

Influence of aluminium source on the crystal structure and framework coordination of Al and Si in fly ash-based zeolite NaA

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ABSTRACT:

In this study zeolite NaA with different crystal sizes and % crystallinity was prepared from a clear solution extract of fused fly ash. Sodium aluminate or aluminium hydroxide was used to adjust the aluminium content in the fused fly ash extract and hence adjust the Si/Al ratio of the various synthesis molar regimes for the synthesis of zeolite NaA. Each molar regime was hydrothermally treated for 3 h at 100 °C. Chemical, mineralogical, morphological and structural composition of the synthesized products was determined using XRF, laser ablation ICP-MS, XRD, SEM and ^{29}Si and ^{27}Al NMR. This study showed that the variation of Si/Al ratio of the synthesis mixture (0.27 to 0.80) allowed control of zeolite NaA crystal/sizes that ranged from 0.67 to 3.18 μm . The decrease in Si/Al ratio of the synthesis mixture was proportional to the crystal size (μm) and the ^{29}Si NMR peak width and area of the synthesized zeolite NaA. The increase in crystallinity and decreases in crystal size caused the ^{29}Si NMR peak width to be narrower as the peak area reduces. Interestingly, the Si/Al ratio of the synthesis mixture was inversely proportional to the crystallinity of zeolite NaA when Na-aluminate was used as Al source. The effect of Al source was also noticed by the appearance of a small additional distorted tetrahedral Al peak between 15 and 17 ppm (^{27}Al NMR) when Al-hydroxide was added to fused fly ash extract.