DEFLUORIDATION OF POTABLE WATER IN CKDu PREVALENT AREAS OF SRI LANKA BY FUNCTIONALIZED MODIFIED-FLY ASH

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Declaration

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Name of the co-supervisor: Dr. (Ms.) W. B. Gunawardana

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Abstract

The last two decades marked a progressive increase in an epidemic of Chronic Kidney Disease of unknown ('u') origin (CKDu) among the farming communities in Sri Lanka. In the presence of the combination of fluoride, with other potential nephrotoxic ions or constituents can lead to the development of CKDu, even at lower concentrations of individual ions. The Na/Ca ratio and fluoride combination in potable water, has been identified as one of the plausible causes of CKDu.

The toxicity of potable water from CKDu prevalent areas could be minimized, if the fluoride level of the CKDu prevalent areas can be brought below 0.4 mg/L, to overcome the synergistic effect between Na/Ca ratio and fluoride. The effects of solution Na/Ca ratio, on the adsorption of fluoride onto functionalized modified fly ash (FMFA) were investigated in this work. $(FMFA)_{opt}$ was selected as the optimized FMFA from a series of synthesized adsorbents, with varying degrees of functionalization with CaO, MgO and Al_2O_3. It was found that the maximum adsorption took place at pH 6.8 and the maximum monolayer adsorption (Q_m) increased from 0.452 mg/g to 0.755 mg/g when the Na/ Ca ratio of the solution was changed from 01 to 07. The adsorption studies confirm that the Ca^{2+} ions in the solution were rejected by $(FMFA)_{opt}$ while giving preference to F- ion adsorption, according to the Donnan coion exclusion rule. The defluoridation reaction fits the Langmuir Model and pseudo second order kinetics. NaOH was identified as the best desorbent for $(FMFA)_{opt}$. regeneration. (FMFA)opt is a low cost, an effective and efficient adsorbent to remove fluoride irrespective of the Na/Ca ratios present in CKDu prevalent areas.

Keywords: CKDu, fluoride, Na/Ca ratio, functionalized modified fly ash, defluoridation.

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