

# Reduction of Chromate and Chlorate Using Zero Valent Iron (ZVI) and Bio-ZV

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**Background/Objectives.** Canada, the US, China, Finland and Brazil are the world's largest producers of chlorates, about 4 million tons/year. Chlorates are used widely in electrolytic processes, including in the manufacturing of chlorine dioxide for bleaching in the paper industry. To prevent corrosion of the electrodes used in the electrolytic processes, the cathodes are generally covered with alkali metal dichromate, specifically sodium dichromate. As a consequence, at pulp and paper mills and other industries, chlorate and chromate occur as co-contaminants. Chlorate and chromium are also found as co-contaminants in wastes from perchlorate manufacturing facilities. This research focuses on the removal of high levels of hexavalent chromium (Chromate) and chlorate from water using zero valent iron (ZVI). Reduction of both contaminants using both ZVI alone (i.e., abiotic reduction) and ZVI augmented with biological reduction (BIO-ZVI) are evaluated.

**Approach/Activities.** Batch ZVI treatment used 80 mL glass vials containing various water compositions, substrate, and biomass. ZVI dosages varied from 10 X to 400 X stoichiometric ratios. Fisher Chemical 50-70 mesh iron filings, degreased were utilized. Batch experiments were performed using both, chromium alone and chromium in combination with chlorate. Testing was also performed using two transparent acrylic columns, 2.54 cm diameter by 91.44 cm long. Each column was packed with a 20 cm layer of 90% sand, 10% ZVI followed by a layer 10 cm layer of ZVI iron. Column-A used 0.35-0.45 mm sand (Red Flint Sand & Gravel) and column-B utilized 0.70-0.80 mm sand (Red Flint Sand & Gravel). The influent was fed upflow using a peristaltic pump. Chlorate and chromium concentrations were measured, before and after treatment. The pH was also monitored, as it is expected to increase due to the ZVI interactions with water.

**Results/Lessons Learned.** The results show that for chromium concentrations varying from 5 to 40 mg/L were completely degraded within 2 hours for ZVI ratios of 100 X stoichiometric. Removal of chlorate, 100 mg/L, took much longer, 162 hours. Biotic data showed that, within the time frame of abiotic reduction, 162 hours, the biological reduction of both chromate and chlorate were insignificant and therefore ZVI reduction have faster kinetics than biotic reduction. Therefore, abiotic ZVI is a potential technology that can be applied to contaminated water in which chlorate and chromate occur together. Although the dosages of ZVI needed are relatively high, the low cost of ZVI makes this technology very feasible.