2nd World Conference on

Industrial Chemistry and Water Treatment

May 22-23, 2017 Las Vegas, USA

Scientific Tracks & Abstracts

Day 1

Industrial Chemistry 2017

Sessions

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Session Chair
Masayoshi Tabata
Muroran Institute of Technology
Japan

Session Co-chair
Jun-ichi Kadokawa
Kagoshima University
Japan

Session Co-chair
Majid Mohammadian
University of Ottawa
Canada

Session Introduction

Title: **Properties of porous alumina ceramics**
Zaw Ye Maw Oo, Mendeleev University of Chemical Technology of Russia, Russia

Title: **Optimization using central composite design (CCD) and the desirability function for biosorption of methylene blue from aqueous solution onto dried sunflower seed hull**
Gbekeloluwa Oguntimein, USA

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Xiaomin Wu, Tsinghua University, China

Title: **Functionalized gold nanoparticles based colorimetric sensors for heavy metal ions from waste water**
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Title: **Membrane condensers as emerging technology for water recovery from waste gaseous streams**
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Title: **The potential of natural gelatin generated from Sisymbrium irio seed in water treatment processes**
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Title: **Reduction on water consumption on a cooling tower with the application of a novel biocide**
Anderson Jose Beber, Solenis Water Technologies, Brazil

Zaw Ye Maw Oo, Ind Chem 2017, 3:2 (Suppl)
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Properties of porous alumina ceramics

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Porous materials are commonly used as catalyst supports in the processes of oxidation, hydrogenation and dehydrogenation at high temperature, corrosion in feed processing- corrosive environments at endothermic and exothermic reactions. In particular, for this purpose various types of corundum materials with high chemical inertness is needed. Porosity materials due to the high porosity and the peculiar structure have specific properties dramatically different from those of the corresponding chemical composition of dense materials. Then a highly porous cellular material of alumina carriers for catalysts was obtained. The filler used to be electro corundum, as reinforcing filler, forming on fire a bundle used porcelain. The samples were prepared by impregnating the ceramic slurry polyurethane foam (PUF), followed by drying and calcining at 1450 °C. The porosity after firing was 60-65%, the compressive strength of 3.5 MPa.

Biography

Zaw Ye Maw Oo has completed his PhD from D Mendeleev University of Chemical Technology of Russia. Currently, he is attending Postdoctoral studies in the same university. He has published more than 5 papers in reputed journals.

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Optimization using central composite design (CCD) and the desirability function for biosorption of methylene blue from aqueous solution onto dried sunflower seed hull

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The objective of this work was to optimize the experimental conditions for biosorption of methylene blue dye using dried sun flower seed hull as the biosorbent. With this aim, central composite design model was applied to achieve maximum biosorption capacity q (mg/g). In the model studied, independent variables were pH (2-10), ash dosage (0.05-0.45 g/20 ml), dye concentration (0.005-0.025 mg/L), and temperature (24.5-54.5 oC). The quadratic model was developed for the predetermined responses PDR and biosorption capacity and it was clearly seen that the experimental data fit well to model predictions statistically (R2≥0.79) and Prob>F<0.0001). Experimental conditions for maximum biosorption capacity was determined as pH 6.0, 0.0169 mg/L MB, 0.244 g DSSH dosage and 39.5 oC temperature.

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Hybrid water treatment process of alumina ceramic ultrafiltration and PP beads with air back-flushing: Effect of pH and polypropylene beads

Jin Yong Park and **Soojung Lee**
Hallym University, South Korea

For advanced water treatment, effects of pH and pure PP beads packing concentration on membrane fouling and treatment efficiency were observed in a hybrid process of alumina ceramic MF and pure PP beads. The tubular UF membrane (NCMT-5231) with pore size 0.05 μm was manufactured by α-alumina in nanopore materials. The diameter of PP beads was 4-6 mm, and the synthetic feed was prepared with humic acid and kaolin. The synthetic feed was allowed to flow inside the MF membrane and the permeated contacted the PP beads fluidized in the gap of the membrane and the acryl module case with outside UV irradiation. Periodic air back-flushing was performed to control membrane fouling during 10 sec (BT, back-flushing time) per 10 min (FT, filtration time). These results were compared with the previous studies. The membrane fouling resistance (Rf) was minimum at 50 g/L of PP beads concentration. Finally the maximum total permeate volume (Vt) was acquired at 50 g/L of PP beads. It means that the membrane fouling could be controlled by PP beads at 50 g/L. The treatment efficiency of turbidity decreased slightly from 99.4-99.0% as PP beads concentration decrease; however, that of dissolved organic materials (DOM) decreased dramatically from 87.8-73.9% as decreasing PP beads concentration. It means that more PP beads could adsorb or photo-oxidize DOM more effectively. The Rf increased as increasing pH of feed as compared and the maximum Vt was acquired at pH 5.1. It means that the membrane fouling could be inhibited at low acid condition. The treatment efficiency of turbidity was almost constant independent of pH; however, that of DOM was the maximum at pH 6.5. It means that the DOM could be removed more excellently at the low alkali condition.

Biography

Jin Yong Park has his expertise in membrane separation technology for water or wastewater treatment at Department of Environmental Science and Biotechnology, Hallym University, Korea. Recently, he has researched the hybrid water treatment process of ceramic membrane and polymer beads coated with photocatalyst. He was involved in the projects of artificial kidney and reverse osmosis for drinking water as Research Scientist in Membrane Laboratory, KIST, Korea and developed the group contribution method to predict the permeability of gas separation polymer membranes as a Postdoctoral Fellow at Centre for Polymer Research, University of Texas at Austin, USA. He has worked as a Visiting Professor at the Department of Civil and Environmental Engineering, UCLA, USA. He has performed more than 40 projects and has published 70 articles related to membrane technology including 20 articles in SCI journals. Also, he has worked as General Affairs Director, Editor-In-Chief and Executive Director in the Membrane Society of Korea

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Kartick C Bhowmick, Ind Chem 2017, 3:2 (Suppl)
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Small organic molecules as catalysts for asymmetric direct aldol reactions in aqueous media: A green chemistry approach for industrial applications

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Presently asymmetric organocatalysis in aqueous media is one of the most focused areas of research field in asymmetric synthesis. Asymmetric carbon-carbon bond forming reactions occupy the central area in the field of asymmetric organic synthesis where aldol reaction is the vastly studied one. A wide range of smart organic materials, including proline and its derivatives have been proved to be efficient catalysts for asymmetric aldol reactions. In recent years, more attention has been paid to develop organocatalysts for the asymmetric direct aldol reactions in water because it provides some unique properties, which include large cohesive energy density, very high surface tension, hydrophobic effect and most importantly it is environmentally benign solvent. The development of asymmetric organocatalyzed direct aldol reactions in aqueous media, for example, a very small organocatalyst, L-Proline hydrazide has been used for direct asymmetric aldol reaction of various ketones with aromatic aldehydes at room temperature in presence of several acid additives. A loading of 10 mol% of the catalyst and p-toluenesulphonic acid as additive was employed in this reaction, and good yields (up to 99%), with high anti/syn diastereoselectivities (up to 95:5) and enantioselectivities (up to >99.9%) could be achieved in aqueous media. Another new organocatalyst, derived from 4-hydroxy-L-proline and abietic acid was used for aldol reactions between substituted aromatic aldehydes and various ketones in presence of several acid additives in aqueous media. The corresponding aldol products were obtained in high isolated yields (up to 99%) with high anti-diastereoselectivities (up to 94%) and enantioselectivities (>99.9%). The catalyst loading was reduced to as low as 1 mol% only and very significantly, the aldol reactions were found to be extremely fast in water. In addition to the development of the above organocatalysts, the effect of several acid additives was investigated in asymmetric direct aldol reaction catalyzed by a C2-symmetric organocatalyst in aqueous media.

Biography

Kartick C Bhowmick research focus on the development of asymmetric organocatalysis for carbon-carbon bond-forming reactions in aqueous media. His research on the development of small organic molecules as organocatalysts for direct aldol reaction impacted significantly in the field of asymmetric organocatalysis. He has developed many optically pure organic molecules which efficiently catalyzed the direct aldol reactions with great yield and selectivity in aqueous media. His newly developed methodology replaced the use of volatile organic solvents and hazardous metal catalysts in asymmetric aldol reactions, thus by contributing enormously towards the development of sustainable organic synthesis.

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Process improvement for arsenic removal from dirty acid wastewater

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The aim of this study is to reduce the gross weight of As-containing hazardous waste in the process of treating dirty acid wastewater. Research focused on arsenic removal from gypsum by washing. With washing solution pH being 3.0 and solid liquid ration being 1:5, arsenic leaching concentration of gypsum after the washing process reduced from 40 mg/L to 2.1 mg/L. In pickling condition, As(III) was oxidized to As(V) and the size of gypsum crystal was reduced. The above are reasons for decreased arsenic leaching concentration. In addition, comparing to one-stage treatment process by using Ca(OH)2, the three-stage counter current treatment process showed several advantages. First of all, arsenic concentration of filtrate was reduced from 5 mg/L to 0.2 mg/L, which is below discharge limit (0.3 mg/L) (GB26132-2010). Secondly, it also avoided the production of ferrous arsenate slag. With the use of this novel process, gypsum could become nontoxic and arsenic concentration could be effectively reduced to 0.2 mg/L by adding Ca(OH)2. Therefore, such process has great potential in various industrial applications.

Biography

Dongyun Du has abundant theoretical knowledge and practical experience in arsenic wastewater treatment. He has developed three novel methods for the disposal of dirty acid wastewater and two kinds of absorbent material for removal of arsenic from groundwater. He has developed these technologies after years of experience in research, teaching and administration in university. Recently, he studied on the recovery of valuable metals from waste residues in metallurgical industry and the stabilization/solidification technology about high arsenic content of solid waste.

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Arvind Kumar Mungray et al., Ind Chem 2017, 3:2 (Suppl)
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Graphene Modified Anodes in a Cross-Linked Microbial Fuel Cell (CMFC) for the Treatment of Real Wastewaters and Energy Generation

Arvind Kumar Mungray and **Swarup Biswas**
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The objective of the paper is to investigate a laboratory scale sand-activated carbon based system as a post treatment option for Up-flow Anaerobic Sludge Blanket Reactor (UASBR) effluents. The performance of combined sand and activated carbon system using 0.45 mm diameter sand particles and granular activated carbon with a maximum flow rate of 9.4 mL/min was observed for a period of 121 days. Performance monitoring parameters were measured and found maximum removal in terms of BOD (91.98%), COD (93.54%), TSS (98.36%), TDS (82.62%), NH_3-N (95.55%), Nitrite-N (91.13%), Nitrate-N (86.72%), Phosphorous (92.76%), Total Coliform (99.9%) and Fecal Coliform (99.9%). The intensity of microbiological activity was found increased in the system with time which resulted in biological activation of the sand and activated carbon bed. Overall, sand and activated carbon based system was found efficient, simple and cost effective post treatment option for UASB reactor.

Biography

Arvind Kumar Mungray has his expertise in biological wastewater treatment especially in UASB and its post treatment systems. Extension of his research area is towards Microbial Fuel Cell (MFC) and therefore working also on the improvement of the design of MFC for decentralized waste water treatment. He is also focusing on making hybrid systems which can be utilized in rural areas as a sustainable solution for waste water treatment.

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Wondalem Misganaw Golie et al., Ind Chem 2017, 3:2 (Suppl)
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Continuous fixed-bed column study for the removal of nitrate from water using chitosan/alumina composite

Wondalem Misganaw Golie and **Sreedevi Upadhyayula**
Indian Institute of Technology Delhi, India

A continuous adsorption study in a fixed-bed column was conducted for the removal of nitrate from water by using chitosan/alumina composite as an adsorbent. The effects of influent nitrate concentration, flow rate, and bed depth on the adsorption characteristics of adsorbent and column performances were evaluated at room temperature and original pH of the solution. The results revealed that the breakthrough curves are significantly affected by the variation of flow rate, initial concentration and bed depth. The nitrate removal efficiency increased with increase in bed height and decreased with increase in influent nitrate concentration and flow rate. The breakthrough time increased with increase in bed height. Thomas and Yoon-Nelson kinetic models were applied for the analysis of adsorption kinetics. The model data confirmed that both models are fitted well with the experimental results of continues fixed-bed column adsorption study. Bed-depth service time (BDST) model was used to study the effect of bed depth on breakthrough curves and to predict the time required for breakthrough. The model data revealed the applicability of the BDST model for the present system. The results show that chitosan/alumina composite can be used in fixed bed column for the removal of nitrate from water.

Biography

Wondalem Misganaw Golie has completed his BTech in 2007 in Chemical Engineering and MTech in 2010. Currently, he is a PhD Research Scholar in the Department of Chemical Engineering at Indian Institute of Technology Delhi, India.

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Xiaomin Wu et al., Ind Chem 2017, 3:2 (Suppl)
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Water-saving eco-friendly cooling tower development and its performance evaluations

Xiaomin Wu, Fuqiang Chu and **Song Yang**
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The weak points of traditional wet cooling tower include water loss and water mist pollution to the surrounding environment as well as water freezing in cold winter. To solve these problems, a novel cooling tower that is water-saving and eco-friendly is developed. The tower realizes the water-saving and mist-suppressing by adding an air heat exchanger to achieve the non-evaporative heat rejection and reduce the dew-point temperature of the humid air at the tower outlet. A model for calculating the tower thermal performance is established and software is developed based on the model. With the help of the software, calculations can be carried out to optimize the cooling loads of the heat exchanger and the packing, with the airflow resistance being matched between the air heat exchanger and packing layer for a given fan characteristic curve. Calculations are implemented for a project that needs to reduce 60000 m^3/h circulating water temperature from 42 °C to 32 °C. The results show that, in case a single tower can treat 4000 m3/h circulating water, 15 towers are needed to guarantee the cooling capacities throughout the year. As compared with the conventional wet tower, the towers can save 3.785×10^6 m^3 water per year, so more equipment investments for the tower can be recovered in the first year; the annual net savings is 1,900 million RMB for the first year and 2900 million RMB for the year afterward, in the climate of Beijing area. In the area north of Beijing, even better water-saving effect and economy can be achieved. Expression for demist rate of the new tower against the traditional one is also proposed. The technology associated with the new tower is applied to several practical projects and good results are obtained.

Biography

Xiaomin Wu is a Professor and Deputy Director of the Institute of Engineering Thermophysics, Department of Thermal Engineering, Tsinghua University, China. Her current research interests include heat and mass transfer, meso-scale process of phase transition and frosting control, boiling and condensation heat transfer enhancement, design and optimization of heat exchanger, performance analysis and optimization of air-conditioning/refrigeration systems, water-saving and energy-saving technologies.

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Functionalized gold nanoparticles based colorimetric sensors for heavy metal ions from waste water

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Contamination of water by heavy or toxic metal ions can lead to serious environmental and human health problems. There are several toxic metal ions (e.g., mercury, cadmium and lead) can cause serious environmental and human health problems because of their acute and chronic toxicity to biological system. For example, the most common form of mercury in water is mercuric ion (Hg^{2+}) which is widely released to the environment from industrial source, shows high toxicity mainly on renal and nervous systems through the disruption of enzyme activity. On the other hand, lead ions (Pb^{2+}) released to the environment through dyes, gasoline and batteries and it can cause neurological, cardiovascular and developmental disorders in especially children. Another highly toxic metal ion is cadmium (Cd^{2+}), found in many end user products such as plastics, batteries, cigarettes and dyes. Therefore, monitoring of toxic metal ions in water (drinking, sea, lake, etc.) is very essential in terms of improving human health and water quality. There are several methods used for heavy or toxic metal ion detection which is often based on chromatographic and spectroscopic techniques such as inductively coupled plasma mass spectrometry (ICP-MS), atomic absorption spectrometry (AAS), high performance liquid chromatography (HPLC) and electrochemistry. Although these methods are highly sensitive and selective, they require high sophisticated instruments, are expensive, time-consuming and non-portable. Therefore, low cost, simple, rapid, portable and green methods for metal ion detection are still highly desired. In this regard, colorimetric methods based on functionalized gold nanoparticles (AuNPs) are convenient and attractive, and can satisfactorily meet these demands. Because AuNPs exhibit high extinction coefficients, strongly distance-dependent optical properties, and colors arising from AuNPs at nanomolar concentrations allow them to be easily monitored by the naked eye without the aid of any advanced instruments.

Biography

Palash Mondal has completed his PhD from Visva-Bharati University, Santiniketan, India, in 2013. During his PhD study, he focused research on polymer encapsulated nanomaterials for extraction of toxic metal ions from aqueous solution. Currently he is a Post-doctoral Research Scholar at Arizona State University, Arizona, USA. Presently he is working on polymer capped functionalized gold nanoparticles for detection of heavy or toxic metal ions from waste water.

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Membrane condensers as emerging technology for water recovery from waste gaseous streams

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The University of Calabria, Italy

The shortage of potable water has become an environmental issue more and more pressing owing to the continuous growth in water demand not balanced by an adequate recharge. If we think the water use in power generation for boilers, cooling and cleaning purposes account for around 22% of global water consumption. Separation and recovery of water contained in the waste gaseous streams can be considered as a new water source, also simply pursuing the possibility that industry can close the own water cycle by capturing evaporated water, minimizing the make-up from external sources. In this work, an emerging technology, so-called membrane condenser for the selective removal of water from the evaporated industrial waste will be introduced. In this system, the feed (super-saturated industrial gas) is brought into contact with hydrophobic microporous membranes in membrane contactor configuration. The water condenses onto the membrane surface and the hydrophobic nature of the latter prevents the penetration of the liquid into the pores, letting the dehydrated gases pass through the membrane and retaining the liquid water at the retentive side. An experimental and simulation study is developed for predicting the membrane-based process performance. Feed flow rate, interfacial membrane area, temperature difference between the fed flue gas and the membrane module result the driving parameters controlling the process. The analysis of the potentialities of this new technology is supported by the introduction of process intensification metrics which provide an alternative and innovative point of view regarding the unit performance, highlighting important aspects characterizing the technology and not identified by the conventional analysis. In the end, this presentation aims to give a point of view on the approach to be used for a proper evaluation of emerging membrane technologies performance and comparison with conventional units.

Biography

Adele Brunetti has obtained her PhD in Chemical Engineering in 2008 at the University of Calabria. In 2004, she worked at ITM-CNR in the framework of several projects at international and national level. In 2012, she has worked as a Researcher at ITM-CNR. She is the author of 50 papers published on referenced international scientific journals, 9 book chapters edited by Elsevier, Wiley, Royal Society of Chemistry and about 150 international conference proceedings. She is a Referee of several scientific journal of international level. Her research interest includes membrane condensers for water recovery; catalytic membrane reactors for high temperature reactions; design of membrane separation unit for the recovery of high purity hydrogen; study of integrated membrane plants for high purity (CO<10 ppm) hydrogen production; membrane gas separation; CO_2 capture by membrane technology; testing and characterization of polymeric, zeolitic, ceramic membranes for gas separation, also in controlled relative humidity conditions.

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The potential of natural gelatin generated from Sisymbrium irio seed in water treatment processes

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Many treatment methods have been proposed for removal of pollutants from water. The feasibility of a natural gelatin from *Sisymbrium irio* seeds to remove dyes (methylene blue, and methyl orange) and reducing turbidity of kaolin water has been examined. Various natural materials were applied for removal of dyes, heavy metals, organic compounds and reducing turbidity from wastewater; however, some issues such as the presence of poisoning materials appeared due to utilization of those natural materials. *Sisymbrium irio* seed is widely used as medicine for treating some disease, indicating the edible seed is free poisoning. Various enzymatic degradation products are formed from *Sisymbrium irio* seed when the seed tissue is disrupted due to content glucosinolates. These products contribute to adsorbing anionic and cationic dyes from water in which the dyes are totally removed in all pH range of solutions; however, reduction in turbidity of kaolin water was not observed. The highest amount of natural gelatin was obtained in the pH range 5 to 7. A color reduction of over 99% was achieved at equilibrium using an methylene blue concentration of 200 mg/L with 5 g seed in the pH range 3 to 10 and also 98% methyl orange was removed in the pH range 5 to 10. A color changing of the *Sisymbrium irio* seed was observed form orange to dark blue after removal of methylene blue. The results show that the enzymatic degradation products are totally able to remove both cationic and anionic dyes that may have occurred due to bonding with various functional groups such as OH, SO_3, SH, CN, etc. For this reason, no flocculation occurred in kaolin water without any surface charge to reduce turbidity.

Biography

Soraya Hosseini has completed her PhD in Chemical Engineering from University Kembangan Malaysia in 2010, followed by a series of Post-doctoral positions at University Putra Malaysia from 2010 to 2016 within the same department. Her PhD and the subsequent postdoctoral research have led to about 45 research papers published in high-profile scientific journals in the field. Although she has been actively involved in environmental research and catalyst fabrication, her main research interest falls in the area of the fabrication of anhydrous membranes in fuel cell application. She has also been developing a growing interest in the area of advanced materials and electrochemical reactions. She has also conducted in-depth research on the fabrication of biosensors, employed in a range of food and energy. Her current research is concentrated around the fabrication of biosensors and probing into their performance by means of electrochemical reaction and impedance spectroscopy.

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Reduction on water consumption on a cooling tower with the application of a novel biocide

Anderson Jose Beber
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Microbiological control is essential in any cooling water system. A cooling system such as a large cooling tower is an excellent environment for microbiological growth: Water, warm temperature, oxygen, dust and debris from air, nutrients and others are some of the variables that contribute largely to the growth of microbiology colonies. The main negative consequence is that the biofilm (sludge) formed is highly insulating. It is known that biofilm is more insulating that $CaCO_3$ or SiO_2 scales. The best and less expensive way to control MB is by using large amounts of oxidizing biocides like chlorine gas, hypochlorite, bromine, chlorine dioxide. The goal is to maintain an oxidizing environment which is not friendly for bio cells. However, strong oxidizer may cause high chloride content, lower concentration cycles, higher cost among others. Also, a high oxidant environment may lead to higher corrosion rates. And finally the strong oxidizers are not selective, reacting to any contamination not only MB. This paper shows the results of the application of a novel mild oxidizer on a large cooling tower at a power plant. This specific cooling tower utilizes grey water (tertiary treated domestic sewage) as make up water. After the application of this mild oxidizer, the concentration cycles were enhanced from an average of 4 up to 6.5, resulting in large savings to the plant. Also, stainless steel corrosion rates dropped significantly due to the reduction of chlorides and sulfates residuals.

Biography

Anderson Jose Beber has over 17 year of experience in industrial water treatment, especially clarification, demineralization, reverse osmosis, low and high pressure boiler water treatment and cooling water treatment. He has worked for different multinational water treatment companies, servicing several industries: Pulp and paper, power, steel, manufacturing, food and beverage, automotive and many others. Over the past 6 years, he has dedicated his expertise on special projects and technical assistance to Solenis sales team, being responsible for new product launch, technical training, project development, consultancy for boiler and cooling water treatment for industries in Latin America.

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Scientific Tracks & Abstracts

Day 2

Industrial Chemistry 2017

Sessions

Agro-based Industries and Industrial Processes | Chemicals & Pharmaceuticals | Food, Beverage & Tobacco | Industrial Water Supply | Geochemistry | Mining & Metallurgy | Oil & Gas | Power Generation | Paper & Pulp | Desalination | Membrane Technology-Nano Filtration and Reverse Osmosis | Hazardous Waste Management | Petro-Chemistry | Lead Drug Discovery | Petroleum and Polymer Processing | White Biotechnology and Green Chemistry | Material Science and Chemical Metallurgy | Industrial Photo Chemistry

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National Research Council, Italy

Session Co-chair
Hyoyoung Lee
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Session Co-chair
Toshiki Aoki
Niigata University
Japan

Session Introduction

Title: **Filed Demonstration of a portable TS-af-HFM nanofiltration process for the cost-effective treatment of oilfield produced water**
Jianjia Yu, New Mexico Tech, USA

Title: **Application of Ultrasound to control and Enhance Performance of Dynamic Membrane in Anaerobic Bioreactor**
Alka A. Mungray, National Institute of Technology, India

Title: **Quality assessment of groundwater from Avenorfeme: Akatsi District, Ghana**
Victus Bobonkey Samlafo, University of Education, Ghana

Title: **Preparation and characterization of chitosan coated diatomaceous earth for hexavalent chromium removal**
Suhaib Salih, University of Missouri-Columbia, Missouri

Title: **A numerical study on longitudinal vortex induced enhancement of mass transfer in a membrane channel**
Jingchun Min, Tsinghua University, China

Title: **Decontamination of polluted water by veterinary antibiotics by studying the photochemical behavior under light excitation**
Soumaya Mezghich, Blaise Pascal University, France

Title: **A Green Polyester and Products from Carbon Dioxide, Water and Solar Power**
Jian Yu, University of Hawaii at Manoa, USA

Title: **Porous Silicon Nanoparticles and Magnetite-Chitosan-Reduced Graphene Oxide for Simultaneous Removal of Heavy Metals and Anionic Surfactant**
Mingtan Hai, University of Science and Technology Beijing, China

Title: **Microwave Applications in Petroleum Processing**
Adango Miadonye, Cape Breton University, Canada

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Filed demonstration of a portable TS-af-HFM nanofiltration process for the cost-effective treatment of oilfield produced water

Jianjia Yu, Shangwen Zha and **Guoyin Zhang**
New Mexico Tech, USA

Statement of the Problem: Flowback and/or produced water (P/F water) is the largest byproduct stream associated with oil and gas production. The P/F water contains elevated concentrations of dissolved salt (20,000 to 300,000 ppm), suspended solids, soluble organics and low concentration of BTEX. Management of F/P water is a particular concern due to the wide range of constituents which are of concern to both unconventional shale gas developers and the environment. The overall objective of this project is to develop and demonstrate the performance and cost-effectiveness of a portable Two-Stage, Antifouling Hollow Fiber Membrane (TS-af-HFM) nanofiltration process to convert produced water into a clean water product for a reused fluid or direct discharge.

Methodology & Theoretical Orientation: Large amounts of super hydrophobic PVDF/Si-R hollow fiber membranes and super hydrophilic PES/SiO_2 hollow fiber membranes were fabricated to assemble the pilot-scale hollow fiber membrane modules for the installation of the TS-af-HFM nanofiltration system. The nanofiltration system was installed and tested in a production facility located at Carlsbad, New Mexico.

Conclusion & Significance: It was found that the permeate water flux and water recovery was proportional to the feed rate. The optimal feed rate for a single hollow fiber membrane module was in the range between 10.96-12.95 bbl/day, with the water recovery around 60%. The performance of the nanofiltration system was not influenced by the temperature. The TS-af-HFM system exhibited good antifouling ability during a continuous filtration process. A comprehensive cost analysis reveals that the TS-af-HFM system can help generate $61,468 of capitals compared to without the system

Biography

Jianjia Yu is a Research Scientist at Petroleum Recovery Research Center of the New Mexico Institute of Mining and Technology (NMIMT). His research interests include CO_2 foam EOR, CO_2 capture and produced water remediation. He has authored/or coauthored more than 35 technical papers and holds 1 US patent. He holds a PhD degree in Petroleum Engineering from NMIMT.

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Application of ultrasound to control and enhance performance of dynamic membrane in anaerobic bioreactor

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The concept of Dynamic Membrane (DM) where the fouling layer itself is used as the retaining medium could be used as the possible solution for countering the problems encountered in membrane bioreactor processes. Anaerobic DM gives high filtration resistance even at moderate flux within a short period of time. In this study, a novel concept of using ultrasound to control and enhance dynamic membrane performance was studied. Two reactors with an ultrasound probe in the center of one reactor were run simultaneously. The concept of steady Flux Decay Ratio (FDR) and analytical methods like extracted Extra Polymeric Substance (EPS), soluble microbial product analysis, Scanning Electron Microscopy (SEM), Fourier Transform Infrared (FTIR), Particle Size Distribution (PSD), Dehydrogenate Activity (DHA), Specific Methanogenic Activity (SMA) and Chemical Oxygen Demand (COD) analysis were used in this study. Lower filtration resistance (20×10^{-10} m^{-1}), increased flux (10-12 L/m^2h), lesser blocking degree of 62% FDR, more stickier and compact dynamic membrane layers, enhanced microbiological activity and COD removal (95%) were observed. All results indicated that the dynamic membrane formed with ultrasound application was less severely blocked more compact, microbiologically active and efficient compare to without ultrasound

Biography

Alka A Mungray is an Assistant Professor in Chemical Engineering Department, SVNIT, Surat. Her research area is membrane separation process, wastewater treatment, microbial fuel cell (MFC), polymer nanocopmposite, polymer degradation, forward osmosis and osmotic microbial fuel cell (OMFC). She has published/ presented 40 papers in international journals and conferences.

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Quality assessment of groundwater from Avenorfeme, Akatsi district, Ghana

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A holistic assessment of the quality of groundwater from the shallow unconfined aquifers of the Avenorfeme and surrounding villages in the Akatsi South District in the Volta Region of Ghana has been conducted. A groundwater classification scheme has been developed for groundwater in the area using a robust water quality index (WQI) modified for the case of the study area. For calculating the WQI, pH, sodium, potassium, calcium, magnesium, bicarbonate, chloride, nitrate, sulfate, total dissolved solids, and fluorides have been considered. On the basis of the WQI so computed, groundwater fell within the excellent, good, poor and unsuitable for drinking categories. This study finds that the salinity of groundwater in the area is largely attributed to mineral weathering leading to evolution of predominantly intermediate to high salinity NaCl water types. On account of salinity hazard, most of the waters are not suitable for irrigation in the area. Based on total hardness, the groundwater in the area is permanently hard.

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Preparation and characterization of chitosan coated diatomaceous earth for hexavalent chromium removal

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Hexavalent chromium is not biodegradable in nature and has a great effect on ecosystem and human health. Batch and continuous fixed-bed column studies for Cr (VI) removal from aqueous solutions were carried out by using chitosan coated diatomaceous earth as an adsorbent. The adsorbents were characterized by FTIR, TGA, BET, XPS, SEM, EDS and zeta potential (located at University of Missouri-Columbia, Missouri). The effects of pH-solution, initial ion concentration, temperature, flow rate and the contact time were examined. Results revealed that Cr (VI) adsorption was found fitting well with Langmuir model indicating monolayer adsorption. The adsorption of Cr (VI) onto adsorbent behaves as a pseudo-second-order models rather than the pseudo-first order model and found to have fast kinetics in the first 60 min and then the rate slowed down as equilibrium was approached. The increase of temperature has a negative effect on chromium adsorption which decreases the Cr (VI) removal from 1.62 to 1.44 mmole/L when it rise from 283 to 313 K. Thermodynamic parameters such as ΔG^o, ΔH^o, ΔS^o and ΔH_x indicated the suitability of adsorbent towards the removal of Cr (VI). The maximum chromium uptake in batch adsorption was 1.62 mmole/g or 84.23 mg Cr/g at pH 3, initial ion concentration 1000 ppm, and temperature 283 K. However, a forward breakthrough point is decreasing exhaustion time with increasing the flow rate of solution in dynamic process. Recovery of the Cr (VI) ions was made by passing 0.2 M NaOH solution through the exhausted columns and about 91.2% of chromium was de-adsorbed from the bed column. Results indicate that the sustainable, abundant, low-cost adsorbent, chitosan coated diatomaceous earth, can be considered as economically applicable for the removal of Cr (VI) from aqueous solutions.

Biography

Suhaib S Salih is currently pursuing PhD and is a Research Assistant at the University of Missouri-Columbia majoring in Chemical Engineering. His PhD work is on industrial wastewater treatment under the supervision of Dr. Tushar K Ghosh. He has received his BE and MSc degrees in Chemical Engineering from the University of Tikrit, Iraq. He later joined the Department of Chemical Engineering, University of Missouri-Columbia as a PhD Scholar. His current research interest is in Adsorption Processes. He has expertise in lab management, operation of atomic absorption spectrophotometer, infrared spectrophotometer, ultra violet spectrophotometer and HPLC spectrophotometer.

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A numerical study on longitudinal vortex induced enhancement of mass transfer in a membrane channel

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Concentration polarization phenomenon often occurs in membrane separation, it acts to deteriorate the transmembrane mass transfer, so measures should be taken to suppress it. The present work simulates the flow and mass transfer in narrow membrane channels with and without flow disturbers. The channel is composed of an impermeable solid wall and a membrane. The flow disturbers include the rectangular and delta winglets, which are generally used as longitudinal vortex generators to enhance heat transfer in heat exchanger applications, and the square and triangular prisms and circular cylinder, which are employed here to simulate the traditional spacer filaments for comparison purpose. Calculations were made to investigate and compare the effects of various flow disturbers, which are attached to the solid wall surface to enhance the mass transfer near the membrane surface to reduce the concentration polarization. The disturber performance was evaluated in terms of concentration polarization factor versus consumed pumping power and pressure drop, with a larger factor meaning a more serious concentration polarization. Calculations were done for NaCl solution flow in membrane channels having a 2.0 mm height for Reynolds numbers of 400-1000. The results show that the concentration polarization occurs mainly in a very narrow range near the membrane surface and the degree of concentration polarization increases along the fluid flow direction but decreases with Reynolds number. The traditional prism- and cylinder-type disturbers can considerably reduce the concentration polarization factor, but they simultaneously cause substantially increased pressure drop and pumping power, while the novel winglet-type disturbers can effectively enhance the mass transfer with much less pressure drop penalty. Overall performance comparison of the abovementioned various disturbers suggests that under equal pressure drop and equal pump power conditions, the delta winglets yield the best mass transfer enhancement effect while the tri-prism gives the worst mass transfer enhancement effect.

Biography

Jingchun Min is an Associate Professor of Engineering Thermophysics at the Department of Engineering Mechanics in the Tsinghua University, China. He has received his Bachelor's degree from the Dalian University of Technology, China, Master's and PhD degrees from the Hiroshima University, Japan. He currently serves as an Editor for *Journal of Enhanced Heat Transfer* and an Editorial Board Member for *Energy and Power Engineering*. His current research interests include membrane transport, transport phenomena in porous media, aircraft icing, aero-engine cooling, enhanced heat and heat exchanger technology.

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Decontamination of polluted water by veterinary antibiotics by studying the photochemical behavior under light excitation

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Nowadays, the emergence of pharmaceuticals in the aquatic and terrestrial environment has been a major concern. They have been detected in sewage-treatment plants, sediments, and soils, as well as, at surface and drinking water. So far, there is limited information in the literature on the fate of these compounds when they are exposed to solar light in the various environmental compartments. The objective of the present study is to investigate the degradation process of two different antibiotics Sulfamethoxazole (STZ), Hydrochlorothiazide (HCD) in aqueous solutions when exposed to simulated solar light. We mainly concentrate our effort on the kinetic studies by evaluating the degradation quantum yield, as well as, the effect of various parameters such as oxygen concentration, pH and the presence of inorganic ions. The main effect was observed by molecular oxygen parameter. We also make an important effort in the elucidation of the main intermediate and stable byproducts. A lot of information is available on the stability and fate of parent compounds and not so many on their transformation products. These may present a toxicity level higher than the precursor substrate and should be identified and analyzed. The structure elucidation was obtained by using the HPLC/ESI/MS and HPLC/ESI/MS^2 techniques in negative, as well as, positive modes and through the complete study of the various fragmentation pathways. The main involved photochemical processes were: The scission of the bridge through a photohydrolysis process, selective hydroxylation of the aromatic moiety, desulfonation process and in the case of HCD to dechloration reaction. A mechanism was then proposed in the light of the kinetic and analytical studies.

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A green polyester and products from carbon dioxide, water and solar power

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Statement of the Problem: Carbon dioxide (CO_2) is a prime green-house gas emission from industrial processes. It can be converted into bio-oil and bio-diesel through conventional photosynthesis of microalgae. The CO_2 fixation rate, however, is quite low and affected by the intermittent solar irradiation.

Methodology & Theoretical Orientation: An artificial photosynthetic bioprocess is developed to produce green polyester from CO_2, water and solar power. In this green process, solar energy is captured using photovoltaic modules and converted into hydrogen as a stable energy source via water electrolysis. The solar hydrogen and oxygen is used to fix CO_2 by a hydrogen-oxidizing bacterium.

Findings: Under the autotrophic growth conditions, CO^2 was reduced to biomass at 0.8 g L^{-1} hr^{-1}, about 10 times faster than that of the typical bio-oil-producing microalgae (*Neochloris Oleoabundans*) under indoor conditions. A large portion of the reduced carbon is stored in polyhydroxybutyrate (PHB), accounting for 50-60% of dry cell mass. PHB is a biodegradable thermoplastic that can find various environmentally friendly applications. The green polyester can also be converted into small chemicals (C3-C4) with different functional groups. Specifically, PHB is degraded and deoxygenated on a solid phosphoric acid catalyst, generating a hydrocarbon oil (C6-C18) from which a gasoline-grade fuel (77 wt% oil) and a biodiesel-grade fuel (23 wt% oil) are obtained via distillation. Aromatics and alkenes are the major compounds, depending on the reaction conditions. Their reaction mechanisms from crotonic acid, a major PHB degradation intermediate, are revealed and presented.

Conclusion & Significance: Biodegradable plastics and high-grade liquid fuels can be directly produced from carbon dioxide, water and solar power. The productivity of the green polyester (5.3 g L^{-1} d^{-1}) is much higher than that of microalgal oil (0.13 g L^{-1} d^{-1}). Other technical merits of the new green process may include continuous operation under intermittent solar irradiation and convenient scale up in outdoor.

Biography

Jian Yu has obtained his PhD degree from University of British Columbia in 1991, MSc from Zhejiang University in 1985 and Bachelor of Engineering (BEng) from Zhejiang Institute of Technology in 1982. He was an Assistant Professor at Hong Kong University of Science and Technology (1994-2001) and is currently a Research Professor at University of Hawaii at Manoa (2001-present). His research interest is in the area of bioprocess and bioreactor engineering and production of green plastics, chemicals and fuels from renewable resources. He has published more than 70 research papers in peer-reviewed journal as the first and/or corresponding author, in addition to numerous book chapters and conference papers and presentations. He has three patents that have been licensed to companies and one technology has been successfully scaled up to pilot plant and commercial production.

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Porous silicon nanoparticles and magnetite-chitosan-reduced graphene oxide for simultaneous removal of heavy metals and anionic surfactant

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The simultaneous removal of different types of pollutants is extremely challenging for environmental and material science. Water dispersible magnetite-chitosan reduced graphene oxide (MCRGO) submicron particles were synthesized and combined with positively charged porous silicon nanoparticles (PSi NPs) mainly through electrostatic interactions for the simultaneous removal of toxic heavy metals and anionic detergent pollutants, organic dye and pesticide as well. PSi NPs offer great potential for the simultaneous removal of inorganic and organic compounds due to their ability for adsorbing hydrophobic and hydrophilic compounds, and other negative charged materials, on their internal and external surface. The MCRGO hybrids showed high binding capacity for positive charged heavy metal ions and were easily separated by an external magnetic field. Here, we report the combination of MCRGO and PSi NPs as an efficient biocompatible platform for complete elimination of toxic heavy metals cadmium (Cd^{2+}) and lead (Pb^{2+}) as well as the anionic $C_{12}H_{25}SO_4^-$ from sodium dodecyl sulfate (SDS) water solutions, and dye oil red O and pesticide by adsorption. Overall, the combination of MCRGO and PSi NPs holds great potential for complex waste water treatment beyond multiple heavy metals, detergent and pesticide based pollutants.

Biography

Mingtan Hai has her expertise in cancer research, material science and water treatment. Her group and weitz group cooperates on cancer research, material science, microfluidics and environmental science.

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Microwave applications in petroleum processing

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Statement of the Problem: Microwave energy is successfully being used in the petroleum industry (inspecting coiled tubing/ line pipe, measuring multiphase flow, and the mobilization of asphaltic crude oil). Depletion of conventional crude reserves is accompanied by growing economic demand for various fuel types. In Canada, efforts have intensified to develop microwave irradiation technology for *in situ* enhanced oil recovery of large deposits of heavy oil/bitumen. Of the estimated 30 billion barrels of heavy oil in place, about 26 billion barrels are considered unrecoverable using current technology. Objectives included studying microwave process conditions that affect the upgrading of heavy oil/bitumen to synthetic crude, achieve up to 50% desulphurization and obtain preliminary data on process design and economics.

Methodology & Theoretical Orientation: Typical experiments including mixing of oil with one or more additives, and exposing to various dosages of low pressure microwave radiation. The microwave reactor was constructed from a domestic microwave oven and modified to allow for the accommodation of a mixer, temperature monitor and pressure in the reactor and interfaced with a desktop computer for data acquisition. Power level and irradiation intensity were at level high.

Findings: Results obtained with GC-MS showed evidence of fragmentation process in heavy oil/bitumen samples but, no significant change in molecular structure for majority of the light crude oil samples after being subjected to microwave irradiation. Average reduction in sulfur content of 16% and 39.4% were obtained for heavy oil and light oil, respectively.

Conclusion & Significance: This work has shown strong indications for the employment of microwave technology not only for hydrocarbon extractions but for *in situ* upgrading and field upgrading of heavy oil/bitumen desulphurization of crude oil, and future upgrading of coal and oil shale. Overall, microwave technology presents the best alternative, economically and environmentally, to existing technologies for enhanced oil recovery operations and processing.

Biography

Adango Miadonye has his expertise in rheology and transport property of reservoir fluids, heavy oil and bitumen, microwave energy for enhanced oil recovery, upgrading and refining processes.

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