

## **Modification of a Natural Zeolite with a Short-Chain Quaternary Ammonium Salt in an Ultrasonication Process and Investigation of Its Ability to Eliminate Nitrate Ions: Characterization and Mechanism Study**

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**Abstract :** This work mainly focuses on studying the mechanism governing the adsorption of tetraethylammonium bromide, a short-chain quaternary ammonium salt, on the surface of natural zeolite and to characterize modified and raw zeolites in order to study the removal of nitrate anions from water. Natural clinoptilolite, as the most common zeolite, was chosen and modified in an ultrasonication process using tetraethylammonium bromide, subsequent to being contacted with NaCl solutions. FT-IR studies indicated a peak attributed to the stretching vibrations of the  $-CH_2$  group in the molecule of tetraethylammonium bromide in the spectrum of the modified sample. Moreover, the SEM images showed some obvious changes in the surface morphology and crystallinity of clinoptilolite after being modified. Batch adsorption experiments show that the modified zeolite is capable of removing nitrate anions, and the predominant removal mechanism is suggested to be a combination of electrostatic attraction and ion exchange since the results from the zeta potential analysis showed a decrease in the net negative charge of clinoptilolite after modification, while bromide ions were detected in the modified sample in the  $\mu$ XRF analysis.

**Keywords :** adsorption, clinoptilolite, short-chain quaternary ammonium salt, tetraethylammoniumbromide, ultrasonication

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