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ÁREA: Síntese e caracterização de catalisadores e adsorventes

Magnetic zeolite for separation of gas mixtures

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Abstract

The search for sustainable energy sources, given the environmental impacts caused by the great demand for conventional energy sources, especially the anthropogenic production of greenhouse gases, involves the actions of several areas of science and research fields, in particular chemistry of materials. An important focus in this area is the development of porous materials, such as zeolites, which act as adsorbents in gas separation and purification processes. Biogas, formed mainly by methane (CH_4) and carbon dioxide (CO_2), accompanied by minor compounds such as sulfide and hydrogen (H_2S), is generated from the decomposition of organic waste in landfills and has great energy potential. Nonetheless, for optimal utilization, biogas must undergo purifying operations that involves the elimination of water and H_2S, as well as the enrichment that consists of the removal of CO_2 to increase its calorific value. Given the adsorptive properties of zeolites, they are widely used in the CO_2 removal. Once the zeolite is saturated, it demands a regeneration which can be achieved via heating. By considering the high costs involved in heat generation, a promising alternative is the modification of zeolites by impregnation of magnetic particle, allowing heating via magnetic induction to release the adsorbed CO_2. In this work, a composite based on zeolite A synthesized by employing fly ash (FA) and magnetite nanoparticles if presented. FA was first submitted to a series of treatments including the removal of water-soluble salts and the extraction of Fe-rich particles. Then, Si and Al present in the treated-FA sample was extracted by using 4.00 mol L^{-1} at 90 ℃ under magnetic stirring and reflux. Si:Al ratio of the solution obtained was adjusted by using $NaAlO_2$ and the reaction mixture was hydrothermally treated. Separately, magnetite nanoparticles were synthesized via a co-precipitation route. The prepared zeolite was dispersed in distilled water, heated at 60 C, submitted to mechanic stirring and to it a determined amount of the magnetic nanoparticles was added. The precursor materials and the produced composite were characterized by XRD, SEM and FTIR. The results show that zeolite A was successfully obtained from FA and is free of secondary phases. The composite is formed by magnetic nanoparticles dispersed throughout the surfaces of the zeolite particles, as intended. Complementary analyses of magnetic curves and induction heating are still necessary to better understand the features of the magnetic composite and assess its potential to heating via magnetic induction.

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Keywords: Zeolites, Magnetic Zeolites, Magnetic induction, Biogas.

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