

Removal of TcO_4^- using zero-valent manganese

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After the FDNPP accident, Tc-99 is recovered by anion-exchange resin in ALPS from the contaminated water. Since anion-exchange resin is concerned about gas generation by radiolysis, an alternative recover of Tc-99 should be challenged for final disposal. Zero-valent metals have been widely studied for reductive remediation of toxic metals due to their suitable redox potentials[1-3]. We here studied the removal of dissolved Tc-99 in aqueous water by using zero-valent metals for the reduction of $\text{Tc}^{7+}_{(\text{aq})}$ to $\text{Tc}^{4+}_{(\text{s})}$. We examined the removal of ReO_4^- (as an alternative of TcO_4^-) using zero valent Mn, Fe, Co, and Cu (Mn^0 , Fe^0 , Co^0 , Cu^0 , respectively), and chemical species change of the Re after the treatment by Mn^0 .

Removal experiments of ReO_4^- were conducted that a 6.67 g/L of zero-valent metal was suspended in 30 mL of 0.01 mg/L ReO_4^- stock solution under anaerobic condition.

Removal ratios of ReO_4^- after the treatment of the metals are obtained ~99% by Mn^0 , ~60% by Fe^0 ~30% by Co^0 , and ~2% by Cu^0 , indicating the highest removal of ReO_4^- by Mn^0 among the metals used. Time course of the removal ratio of ReO_4^- by Mn^0 showed that ReO_4^- was abruptly increased up to 98% within 2h at pH5.5. Re L_{III}-edge XANES spectra indicated chemical species change of ReO_4^- to Re^{3+} after the treatment by Mn^0 . XRD spectra of Mn^0 after the treatment was correspond to $\text{Mn}(\text{OH})_2$.

These results indicate that dominant removal mechanism of ReO_4^- by Mn^0 was the formation of insoluble Re oxides by collaborated redox reactions of Re^{7+} to Re^{3+} with Mn^0 to Mn^{2+} . Our results strongly suggest that Mn^0 is an adequate reductant for the removal of TcO_4^- from aqueous solution.

[1] Sherman M. P *et al.* (2000) *Environ. Sci. Technol.* **34**, 2564-25690.

[2] B. Gu *et al.* (1998) *Environ. Sci. Technol.* **32**, 3366-3373.

[3] Noubactep C. (2010) *Water SA*, **36**, 663-670.