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OPTIMIZED CONDITIONS FOR SYNTHESIS OF Na-A ZEOLITE FROM COAL FLY ASH BY APPLYING THE RESPONSE SURFACE METHODOLOGY

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ABSTRACT

Response Surface Methodology (RSM) was used in this study to determine the optimum conditions for the synthesis of Na-A zeolites from coal fly ash (CFA). Application of this methodology allows a better understanding of the influence of various factors (Si/Al ratio (0.5-1.5), incubation temperature (70-120 °C) and time of incubation (2–4 days)) on the synthesis of zeolites. The Box–Behnken design was applied with different levels of the factors, determining its influence on yield percent in order to obtain contour plots. The silicates and aluminates were extracted from coal fly ash (CFA) with 4M NaOH solution assisted by microwave irradiation (power level 100 watts) for 6 minutes followed by incubation at various temperatures. The products isolated were characterized by their XRD images and found to be Na-A zeolites, sodalite octahydrate and gibbsite. The highest percent yield of product was obtained at 0.5 SiO_2/Al_2O_3 molar ratio, 70 °C incubation temperature for 3 days, the product however, was not a zeolite. It was gibbsite which contains $Al(OH)_3$. Na-A zeolite was formed at SiO_2/Al_2O_3 molar ratio 1-1.5, incubation temperature was 70 – 95 °C and 2-4 days of incubation and the highest yield was observed at $SiO_2\backslash Al_2O_3$ ratio = 1, incubation temperature 70 ^oC for 4 days. The contour plots showed that the yield percent of the product was inversely proportional to the three factors used. The order of effectiveness of the factors on yield percent is: SiO_2/Al_2O_3 molar ratio > incubation temperature > duration of incubation.

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