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Abstract
The geology of Kenya makes it one of the countries in the World where fluoride occurs in high concentrations, not only in rocks and soil, but also in surface and groundwaters. The highest water fluoride concentrations occur in certain springs, boreholes, and some lakes in the Rift Valley. With the rapid growth of Kenya's population that stands at 38 million, it has become increasingly difficult to find sufficient fresh water supplies that are fit for human consumption. Access to quality drinking water in Kenya is therefore limited and if available, the water contains relatively high fluorides. It is estimated that 19.5% of groundwater contain fluoride concentrations above 5 mg/L. Fluoride levels above 1.5 mg/L leads to skeletal and dental fluorosis, cases which are common in parts of Western Kenya, Rift Valley and Central Provinces. The millennium development goals (MDGs) aim at providing quality water to all Kenyans especially in the rural setup by the year 2030. This therefore requires that the level of fluoride be reduced below the World Health Organization (WHO) level of 1.5 mg/L. Defluoridation of water is usually a very expensive process and there are many methods that include; adsorption, ion-exchange, membrane filtration processes and distillation. Some of these methods are not in common practice.

In this study, we have investigated the possibility of modifying the Nalgonda process that uses calcium oxide and alum, by substituting CaO with wood ash leachate. We used water sampled from one area in Western Kenya and two areas in Rift Valley with fluoride concentrations of 15.6 mg/L, 9.2 mg/L and 5.1 mg/L respectively. The wood ash leachate was prepared by dissolving one part of wood ash to two parts of distilled water, stirred overnight and decanted to obtain a clear supernatant. The leachate was added to 200 ml, 300 ml and 400 ml of each water sample to adjust their pH values to between 5.5 and 7.0. Alum was added at five concentration levels of 1%, 2%, 3%, 4% and 5%. Defluoridization was achieved within five minutes during which a gelatinous precipitate was observed. The defluoridized samples were analyzed for fluorides by the SPADNS method, total coliforms using the plate count method, turbidity by filtration method while selected metals and nutrients were analyzed spectrophotometrically by the HACH DR 4000 Spectrophotometer. The wood ash aided double precipitation method reduced fluoride levels to below 1.5 mg/L in all the three samples. Besides fluorides, other parameters

were also reduced. Total coliform counts/L was reduced from 290, 270 and 310 to zero respectively. Total solids, total dissolved solids were reduced. Turbidity was equally lowered from 35 NTU to below 15 NTU while NO3-, PO4-3, Cl-, Zn, Cu, Fe and Mn were also substantially reduced below their WHO recommended levels. This method was found to be affordable and applicable in rural settings. It is therefore recommended that further studies be carried out to determine the optimum ratios of the chemicals needed to provide good quality water to the rural poor. Further extension of this research should look at making inexpensive filtration setups to remove any remnant suspended solids.

Keywords: alum; defluoridation; double precipitation; leachate; water; wood ash.

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