Modeling of Light Olefin-Paraffin Separation Process Using Supported Liquid Membrane: with Emphasis on Separation of Ethylene-Ethane and Propylene-Propane

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Abstract

Olefin-paraffin separation with equivalent carbon number is an important cost-effective step in olefin production in petrochemical industries. Liquid membrane technology using ionic solutions can perform olefin-paraffin separation in a selective manner. In this paper, the separation of light olefin-paraffin mixtures using supported liquid membrane is modeled in an unsteady-state manner. In this model, mass transfer is considered in the direction of membrane thickness and the effect of feed pressure, silver concentration, solvent type and time on flux rate was investigated. For model evaluation, experimental data of ethylene-ethane separation with aqueous solution of silver nitrate and propylene-propane separation with aqueous solution of silver nitrate, AgNO3-NMP and AgBF4-BMImBF4 were used. There is a good agreement between experimental and modeling data (with 12.2% difference). Moreover, it was concluded that by using viscose or ionic liquids, which are substituted for water (solvent) in order to solve evaporation problems, cause a decrease in flux and product selectivity.

Keywords: Supported Liquid Membrane, Facilitated Transport, Modeling, Light Olefin-Paraffin Separation.

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Investigation of Protein Extraction from Microalgae Using Different Pretreatment Methods

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Abstract

Microalgae are promising sources of protein due to their high nutritional value, rapid growth rate and ability to survive in harsh conditions. In this study, first, different and indeterminate species of microalgae were cultured in flat plate photobioreactors and for the first time, the process of protein extraction from mixed microalgae biomass using various pretreatment methods such as autolysis, hydrolysis with acidic and alkaline methods, ultrasound and their composition was investigated. In acidic and alkaline pretreatment using solutions with different concentrations and at different times, the highest percentage of protein extraction (at 121 temperature and duration of 30 minutes) was 83% and 93%, respectively, which showed that the use of alkali was more efficient in protein extraction. Also, using autolysis and ultrasound methods, the highest extraction efficiencies were 60% and 39% of total protein, respectively. In this study, an autolysis with freezing method was used for the first time and based on the results, the efficiency of the autolysis process increased by 3 to 10%.

Keywords: Autolysis, Extraction, Ultrasound, Protein, Microalgae.

High-Rate Activated Sludge Process: New Insight into Energy Recovery from Municipal Wastewater

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Abstract

In recent decades, population growth, declining oil resources, and high production of municipal wastewater have raised many concerns for communities. Due to the shortage and limitations of fossil fuels, renewable energy sources are of particular importance. Municipal wastewater has become a remarkable source of energy due to its continuous production and treatment worldwide. The conventional activated sludge process has been used for more than a century to treat municipal wastewater. This process, despite its advantages such as high effluent quality and reliability, due to problems such as aeration, oxidation of organic matter present in the wastewater and waste production can hardly be considered as a sustainable method for wastewater treatment. In order to recover the energy present in the wastewater efficiently, it is necessary to change the process and up-concentrate the organic matter in it. Several physical, chemical and biological processes are used to increase the up-concentration of organic matters present in the wastewater and capture them onto the sludge surface, which improve energy recovery through anaerobic digestion. Due to the special disadvantages of physical and chemical processes, attention is drawn to the biological process. This study will provide a comprehensive assessment of the energy available in municipal wastewater and the methods used to increase the concentration of organic matter. It will also assess the limitations of physical and chemical methods and examine the biological process of high rate activated sludge, mechanisms, operational parameters, and recent studies on this process.

Keywords: **Energy Recovery, Municipal Wastewater, High-Rate Activated Sludge, Bioflocculation, Anaerobic Digestion, Membrane Bioreactor.**

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Calculation of Exergy Loss in Process Industries Using Omega-Enthalpy Diagram

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Abstract

Having calculated the exergy loss for all pieces of process equipment, it is possible to show the thermodynamic irreversibility, which makes certain guidelines for modifying the process industries and improving their performance. In this study the exergy loss is calculated using Omega Composite Curves, which is a novel graphical tool for calculating exergy loss in heat exchanger networks. Unlike other current tools, this graph is linear and calculation of exergy loss using the rectangular shaped area is so easy. The Omega-Enthalpy diagram is used to calculate exergy loss for other unit operations. First, how to achieve this diagram is explained and then the diagrams are used for exergy loss calculation in two case studies. In the first study, each of a PRICO process (LNG production) equipment was investigated especially the multi-stream heat exchanger. The results showed that in the whole process 27.66 MW of exergy is wasted. In the second study, the heat exchanger network of Shazand thermal power plant was investigated and exergy loss of this network was calculated by 8.14 MW.

Keywords: **Exergy Loss, Combined Pinch and Exergy Analysis, Omega Composite Curves, Omega Enthalpy Diagram, PRICO Process, Shazand Power Plant.**

Possibility of Gas Heater Elimination for City-Gate Gas Stations in Hot-Climate Regions of Fars Province

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Abstract

In common natural gas pressure reducing stations, gas heaters and throttle valves are used for pre-heating and pressure reducing. The gas heaters are used to prevent the hydrate formation after the station because of temperature reduction. In this work, in addition to study the existence of gas heaters in common stations, four substitute methods are presented and together with the commonly used method are simulated for 5 hot-climate cities in Fars province, i.e., Darab, Lar, Lamerd, Mohr and Farashband. These four methods are comprised of: 1- Use of an expansion turbine in place for the throttle valve, 2- Use of an expansion turbine for pressure reduction and an electric heater instead of the gas-burning heater, 3- Use of a vortex tube for the throttle valve, 4- Use of an evaporation-condensation cycle instead for the gas-burning heater. Heating loads and gas consumption for the commonly used method and suggestive methods are compared. Furthermore, the work gained through the use of the expansion turbine was calculated and reported. The expansion turbine and vortex tube need most and least heating loads and gas consumptions for preheating, respectively. The expansion-condensation cycle need lower heating load because of its higher efficiency in comparison of the direct gas-burning heater

Keywords: City-Gate Gas Stations; Throttle Valve; Expansion Turbine; Electrical Heater; Vortex Tube; CWT Heater.

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Evaluation of Porous Materials Performance on Forced Heat Transfer: Current Conditions and Future Challenges

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Abstract

Expanded surfaces are considered as the common way to heat transfer increment in the industry, but due to their operating conditions and lack of footprint, their use in some situations is limited. Because of its ability in thermal efficiency increment using increasing available area and change in velocity gradient, the porous medium has been considered as a novel solution in heat transfer increment. During this investigation the effective parameters on heat transfer (Nusselt number (Nu)) in the presence of porous medium (configuration, thermal conductivity, pore gradient, porosity, permeability and Darcy number (Da), thickness, fluid velocity, and heat source) were studied. The studied configurations can be classified in partial and fully porous categories. Among the investigated papers, the fully filled configuration usually has shown the maximum exchanged energy and pressure drop. Because using a porous medium leads to pressure drop increase, an index was reported to compare between different configuration can be applied. Finally, limitations and challenges in this field were investigated.

Keywords: Porous Medium, Porosity, Heat Transfer, Pressure Drop, Nusselt Number, Darcy Number.