CO$_2$ capture by modified kaolinite minerals

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After industrial revolution, the CO$_2$ emission to the atmosphere has gradually increased, therefore it is more important to reduce the CO$_2$ discharge. Kaolinite, a common caly mineral, is a dioctahedral 1:1 phlosilicate formed by Si-O tetrahedral sheets and Al-O octahedral sheets. In this study, kaolinite minerals are used to capture CO$_2$ due to their layer structures and high adsorption efficiency. Moreover, the surface area and porosity of kaolinites are enhanced by acidic treatment. Kaolinites are also modified with MEA and EDA to promote the ability of CO$_2$ adsorption. The crystalline structures before and after acidic treatment and amine-modification would be analyzed by using X-ray diffractometer. The specific surface area and porosity would be examined by BET analyzer. The morphology would be observed by scanning electron microscope.

The results show that the best acid-treatment condition for kaolinite is with 3M H$_2$SO$_4$, reaction time of 10 hr, stirring rate of 100 r.p.m at 95 °C. The specific surface area increase from 18 m$^2$/g of the original kaolinite to 83 m$^2$/g of acid-treated kaolinite. And then the acid-treated kaolinite was modified by MEA and EDA. The CO$_2$ adsorption capacity was examined by thermo-gravimetric analyzer. It is observed that kaolinite with amine-modification has a better CO$_2$ adsorption capacity than that only with acid-treated kaolinite. The CO$_2$ adsorption mechanism via the property analysis before and after CO$_2$ adsorption will be discussed latter.

Keywords: Kaolinite, acid-treatment, amine-modification, CO$_2$ capture.