

Microporous and Mesoporous Materials

Transformation of fly ash based nanosilica extract to BEA zeolite and its durability in hot liquid

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Abstract

Power generation in South Africa relies heavily on the combustion of coal and during this process, coal fly ash (CFA) is generated as by-product, which raises several environmental issues. The transformation of CFA into a value added zeolite product is a potential beneficial way to manage and reduce the negative environmental impact of the waste. The present study describes suitable formulations of the synthesis of BEA zeolite from South Africa CFA via an indirect hydrothermal process without the addition of an external silica or aluminium source. Herein, the Si/Al ratio of the nanosilica extract significantly increased from 11 to 48, 53 or 61 depending on applied conditions, thus elucidating that the major component in the extract is 92% silica, with a high purity of 94%. A pure phase BEA zeolite was obtained after the hydrothermal crystallisation of the synthesis precursor with Si/Al ratio of 53 or 61 at 140 C for 24, 48 or 72 h. The BEA zeolites are micron-sized crystals with high thermal framework stability, high surface area and contained mainly framework but some extra framework Al acid sites. Under hot liquid phase treatment, the BEA zeolite framework maintained structural integrity with no phase transformation at elevated treatment duration and temperature.