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# Investigating the suitability of Fe<sup>0</sup> packed-beds for water defluoridation

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## Abstract

A commercial granular metallic iron (Fe<sup>0</sup>) specimen was used to evaluate the suitability of Fe<sup>0</sup> materials for removing aqueous fluoride (F<sup>-</sup>) (water defluoridation). Experiments were performed to characterize the defluoridation potential of the tested Fe<sup>0</sup> as influenced by the presence of chloride (Cl<sup>-</sup>) and bicarbonate (HCO<sub>3</sub><sup>-</sup>) ions using tap water (H<sub>2</sub>O) as operational reference system. Duplicate column studies were conducted for 120 days (4 months) using an initial F<sup>-</sup> concentration of 22.5 mg L<sup>-1</sup>, columns flow rates were about 17 mL h<sup>-1</sup>. Each column contained a reactive layer (11 cm) made up of 100 g of Fe<sup>0</sup> in a 1:1 volumetric Fe<sup>0</sup>:sand mixture. The reactive layer was sandwiched between two layers of the same sand. A pure sand column was used as control system. After the F<sup>-</sup> removal experiments, the columns were flushed by methylene blue (MB) and Orange II for 21 days. Removal studies revealed (i) no F<sup>-</sup> removal in the control system, (ii) no F<sup>-</sup> significant removal on the Cl<sup>-</sup> system, (iii) limited F<sup>-</sup> removal in the HCO<sub>3</sub><sup>-</sup> system, and (iv) the best F<sup>-</sup> removal efficiency in tap water (H<sub>2</sub>O). Dye flushing studies confirmed the ion-selective nature of the Fe<sup>0</sup>/H<sub>2</sub>O system and demonstrated the relatively low efficiency of the same for F<sup>-</sup> removal. The overall results challenge the prevailing perception that water defluoridation using granular Fe<sup>0</sup> is not possible and suggest that effective water defluoridation in Fe<sup>0</sup> packed-beds is pure a site-specific design issue.

**Keywords:** Frugal innovation, Fluoride determination, packed-bed adsorption, Water defluoridation, Zero-valent iron.

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