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Evaluation of several inorganic reductant/adsorbent materials for Cr(VI) removal by rapid small-scale column tests

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ABSTRACT

This article reports on the results of continuous flow tests for a variety of Cr(VI) inorganic reductants/adsorbents, including zero-valent metals (Fe^0, Mg^0, Zn^0, Cu^0), iron oxides (Fe_3O_4), iron oxy-hydroxides (FeOOH), iron sulphides (FeS/Fe_2S_3) and SnS, with respect to their potential implementation for drinking water treatment. The selection criteria for the examined materials were based on their high efficiency during batch experiments, along with their low toxicity to human health, directly related to the respective regulation limits. Among zero-valent metals tested, only Fe^0 can completely remove Cr(VI), while the leached concentration of Fe and Zn overpasses the corresponding drinking water regulation limits. Iron sulphides can minimize Cr(VI) at sub-ppb level, yet leached Fe(II) concentration is substantially higher than the drinking water regulation limit of 0.2 mg/L. Similarly, SnS can minimize Cr(VI) at sub-ppb level, although leached Sn concentration overpasses the aesthetic limit for drinking water quality. Iron oxy-hydroxide proved effective for Cr(VI) removal at sub-ppb level, preserving simultaneously the water quality. However, its relatively low adsorption capacity (0.1 mg Cr(VI)/g FeOOH) is a significant drawback for full-scale implementation. Among the examined adsorbents only magnetite presented sufficient uptake capacity (4 mg Cr(VI)/g Fe_3O_4) at the breakthrough concentration of the upcoming regulation limit of 10 μg/L, without downgrading water quality, and thus qualified for drinking water treatment.

Keywords: Cr(VI) removal; Drinking water; Reductants; Adsorbents; Evaluation; RSSCTs

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