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Application of the Zero Length Column (ZLC) Technique for Measuring Crystal Diffusivities of NaX and CeNaX Zeolites

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1. Introduction

The X zeolite is a porous crystalline aluminosilicate having unique structural properties such as uniform pores, high surface area and high ion exchange capacity. Its pores and cavities range from 3 to 12 Å, which coincides with the dimensions of many gas molecules. These molecules are transported from the surrounding into the interior through the micropores of the crystal, following an intracrystalline diffusion mechanism [1]. The zero length column (ZLC) technique, developed by Eic and Ruthven [2], provides the option of measuring diffusivities and Henry constants of the zeolites.
The aim of this study is to investigate the adsorption of N_2, CO_2 and CH_4 gases over NaX and CeNaX zeolites obtained with the exchange. The ultrasonic method was used as a method alternative to the traditional method of ion exchange.

2. Results and Discussion

Kinetic sorption was studied with the ZLC method. All calculations were made according to the desorption curves. The linearity of the response of the mass spectrometer with concentration was verified. This shows that the nature of the sorbate did not affect the response.
Between the adsorbents, NaX zeolite was found the best adsorbent for the N_2 adsoption according to the Henry constant. Henry constant was found lower for CeNaX zeolite obtained with the ultrasonic method when compared with the traditional method. Although ultrasound increased the exchange capacity of the X zeolite, it decreased the sorbent capacity. The ideal selectivity (S) values were calculated as the ratio of the Henry constants (K_A/K_B) for two components as an initial indicator how easy the separation would be [3]. The highest selectivity value between the gas pair was determined for CH_4-CO_2 over CeNaX zeolite obtained with the traditional method. All Henry's law constants decreased with increasing temperature, since adsorption is an exothermic process.

3.Conclusion

The present study was carried out under the condition of micropore diffusion control, because of the larger diffusion time. NaX zeolite should be preferred to CeNaX zeolite for N_2 adsorption. The selectivity value of CeNaX zeolite was found higher for CH_4 when compared with CO_2 and N_2.

References

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