



## Effect of synthesis parameters on the formation 4A zeolite crystals: characterization analysis and heavy metals uptake performance study for water treatment

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Received 15 March 2019; Accepted 12 June 2019

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### ABSTRACT

This paper sheds light on key factors controlling the growth of 4A zeolite crystals during a conventional hydrothermal synthesis.  $\text{SiO}_2/\text{Al}_2\text{O}_3$  ratio,  $\text{Na}_2\text{O}/\text{SiO}_2$  ratio,  $\text{H}_2\text{O}/\text{Na}_2\text{O}$  ratio, crystallization time and crystallization temperature affecting zeolite growth during the hydrothermal synthesis were investigated. Optimizing the  $\text{SiO}_2/\text{Al}_2\text{O}_3$  ratio,  $\text{Na}_2\text{O}/\text{SiO}_2$  ratio and  $\text{H}_2\text{O}/\text{Na}_2\text{O}$  ratio crucially controls the formation of pure zeolite. It was found that mild alkalinity favors crystallization of 4A zeolite. Also for a chosen gel formula, crystallization temperature and time significantly affect the morphology and crystal size of the final products. Conducting the crystallization at 100°C for 4 h produced crystals having cubic morphology with planar surfaces, well-defined and sharp edges. Rietveld refinement analysis was used to study the influence of crystallization temperature on the structure of 4A zeolite. The micro strain values for an amorphous sample significantly varied from those values for the well-crystallized samples. Also, the efficacy of the prepared 4A zeolite for heavy metal removal was examined with both nickel and lead ions. All 4A zeolite samples showed significant heavy metal uptakes due to obtaining a well-crystallized structure which offers sufficient surface area for ion-exchange. Removal of lead ion encompasses both ion-exchange and precipitation process simultaneously.

*Keywords:* 4A zeolite; Hydrothermal synthesis; Characterization; Ion-exchange; Nickel; Lead

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