Design and Numerical Analysis of Air Duct Heater

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Abstract

In this investigation, mathematical modeling of a duct heater has been performed using energy conservation law, Estefan-Boltzman law in thermal radiation, Fourier's law in conduction, and Newton's law of cooling in convection. The duct was divided to some elements with equal length, each element has been studied separately and physical properties in each element have been used on the basis of its temperature. Derived equations have been solved using finite difference method and consequently air temperature, duct internal and external wall temperatures, internal and external convection heat transfer coefficients, and the quantity of heat transferred have been calculated in each element. Then with changing inlet air flow rate, duct diameter and duct material of construction, effects of the aforementioned parameters have been studied. Finally the best condition for heating has been introduced. These results and modeling can be used in heat exchangers design and for improvement of their efficiency.

Keywords: Duct Heater, Numerical Analysis, Variable Physical Properties, Finite Difference

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A Review on Chemical Fertilizer Industries and Natural Resources in Iran

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Abstract

Chemical fertilizers provide one of the vital requirements to the plants. Shortage of some necessary elements such as nitrogen, phosphorous, potassium, sulfur and other elements in the soil can be compensated through the application of chemical fertilizers. Raw materials for the production of chemical fertilizers is mainly natural gas and some minerals which fortunately are highly abundance in Iran. Presence of various natural resources as well as the relatively non-expensive energy costs in Iran, has provided a great potential for the development of fertilizer industries. In order to identify the capacity of the national and regional consumption markets, it is necessary to refer to the supply and demand statistics in the regional countries.

In this study, it has been attempted to introduce the various types of chemical fertilizers and review the statistics on their national supply and demand. Such a study, through identification of potentials in domestic and regional markets, might facilitate the investment in this sector of chemical industries as well as boosting the job opportunities for young educated engineers.

Keywords: Chemical Fertilizer, Plant Nutrition, Nitrogen, Phosphorous, Potassium, Sulfur

Investigation on Hydrogen Storage Using Carbon Nanostructure Materials

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Abstract

Today, hydrogen storage as a clean and renewable energy source has main rule in the energy saving studies. Adsorption of hydrogen molecules on the adsorbent surface is an effective method in this point. In this paper, application of nanostructure carbon metrials such as carbon nanotubes, nanohorns and fullerene molecules in the hydrogen adsorption are investigated. Generally Nanotube carbons have low specific surface area and therefore have low affinity in hydrogen adsorption, but this affinity can improve. Some examples of these improvements are impregnation with metals such as Li, chemical treatment with KOH and heat treatment in temperature 400-500 oC. Nanohorns have higher specific surface area than nanotubes and their surface area can improve to 1900 m2/gr by means of heat treatment. In this condition, hydrogen storage capacity are around 4 wt% at T=77 K. Hydrogen storage of fullerenes improve with both mechanisms of adsorption within molecular structure and hydride formation. In addition, activated carbons produced from fullerene have high adsorption capacity to storage of hydrogen.

Keywords: Hydrogen, Adsorption, Nanotube Carbon, Nanohorn, Fullerene

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Prediction of Liquid Hold up and Pressure Distribution in the Structured Packings Using CFD Analysis

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Abstract

In this study, Computational Fluid Dynamics (CFD) has been used to determine the dry pressure drop, wet pressure drop and Liquid holdup in four types of structured Packings (Mellapak 250Y, Mellapak 250X, Flexipak 1Y and Gempak 1A). By predicting the dry pressure drop and liquid hold up, the two-phase pressure drop can be easily calculated from the correlations. The results show that the liquid film thickness in the Mellapak 250Y, Flexipak 1Y, Gempak 1A and Mellapak 250X are 0.324, 0.34 and 0.3232 mm in the preloading region, respectively. The liquid hold up in the Mellapak 250Y, Flexipak 1Y, Gempak 1A and Mellapak 250X are 7.62%, 4.24%, 3.77% and 7.55% in the preloading region, respectively. In general the predictions agree well with the experimental data, indicating the suitability of the proposed models for the simulation of the hydrodynamics and mass transfer in structured packed columns.

Keywords: Computational Fluid Dynamics (CFD), Structured Packed Column; Liquid Hold up, Dry Pressure drop, Two-Phase Pressure drop

Investigation and Comparison of Zeolites and Zeo-Types for Separation of Light Molecules (CO_2, N_2, CH_4) in Membrane Processes

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Abstract

Membrane processes is one of the latest methods in separation of light molecules. Selection of a proper molecular sieve with high selectivity and permeability in moderate pressure and ambient temperature is the significant point in membrane processes. The objective of this review paper is the study of zeolite and zeo-type molecular sieves for separation of CO_2 from natural gas (CH_4) as well as separation of CO_2 from N_2 as the major component of the air, in membrane processes. According to this study, the separation factor of $CO_2/CH4$ and CO_2/N_2 was investigated and compared for different kinds of of zeolites and zeo-type membranes. The literature survey demonstrated that T and SAPO-34 show the highest separation factor of CO_2/N_2 and CO_2/CH_4 separation.

Keywords: **Natural Gas, Separation, Membrane, Molecular Sieves, Separation Factor**

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Prediction of Continuous Phase Overall Mass Transfer Coefficient in a Hanson Mixer-Settler

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Abstract

The volumetric overall mass transfer coefficients in a pilot plant Hanson mixer-settler extraction column of seven stages have been measured using toluene-acetone-water and butyl acetate- acetone- water systems. The effects of agitation speed and dispersed and continuous phases flow rates on volumetric overall mass transfer coefficients have been investigated and found to be significant. By using interfacial area, the overall mass transfer coefficients for continuous phase are determined from volumetric coefficients. An empirical correlation for prediction of the continuous phase overall mass transfer coefficient is proposed in terms of Sherwood and Reynolds numbers. The prediction of continuous phase overall mass transfer coefficients from the presented correlation is in good agreement with experimental results.

Keywords: **Overall Mass Transfer Coefficient, Hanson Mixer-Settler, Interfacial Area, Dispersed Phase Holdup**

Cost Estimation for Application of Membrane Technology in Water Desalination Industry- Comparison with Similar Processes in Iran and the World

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Abstract

In this research the manufacturing (capital-operational-total) cost of membrane-based reverse osmosis (RO) for treatment of brackish and sea water were compared. Also total costs of membrane-based reverse osmosis (RO) and multi effect distillation (MED) technologies for desalination of sea and brackish water were estimated and compared. Also a comparison between costs of membrane technology in Iran versus Europe was carried out. The calculation of Membrane costs were estimated using Verberne and Wouters technique and expenses for distillation process were carried out on the basis of Hisham Ettouney method. All costs were calculated on the basis of the local expenditures in Iran.

It was shown that desalination of sea water in more expensive than brackish water also the the manufacturing costs of RO technology is less than MED technology.

It was concluded that the capital costs in Iran are higher than Europe while the operational costs are lower. These results in lower total cost in Europe compared to Iran.

Keywords: **Reverse Osmosis, Distillation, Operational Cost, Capital Cost**

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Investigating Effective Parameters on the Removal Mercury Ion from Aqueous Phase by Adsorption Using Carbonaceous Sorbents

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Abstract

Nowadays, better life is provided for human being by means of new knowledge and technology, but on the other hand, the environment is periled by their consequences. One of the pollution menace the environmental life of human and other creatures is the presence of mercury ion in aqueous streams. In the present article, adsorption of this poisonous material and effective operating parameters such as: temperature, pH, initial concentration and impregnating materials are thoroughly investigated. One of the efficient methods for removing mercury ion from liquid and gas phases is adsorption technique using porous solids. Among them, carbonaceous sorbents perform a prominent roll. In this regards, effective parameters in the adsorption of mercury from aqueous solutions using carbonaceous sorbent are explained in the present paper. Among different factors, smaller particle size of adsorbent, degree of microporosity, higher pH, and higher initial Hg concentration, would increase the adsorption amount of mercury from the liquid phase.

Keywords: **Adsorption, Mercury, Activated Carbon, Aqueous Phase**

Review on Vermicomposting Technology and Vermicompost Applications

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Abstract

Some species of earthworms with other microorganisms have stabilized many types of organic waste in vermicomposting process. This bioconversion occurred in physical and biochemical processes. The physical process includes aeration, mixing and grinding of materials and in biochemical process, microbial activity and enzyme secretion in earthworm gut were the main factors. Vermicompost has a high content of humic substances. This property has caused vermicompost as a biosorbent for heavy metal ions and PAH removal. Nutrient content and plant growth hormones in vermicompost are greater than soil. Vermicompost has used for soil property improvement. Odorless, normal appearance, no undesirable effect on the human health and good physical matrix are other vermicompost advantages. vermicomposting process needs less time than other conventional composting methods. This process can also be used for wastewater sludge biostabilization and converts it to environmental harmless substances.

Keywords: **Vermicomposting Process, Vermicompost and Applications, Earthworms and Organic Wastes**