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Development of Activated Iron Oxide Soil Pellets to Study the Filtering Efficiency of Fluoride Ions in Aqueous Fluoride Solutions

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Abstract

Fluoride in drinking water has become a severe problem especially in the dry zone of the Sri Lanka. The common methods available for removal of fluoride from aqueous solutions are not practical. Therefore there is a high demand for reliable fluoride removal techniques. Thus, natural red earth has been selected as the filter material. The main objective of this study is to investigate properties available in red earth to develop activated red earth pellets with the aim of removal of fluoride in prepared aqueous solutions. Red earth pellets were prepared using metal dies. Then the pellets were thermally activated. As control media raw red earth was used to compere the filtering efficiencies. Filtering process was conducted in three filters based on different influential fluoride concentrations of 1.5 ppm (filter A), 2.5 ppm (filter B) and 3.5 ppm (filter C). Each filter maintain with three filter columns which was filled by raw red earth, activated red earth and activated red earth pellets. The filtering process was conducted for 20 days until basic physical changes occur in the system. Results revealed that physical conditions of the red earth such as very low levels of trace metals, organic matter (OM), inorganic carbon and total organic carbon (TOC) are useful for the better filtering process and very fine unconsolidated nature provide passage for better infiltration. In general, raw red earth and activated red earth pellets have shown good filtering performances for the fluoride. According to the statistical analysis, filtering of low fluoride levels (1.5 ppm), red earth pellets are successful. Filtering of moderate level of fluoride (2.5 ppm) there was no difference among raw red earth and activated red earth pellets. However, activated red earth pellets can be recommended due to less turbidity in filtrate, durability, and easy handling. Conversely, to filter the higher fluoride values (3.5 ppm) raw red earth is the suitable media. In contrast, Fourier Transfer Infra–Red (FTIR) analysis for the filter materials shows possible vacant adsorption sites even after the completion of the experiment. Those vacant sites revealed additional capacity in the filter media. Also, the available adsorption sites have been diminished during the filtering, which can be concluded as the absorbance of fluoride on to them.

Keywords: Red earth, Pellets, Filtering, Efficiency, Fluoride, Activation