Adsorption of Cr(VI) by Metal-doped Maghemite Nanoparticles

Irene M. C. Lo*, Jing Hu[1] and Guohua Chen [2]

In this study, various metals (Cu, Zn, Mg, Ni and Al) doped into maghemite nanoparticles were synthesized and examined for Cr(VI) adsorption. The preliminary batch adsorption results showed that doping Al, Cu or Mg into maghemite could enhance Cr(VI) adsorption while doping Ni or Zn could reduce the adsorption capacity of maghemite. Aluminum doping gives the best result with the adsorption capacity enhanced by 25%. The effects of the aluminum dosage on the adsorption efficiency, adsorption rate, and magnetic separation were therefore investigated and compared with pure maghemite. The optimal dosage was found to be 9.3% aluminum and the nanoparticles made from this dosage were used in equilibrium adsorption and mechanism studies. The data on Cr(VI) adsorption fit well with Langmuir isotherm. The effects of contact time and solution pH on undoped or Al-doped maghemite were studied to determine the possible dissolution of nanosized particles. It was observed that the dissolution of maghemite nanoparticles was insignificant under normal adsorption conditions but was significant under very acidic pH and after a much longer contact time. However, doping aluminum into maghemite prevented nanoparticle dissolution by 30%. Raman spectroscopic studies suggest that Al-doping on maghemite changed the adsorption mechanism between Cr(VI) and the nanoparticles from a weak electrostatic attraction into specific complexation.

* Corresponding author. Assoc. Professor, Dept. of Civil Engineering, The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong. E-mail: cemclo@ust.hk; phone: (852)23587147; fax: (852)23581534.

[1] Research Assistant, Environmental Engineering Program, Institute for the Environment, The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong.

[2] Assoc. Professor, Dept. of Chemical Engineering, The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong.