An Introduction to Ion Exchange Polymeric Membranes with Potential Application in Chlor-alkali Industry

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Abstract

The chlor-alkali industry is one of the largest electrochemical technologies in the world and its main productions are chlorine, sodium hydroxide, sodium carbonate, potassium hydroxide, and hydrochloric acid. Chlorine and sodium hydroxide (or caustic soda) are among the top 10 world's chemical productions that are used for manufacturing variety of intermediate products. Common technologies for chlor-alkali industry are mercury, diaphragm, and membrane processes. Among these processes, the membrane process is the most economic and environmental friendly for production of chlorine gas and sodium hydroxide. In the early of 1970s, development of chlor-alkali industry based on ion-exchange membranes began in electrolytic cells due to the environmental concerns caused by mercury and asbestos. One of the most important obstacles of the petrochemical industry is, removing of mercury and diaphragm processes and applying membrane technology. In membrane processes, perfluorinated polymers electrolyte are generally used as membrane. These membranes have good chemical resistance, high ionic conductivity and favorable mechanical properties due to chain structure of its poly(tetrafluoro ethylene). But commercial usage of perfluorinated polymers is limited due to the high price and performance loss of polymers in the high temperatures and low humidity. Therefore, many efforts are accomplishing to replace other structures of polymer. According to the importance of chlor-alkali industry in this article, conventional processes especially membrane technology and a variety of polymeric membrane is reviewed.

Keywords: Chlor-Alkali, Membrane Process, Mercury Process, Diaphragm Process, Polymeric Membrane.

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A Review of Beta-Carotene Accumulation in Microalgae Under Different Stress Conditions

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Abstract

One of the major produced metabolites by the microalgae is beta-carotene. It has many application in preparation of cosmetic, as antioxidant and precursor to vitamin A. Beta-carotene is more efficiently produced through microalgae compared to plants, bacteria and fungi, since microalgae can be cultured all year long with low nutrient requirements and higher yield. In this study, beta-carotene accumulation in microalgae was investiagted under different stress conditions of light intensity, temperature, nutrient satrvation, and saltinity. The results of the previous researches shows high accumulation of beta-carotene with increasing concentration of salt. However, at very high concentrations of salt, beta-carotene production is decreased. Among nutrient stresses, the deficiencies of nitrogen and phosphorus have shown the greatest impact on beta-carotene accumulation. Light stress has also been investigated from quantitative and qualitative point of views in which has the greatest impact among other stresses. Applying simultaneous stresses can be used for beta-carotene production.

Keywords: Microalgae, Beta-Carotene, Stress.

CFD Simulation of Heat Transfer in Taylor Flow Regime Passed Through a Single Channel of Monolithic Reactor

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Abstract

In this contribution, heat transfer of the Taylor flow regime in one tube of monolithic reactor has been studied by CFD simulation. The regime has been assumed to be periodic and axis symmetric. The volume of fluid based (VOF) interface tracking method was used for hydrodynamics simulation. In this case the bubble is stationary and liquid flows over it. In order to investigate the effect of Taylor bubble on heat transfer enhancement, heat transfer phenomenon has also been simulated for liquid only flow. Afterwards the effects of capillary number and gas volume fraction variations have been studied. The results show that in every capillary number the heat transfer has been increased by volume fraction enhancement. The results also show that the average Nusselt number has been increased by capillary number enhancement till 0.2. The average Nusselt number has been smoothly decreased by further capillary number promotion.

Keywords: Monolithic Loop Reactor, Taylor Flow Regime, Heat Transfer, CFD Simulation.

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A Review of Different Types of Solar Cells

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Abstract

Today, a variety of solar cell technologies in order to use the sunlight renewable energy has been developed. Silicon based solar cells are the first generation of solar cells that are grown on Si wafers, mainly single crystals. Further development in solar cells causes to thin films, dye- sensitized solar cells and organic solar cells that increased the cell efficiency. The solar cell development is mainly inhibited due to the cost and efficiency. In order to choose the suitable solar cells for a specific geographic location, we need to understand the fundamental mechanisms and the functions of various solar techniques. In this review paper, the gradual development of solar cells will be compared and discussed. In the following, various practices and methods that improve and increase the solar cell efficiency will be investigated and discussed.

Keywords: Solar Cells, Semiconductors, Photovoltaic, Electrical Power, Renewable Energy.

A Review of the Biooxidation Process and Neutralization of Wastewater for Gold Refractory Ores

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Abstract

Bioleaching and bio-oxidation caused from activations of acidophilic are used to extract metals from low-grade, and refractory ores. Although these terms are often used interchangeably, there are distinct technical differences between these two technologies. Bioleaching refers to the conversion of an insoluble metal into a soluble. Whereas in the bio-oxidation, the valuable metal such as gold remains in the solid phase. Using this process, gold existent in pyrite and arsenopyrite networks is released and can be suitable for cyanidation process. Nowadays bio-oxidation method has attracted particular attention in the mining industry because of its technical, economic and environmental advantages, and is the most suitable technology for pre-treatment of refractory gold. Hence, this paper was focused to review the biooxidation process of refractory gold ores. The results indicate that the microorganisms used in biooxidation process have the role of catalyst and conversion of ferrous ion to ferric and sulfur into sulfate. Also, bacteria used are mainly mesophilic.

Keywords: Biooxidation, Gold Refractory Ore, Bioleaching, Wastewater Neutralization.

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Methods for Magnetization of Nano Titaniumdioxide Photocatalyst in Order to Improve its Performance

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Abstract

One of the most important problems related to application of titanium dioxide (TiO_2) photocatalyst is its recycling and separation from aqueous system after the reaction. This problem has limited applications of TiO_2 in wastewater treatment. Magnetization of TiO_2 and using a magnetic field for separation is one of the most effective methods which have been mostly used to solve these challenges. In this review study, magnetization of TiO_2 photocatalyst and methods to improve its performance was evaluated. Researches show that the composition of the magnetic material affects the photocatalytic activity of TiO_2 and the activity increases by reduction the magnetic materials. The middle layer of SiO_2 increases the stability of the magnetic properties and photocatalytic activity. $CoFe_2O_4$ in comparison to $NiFe_2O_4$ and Fe_3O_4 has the best magnetization effect. However, Fe_3O_4 due to some features such as non-toxicity, low price, high stability and excellent ferromagnetic properties is more considered. Studies show that graphene due to its unique properties, has significant impact on the performance of magnetic TiO_2 photocatalyst.

Keywords: Titanium Dioxide, Photocatalyst, Magnetic Nanoparticles, Separation, Graphene.

Mathematical Modeling of Bioethanol Production from Broomcorn Stalk Using Simultaneous Saccharification and Fermentation Process

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Abstract

In this work, ethanol production from pretreated sorghum stem in two initial enzyme concentrations was studied by simultaneous saccharification and fermentation (SSF) process. Maximum achieved ethanol concentration from this lignocellulosic material was 13.7 (g/L). A mathematical model was developed for SSF process which consists of five ordinary differential equations that describes the variation of five components of Glucose, ethanol, Cell, glycerol and Lactic acid concentrations. The inhibition of ethanol on cellulose conversion and lignin effect on enzyme activity are introduced in order to increase the reliability of proposed model. The parameters were determined using a MATLAB fitting program. The developed model was verified by comparing the model predictions with experimental data obtained from the ethanol production based on pretreated sorghum stem. High determination coefficient $R^2>0.96$ and low value of error $MSE<0.171$ showed good agreement between simulation and experimental results. This model can be used for rational SSF optimization and scale-up.

Keywords: **Broomcorn, Simultaneous Saccharification and Fermentation, Ethanol, Modeing, Alkali Pretreatment.**

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A Review of Recent Researches on the Application of Metal-Organic Framework /Polymer Mixed Matrix Membranes for Gas Separation

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Abstract

Gas separation by polymer-based membranes, has many applications in various fields particularly gas refinery, petrochemical industries and environmental protection. With the growing interests in this technology, a new type of membranes as mixed matrix membranes (MMMs) have been fabricated in order for employing the advantages of both polymeric and inorganic materials, simultaneously. The metal-organic frameworks (MOFs) incorporated in polymer matrix indicated a desirable gas separation performance. In the present study, first, the structure of MOFs, their role in the membrane and gas transfer mechanism is studied. Then, the recent studies on MOFs/polymer MMMs and the effects of factors on their gas separation performance are reviewed.

Keywords: **Mixed Matrix Membrane, Polymeric Membrane, Metal Organic Framework, Gas Separation.**

A Review of Nano-Porous Silica Particles Production Methods

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Abstract

Micrometer-size nano-porous silica particles have great potential to be exploited in high performance liquid chromatography columns as well as in most of the separation processes. In addition, the nano- or micron-size particles are applicable as a drug carrier, catalyst substrate, adsorbent and adsorbent base, sensors, etc. Therefore, in the present paper, different synthesis methods such as sol-gel and Stöber, flame spray pyrolysis, modified Stöber, micro-emulsion, micelle and visicol formation, sol-emulsion-gel, hard and soft template for the synthesis of hollow spheres, and hierarchical core/shell method for the production of spherical silica particles in various shape and size with predetermined pore size are reviewed and discussed.

Keywords: Silica Particles, Tunable Nanopores, Production Methods.