American Mineralogist, Volume 104, pages 317–324, 2019

Outlooks in Earth and Planetary Materials

Highlighting the capability of zeolites for agro-chemicals contaminants removal from aqueous matrix: Evidence of 2-ethyl-6-methylaniline adsorption on ZSM-12

Elisa Rodeghero[1], Luisa Pasti[2,*,†], Giuseppe Nunziante[1], Tatiana Chenet[2], Lara Gigli[3], Jasper R. Plaisier[3], and Annalisa Martucci[4,*]

[1]Department of Physics and Earth Sciences, University of Ferrara, via Saragt 1, I-44100 Ferrara, Italy
[2]Department of Chemistry and Pharmaceutical Sciences, University of Ferrara, I-44100 Ferrara, Italy
[3]Elettra-Sincrotrone Trieste, I-34149, Basovizza Trieste, Italy
[4]Department of Physics and Earth Sciences, University of Ferrara, via Saragt 1, I-44100 Ferrara, Italy; Orcid 0000-0002-6467-881X

Abstract

Chloroacetanilides and their degradation products are frequently detected in surface and subsurface water due to their relatively high water solubility and their high potential to leach and migrate through the soil and contaminate groundwater.

In this study, we explored for the first time the capability of ZSM-12 zeolite for 2-ethyl-6-methylaniline [$C_2H_5C_6H_3(CH_3)NH_2$, labeled EMA] removal from water by combining chromatographic, thermogravimetric, and synchrotron X-ray powder diffractometric techniques. Rietveld refinement revealed the incorporation of about 4 EMA molecules per unit cell, in very good agreement with the weight loss given by TG analyses and with the saturation capacity determined by the adsorption isotherms.

The formation of supramolecular complexes mediated by co-adsorbed water and their strong interaction to framework O atoms confers stability to the pollutants in the zeolite cages. This prevents adsorbed molecules from desorbing as well as the entering of other competitive molecules. The rapid kinetics combined with the good adsorption capacity makes ZSM-12 a promising material to control and minimize water pollution from acetanilide compounds as well as other agro-chemicals contaminants.

Keywords: 2-ethyl-6-methylaniline adsorption, water pollution, ZSM-12, chromatography, thermogravimetry, synchrotron X-ray powder diffraction; Microporous Materials: Crystal-chemistry, properties, and utilizations