treatment with a significant increase under TSW. Meanwhile, K^+ usage was enhanced with EMSW only in Alaska. On the basis of the presented results, it is possible to optimize saline water usage in agricultural irrigation, to provide better valuation of saline water and plant resistance to climate change.

Keywords : Electromagnetic treatments, Potato, Saline water, Soil, Use efficiency.

CMTDE 2022_161

Effect of PGPR and biostimulant supply on agro-physiological behavior of pepper grown under saline conditions

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Abstract

Salt stress due to saline irrigation is associated with decrease of plant growth and physiological traits. Application of biostimulants and microbial treatments could be of positive effects for plants grown under saline circumstance. The aim of this experiment is to study the vegetative growth and physiological parameters of saline irrigated pepper plants under biological and biostimulant supply. The study was carried out in the experimental station of the Regional Center of Agricultural Research of Sidi Bouzid, Tunisia. The design used was split plot with saline water treatments (T1: 3 gNaCl/L; T2: 6 g NaCl/L; T3: 9 g NaCl/L) as main plots whereas biostimulants and bacterial inoculation (C: Control; PGPR: inoculation with PGPR; Sel: Selenium and PGPR+Se) were considered as sublopts. Parameters assessed were plant height, number of leaves, leaf area, chlorophyll content, leaf gaz exchange parameters and yield. PGPR and Se had positive effects on leaf expansion rate and plant height under 6 g NaCl/l salinity level. Results also showed a positive interaction between PGPR and Se to increase total chlorophll content in leaves under T2 and T3. However, the net photosynthesis (Pn) and stomatal conductance (gs) were enhanced only by Se in T2 treatment. Similarly, to photosynthetic activity, the yield per plant was superior with Se application under T2 treatment. It was concluded that, PGPR and Se independently could be beneficial for pepper growth whereas Se may be useful for enhancing photosynthetic capacity and yield.

Keywords : Growth, Pepper, Photosynthetic activity, Saline water.

CMTDE 2022_162

Adsorption of Erythromycin from aqueous solution using Tunisian clay materials- Effect of operating parameters

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Abstract

Nowadays, all the countries of the world are aware to protect the quality of the environment, as many studies have been carried out to find economically, socially and environmentally viable solutions. Our work

is part of this context, which aims to investigate the capacity of raw Tunisian clays to remove the residues antibiotic drugs used for human and veterinary from wastewater. In this study, batch equilibrium experiments were conducted to explore the efficiency of the sorption behavior of Erythromycin (ERY) molecule from aqueous solution.
The optimum conditions for ERY removal were established such as contact time, the effect of pH and the varying of the concentration. The results claim that the pH =5 was optimum for the highest ERY removal, the highest removal efficiency R% = 39.8% and the equilibrium for the contact time is reached at 45 min. Additionally, Freundlich model was best fitted to ERY sorption data (R^2 = 0.9872) and the ERY adsorption kinetics on the natural clay follows the pseudo-second order kinetic model.

Keywords : Adsorption, Antibiotics, clay, Kinetics, Isotherm.

CMTDE 2022_163

Effect of PSS concentration on physico-chemical characteristics and performance of CTA-based membranes

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Abstract

The influence of Polystyrene Sulfonate Sodium (PSS) concentration as polymer additive on the physico-chemical characteristics and performance of cellulose triacetate-based membranes (CTA) used for Na^+, K^+, and Ca^{2+} ions transport was studied in this work. A membranes series containing the mixture of CTA+PSS polymers and Di-(2-Ethyl Hexyl) phosphoric acid (D2EHPA) as plasticizer was developed. The membranes were prepared by dissolving amounts of CTA and D2EHPA in chloroform. Varying amounts of PSS were dispersed in THF and added to the CTA+D2EHPA+Chloroform mixture. The films obtained after solvent evaporation were characterized by scanning electron microscopy (SEM), X-ray diffraction (DRX) and Fourier transform infrared spectroscopy (FTIR). The results showed that membranes have a moderately porous structure and amorphous structure. This is probably due to the presence of the D2EHPA as plasticizer in the membranes. The influence of PSS concentration on membrane performance was examined by application of the dialysis process using solutions containing Na^+, K^+, and Ca^{2+} ions and a seawater solution after pretreatment. The results showed that the transfer efficiencies increase with increasing amounts of PSS in the membrane and the best transfer efficiencies was in the order of 40%, 35%, and 30% for K^+, Ca^{2+} and Na^+ ions respectively using synthetic solutions and 32%, 25% and 20% for K^+, Ca^{2+} and Na^+ ions respectively using seawater solution. Finally, the transfer efficiencies will be improved by using electrodialysis process with the same membranes.

Keywords : Membrane; Polymer; CTA; PSS; Seawater.

CMTDE 2022_164

Valorization of treated and desalinated wastewater in an aquaponic system

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Abstract

It became more challenging for Tunisia and other Maghreb countries to supply the demand of fresh water needed for agriculture due to limited water resources. Consequently, it is becoming increasingly crucial to exploit non-conventional water supplies. As part of a Tunisian-German collaboration project (TUNGER18-044; Water ReTUNe) for reuse of treated wastewater in aquaponics, a pilot unites of MBBR reactor, constructed wetlands, sand and carbon filters, as well as a desalination unit has been installed at GDA Sidi Amor. Aquaponics is an integrated system of recirculation aquaculture and soilless culture that mainly aims to reduce water requirements, reduce waste discharge and maximize nutrient use.

In the present study, an aquaponic system consisting of two 600 L fish tank, sedimentation tank, biofilter and a hydroponic compartment consisting of four grow beds with clay babbles, an NFT system, and Deep-Water Culture (DWC). To achieve those results, the system was running continuously for four months. The startup of fish tanks is staggered to ensure a steady output of nutrient from fish. 144 Nile tilapias (Tilapia Oreochromis) were reared and fed thrice daily and water samples were collected once a week to analyse pH, EC, Temperature, NH_4^+, NO_3^-, PO_4^{3-}, SO_4^{2-}, K^+, Na^+, Ca^{2+}, Mg^{2+}, Cl^- and Fe^{2+} concentrations.

We maintain the pH around 7 ± 0.5 with the addition of approximately 200 mL of phosphoric acid daily. Fish weight increased in the two tanks from 50 g/fish at the beginning of the experiment to 97 g/fish and to 165 g/ fish respectively. In the first trial, the crops initially grew well, but growth rates declined remarkably and showed complex nutrient deficiency. We conduct the experiment again while including fertilizers like potassium, magnesium, and iron. The latter crops increasingly grow well without any indication of nutrient deficiency. Nitrate, Sulfate, Na^+ and Mg^{2+} accumulated in the system, whereas Cl- gradually increased and reached 332 mg/L, which is near the limit for hydroponic.

As a result, the system's total nutrient content varied considerably at concentrations lower than the general requirement of the soilless crops. According to this study, aquaponics holds a huge potential for the transformation of conventional agriculture toward sustainable systems that conserve water resources and reduce waste.

Keywords : Treated Wastewater, Reuse, Aquaponic, Tilapia, Soilless culture

CMTDE 2022_165

Agro-physiological responses in pistachio (*Pistacia vera* L.) cultivars as induced by saline water irrigation

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Abstract

Regulated deficit irrigation (RDI) is a technic based on reducing the water supply in specific fruit developmental stages without detrimental effects on production and fruit quality. For this purpose, the agronomical and physiological responses of fifteen years-old pistachio (*Pistacia vera* L.) trees (Mateur, Elguetar) budded with *P. atlantica* rootstock were studied during two years (2021 and 2022) with saline water. The experiment orchard was located in the Regional Center of Agriculture Research (CRRA, Sidi Bouzid) in west central Tunisia. Three water treatments were applied; well-watered treatment (T0; 100% ETc during all the developmental stages), RDI treatment (T1; 50% ETc during stages I and II of fruit development followed by full irrigation 100 % ETc during stage III) and the stressed treatment (T2; 50% ETc during all the growing season). Agronomical traits and gas exchange parameters were determined using a portable photosynthesis system (CI-340 handheld photosynthesis system, USA). Results showed that the stressed trees (T2) presented lower photosynthetic net assimilation (A_n), stomatal conductance (g_s) and transpiration (E). Pistachio trees showed a change in proline and soluble sugar content with drought in leaf tissues, significant differences between treatments were evident especially in the stage III. Regarding fruit production, kernels weight and dimensions there were no significant differences between water treatments. The application of water deficits in stage I and II following an RDI program reduced applied water in the RDI by 63.5 mm, relative to full irrigation (T0).

Keywords : Pistachio, Gas exchange, Relative water content, Stomatal conductance.

CMTDE 2022_166

Photocatalytic activity of Fe/TiO_2-SiO_2 NPs for anionic dye degradation

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Abstract

Catalytic photodegradation is an advanced oxidation technique based on catalyst activation by radiation. The main advantage of this method is being economical and no requiring energy input. This method is sustainable; it uses only solar radiation a renewable energy. On the other hand, the scarcity of water resources imposes the treatment of domestic or industrial waste water. Thus, photocatalysis under solar radiation represents an interesting alternative to clean up the different types of water. Nowadays, the number of researches devoted to photodegradation by the use of titanium dioxide has been constantly increasing since it presents semi-conducting properties.

In this work, we focused on the study of the effect of the introduction of iron in titanium dioxide supported on silica nanoparticles in photocatalytic degradation of an anionic dye. The study was conducted while using the materials before and after iron loading for the catalytic treatment of aqueous solutions charged with methyl orange dye under solar radiation.

The first step is the synthesis of silica nanoparticles which have been dispersed in the titanium dioxide synthesis medium. After drying and calcinating the obtained material, impregnation with Fe(III) ions was carried out at a content of 1%. Finally, calcination at 450°C under air was carried out.

The materials obtained were characterized by X-ray diffraction which revealed the presence of the anatase phase. Infrared spectroscopy revealed the presence of absorption bands relating to the different groups constituting silica and titanium oxide. The exploitation of the UV-Vis spectra showed that the incorporation of iron causes a shift of the absorption towards higher wavelengths. In order to evaluate the effect of iron, the materials TiO_2, SiO_2-TiO_2 and Fe- SiO_2-TiO_2 were used for methyl orange degradation.

CMTDE 2022_167

Modelling the onset of thermosolutal convective instability in a non-Newtonian -saturated porous medium layer

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Abstract

The onset of thermosolutal convection in a square porous layer the thermal conductivity of a porous layer saturated by a non-Newtonin fluid. In terms of temperature and concentration gradients (heat and mass flux), the active walls of the cavity are subjected to a constant and uniform flow, while the other two walls are maintained impermeable and adiabatic. A Carreau-Yasuda model is used to determine the fluid behavior. The Darcy model along with the Boussinesq approximation was assumed in the problem formulation, that it is laminar and incompressible. The equations describing the double-diffusion convection phenomenon are solved numerically using a finite difference method. This study was calculated for some relevant parameters of the rheology of the Carreau-Yasuda (n, a, E, and s), the buoyancy ratio, N, the Lewis number, Le, and inclination angel, γ. Representative velocity, temperature, and concentration profiles are presented and discussed. Numerical results are represented in terms of streamlines, isotherms, iso-concentration, and apparent viscosity, and the influence of some parameters on the variation of the

stream function, ψ_0, and apparent viscosity, μ, temperature, T and concentration, C, profiles and Nusselt, Nu, and Sherwood, sh, numbers. In addition, the heat and mass decrease progressively when E, of increases with the increase of the low power index, n. On the other hand, we find that the heat and mass increase as the Lewis number, Le, increases.

Keywords : Thermosolutal convection, Carreau-Yassuda, Double Diffusive, Non-Newtonian fluid, Porous cavity.

CMTDE 2022_168

Enhancement of reactive textile dye removal by synthesized PVDF/ZnOPb adsorptive membranes

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Abstract

Membranes filtration processes show indeed high removal efficiencies of organic compound and enable the reuse of the treated wastewater. Nanotechnology has been successfully integrated in membranes developments. Adsorptive nanocomposite polyvinylidene fluoride/Lead doped Zinc Oxide nanoparticles (PVDF/ZnOPb) ultrafiltration membranes were successfully fabricated by non-solvent induced phase separation wet-process method for the removal of anionic Reactive Black 5 textile dye. Static sorption and dynamic filtration were performed to evaluate the capacity of membranes to remove the RB5 dye. Results showed the PVDF-ZnOPb composite membranes exhibits high efficiency both on adsorption and retention of RB5 dye in comparison with PVDF neat which was attributed to the electrostatic attraction between dye and membrane surface as well as the adsorption ability of ZnOPb NPs. The addition of 20 wt % of nanoparticles in membrane matrix showed high color removal rate (98%). The real sorption of the composite membrane was 41.4 mg/g composite_membrane and 207 mg/g_{NPs}. The recyclable capacity in the treatment of dye solution has been studied using simple water cleaning, without addition of any chemical agent. After three cycles of filtration-cleaning using PVDF/ZnOPb-20%, membranes can retain the dye molecule.

Keywords : PVDF/ZnOPb membrane; ZnOPb nanoparticles; Ultrafiltration; Reactive Black 5; Sorption

CMTDE 2022_169

Preparation and characterization of PVDF/ZnOPb composite ultrafiltration membranes

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Abstract

In recent years a number of studies have focused on creating synergism membrane/nanoparticles or multifunctional membranes by adding nanomaterials into polymeric or inorganic membranes. Several metal oxide nanoparticles have been incorporated in the composition of PVDF ultrafiltration membranes such as ZnO, TiO_2 and Fe_2O_3 with the aim to enhance their physico-chemical proprieties, to reduce fouling, to increasing hydrophilicity and to improve the water flux and permeability. In this study novel hybrid polyvinylidene fluoride/lead-doped zinc oxide nanoparticles (PVDF/ZnOPb) composite ultrafiltration membranes were successfully fabricated by non-solvent induced phase separation wet process method. The matrix membranes embedded with various weights of nanoparticles (5, 10 and 20 wt% of polyvinylidene fluoride). The membranes morphology structure, surface, chemical composition and hydrophilicity were characterized by scanning electron microscope, energy-dispersive X-ray spectrometer analysis and water contact angle. The performances in terms of permeability, porosity and permeate flux were evaluated. Whereas the addition of low concentration of lead-doped zinc oxide nanoparticles doesn't significantly modify PVDF membranes structure and performances, the addition of 20 wt% of nanoparticles to casting solution modified the morphology, led to reduce the contact angle from 77° to 67° and enhanced the hydrophilicity and permeability of membranes.

Keywords : Membrane preparation, Ultrafiltration, Nanoparticles, PVDF/ZnOPb, Membrane characterization.

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Performance of triangular solar still with different shapes of absorber

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Abstract

In Sfax region southeaster Tunisia where seawater is abundant but potable water is not usually available, solar distillation of seawater is one of the many processes that can be used for purification as well as desalination. Solar still is the widely used solar desalination device. But the productivity of fresh water of this device is very low. In this case, the shape of absorber plays important role to increase this productivity by using a Triangular Solar Still 'TSS'. For this reason, two identical triangular solar stills with different shapes (plate and trapezoidal) of absorber have been constructed in the Laboratory of Electro-Mechanic Systems (LASEM) at the National School of Engineers of Sfax and investigated experimentally in this paper. The other design parameters (thickness of seawater, thickness of glass cover, thickness of thermal insulator and tilt angle of the glass cover with the horizontal) were kept constant to study the effect of absorber shape on the productivity of TSS. The present study showed that the productivity of distillate by TSS with trapezoidal absorber is more important than that of TSS with plate absorber during the period from 8:00 a.m. to 2:00 p.m., while for the period from 2:00 p.m. to 6:00 p.m. the productivity of TSS with plate absorber becomes bigger than that of TSS with trapezoidal absorber. Correlations for the hourly evolution of distillate productivity of TSS with two shapes of absorber are also developed in this study.

Keywords : Triangular solar still; Plate absorber; Trapezoidal absorber; Productivity; Correlation.

Graphical abstract

CMTDE 2022_172

Systèmes de dessalement de l'eau par le procédé Humidification-déshumidification : Configurations et performances

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Résumé

Le dessalement de l'eau est un ensemble de techniques appliquées depuis des siècles sur différentes qualités d'eau bruts en utilisant des transformations physico chimiques de différentes natures et performances. Dans le présent article, nous analysons les effets de la configuration sur les performances de dessalement de l'eau par le procédé humidification-déshumidification (HDD) de l'air. En effet, les performances d'une unité HDD dépend de principaux facteurs d'humidification et de déshumidification tels que : la température de l'eau, le débit et la vitesse de l'air, l'aire d'échange entre les fluides, les caractéristiques technologiques et opératoires, la pression exercée sur l'air humide, et la taille des bulles d'air.
Notre étude a montré que la configuration co-courant est plus performante par comparaison avec celle à contre-courant. L'épaisseur de l'eau liquide traversée par une bulle d'air, doit être dans un intervalle optimum pour une humidification optimale. En conclusions, les humidificateurs où les écoulements de l'eau et de l'air sont co-courants sont plus rentables que ceux où les écoulements sont contre-courants. Ces résultats sont valables pour les colonnes à plateaux ou les colonnes à garnissage utilisés comme humidificateurs.

Mots clés : Configuration, HDD, Conditions opératoires.

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CMTDE 2022_173

Pretreatment of seawater by commercial and synthesized membranes

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Abstract

Desalination process efficiency is seriously constrained by reverse osmosis (RO) membrane fouling, causing the dysfunction of the seawater treatment. In the aim of reducing this membrane damage, an eventual pre-treatment is recommended. In the present work, commercial membranes; the ultrafiltration membrane ETNA01PP and the nanofiltration membrane NF270 were used singly and successively as a pre-treatment step of seawater desalination. Mad-lab polyethersulfone membranes were also employed in this object.

The efficiency of the different processes was studied by the parameters: Turbidity, salinity, TDS, conductivity, dissolved oxygen and some cations concentration.

The successive membrane filtration ETNA01PP- ETNA01PP seems have a good yield, and the lab made membranes were considered as promising alternative membranes.

Keywords: Seawater pre-treatment, Ultrafiltration, Nanofiltration

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CMTDE 2022_174

Recovery of water from fine phosphate wastewater by flotation-coagulation-floculation

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Abstract

Natural phosphates, from the mining area of the Gafsa_Metlaoui basin in southern Tunisia, enriched by scrubbing generate a large quantity of muddy water called fine washing discharges which mainly contain carbonates and clays. This work consists precisely in determining the optimal conditions for the clarification of wastewater for industrial reuse.

The optimization and adjustment of the process parameters as well as the doses of flotation reagents, coagulant and flocculant for the elimination of suspended solids (SS) and colloidal matter on the pilot unit have bypassed a solution for industrial fine discharges of phosphates.

Indeed, the recovery of phosphates loss is possible using oleic acid flotation. The optimal elimination of SS and the destabilization of colloids by $Al_2(SO_4)_3$ and $FeCl_3$ is respectively for pH between 5.5 to 7.2 and 5.5 to 8.3 with 58.5% and 82.9% elimination for 14 mg/l and 9.4 mg/l respectively.

During flocculation, with 2 mg/l and 1.6 mg/l of Flotinor flocculant respectively for solutions rich in $Al_2(SO_4)_3$ and $FeCl_3$, it was noted that the turbidity reached minimum values of 0.72 NTU and 0.68 NTU for maximum elimination percentages of macro-flocs formed of approximately 98.69% and 98.76%.

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Pollution biologique des eaux souterraines dans la région aride *bibans* Nord-Est d'Algérie : croissance et survie des espèces procaryotes aquatiques lors du captage et stockage aquatique

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Résumé

La disponibilité/qualité des eaux souterraines, est préoccupation des habitants des régions rurales/arides. L'étude vise l'évaluation des contaminations des eaux souterraines, pour un effectif de 21 échantillons collectés durant saison estivale, de différentes localités de la province (Aride) Bordj Bou Arreridj, Nord-Est d'Algérie per la réalisation des analyses bactériologiques (recherche/dénombrement des flores/espèces indicatrices des contaminations récentes/anciennes). Analyse a donné résultats suivants : Coliformes totaux (42%) /fécaux (48%), Entérocoques (48%), spores (48%). Espèces aquatiques pathogènes : Salmonella sp(57%), Vibrio sp (57%), Pseudomonas sp (57%).pH neutre, taux du Chlore entre 0 et0,2mg/l.

Recherche, caractérisation, identification des flores aquatiques dominantes, a donnée : Photobacterium damsela, Stenotrophomonas maltophili, Salmonella arizonae, Pseudomonas aeroginousa, Burkholderia cepacia, Enterobacter cloacae. Les antibiogrammes ont exhibé : Sur 2 souches de Salmonella :62% résistantes vis-à-vis des : Ciprofloxacine, Amoxycilline, Acide Nalidixsique, Cephaloshine, Pristinomycine, Acide Fusique, Chloramphenicole. Sur 5 souches de Vibrions 13% résistantes vis-à-vis de Gentamicine, Nitroxoline, chloramphenicol, acide Nalidixsique, acide Fusique, Ciprofloxacine, HLG. Sur 2 souches de Pseudomonas : 64% Résistantes vis-à-vis Ciprofloxacine, Amoxycilline, Nitroxoline, Cephaloshine, Acide Nalidixsique, Pristinomycine, Acide Fusique, Chloramphenicole. L'estimation de la

survie/croissance des isolats aquatiques sur cinq catégories des eaux potables, traitées par cinq procédés physiques : (autoclavage/ chauffage/ filtration/ Ultra-violet/Ultrasons), contre un témoin (négatif), pendant 72heures ; à montre croissance exponentielle, au-delà de 72H. L'ensemble des eaux souterraines, semblent de qualité en dessous des normes Algeriennes/internationales, l'antibiorésistance des isoalts, leur aptitude au survie/ croissance, lors du stockage/conservation des eaux constituent un risqué epidemiologique. Il est souhaitable d'approfondir l'étude par d'autres explorations, sur un effectif élevé, étalé sur l'ensemble de la région.

Mots clés : Eaux souterraines ; Pollution Chlore ; Flores bactériennes ; Normes.

CMTDE 2022_176

Réutilisation des eaux usées issues de la station de traitement de la wilaya de bordj bou arreridj, nord-est d'Algeire : prospection en aval et en amant, évaluation du rendement épuratif impact sur l'irrigation agricole

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Résumé

Contexte : Les rejets hydriques, d'origine domestique, industrielle et/ou agricole, sont polluées, doivent d'être traitée avant leur diversement en milieu naturel. La pollution hydrique est peut-être biologique, physique et/ou chimique. L'épuration des eaux usées consiste à l'élimination de ces polluants. L'objectif de l'étude est d'évaluer le rendement épuratif, de la station d'épuration de la ville de Bordj Bou Arreridj Nord- Est d'Algerie, par exploration et suivi des étapes épuratives au sein de la station. Des analyses physiques (Température T °C, pH, Conductivité, Salinité, oxygène dissout), chimiques par dosage et suivi des : (MES, DBO_5, DCO, NH_4, NO_2, NO_3) et bactériologiques par recherche et dénombrement en UFC/mL des : Coliformes totaux et fécaux, Streptocoques fécaux, *Salmonella sp.*et *Vibrio sp.*, réalisé par collecte et suivi quotidien des débits des effluents en amont et en aval de la station. Résultats ont montré que le rendement épuratif de cette station, spécialisée dans le traitement des eaux domestiques et pluviales, déversées par la ville, dont elle utilise le procédé d'épuration par boues activées à faible charge, semble très faible. Le début des activités au niveau de la station remonte à 2001, elle s'étale sur une surface de 42750 m^2, dotée d'une capacité de 150.000 équivalents habitants, soit un débit journalier de 30.000 m^3/j. Résultats des différentes analyses, physiques, chimiques et bactériologiques étaient en dessous des normes nationales*. Conclusion : Station nécessite des travaux de rénovation et de développement. Les rejets issus de la station, ne peuvent être utilisés pour l'irrigation et constituent une menace pour la santé publique et l'environnement.

Mots clés : Analyses ; Eaux usées ; Epuration ; Rendement ; Station

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CMTDE 2022_177

The distribution of *Tuta absoluta* population in a greenhouse heated by geothermal energy

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Abstract

Crops in greenhouses, irrigated and heated by geothermal water are favorable to various pests such as *Tuta absoluta*. The fight against this insect requires a thorough knowledge of the biology of the insect in the specific conditions of geothermal greenhouses in order to develop control methods that preserve the environment. It is within this framework that a physicochemical analysis of the irrigation water as well as the population dynamics of *Tuta absoluta* was carried out in a tomato greenhouse heated by geothermal water.The study showed the presence of *Tuta absoluta* in the greenhouse from February to June. The monitoring of the distribution of the pest in the greenhouse showed that the population is concentrated at the extremities and at the entrance of the greenhouse.

Keywords : Water analysis, Energy, Environment, Geothermal water, Greenhouse and Population dynamics, *Tuta absoluta*.

CMTDE 2022_178

Modelling and performance analysis of a fully of a solar -multi-effect distillation desalination system with thermal vapor compression for coastal households of the city of Algiers (Algeria)

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Abstract

In the Mediterranean regions especially Algeria, fresh water resources are very scarce and its production requires higher electrical energy and consumption of fossils such as natural gas, thus increasing the price of production. Desalination of seawater is the method to meet the growing demand for water. The main objective of this research is to develop solutions to provide drinking water to small communities in isolated coastal areas by integrating multi-effect distillation desalination system with thermal vapor compression (MED-TVC) purification units associated with solar energy installations (thermal and PV). An attempt was made to achieve this goal with a study, modelled with MATLAB software and the optimization of the solar thermal system for desalinated seawater. For the system, a MED-TVC powered by a plant glass solar collector is proposed and carried out on July 15 in the meteorological conditions of the city of Algiers (Algeria). The results showed that the present model is in good agreement with the experimental and theoretical data in the literature.

Keywords : Solar desalination, Multi-effect distillation, Thermal vapor compression, Plant solar collector, Photovoltaic panel.

CMTDE 2022_179

Batch and dynamic studies for removal of triphénylméthane dye on root of solid waste as a novel biosorbent: Modelling

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Abstract

This work involves the use of root waste (RW) as a novel biosorbent for the removal of basic triphenyl-methane dye from aqueous solutions. Effects of process parameters as contact time, concentration, pH and

temperature were studied. A fixed-bed column study for this dye was carried out to optimize the effect of bed height and initial dye concentration using RW biomass. To predict the breakthrough curves and to determine the characteristic parameters of the column useful for process design, two kinetic models namely Bohart –Adams, Yoon and Nelson and Wolborska were applied to experimental data.

Keywords : Removal, Triphenyl-methane dye, Roots solid waste, Kinetics, Dynamic, Modelling.

CMTDE 2022_180

Effect of ultrasound on biosorption of basic dye from aqueous media by using Typha as biosorbent

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Abstract

In this study, the Typha was evaluated as biosorbent for the removal of basic dye as organic pollutant model from aqueous media in the absence and presence of ultrasonic irradiation. The influence of acoustic power, initial concentration of the dye, pH, and temperature has been verified in order to explain the influence of ultrasonic irradiation on biosorption kinetics.
The sorption kinetic data at different concentrations were found to be well-represented by the Blanchard pseudo-second-order model, both in the absence and presence of ultrasound.
This study showed that the biosorption in presence of ultrasonic irradiation can be an alternative technique to conventional method. Additionally, the parameters thermodynamic were determinate and the biosorbent surface was characterized.

Keywords : Ultrasonic irradiation; Biosorption; Typha; basic dye, Kinetics, Parameters thermodynamic, Characterization.

CMTDE 2022_181

Assessment of geothermal water quality for irrigation purpose in the experimental station of technical center of protected and geothermal crops

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Abstract

With growing concern about climate change and the need to reduce the use of fossil fuels, there is increasing interest in the use of renewable energy. In this regard, geothermal energy has a great importance in agriculture activity in southern of Tunisia known by the lack of irrigation water. But when using geothermal water in irrigation, the chemical composition of the nutrient solution must be carefully monitored to prevent damage to the plants. Three irrigation treatments: irrigation with geothermal water, irrigation with treated water using reverse osmosis membranes, irrigation with geothermal water (50%) + treated water using reverse osmosis membranes (50%); with three repetitions were planned to irrigate tomato plants under greenhouse in experimental station of technical center of protected and geothermal crops. The hydrochemistry of geothermal water and mixed water was studied and samples were examined by calculating different parameters, the key indices like Sodium Absorption Ratio (SAR), Sodium Percentage (SP), Kelly Ratio (KR), Residual Sodium Carbonate (RSC) and Permeability Index (PI) were examined. Chemical characteristics of soil were measured before plant cultivation and at the end of experience. Results show that tomato yield, plant height, stem diameter and number of leaves in soil irrigated with geothermal water + treated water using reverse osmosis membranes were significantly the highest. There were no significant differences between treatments on plant dry weight. Treatments had no influence on the average fruit weight, whereas fruit quality parameters differ significantly with irrigation water quality.

Keywords : Geothermal water, Chemical composition, Tomato, Soil.

CMTDE 2022_182

Adsorption performance of tartrazine dye from agro-food wastewater by raw and modified biomaterial: Equilibrium, isotherms, kinetics, thermodynamics and regeneration studies

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Abstract

Application of raw sawdust (SD) and activated sawdust (ASD) for the removal of tartrazine has been investigated. Both materials were characterized via elemental analysis, BET, Thermogravimetry, pH of zero charge, Boehm titration, fourier transform infrared spectroscopy and scanning electron microscopy. The effects of various parameters such as pH, contact time, agitation speed, adsorbent mass, initial dye concentration and temperature on the removal of the dye were studied. The highest removal percentages

were found to be 47.88 % for SD and 99.52 % for ASD. Langmuir saturation adsorption capacities were equal to 0.8 mg/g for SD and 127 mg/g for ASD at 298 K. Even if SD shows a more limited efficiency in tartrazine removal, it can be used as it is, without any activation step, therefore it can be a convenient alternative to the activated material. In conclusion, SD and ASD are promising, biodegradable, eco-friendly, cost-effective and efficient adsorbents for the removal of tartrazine from wastewater effluents.

Keywords : Activated sawdust, Biosorption, Tartrazine, Isotherm modelling, Kinetic.

CMTDE 2022_183

Elimination des effluents aqueux par des bioadsorbants à faible coût

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Résumé

L'objectif de cette étude a été focalisé sur la synthèse et la préparation des biomatériaux de type cationique et anionique. Ces matériaux ont été utilisés comme adsorbants dans les eaux polluées par différents adsorbats susceptibles d'être présentes dans l'environnement. Les différents matériaux vont être caractérisés par différentes techniques (IRTF, DRX, MEB, BET et ATG/DTA). Les études d'adsorption par ces matériaux, vont été réalisées en contrôlant les différents paramètres tels que : le pH, la masse, la concentration et la température

Mots Clés : Caractérisation, Différents matériaux, Traitements des eaux.

CMTDE 2022_184

2-nitrophenol is adsorbently removed from aqueous solution using date palm waste-based activated carbon

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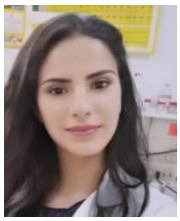
Abstract

Nowadays, the degradation of ground and surface water quality by organic pollutants becomes a public health problem. Huge quantities of several pollutants are discharged without undergoing the curing process which poses a significant danger to human health and aquatic environment. Phenolic compounds, especially the chlorinated ones, are considered very harmful to plants, animals, and human, even at low concentrations. This study evaluated the ability of low-cost Biochar to adsorb the 2-Nitrophenol (2-NP) contaminant in water media. Biochar (named PF600) was prepared through one-step pyrolysis of palm fibres at 600 °C (named PF600). Physicochemical properties of PF600 were investigated by FTIR, SEM-EDX, and pHpzc analysis. Various adsorption tests, such as stirring time (0 to 360 min), initial pH (3 to 11), and initial concentration (2 to 200 mg/L) were studied and interpreted. Results of batch experiments showed that the pseudo-second-order model can be used effectively to evaluate the adsorption kinetics. The Langmuir model provides the best fit for the equilibrium data of 2-NP adsorption. The pHpzc of the PF600 sample was found to be 6.7.
The Biochar prepared in this work showed great success in removing 2-NP even at high concentrations, which can be used as a sustainable solution in the industrial scale.

Keywords : Biochar; Palm fibres; Adsorption; 2-Nitrophenol, kinetics; Equilibrium.

CMTDE 2022_185

Application of the response surface methodology for the elimination of a micropollutant from water by bioadsorption on biomass



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Abstract

In this study, response surface methodology (RSM) was used to optimize the experimental conditions in the adsorptive removal of chromium from aqueous solution using Coffee grounds. The studied parameters are the pH of the solution, the temperature, the adsorbent mass and the stirring speed. The analysis of variances (ANOVA) showed that the quadratic model of boron ion removal rate is highly significant (R^2 = 0.941). The graphical representation of the Pareto diagram shows that the pH, with a negative effect, is the most influential factor, followed by the adsorbent mass and stirring speed which have a positive effect. The temperature has the least significant effect. In order to determine the optimal conditions giving a better elimination, the desirability study shows that we can reach a maximum rate of 99.76% at pH equal to 6, temperature of 45 °C, a mass of adsorbent of 1g and a stirring speed equal to 150 rpm. The adsorption isotherm and the kinetics study were carried out using the optimum conditions determined previously. The correlation coefficients and the values of the "Chi-square" test show that the adsorption can be described according to the Langmuir model and that the adsorption kinetics follow the pseudo-first-order model.

Keywords : Adsorption, Chromium removal, Spent coffee grounds, Response surface methodology, Adsorption models, Kinetic models.

CMTDE 2022_186

UV-visible assisted Photocatalytic degradation of dye pollutant using biosynthesis nanoparticles of TiO_2

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Abstract

Biosynthesis of titanium dioxide nanoparticles (TiO_2NPs) by plant extracts is an alternative process to physical and chemical methods that leads to eco-friendly products due to the use of non-toxic solvents, and does not require high temperatures and pressure [1, 2].

The aim of this work is the preparation of titanium dioxide nanoparticles (TiO_2NPs) using Eucalyptus leaf extract and their characterization by photocatalytic activity. This extract is used as a reducing agent for titanium metal ions in the aqueous medium.

Photochemical oxidation experiments were carried out under UV (365 nm) in order to evaluate and compare the performance of the processes.

In the presence of nanoparticles thermally calcined in air at 500°C, the total degradation of toxic dye (BM) under UV irradiation is about 85–90% after 90 min. Total organic carbon analysis results confirmed photodegradation efficacies. Also, the scavenger's experiments show that hydroxyl radical is the most important specie in the degradation of pollutant model. Furthermore, a comparative study with commercial TiO_2 was carried out for the oxidation of MB. The results showed that the kapp for the both photocatalysts (biosynthesis of titanium dioxide nanoparticles and commercial TiO_2) is almost identical, which confirms the significant performance of the biosynthesis material.

It can be concluded clearly that biosynthesis of TiO_2 nanoparticles is very simple and effective photocatalyst for degradation of organic pollutants in short time under illumination.

Keywords : TiO_2NPs, Biosynthesis, UV (365nm), Pollutant, Photocatalytic activity.

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CMTDE 2022_187

Valorisation des eaux usees epurees dans l'irrigation, Cas du step de Sidi Merouane, wilaya de MILA, Est Algérien

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Résumé

L'eau est une denrée de plus en plus rare en Algérie. Actuellement, elle fait l'objet d'une exploitation concurrentielle entre les besoins domestiques, agricoles et industriels qui se disputent une disponibilité très limitée. Sachant que l'eau est un facteur limitant du développement, la rareté est soutenue en termes de stress hydrique par l'irrégularité spatio-temporelle des précipitations et la pollution des ressources mobilisées, deux facteurs susceptibles de s'accentuer avec les changements climatiques. La pollution des eaux de surface est due aux rejets d'eaux usées domestiques et industrielles. La pollution risque de constituer, à court terme, un risque de pénurie d'eau accentué imposant la nécessité de protéger cette ressource contre toute altération et utilisation irrationnelle.

Face au défi d'assurer la couverture des besoins en eau pour l'agriculture en Algérie, une politique active de mobilisation des ressources en eau non conventionnelle a été mise en œuvre, par le biais de la réutilisation des eaux usées épurées en agriculture. L'épuration des eaux usées s'est donc imposée pour préserver la qualité des milieux naturels et notamment les eaux de surface comme une solution adéquate pour pallier la rareté de l'eau dans notre pays.

Les eaux usées des centres de Mila, Sidi Merouane et Grarem Gouga sont essentiellement d'origine domestique et rejetées auparavant directement dans le lac du barrage de Beni Haroun. La station d'épuration (STEP) de Sidi Merouane a été réalisée pour atténuer la pollution du lac du plus grand complexe hydraulique dans le pays, première d'une série de trois programmées dans le bassin versant du barrage Beni Haroun. La station a été réceptionnée en 2009 par l'Office National d'Assainissement. D'après les résultats des analyses effectuées au niveau de la STEP de Sidi Merouane, nous sommes arrivés à une conclusion très importante et prometteuse. Les eaux épurées de la station sont globalement aptes à la réutilisation dans le domaine agricole, cette aptitude est confirmée par le rendement épurateur de la STEP signifié par des abattements de l'ordre de 95,84%, 93, 99% et 93, 26% respectivement pour la DBO5, la DCO et les MES et un pH acceptable**.** Le calcul du ratio d'absorption sodium (S.A.R) et le pourcentage de sodium (%Na) et après leurs projections sur les diagrammes de Wilcox et Richards confirment les résultats susmentionnés. De même le risque par les bicarbonates et les chlorures est faible à modéré. D'après les résultats microbiologiques, l'eau épurée est recommandée pour des cultures bien spécifiques et avec une technique d'irrigation localisée. Globalement et d'après les résultats que nous avons obtenus, les eaux épurées de la STEP de Sidi Merouane sont aptes à l'irrigation mais avec restriction ; peuvent être utilisées pour la culture d'arbres fruitiers et forestiers, culture fourragère, céréalière et plantes florales.

Mots Clés : Beni-Haroun, STEP, Eaux épurées, SAR, Agriculture.

CMTDE 2022_188

Gestion intégrée des eaux souterraines sous un climat semi-aride, cas de la plaine Zana-Gadaïne (Est Algérien)

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Résumé

Ce travail traite l'optimisation de l'utilisation des ressources hydriques souterraines dans un milieu essentiellement à vocation agricole, où l'agriculture irriguée représente 85% de la consommation en eau des sous bassins versant de Zana- Gadaïne, sous un climat semi-aride marqué par une sécheresse d'autant plus prononcée ces dernières années, induisent une mobilisation de plus en plus des eaux souterraines, avec un recours croissant à l'irrigation. Les outils d'analyse utilisés dans cette étude comportent le traitement statistique des données climatiques (notamment le logiciel Khronostat 1.01), bilan hydrique par l'utilisation du logiciel Cropwat et les outils de cartographie et géo-références Surfer et Map-info. Nous allons examiner l'évolution des précipitations et des écoulements souterrains au cours des dernières décennies. L'étude piézométrique à été analysée après des descriptifs climatiques, hydrogéologique et des enquêtes réalisées sur la plaine où plus de 500 forages ont étés inventoriés et mesurés représentant l'ensemble des exploitant de la région. Malgré, les ressources limitées, on constate amèrement un gaspillage signifiant de la ressource amplifiant d'avantage la baisse continue du niveau d'eau dans l'ensemble des piézomètres étudiés, entrainant un rabattement conséquent de 30 mètres sur 11 ans. Nous avons choisi d'observer et de comparer l'évolution des niveaux d'eaux des nappes en fonction des précipitations, des cartes pluviométriques donnant une vue d'ensemble sur l'évolution de la pluviométrie au cours des dernières décennies ont étés dressées. Nous avons calculé l'évapotranspiration et les besoins en eau d'irrigation pour chaque culture pour pouvoir les comparer aux ressources hydriques disponible, donc nous somme sensé connaître les ressources en eau disponible d'une part et les besoins en eau d'autre part pour une meilleurs gestion intégré de ces ressources et l'établissement des calendriers d'irrigation des principales cultures irriguées dans les sous bassins de Zana-Chott Saboun et Gadaïne à l'aide de logiciel Cropwat version 8.0.

Mots clés : Zana, Gadaïne, Piézométrie, Evapotranspiration, Bilan hydrique, Climat.

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CMTDE 2022_189

Preparation and characrerization of PVDF flat sheet membranes using DMF solvent for the water treatment by membrane distillation

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Abstract

Membrane Distillation (MD) is a thermally-driven separation process, in which only vapour molecules transfer through a microporous hydrophobic membrane.
In this work, flat sheet PVDF membrane have been successfully prepared from Polyvinylidene fluoride polymer (PVDF) and dimythylformamide DMF as solvent by using phase inversion induced by an immersion precipitation technique. The effect of polymer concentration and additives were investigated.
Furthermore, the surface structure of the membranes was characterized via series of techniques. The characterization techniques used in this study are: morphology, porosity, contact angle, pure water permeability (PWP), scanning electric microscopy (SEM), Fourier Transform Infrared spectroscopy (FTIR).

Keywords : Membranes PVDF, Additives, Characterization, Membrane distillation.

CMTDE 2022_190

Preparation and characterization of membrane for membrane distillation : application for water treatment

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Abstract

Over the past fifty years, membrane technologies have grown steadily as demand for high-quality drinking water has steadily increased around the world. In fact, membrane distillation (MD) is a non-isothermal membrane separation process applied to the desalination of seawater and brackish water.
In this study, membrane have been successfully prepared by using phase inversion induced by an immersion precipitation technique. An optimization of the operating conditions for the preparation of the membranes was carried out. The prepared porous membranes were fully characterized in terms of their morphology observed by scanning electron microscopy (SEM), porosity, thickness, pore-size, contact angle, Fourier Transform Infrared spectroscopy (FTIR).and pure water permeability (PWP).

Keywords : Membrane distillation, Preparation, Characterization, Desalination.

CMTDE 2022_191

Separation of metal ions by nanofiltration process. Application of Box-Behnken Design to the modelling of cadmium retention

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Abstract

This work considers a new approach in the study of metal ions separation by the nanofiltration process using Filmtec-NF270 membrane as a negatively loaded membrane, in a total recycling system. The nanofiltration experiments of nickel, zinc, cadmium, copper and lead ions were carried out. The optimization of separation process of metal ions nitrates, from their equimolar synthetic mixture, was conducted by optimizing one operating parameter at a time. Several parameters, such as hydraulic permeation of membrane, transmembrane pressure, initial concentration and pH of feed solution, were studied. The results showed that under the conditions of moderate pressure and an acidic diluted feed phase (100 to 400 ppm at pH=2.30); the retentions ranges as: 80.08% (Pb), 93.76% (Cd), 94,93 % (Cu) and

95.09% (Zn). It was more quantitative for nickel ions (97.95%). The retention of lead ions become total in presence of 0.25 g/L of sulfate counter-ions. Box-Benheken Design (BBD) was used for the statistical study of metal ions nanofiltration, based on the response surface methodology (RSM). A modelling test was conducted using the experimental data of cadmium ions nanofiltration. Therefore, the reduced quadratic model showed that the predicted values were in good agreement with those found experimentally and the parameter of transmembrane pressure has an important individual effect on the response where, it is necessary to decrease the quantity of sodium sulfate to increase the cadmium retention. Thus, the nanofiltration of Cd(II) can be predicted at 99.88% with the best desirability (100%) of the BBD model.

Keywords : Nanofiltration process; Metal ions; Separation; Counter-ion; Modelling; Box-behnken design.

CMTDE 2022_192

Development of a new adsorbent from biomass material treated by basic solution to remove naphtol blue black dye

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Abstract

In this work, an agricultural solid waste, chemically treated is proposed as a novel material for the removal of naphtol blue black (NBB) from aqueous solution. The adsorption behavior of the biosorbent was investigated by performing both kinetic and equilibrium isothermal studies in batch conditions at 30°C. During study, the adsorption conditions for the adsorbent were calculated by changing different experimental parameters i.e. contact time, initial dye concentration, adsorbent dose, temperatre and pH of the solution. The adsorption studies were best fit with Langmuir isotherm, and it gives monolayer adsorption capacity at pH 4, and temperature 30°C.The correlation coefficient value indicate a moderate fit for monolayer Langmuir model (R2 = 0.99). The qe experimental and calculated values for the pseudo-second-order kinetic model were in good agreement as compared to that by pseudo first order kinetics. The structural characterization of the adsorbent was done by using Fourier Transform Infrared Spectroscopy (FTIR).

Keywords : Biosorption, Batch study, Naphtol blue black, Modeling, Basic activated

CMTDE 2022_193

Novel green synthesis of iron oxide nanoparticles using opuntia ficus-indica for dye removal : kinetic and thermodynamic study

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Abstract

In the present work, the biosynthesis of iron oxide nanoparticles was investigated using aqueous extract of Opuntia ficus-indica as a reducing agent. Opuntia ficus-indica is a plant of high medicinal value and rich in polyphenolic antioxidants. The extraction is simple and the product rapidly reduces ferric ions without involvement of any external chemical agent. This study aimed on the remove of methyl orange dye from aqueous solution using green iron oxide nanoparticles (Fe_2O_3NPs). Structural and morphological properties of the Fe_2O_3NPs were studied by XRD, FTIR, DTA/DTG, DLS. The effects of experimental parameters such as initial dye concentration, solution pH were studied. Adsorption kinetics, thermodynamic behavior, isotherm models and regeneration ability analyses were also carried out. The adsorption isotherm data were analyzed by applying the Langmuir, Freundlich, Dubinin– Raduskevich, Temkin and Redlich–Peterson models. The experimental results were better fitted by the Langmuir model. The pseudo-first order, pseudo-second order, Elovich and intraparticle diffusion models were applied to the description of the kinetic data. The best fit was achieved for the pseudo-second order model, and the presence of both film and intraparticle diffusion mechanisms was demonstrated. Thermodynamic studies indicated that the biosorption on the Fe_2O_3NPs is endothermic and chemical process.

Keywords : Green Synthesis, Novel iron oxide nanoparticles, Adsorption, Dye, Kinetic and thermodynamic.

CMTDE 2022_194

Modelling and optimization of polluted water treatment processes using ionizing technologies and estimation of energy consumption

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Abstract

Advanced ionizing technologies are promising innovative and effective oxidation treatments for removing persistent contaminants from water as an alternative to conventional technologies. The main advantage of radiation processing over alternatives is the generation in situ during radiolysis of powerful reactive species removing recalcitrant pollutants without addition of chemicals. The degradation efficiency of several detected contaminants, mainly non-steroidal anti-inflammatory drugs, was investigated. The most successful irradiation facilities (electron beam accelerator and Cobalt-60) applied in the treatment of these pollutants were considered in our study. Many applications, highlighting the technology's strong points and operational conditions are described, with the presentation of main advantages of these innovative processes. In the aim to reach the highest degradation efficiency of treated pharmaceuticals, an optimization of the main parameters influencing this process was investigated using response surface methodology (RSM). The central composite design was used to evaluate the effects and interactions of considered factors on pharmaceutical removal efficiency. Treated pharmaceuticals were irradiated with 0.1 to 15 kGy doses using different irradiation facilities. Significant modifications attributed to the main applied parameters appeared in the variation of degradation efficiency, COD removal, TOC values and concentration of radio-induced radicals, confirming their synergistic effect to attempt total mineralization. Moreover, the catalytic oxidation of these compounds by irradiation was investigated with the addition of optimal amounts of convenient oxidants (hydrogen peroxide, thiosulfate). This hybrid application was efficient to improve oxidative degradation and contribute to the high performance of this process at very low doses and less energy consumption. The electrical energy consumption (EEC) was evaluated by applying the concept of electrical energy per order (EE/O) to assess the performance of e-beam for wastewater treatment. The results showed that EE/O is an important criterion to evaluate the energy efficiency of an advanced oxidation technology and to investigate the effects of treated water composition and operating parameters on irradiation process performance. An advanced analytical study was released to detect and quantify generated radicals and intermediates applying specific analytical methods (LC-MS-MS, NMR and EPR with spin-trapping). All results showed the high performance of these processes in the degradation of pharmaceuticals and led to a large-scale realization of radiation technologies. Finally, the application of radiation processing for contaminated water treatment is a cost-effective process that may ensure adequate availability of water worldwide.

Keywords : Contaminants; Radiolysis; Electron Beam; RSM; Energy consumption.

CMTDE 2022_195

Improvement of tap water quality by domestic filtration systems

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Abstract

The scarcity of fresh water is one of the biggest issues that Tunisia urgently needs to address. The per capita share of drinking water is about 120 L/day/person [1]. The majority of tap water is characterized by an elevated salinity value (between 1 and 2 g/L). The water quality is often aggravated by the presence of suspended solids, an unpleasant taste, and a chlorine smell. This prompted Tunisians to abandon tap water in favor of bottled water and other types of drinking water.

Therefore, an observational study was conducted, focusing on physico-chemical analyses of Soliman tap water, to assess their conformity to Tunisian standards (NT.09.14).The results showed that the majority of studied physicochemical characteristics, including pH, conductivity, hardness, etc., are within to Tunisian standard, which is not the case for the turbidity and free chlorine values. Despite that, the tap water can be considered as hard (TH>30°F) and slightly brackish (salinity>1.2g/L during the summer).

To address this issue, two domestic filtration systems were proposed to improve the tap water quality. The first system, advised for salinity valueslower than 1 g/L, is a treatment stage which includes, (i) 5-micron filter for suspended particles retention, (ii) Activated Carbon (AC) filter for chlorine reduction and (iii)ion exchange filter for water softening. The results revealed that the AC filter can treat between 1000 and 1500 L with a significant reduction in its efficiency when the chlorine level exceeds three times the standard values. Likewise, the ion exchange filter can reduce the hardness of only 500 L of tap water.

For salinity higher than 1 g/L, the recommended system for reducing water salinity is a reverse osmosis (RO) domestic unit [2]. The obtained osmosis water cannot be directly used because it is aggressive and unhealthy. The mixture of desalinated water with prefiltered tap water can provide drinking water with quality similar to that of commercially bottled water. The economic study showed that the cost of produced drinking water by the RO unit was estimated to be around 0.2 DT/L, which is much cheaper than that obtained with commercially bottled water. Interestly, using RO for tap water is environmentally friendly allowing the reduction of the levels of microplastics from the use of plastic bottles.

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CMTDE 2022_196

Assessment of physicochemical and microbiological quality of the old Port of Bizerta waters affected by lytic phages infecting *Salmonella enterica subspecies arizonae*

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Abstract

Phage therapy is among innovative method to improve water quality. Most previous phage studies have commonly focused on the interactions of phages on a host-cells or the effect of the environment on the phage in relation to its host cell. In this present work we demonstrated that when the phage is added to seawater it affects both its physicochemical and microbiological characteristics. The addition of the phages fBC-Eco01(OM272052) and PA25 in sea-water samples during three days of incubation indicated a rise in water sample temperature rates estimated at 1.6°C by adding the phage fBC-Eco01(OM272052), and 2.1°C by adding the phage PA25, we Also noticed an increase in water conductivity over time with values in range 50.09 to 51.94 µS, by adding the phage PA25 and from 50.06 to 53 µS by the addition of the fBC-Eco01 phage; A decrease in dissolved oxygen levels of 3 mg/L following the addition of PA25 phage and of 18.5 mg/L by the addition of fBC-Eco01 phage were detected. The TOC increases from 0.32 ppm to 0.68 ppm in the presence of the PA25 phage and from 0.24 ppm to 1.51 ppm with the addition of the fBC-Eco01 phage, the absorbance and fluorescence by spectrophotometry were also affected by phages addition. Also, phages addition altered the bacterial biomass of the waters by reducing the number of both thermophilic and mesophilic bacteria, inducing a decrease of 2Ulog and 1Ulog discharge, respectively following addition of PA25 and 3 Ulog and 2Ulog discharge, respectively with addition of fBC-Ec01 phage.

Keywords : Physicochemical and microbiological parameters, Bacteriophages, E. coli, Salmonella enterica ATCC13314, Pseudomonas Aeruginosa, lysis.

CMTDE 2022_197

Effect of demister separation efficiency on the freshwater purity in MSF-OT/TCV desalination process

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Abstract

The purity of freshwater is very important for consumption by living beings and for industrial services such as boiler feed to produce steam and demister plays an important role in determining the purity of freshwater produced in MSF-OT/TCV desalination plants. For fixed water demand and top brine temperature, this work studies the effect of separation efficiency of demister on the final purity of freshwater for both clean and fouled demister with seasonal variation of seawater temperatures. Also, this study estimates the required number of flash stages to maintain the purity of freshwater at the desired level using clean demister. To maintain the purity of freshwater product, comparatively large number of flash stages is required for fouled demister. Also, for clean demister it is found that the total number of stages needs to increase when the seawater temperature decreases and vice versa.

Keywords : MSF-OT/TCV desalination process, Demister, Freshwater purity.

CMTDE 2022_198

Towards a CFD model to predict hydrodynamics and optimize operation in aeration basins

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Abstract

The process for treating textile dyes with activated sludge promotes the development of agglomerated microorganisms in the form of flocs kept in suspension in the bioreactor supplied with the wastewater to be treated. Aeration must allow the supply of oxygen to the micro-organisms living in an aerobic environment which can then degrade the color of the wastewater. A detailed study of the hydrodynamics of aeration basins is of crucial importance for improving treatment efficiency, optimizing process design and energy efficient operation. Thus, in this work we carried out CFD transient simulations of the hydrodynamics in an aeration basin at the laboratory scale.

The objective of this study is to:

• Implement a CFD modelling approach to simulate the turbulent two-phase flow in the bioreactor using the Eulerian model associated with the standard k-ε model. This part also concerns the choice of models for closing the interfacial forces of exchange (force of drag, lift, walls, added mass, turbulent dispersion).

• Optimize and characterize the oxygenation and mixing capacities in the bioreactor.

• Simulate aeration system performance and identify process problems resulting from design parameters and operating conditions.

• Validation of the CFD model by experimental measurements from the literature.

The results obtained showed the presence of a fully developed spiral flow. The influence of bubble-induced mixing on reactor performance was then assessed via fluid residence time distribution (RTD) simulations. Indeed, the distribution of the residence time allows the monitoring of the concentration of a passive tracer from its injection at the inlet of the reactor until its outlet in order to detect the dead zones in the bioreactor and to analyse the mixing performance.

Keywords : Aeration; Activated sludge bioreactor; Residence time distribution; Industrial wastewater.

CMTDE 2022_199

Iron-based MOFs for Arsenate and Arsenite sorption in aqueous media. Isotherm and kinetic studies

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Abstract

The presence of arsenic in ground water, a toxic and cancer-causing metalloid, is an environmental, health and economical issue which affects developing countries around the world. World Health Organization (WHO) was recently stablished a value of 10 ppb (0.01 mg/L) for the maximum allowable limit in drinking water. Several strategies for diminishing arsenic content in ground water and aquifers have been proposed. Among them, the use of iron-containing sorbents has been shown to be very specific for arsenate species, although most of them present low sorption capacities and slow kinetics.

Metal–organic frameworks (MOFs), composed of metal ions and organic connectors, have gained attention as promising sorbent materials due to its advantageous properties: high porosity, uniform cavities, good thermal stability, and high surface area. Iron-based MOFs have been recently evaluated for arsenicals removal showing a high performance in term of sorption efficiency [1].

The aim of this study is to evaluate the sorption performance of a synthesised Nano-{Fe-BTC}MOF and to compare it with the behaviour of Basolite®F300. Both Fe-MOFs are built upon the coordination of Fe(III) ions with trimesate organic linkers (benzene tricarboxylic acid, BTC). The direct synthesis of nano-{Fe-BTC} MOFs was performed following green chemistry rules and both nanomaterials have been characterized by several techniques [2]. The sorption of As(V) and As(III) from aqueous solutions by both Fe-BTC MOFs was studied by varying different parameters such as contact time, pH, the amount of adsorbent and the initial arsenic species concentration. The equilibrium data obtained was analyzed by applying different adsorption isotherm models. Maximum adsorption capacities of 14.99 (at pH 2) and 41.66 mg/g (at pH 7) were obtained for As(V) adsorption by nano-FeBTC and Basolite® F300, respectively. Sorption of As(III) only occurs at pHs > 9 and the maximum sorption capacity was similar (~10 mg/g) for both of nanomaterials.

Kinetics studies have shown that the equilibrium for all the sorption systems was reached approximately after 1 hour. In the case of As(V) and As(III) sorption on nano-FeBTC, the kinetic data fitted well the pseudo second-order model and the Elovich model with sorption capacities of 14.99 mg/g for As(Ⅴ) and 10.17 mg/g for As(Ⅲ) indicating that chemisorption is the dominant mechanism in the adsorption processes. Similar results were obtained from the kinetic data of As(V) and As(III) sorption processes by Basolite®F300 although in the case of As(V) the maximum sorption capacity was of 33 mg/g [3].

CMTDE 2022_200

The effect of geometry and reactor design on Electrocoagulation performance for heavy metal removal

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Abstract

The effect of geometric parameters of electrocoagulation (EC) process using aluminum (Al) electrodes is experimentally investigated to remove Cu (II) and Ni (II) from synthetics and industrials solutions. Data collected from these experiments demonstrate the effects of reactor geometry and show that a proper scaling of reactors is needed to enhance EC performance. Recommendations for optimum operating parameters and design of EC reactor have been reported: inter-electrode distance die = 1cm, stirring speed = 300 rev/min, area volume ratio A/V and Bipolar connection. Optimum selection of operating and geometric parameters results in total elimination of heavy metals for the industrial wastewater. This research explores and proposes a very cost-effective treatment method to remove heavy metals from industrial wastewater.

Keywords : Electrocoagulation, Heavy metal, Industrial wastewater, Reactor design.

CMTDE 2022_201

Evaluation of Dowex 5×8 ion-exchange resins for the removal of Ni (II): Application water treatment

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Abstract

The use of selective ion exchange to recover metals from aqueous solution has been studied. The parameters affecting the ion exchange of nickel, namely the equilibrium time, the swelling rate, the exchange capacity, the ionic strength... were investigated. The effect of ionic strength variation on the ion exchange equilibrium between Dowex 50X8 cation exchange resin and electrolyte solutions containing the most dominant cations on waters (Ca^{2+}, Mg^{2+}, and Ni^{2+}) was studied. All experiments were carried out at a constant temperature of 25°C. Ion exchange isotherms were established, at different ionic strengths from 0.1 to 0.5 M, for the systems (Ca^{2+}/Mg^{2+}), (Ca^{2+}/Ni^{2+}) and (Mg^{2+}/Ni^{2+}). Obtained results showed that affinity order is strongly dependent of ionic strength and that Dowex 50X8 resin is highly selective for nickel at 0.1M. Selectivity coefficients $K_{Ca}^{Mg}, K_{Ca}^{Ni}, K_{Mg}^{Ni}$ and separation factors were calculated. Increasing ionic strength results in a

decrease of selectivity coefficients. The results outlined above demonstrate that the adsorptive selectivity coefficients depend on ionic strength and the performance of the process suggests that it is effective in removing and recovering nickel ions.

Keywords : Dowex 50X8, nickel (II), Ionic strength, Selectivity coefficients, Separation factors.

CMTDE 2022_202

Synthesis and characterization of PolyVinyl Chloride (PVC) based plasticized polymer membranes : Effects of polymer blend composition on membrane properties

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Abstract

Plasticized polymer membranes (PPMs) are used today in many industrial applications, either to upgrade or purify the components of a mixture, or to selectively control the exchange of materials between different media. They are generally easy to implement and often able to replace in a single separation step several successive steps of less sophisticated processes. The current work focuses on synthesis and characterization of PPMs. The membranes were prepared by using Polyvinyle Chloride(PVC)as a based polymer,di-2-(ethylhexyl) phosphoric acid (D2EHPA) and methyl trioctylammonium chloride (aliquat336) as organic carriers with addition of supplementary plasticizer the Nitrophenyloctylether (2NPOE).The obtained MPPs were characterized by several techniques to obtain information on their composition and morphology namely FTIR, and MEB. The MEB show that the addition of the plasticizer results in a dense and smooth structure in which the pores have been filled with plasticizer molecules. The obtained result show good uniformity and good adhesion between the polymer matrix, the carrier and the plasticizer. The FTIR predict that intermolecular interactions between the base polymer and other compounds are weak. The addition of 2NPOE allowed the PPM to have better chemical resistance.

Keywords : Plasticized polymer membranes, D2EHPA, Aliquat336, Characterization, 2NPOE.

CMTDE 2022_203

Selective extraction of cobalt (II) ions through polymer inclusion membrane containing Aliquat 336 and D2EHPA as a carriers

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Abstract

This study, reports the selective separation and recovery of cobalt(II) ions using PolyvinyleChloride(PVC)-based polymer membrane which incorporated di-2-(ethylhexyl) phosphoric acid (D2EHPA) and methyl trioctylammonium chloride (aliquat336) as organic carriers and 2-nitrophenyl octyl ether (2NPOE) as plasticizer. Co (II) ions extraction experiments were carried out in a transport cell made up of two reservoirs containing respectively aqueous source solution of the metal cation at adjusted pH andaqueous receiving solution. Several important transport parameters such as: carrier type, receiving phase type and effect of 2NPOE addition were investigated. The addition of plasticizer results in an enhancement of Co^{2+}cations extraction percentage. It can be perceived that the PPM containing 2NPOE as plasticizer (10%) and 30 % of carrier assured maximum Co (II) recovery.

Keywords : Plasticized polymer membranes, D2EHPA, Aliquat336, cobalt (II) ions recovery.

CMTDE 2022_204

Removal of humic acid by combining electrocoagulation process and activated carbon as absorbent

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Abstract

Organic matter can be defined as any carbonaceous material. It is formed mainly from compounds of carbon, hydrogen, oxygen and nitrogen. The main objective of this study was to investigate the effects of electrocoagulation (EC) process parameters for HA removal from synthetic solutions using aluminium (Al) electrodes and to determine the efficiency of coupling electrocoagulation and (AC). The experimental results showed that the optimal conditions for HA removal by EC are: Initial pH of 4, current Intensity of 1 A, Na_2SO_4 concentration of 100 mgL^{-1} and electrolysis time of 10 min. These operating conditions allow

very high rejection rates of nearly 94 % with minimal power consumption. Our results thus demonstrate that the combination of adsorption onto AC and EC can significantly improve the economics of industrial wastewater treatment by improving efficiency and reducing treatment time and cost.

Keywords : Electrocoagulation, Humic acid, Activated carbon, Removal efficiency, Energy consumption.

CMTDE 2022_205

Ion Exchange Equilibrium between DOWEX 50X8 Resin and Electrolyte Solution: Selective Removal of Copper (II) ions from Wastewater

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Abstract

Copper is a widely used metal in industry. The present work is a contribution to the study of ion exchange equilibrium between a cation exchange resin (Dowex 50X8) and electrolyte solutions, containing cations that can be encountered in both wastewater and natural water (Ca^{2+}, Mg^{2+} and Cu^{2+}). The ionic strength of the equilibrating solutions was maintained constant, but the molar fraction varied; The ion exchange isotherms for the three binary systems: Ca^{2+}/Mg^{2+}, Ca^{2+}/Cu^{2+}, and Mg^{2+}/Cu^{2+} were established. The obtained results showed that copper ions are more strongly adsorbed and the order of affinity for Dowex 50X8 resin is $Cu^{2+}>Mg^{2+}>Ca^{2+}$ at 0.5 M, under the experimental conditions. Selectivity coefficients $K_{Ca}^{Mg}, K_{Ca}^{Cu}, K_{Mg}^{Cu}$ for the studied binaries solutions and for cationic resin were determined at different ionic strengths (0.1 and 0.5 M) at a constant temperature of 25 °C. The increase in ionic strength leads to a decrease in the selectivity coefficient values. The efficiency of the process suggests that it is effective for the removal and recovery of copper ions.

Keywords: Ion exchange resin, Copper, Selectivity coefficient, Isotherms, Binary system.

CMTDE 2022_206

Separation of copper (II) and nickel (II) ions from wastewater by polymer inclusion membrane containing di(2-ethylhexyl) phosphoric acid

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Abstract

The co-existence of heavy metals in industrial effluents is a prevalent problem. Polymer inclusion membranes (PIMs) are an interesting technology for their recovery and separation. In this study, copper (II) and nickel (II) separation using PIM composed of cellulose triacetate (CTA), di(2-ethylhexyl) phosphoric acid (D2EHPA) and acetylated kraft lignin (AKL) as matrice modifier was studied. To characterize the distribution of different constituents, membranes were characterized by attenuated total reflectance infrared spectroscopy (ATR-IR). The mechanical properties were explored by examining the influence of D2EHPA concentration in PIM composition. The surface and cross-section morphology of the membrane were inspected by scanning electron microscopy (SEM). The influence of feed phase pH and strip phase composition on recovery performance was explored. Results indicate that the percentage of extraction is highly dependent on pH of the feed solution and the difference of driving force. (CTA-D2HPA-AKL) PIM was able to extract 88% of Cu over only 25% of Ni. The results outlined above demonstrate that PIMs can selectively transport Cu(II) by adjusting the pH value, and have the potential to be applied in separation of heavy metals.

Keywords : Polymer inclusion membrane; D2EHPA, Copper, Nickel, Separation.

CMTDE 2022_207

Numerical and Analytical Study of doble diffusion Convection of non-Newtonian fluids in Shallow Porous rectangulair cavity uniformly heated and massed from below

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Abstract

In this study, we investigate the onset of non-linear convection in a horizontal porous layer saturated by non-Newtonian fluid. The shear-thinning behavior of the fluid is described by the Carreau-Yasuda model, which includes the effect of the rheological parameters of the fluid. Constant fluxes of heat and mass are imposed on the horizontal walls of the enclosure while the vertical walls are assumed adiabatic and impermeable. An approximate analytical solution is derived on the basis of the parallel flow approximation, and the Carreau-Yasuda model. An approximate analytical solution is derived on the basis of the parallel flow approximation, and the Carreau-Yasuda model with the Boussinesq approximation, energy and species transport equations are solved numerically using the finite difference method with a time-accurate scheme. Averall, the Carreau-Yasuda rheological parameters have a strong influence on the thresholds of convection.

Keywords : Non-Linear convection, Porous layer, Non-Newtonian fluid, Shear-thinning fluids, Carreau-Yasuda model.

CMTDE 2022_208

Effect of polymer membrane composition on metallic ions recovery

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Abstract

The present work investigated the extraction of metallic ions (Ni, Pb..) through a polymer inclusion membrane (PIM), prepared with cellulose triacetate (CTA) as the base polymer, tris(2-butoxyethyl)phosphate(TBEP),2-Nitrophenyloctylether (2NPOE) or 2-Nitrophenylpentylether (NPPE) as plasticizers and di-(2-ethylhexyl)phosphoric acid (D2EHPA) as the carrier. Structural modifications promoted by the nature of the plasticizer that affect metal ion migration in polymer inclusion membranes (PIMs) were evaluated using Fourier Transformed Infrared Spectroscopy FTIR, Scanning Electron Microscopy (SEM). Measurement of the contact angle gives information about the hydrophobicity and roughness of the membrane. The mechanical properties of the membrane are obtained by the measurement of the tensile strength. Several important transport parameters such as the amount of D2EHPA, the thickness of the membrane, the type of the stripping solution and the pH of the feed phases are discussed. The obtained results demonstrate PIM system can selectively transport metallic ions.

Keywords : Polymer inclusion membrane (PIMs); TBEP; 2NPOE; 2NPPE; Ions recovery.

CMTDE 2022_209

Preparation and characterization of polymer inclusion membrane (PIM) for the recovery and separation of zinc (II) ions

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Abstract

This work describes the recovery and separation of Zn(II) through a novel polymer inclusion membrane (PIM) based on polyvinyl chloride (PVC) as base polymer, 2-Nitrophenyl octyl ether (NPOE) as plasticizer and di-(2- ethylhexyl) phosphoric acid (D2EHPA) as carrier reagent to form thin, flexible and stable film. The prepared PIM was characterized by using Fourier Transform Infrared (ATR-FTIR) spectroscopy, Scanning Electron Microscopy (SEM) techniques, contact anglemeasurements and Thermogravimetric analysis (TGA). The effects of pH of feed phase on the transport and separation of Zn (II) ions was investigated by atomic absorption. The long-term stability of the PIM studied was also examined.

Keywords : PIM, PVC, NPOE, D2EHPA, Recovery, Separation, Zinc (II).

CMTDE 2022_210

Effect of Plasticizer Type on polymer inclusion membranes properties and performance

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Abstract

For aqueous releases treatment, extraction techniques through polymer inclusion membranes (PIMs) have been widely used in recent decades.An experimental investigation of zinc (II) ions transport through PIMs containing 2-Nitrophenyl octyl ether (NPOE) and tris(2-butoxyethyl) phosphate (TBEP) as plasticizers is presented. PIMs are formed by casting a solution containing di-(2-ethylhexyl) phosphoric acid (D2EHPA) as carrier, polyvinyl chloride (PVC) as base polymer and NPOE or TBEP as plasticizers.The synthesized membranes were characterized by a combination of techniques to obtain information on their structural

modifications, composition and morphology using Attenuated Total Reflection-Fourier Transform Infrared Spectroscopy ATR-FTIR and Scanning Electron Microscopy (SEM). Hydrophobicity and thermal stability of the membranes were also evaluated. The transport of zinc through the selected membranes has been investigated by atomic absorption. The results show that zinc ions are completely transported after seven and four hours respectively with TBEP and NPOE.

Keywords : PIMs, PVC, NPOE, TBEP, D2EHPA, Recovery, Zinc (II).

CMTDE 2022_211

Separation of nickel and copper ions using supported liquid membrane and ion-exchange resin

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Abstract

Facilitated transport of Ni(II) and Cu(II) from acidic solution across a supported liquid membranes (SLM) containing D2EHPA as extractant compared with the ion-exchange technology using Dowex 50X8 resin has been investigated. Several important transport parameters through SLM such as the amount of D2EHPA, the type of the stripping solution and the pH of the feed phase are discussed. The optimum conditions for Ni(II) and Cu(II) transport across the membrane are: feed phase pH of 4,5, stripping phase of 0,5M HNO_3, and 30% D2EHPA (v/v). The transport of Cu(II) and Ni (II) was achieved with an efficiency of about 68% and 24 %, respectively. The effect of initial concentration of Ni(II) and Cu(II) ions in aqueous solution and the effect of agitation time on their sorption on Dowex 50X8 exchange resin have been also studied. The sorption equilibrium was reached after 30 min. The calculated values of recovery factor show that better results are obtained for Ni(II) (91%) than Cu(II) (49 %).

Keywords : Nickel, Copper, Ion-exchange, Supported liquid membrane, D2EHPA.

CMTDE 2022_212

Characterization of Electrocoagulation Sludge from Phosphate Treatment Using Aluminum Electrodes

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Abstract

The aim of this work was to remove phosphate from synthetic water using electrocoagulation process with aluminum electrodes and to characterize EC sludge. Electrocoagulation parameters were optimized based on phosphate removal efficiency. For initial concentrations of 10 and 100 mg/L of phosphates, the reduction rates are respectively 100 % and 70 %. The best rate of elimination is obtained under optimal operating conditions: an optimal pH equal to 7, a current density of 1 mA/cm^2 during 30 minutes of electrolysis time. The characterization of the sludge generated revealed mainly the presence of aluminum hydroxide and aluminum phosphate. The sludge generated was meseoporous with large specific surfaces. SEM analysis showed the presence of aggregates on the surface with different shapes and sizes with a leafy appearance.

Keywords : Electrocoagulation ; Sludge characterization ; Phosphate removal ; Aluminium electrodes.

CMTDE 2022_213

Comparative Study of the Elimination of Fluoride, Sulfate and Phosphate Ions by Electrocoagulation : Application to Natural Waters

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Abstract

The aim of this work is to assess the performance of electrocoagulation (EC) for fluoride, sulfate and phosphate removal from natural waters, using aluminum as electrode material.
First of all, the elimination of studied ions from water by EC was investigated. The optimal operating conditions as well as the effect of several parameters are determined in order to evaluate the applicability of the process. The best rate of fluoride removal (85% for Ci = 10 mg /L) is obtained for a pHi equal to 6, current density equal to 0.27 mA / cm^2, NaCl dose of 0.5 g and an electrolysis time of 30 minutes. A pHi equal to 5 and a current density of 5 mA / cm^2 seem to be optimal for a maximum reduction (95 % for Ci = 100 mg /L) of sulfates for an electrolysis time of 60 minutes. The reduction of phosphates is about 90 % at pHi equal to 7, current density equal to 1 mA / cm^2 and NaCl dose of 0.5 g for an electrolysis time. The obtained results showed a good performance in terms of efficiency and energy consumption under the

following optimal conditions: an inter-electrode distance equal to 1cm, the S / V ratio of 7.2 m^{-1}, a pair of electrodes and a moderate stirring speed of the order of 300 trs / min for a monopolar connection mode.
Subsequently, modeling and kinetic study of the phenomenon of adsorption of fluoride, sulfate and phosphate on aluminum hydroxide electro generated in situ were carried out.
This work was completed by the application of the electrocoagulation process for fluorides, sulfates and phosphates removal from natural waters of southern Tunisia (brackish water from the Metlaoui-Gafsa region and sea water from Ghannouch-Gabès).

Keywords : Natural waters; F-, SO_4^{2-} and PO_4^{3-} ; Electrocoagulation; Adsorption study.

CMTDE 2022_214

Photo-catalytic processes for efficient reduction of an inorganic pollutant under different light sources

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Abstract

L'objectif de ce travail est d'étudier le $CrFeO_3$ (CFO) préparé par voie nitrate sont étudiés. La diffraction des rayons X indique une monophase cristallisant dans la structure ilménite avec une bonne cristallinité. Elle était caractérisée par TEM/HRTEM. Le gap optique (Eg = 1,65 eV), La conductivité de type p est mise en évidence à partir des mesures de capacité avec un potentiel de bande plate (Efb = - 0,38 VSCE) et une concentration de trous de 5,87×1018 cm^{-3}. L'hétéro-système (25 % $CrFeO_3$/ 75 % TiO_2) a montré une bonne photo-réduction de Ni^{2+}, donnant une filiation de dépollution de 88 % et 96 % à pH ~ 7 par une source lumineuse différente en 4 h pour une concentration initiale de Ni^{2+} de 15 mg L^{-1}. Une cinétique de premier ordre a été trouvée à partir de la photo-réduction du Ni^{2+} avec une constante de vitesse de 0,011 min^{-1} et une photo-dégradation plus élevée sous la lumière du soleil.

Keywords : $CrFeO_3$; Photo-Réduction ; Lumière Visible Et Solaire

CMTDE 2022_215

Study of seawater desalination brine by Electrolysis process

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Abstract

This work reports an experimental study on the brine treatment of the seawater desalination plant by electrolysis process to produce sodium hypochlorite solution. The ultimate goal is to define the best operating conditions for the electrolysis process. The effects of several parameters such as electrode material, electrolysis time, inter-electrode distance, current density and temperature were examined. The experimental results led to the determination of the best operating conditions of sodium hypochlorite solution chlorometric degree. It was found as 5.9 °chl using titanium electrode under well-defined operating conditions.

Keywords : Brine, Sea water desalination, Electrolysis, Sodium hypochlorite solution, Chlorometric degree.

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CMTDE 2022

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