

## Removal of Excessive $F^-$ , $Mg^{2+}$ and $Ca^{2+}$ in Groundwater by Electrolysis

Jayawardena N.K.R.N<sup>1</sup>, Amarasooriya A.A.G.D<sup>2\*</sup> and Weragoda S.K<sup>3</sup>

<sup>1</sup>Department of Science and Technology, Uva Wellassa University, Sri Lanka

<sup>2</sup>Department of Environmental Engineering, Toyama Prefectural University, Japan

<sup>3</sup>Water Safety Plan Advisory Unit, National Water Supply and Drainage Board, Katugastota

Groundwater contamination in North Central Province, Sri Lanka by excessive fluoride ( $F^-$ ), magnesium ( $Me$ ) and calcium ( $Ca^{2+}$ ) causes many negative health effects to the consumers. Though many technologies are available to remove  $F^-$ ,  $Mg^{2+}$  and  $Ca^{2+}$ , installation and maintenance cost, power consumption, expertise knowledge, output water quality and the water rejection have become bottle necks on providing the safe water. Electrolysis has proven as a cost effective method. Therefore, in this study, electrolysis was investigated to remove  $F^-$ ,  $Mg^{2+}$  and  $Ca^{2+}$  ions. As an electrolysis reactor, a Polyvinyl Chloride material made rectangular box, which was separated from a clay membrane was utilized by employing platinum and stainless steel electrodes. Electrolysis was performed by varying Coulombs (Ampere x second ÷ Liters) per Liter ( $C L^{-1}$ ) for groundwater samples collected from North Central Province. During the electrolysis, contaminants were removed via forming a white colored precipitation in the cathode bath and transportation by coulomb forces towards the anode bath. The total water recovery by the system was 50%. Analytical results showed that significant amount of hardness species ( $Ca^{2+}$  and  $Mg^{2+}$ ),  $HCO_3^-$  and  $F^-$  can be removed. The precipitation could be a mixture of  $CaCO_3$ ,  $MgCO_3$  and  $Mg(OH)_2$  which formed by reacting  $HCO_3^-$  and  $OH^-$  ions with  $Ca^{2+}$  and  $Me$ . Fluoride could be removed via co-precipitation with Magnesium hydroxide. Moreover it was identified that current supplied has a positive effect on hardness species and  $F^-$  removal. The maximum removal percentage was 71.6% for the  $Mg^{2+}$  at  $1000 C L^{-1}$ . The  $Ca^{2+}$  and  $F^-$  removal observed were up to 94.45% and 39.79% respectively for the  $1000 C L^{-1}$ . There was no significant effect on removal percentages by the initial concentration, but the higher the initial  $Me^{2+}$  and  $Ca^{2+}$  concentrations, the higher the removals of  $Mg^{2+}$ ,  $Ca^{2+}$  and  $F^-$ . Accordingly, household scale treatment system was designed and proposed.

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