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REMOVAL OF MANGANESE FROM WATER BY PRECIPITATION – A PLACKETT-BURMAN STATISTICAL APPROACH

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Abstract

One common contaminant in treating natural water for human consumption is Mn^{2+}. In concentrations above 0.02 mg L^{-1}, it can generate the "black water" phenomenon causing organoleptic changes. One of the techniques to remove this contaminant involves oxidation of the soluble Mn species to solid MnO_2 followed by filtration. To facilitate the reaction between Mn^{2+} and the oxidizing agent, a possible strategy is the use of adsorption agents with a catalytical role. In the present work, a study based on a statistical design by Plackett-Burman with the adsorption system containing MnO_2 and/or $Fe(OH)_3$ was carried out to remove manganese using hydrogen peroxide as oxidizing agent. Environmentally, hydrogen peroxide is preferable to traditional oxidizing agents, as its decomposition releases water and molecular oxygen. Seven parameters were chosen for statistical analysis of possible effects: pH; initial concentration of hydrogen peroxide; alkalinity; presence or absence of adsorbents (MnO_2; $Fe(OH)_3$) and flocculants (Fe^{2+}; Fe^{3+} ions). The dependent variables evaluated by the ANOVA were the removal rate and efficiency of Mn ions and H_2O_2 consumption. A significant influence of pH was observed concerning the Mn removal efficiency. Increasing pH from 6 to 9 tripled the removal efficiency. As for the consumption of hydrogen peroxide, most evaluated factors were found to be significant - possibly due to the complex nature of the system where several reactions occur consuming H_2O_2, including its self-decomposition. In four of the eight evaluated conditions, [Mn] fell from 2.0 to less than 0.1 mg L^{-1} after 30 min of reaction time.

Key words: advanced oxidative process, black water, catalytic oxidation, surface water, water treatment

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