CHEMICAL STUDIES ON THE DEFLUORIDATION OF FLUORIDE-RICH WATER

A THESIS PRESENTED BY

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ABSTRACT

Previous epidemilogical studies showed that dental fluorosis is endemic in the Dry Zone of Sri Lanka which is considered to be an area of excess fluoride in drinking water supplies. A simple and inexpensive method of defluoridation of these fluoride - rich water was required.

In the first stage of this work it was found that kaolinitic clay forms a suitable raw material in the defluoridation process. Preliminary investigations were conducted to determine both the mineral and chemical composition of clay. The following studies were carried out.

(a) Fluoride adsorption (b) fluoride desorption (c) sequential adsorption

(d) interaction of water with fluoride adsorption (e) kinetic studies

(f) effect of media pH/conductivity (g) thermodynamic properties for fluoride adsorption and (h) spectroscopic studies, XRD and IR for raw and fluoride treated clay.

When clay is used it was found that a concentration of 10 mg/l fluoride solution could be brought down to 1.17 mg/l fluoride. This concentration is below the W.H.O danger limit of 1.5 mg/l. The pH of 5-6 and the specific conductivity about 490 PS should be maintained to maximize the adsorption. The present results show that the same clay sample can be used three times sequentially, for fluoride adsorption. Further 1% (W/V) NaOH showed good desorption capacity.

In addition to clay, serpentinite was also selected to be used as a defluoridant. Earlier studies showed that the efficiency of serpentinite in removing excess fluoride from fluoride - rich water is limited and that this material tends to be deactivated with repeated use. In the second phase of this research work an acid treated. (Conc. HCL) method for enhancement of fluoride uptake by serpentinite in an aqueous medium is developed. The experiments carried out were similar to those carried out for clay. Using this treated serpentinite a concentration of 5 mg/l fluoride solution can be brought down to 1.3 mg/l fluoride. Further 1% (W/V) NaOH showed good desorption capacity. However in this case more energy is needed to remove fluoride from the serpentinite surface. Structural changes were observed with acid treatment, using XRD and DTA. A surface complex formation model is suggested to describe the adsorption of fluoride by the solid substrate. These reaction mechanisms can be identified as a surface complex formation involving SOH and $S\overset{+}{O}H_2$.