

Arsenic removal from water using a modified rutile ore and the preliminary mechanisms

Lin Ma, Shuxin Tu*

*Department of Environmental Sciences and Engineering, Huazhong Agricultural University, Wuhan 430070, China
email: stu@mail.hzau.edu.cn*

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ABSTRACT

Titanium dioxide (TiO₂) has a greater removal capacity of arsenic (As) from water, however, its practical application in water treatment is limited due to its high cost and handling difficulty. Thus, development of rutile ore (RO) (a natural ore containing titanium dioxide) as an adsorbent for As removal from water is of great significance in reducing treatment cost of As polluted water. Batch experiments were carried out to evaluate the As removal capacity of FeCl₃ modified RO (FMRO) and the preliminary mechanisms characterized by using scanning electron microscopy (SEM), X-ray diffraction (XRD) microanalysis, Fourier-transform infrared spectroscopy (FT-IR), and X-ray photoelectron spectroscopy (XPS). The results showed that ferric modification of RO increased As adsorption from water by 10 times over RO, and both minerals absorbed more As(V) than As(III). The As(V) and As(III) adsorption behavior of FMRO and RO could be best described by Freundlich equation. The effect of solution pH on As removal obviously presented the characteristic of parabola with a maximum around pH = 4. NaOH at concentration of 0.1 mol L⁻¹ desorbed As(V) or As(III)-treated FMRO efficiently, and the regenerated FMRO could be reused. FT-IR characterization of As-treated FMRO indicated the presence of both Fe–O and As–O groups and supported the concept of surface complex formation. XPS analysis indicated that As(III) was oxidized and adsorbed in the form of As(V) on the surface of FMRO. These results explained the preliminary mechanisms of a high As absorption capacity of FMRO, and suggested that FMRO be a promising sorbent for As removal because of its ideal efficacy of As removal, rich sources of material, easy operation and handling as well as low cost.

Keywords: Rutile ore; Ferric modification; As-contaminated water; Removal percentage; Column experiments

* Corresponding author.