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Carbon Dioxide Adsorbents on the Base of Fly Ash Zeolite X

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Extended Abstract

Greenhouse gas emissions are reaching alarming rates and they cause global climate change. Fossil fuels still comprise more than 80% of the total energy resources worldwide and they are the largest source of CO_2 emissions. This fact makes fossil fuel burning power plants the most logical targets for CO_2 reductions [1]. On the other hand the thermal power plants, based on coals, are the main source of fly ash (FA). The production of zeolite from FA would result in a good ingredient of high value as additive to cement. The aim of the present work is to obtain zeolite X by fusion of fly ash, originating from lignite coals burned in TPP. The purpose of this study also is to perform a preliminary study and develop a method to implement this sorbent in a power plant. The proposed CO_2 removal process involves sorption of CO_2 at 150−250°C and regeneration at up to 350°C. The operational temperature is ideal for CO_2 capture downstream to the water−gas shift reactor in an integrated gasification combined cycle power plant but is applicable to other warm gas cleanup processes as well.

The TPD of carbon dioxide curves for FA zeolite NaX (A) and referent zeolite NaX synthesized from pure chemicals (B) are presented in Figure 1.

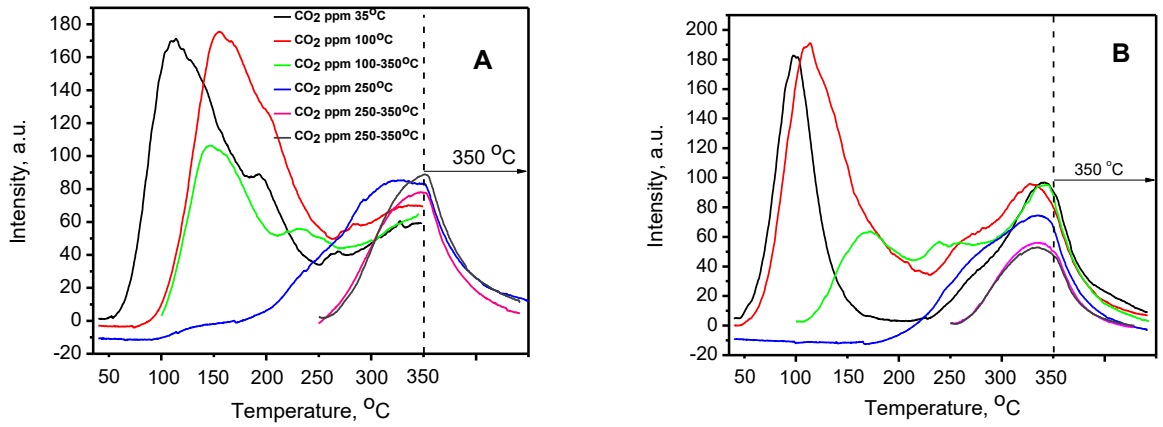

Figure 1. CO_2 TPD curves for FA-NaX (A) and reference NaX (B) at different temperature ranges.

The adsorption is carried out at several temperatures – 35, 100 and 250°C. It can be seen that the CO_2 capture from FANaX and NaX is comparable, especially when the adsorption is carried out at 35 and 100°C, follow by desorption in the range 35-350°C. When adsorption is performed at 250°C, the TPD curves in the range 35-350°C show higher CO_2 amount captured from FANaX than those from NaX. This fact shows that the sample synthesized from FA is more suitable for warm CO_2 capture than the reference although the specific surface area of NaX (621 m^2/g) is higher than that of FANaX (407 m2/g). This can be explained by the presence of magnesium oxide as an impurity in the fly ash that remains and is

contained in the synthesized zeolite. Magnesium sorbents are very effective for warm CO_2 capture [2]. This creates a better sorbent of material that initially contains elements that improve its efficiency in CO_2 capture.

A process for the utilization of fly ash to separate CO_2 at warm gas temperatures in a integrated gasification combined cycle power plant has been designed by synthesis of zeolite X. CO_2 capture is conducted in the temperature range 250-350°C with high effectiveness.

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