



Influence of pH and temperature on Cr(VI) removal from a natural water using Fe(II): A pilot and full scale case study

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ABSTRACT

Aqueous Cr(VI) removal using Fe(II) was studied in a natural water as a function of temperature and pH, in kinetic batch experiments and also in a pilot and a full scale study. Temperature and pH strongly influenced the reduction of Cr(VI) by Fe(II). The reaction rate was increased by increasing pH in the range between 6 and 8 commonly encountered in natural waters. At 25°C and pH values higher than 7, maximum Cr(VI) removal was achieved at a reaction time equal or less than 5 min. The reaction followed a second order rate equation $\{-d[\text{Cr(VI)}]/dt = k_{\text{obs}}[\text{Cr(VI)}][\text{Fe(II)}][\text{Cr(VI)}]\}$ with $k_{\text{obs}}[\text{Cr(VI)}] \geq 1 \times 10^4 \text{ M}^{-1}\text{s}^{-1}$. Reaction rate was also increased by increasing temperature from 10°C to 40°C, confirming the endothermic character of the reaction. Dissolved oxygen strongly competed with Cr(VI) in Fe(II) oxidation and batch experiments showed an increase of the reaction ratio $[\text{Fe(II)}]/[\text{Cr(VI)}]$ from the almost stoichiometric value 3.1 at pH 6 to 25 at pH 8. These reaction ratio values were also verified by the pilot as well as by the full scale experiments. In addition pilot and full scale experiments proved that the sand bed contributed to the oxidation of the excess Fe(II) dose, improving in turn the removal of chromium precipitates. This was attributed to a surface effect due to ferric oxy-hydroxides retained on the sand bed, whose surface hydroxyl groups coordinated with Fe(II) increasing its oxidation rate and removal.

Keywords: Chromate; Ferrous; pH; Temperature; Sand-filter

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