Pozzolanic Potential of the Calcined Clay-Lime System

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Abstract This study investigates the potential use of calcined clays from a mineralogical point of view by linking the characteristics of the untreated clays to the pozzolanic activity of the calcined clays. Since it is of key importance to understand the origin of the pozzolanic activity and to determine the main parameters that influence the pozzolanic activity, pure reference clays have been used to avoid interference of impurities.

Seven reference clays, 4 kaolinitic and 3 smectitic clays, were purified and thermally treated in order to estimate their pozzolanic potential in cementitious materials. The clays were calcined in a fixed-bed electrical furnace at temperatures ranging between 500 °C and 900 °C. Both raw and calcined clays were characterized by XRD, XRF, FTIR and BET techniques. Their pozzolanic activity was evaluated using thermogravimetry (TGA) on clay-lime pastes after 3, 7, 14, 28, 56 and 90 days.

The results indicate that all kaolinitic clays are highly active at a broad range of firing temperatures (500–900 °C), that is influenced by the degree of ordering of the kaolinite clay. The smectitic clays possess a more clear optimal firing temperature at 800 °C for montmorillonite and 700 °C for hectorite. The degree of ordering and thereby the specific surface area of kaolinitic clay, only influences the pozzolanic activity of the sample at the early stage of the reaction. After 28 days high, medium and low ordered kaolinites have consumed a similar amount of portlandite. Ca-rich smectites are proven to be somewhat more reactive than Na-rich smectite and hectorite, however, even at 800 °C, its activity is only mediocre compared to kaolinite. The activity of the smectitic clays might be influenced by the present cation or/and the difference in specific surface area.

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