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Response Surface Methodology for Optimizing Zeolite Na-A Synthesis

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Abstract

A statistical technique for optimizing zeolite Na-A synthesis as a function of percent yield was investigated. A two-step hydrothermal treatment method assisted by microwave heating was applied on the extracted ion solution for zeolites synthesis. The optimization sequence included the application of an experimental design and the results obtained were fitted to a second order model. The resultant predicted data were used in creation of an optimal set of conditions. Box–Behnken design of response surface methodology of three factors with three levels was applied. The three factors which have been adopted were NaOH concentration (2, 4 and 6 M), microwave power level (10, 55 and 100 % of 800 W) and time of exposure to the irradiation (1, 3.5 and 6 min). With the application of the above experimental design three solid products, Na-A zeolite, sodalite octahydrate and gibbsite were formed. The three products were characterized by their X-ray diffraction images. It was found that the percent yield of Na-A zeolite would be optimized when the extracted Si ion concentration in the response optimizer was higher than 2,000 ppm and the base used in the extraction not more than 4 M. The optimum conditions to maximize the percent yield of zeolite Na-A were 3.8 M of NaOH, 2.5 min of time and 48.2 % W of microwave power level.