ClinOPT - OPTIMIZATION OF THE AMMONIUM UPTAKE OF NATURAL CLINOPTILOLITE FOR ENVIRONMENTAL APPLICATIONS

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Natural clinoptilolite and other zeolite rocks are used in different industrial applications and present an attractive material for environmental purification processes due to their high abundance and low costs of production. Based on its capability to easily exchange alkaline and earth alkaline cations it is possible to adapt clinoptilolite to special needs in industrial waste water treatment. In this contribution we present how in-situ NaOH-liquid-treatments of natural clinoptilolite can influence mineral chemistry, and therefore enhance ammonium uptake within a new industrial process ("ion-exchanger-loop-stripping"). The effects are compared to conventional treatment with NaCl and/or HCl.

Natural clinoptilolite (2.5 kg) from Romania was treated in column experiments operated in upflow mode for 24 h by continuously recycling 20 L of NaOH-, NaCl-, NaCl & HCl-, HCl-solution and deionized water, respectively. Duplicate subsamples of the treated material were taken for combined mineralogical and chemical analyses (XRD, EPMA, XRF). Additionally, liquid analysis of the feeding solution before and after the treatment process was conducted by ICP-MS to complete mass balances for the liquid phase. Ammonium uptake experiments were carried out by adding 20 g of treated material and 500 ml of ammonium sulphate solution (concentration range 500-5000mg NH_4^+ L^{-1}) into an overhead shaker for 24 h. Ammonium was then analysed before and after ion exchange using Kjedahl method.

It can be demonstrated that NaOH treatment of natural zeolites has a strong influence on the exchangeable cation composition and, to some extent, decreases the Si/Al-ratio of the zeolite. Zeolite particles (1.5-2 mm) changed during the treatment resulting in the formation of an altered outer zone in each particle. This alteration zone is characterized by a measureable change of the composition of the exchanged cations, such as a significant increase of Na and decrease in K. It could be shown that pre-treatment of natural clinoptilolite with NaOH can enhance its performance to exchange ammonium in industrial processes (+25%). Pre-treatment allows to create a semi-artificial material, which can be adapted to specific demands for environmental applications such as the denitrification of liquid effluents from biogas and sewage treatment plants.