ADDIS ABABA UNIVERSITY

RESEARCH AND GRADUATE PROGRAMS

DEPARTMENT OF CHEMISTRY

FLUORIDE REMOVAL FROM WATER USING MAGNETIC IRON OXIDE / ALUMINIUM HYDROXIDE COMPOSITE

A Thesis Submitted to the Chemistry Department

in Partial Fulfillment of the Requirements for the Degree of Master of Science in Analytical Chemistry

By

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ABSTRACT

This study adopted the adsorption technique among the different fluoride removal methods. In this study, magnetic iron oxide/aluminum hydroxide composite material was used as adsorbent for the removal of fluoride from water. The adsorbent was synthesized and characterized for its surface properties and mineralogy using potentiometric mass titration and X-ray diffraction spectroscopic method, respectively. The result of XRD peak indicated that the structure of iron oxide was crystalline regardless of the different mass ratio of iron oxide and aluminum hydroxide. The point of zero charge was 9.5, indicating that the surface of $Fe_3O_4/Al(OH)_3$ is positively charge which is favorable condition for the adsorption of fluoride ion.

The adsorption of fluoride on iron oxide/aluminum hydroxide was investigated using batch adsorption techniques. A series of experiments were carried out to investigate factors such as proportion of magnetic iron oxide and aluminum hydroxide, effect of adsorbent dosage, contact time, initial concentration, pH of the solution and effect of co-existing ions.

Results showed that at optimal mass ratio 5:2 of $Fe_3O_4/Al(OH)_3$ and adsorbent dosage at 4 g/L. The fluoride removal efficiency was found to be 89% from the initial concentration 10 mg/L. This was confirmed by the experimental data. In general isotherm models followed the order: Freundlich > Langumir > D-R. The maximum adsorption capacity of $Fe_3O_4/Al(OH)_3$ was found to be 6.67 mg/g in the concentration range used in this study. The adsorption of fluoride onto $Fe_3O_4/Al(OH)_3$ proceeds according to a pseudo-second-order model. Among anions investigated, bicarbonates and phosphates exhibited high effect on fluoride adsorption while anions like nitrates, chlorides, and sulfates have not seriously affected the process. Therefore, the magnetic $Fe_3O_4/Al(OH)_3$ is an effective adsorbent for fluoride removal from drinking water.