Fe-BTC AND Fe-BTC DERIVED NANOPOROUS STRUCTURE: A KINETIC AND THERMODYNAMIC STUDY OF ALCOHOLS ADSORPTION

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Introduction

Due to environmental problems by excessive oil consumption and waste generated it has emerged in recent decades interest in the search for environmentally friendly fuels. Bioethanol and other biofuels are alternative environmentally friendly. They have been proposed various processes including evaporation, extraction liquid-liquid[1], gas extraction and adsorption on zeolites as possible alternative recovery of alcohols produced[1].

Metal-organic frameworks (MOFs) are prepared from organic ligands and the multi-dentate metal or small groups containing metals characterizing by having high porosity, to adjust the texture pore materials, as well as chemical superficial[4-10]. In this research, the applicability of the two structures is explored: Fe-BTC and a nano-porous structure (nFe-BTC) obtained by carbonization in an inert atmosphere, in the adsorption of a series of alcohols. The effect of the characteristics of the adsorbents on the adsorption of alcohols will be evaluated and thermodynamic and kinetic information will be acquired.

Materials and Methods

samples

Fe-BTC was synthesized following procedures reported by the literature[11] and later it was carbonized at 750 K (nFe-BTC). The two solids are used in the alcohol adsorption studies.

Characterization

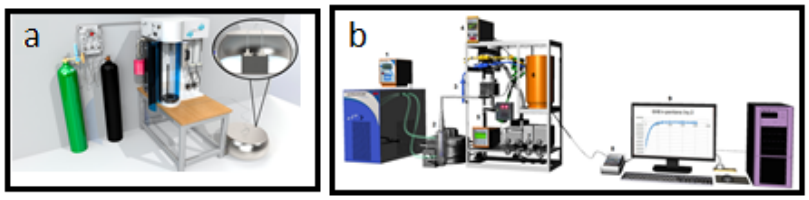

Figure 1. a) Adsorption calorimetry set-up used to determine the differential heat of adsorption of alcohols on MOFs b) Adsorption set-up used to determine of isotherms at different temperatures of alcohols on the prepared samples[12]

The MOFs are characterized by the adsorption-desorption of N_2 at 77 K. The specific surface areas were calculated by the method (BET). Characterization by XRD powder was carried out. The FTIR spectra were recorded for the two samples. The thermal stability was determined by the

thermogravimetric profile (TG). The morphology and microstructural characteristics were recorded by (SEM).

To determine both the adsorption isotherms of the alcohols investigated in this study and their interaction with Fe-BTC and nFe-BTC, a Tian-Calvet adsorption calorimeter constructed in our laboratory was used[12]. In Figure 1, a schematic of the equipment is presented. The parameters of the equilibrium adsorption and the kinetics of the process were determined.

Results and Discussion

The results obtained for the samples synthesized in this investigation presented characteristic SEM, DRX and FTIR (Fe-BTC and nFe-BTC). The results of the N_2 isotherms at 77 K correspond to compounds with a micro and meso porous structure and are reported in Table 1. The enthalpy of adsorption (Fe-BTC/alcohol and nFe-BTC/alcohol) indicates the intensity of the adsorbate-adsorbent interaction and is a function of the surface area of the solids.

Table 1. BET and pore features as prepared samples

samples	BET Surface Area (m^2g^{-1})	Pore Volume (cm^3g^{-1})	With Pore (Å)	External Surface (m^2g^{-1})
FeBTC	1135	0.89	15.6	435
nFeBTC	885	0.78	17.3	215

With respect to the adsorption isotherms, experimental data fit models Freundlich, Langmuir and Temkin and a better fit for all systems to model Langmuir observed. Kinetic data were fitted to models of pseudo-first-order and pseudo-second-order, with further adjustment to the latest model.

Conclusions

The adsorption of alcohols on Fe-BTC and nFe-BTC was studied. The process is affected by Fe-BTC and nFe-BTC characteristics as well as the properties of alcohols. The kinetics and adsorption isotherms were determined, and the behavior of the systems was better adjusted to the Langmuir isotherm. The adsorption kinetics followed the pseudo second-order model, where the adsorption rate is proportional to the concentration of the adsorbate. The enthalpy of adsorption indicates the interaction energy between the adsorbent and the adsorbate.

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