CO2 Adsorption Capacity of Zeolites Synthesized from Coal Fly Ash

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Considering the increasing of CO2 emissions to atmosphere a number of processes have been proposed in order to remove the CO2 from flue gas in pulverized coal-fired power plants. One of these processes is the temperature swing adsorption (TSA) due its smaller energy requirement to regenerate the adsorbent when compared to the liquid absorption processes. The adsorption is an exothermic phenomenon and occurs due its selectivity to some gases in porous materials. Some zeolites are strongly indicated for CO2 capture, mainly the types NaA and NaX. Moreover, it can be synthetesized from coal fly ash, combining environmental and economic issues. The aim of this study is measure the CO2 adsorption capacity of zeolites synthesized from coal fly ash and compare their capacity to commercial zeolites. All tests were carried out in the CO2 Capture Laboratory belonging to Associação Beneficente da Indústria Carbonífera de Santa Catarina (SATC). To this study were selected two powder zeolites synthetized from coal fly ash, NaX type (ZAXPO) and NaA type (ZAAPO) and two commercials pelletized zeolites, NaX type (ZCXPE) and NaA type (ZCAPE). The zeolites were characterized by XRF, XRD and textural analysis (BET). The adsorption capacity tests were carried out using a SDT (TGA-DSC), with CO2 concentrations similar to those found in flue gases from pulverized coal-fired power plants but without moisture. A high concentration of silicon, aluminum and sodium oxide (Na+ as exchangeable cations) were verified through XRF and it is typical on zeolites samples. Besides it, the exchangeable cations give to zeolites a basic character, what is responsible by the attraction of acidic molecules, such as CO2. In regards to the structural analysis (Table 1) the mean pore diameter values are typical to mesoporous materials, what is good to CO2 capture (3,3 Å). In addition, the samples presented a high specific surface area and total pore volume, given to these samples good characteristics to be applied to CO2 capture. The XRD shows a great similarity between the zeolites synthesized from coal fly ash and the commercial zeolites, where both present well defined and high intensity peaks, indicating a good degree of crystallinity. Even though the CO2 adsorption capacity of the synthetics NaX and NaA zeolites were a little lower than the adsorption capacity obtained from the commercial zeolites the values are yet very close to others reported on the literature, indicating that zeolites from coal fly ash can also be used in commercial applications. Using different temperatures, a substantial decreasing is observed in the CO2 adsorption capacity with linear behavior for all

samples. As the CO2 capture process is a physical and exothermic phenomenon, the adsorption capacity in zeolites decreases as the temperature increase, thus favoring the desorption.