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Transformation of South African coal fly ash into ZSM-5 zeolite and its application as an MTO catalyst

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ABSTRACT:

This study presents a way of using South African coal fly ash by extracting metals such as Al and Fe with concentrated sulphuric acid, and then using the solid residue as a feedstock for the synthesis of ZSM-5 zeolite. The percentage of aluminium and iron oxides decreased from 28.0 ± 0.2% and 5.0 ± 0.1% in coal fly ash to 24.6 ± 0.1% and 1.6 ± 0.01% in the acid treated coal fly ash respectively. The fly ash-based zeolite ZSM-5 sample synthesised from the solid residue after extraction of Al and Fe, contained 62% of ZSM-5 zeolite pure phase with a number of Brønsted acid site density of 0.61 mmol per gzeolite.
By properly treating the as-prepared coal fly ash-based ZSM-5 zeolite, an active and selective methanol-to-olefins acid catalyst could be designed, leading to full methanol conversion during 15 h on stream. The optimised catalyst exhibited a cumulative methanol conversion capacity of 71 g(MeOHconverted)/g(catalyst) and a light olefin productivity of 21 g(C2¼eC4¼)/g(catalyst).