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HOUSEHOLD-LEVEL REDUCTION OF FLUORIDE FROM DRINKING WATER USING CRUSHED FIRED CLAY

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INTRODUCTION



- Fluoride is found in all natural waters at varying concentrations. Seawater (~1.0mg/L), rivers and lakes (<0.5mg/L). Groundwater concentrations vary due to the occurrence of Fluoride-bearing rocks.
- Geographical areas world that have concentrations of Fluoride include Syria, Jordan, Egypt, Libya, Algeria, Morocco and the Rift Valley area in Africa. Most affected by Fluoride include India, China and Rift Valley countries in Africa (Demelash et al., 2019; Mosonik, 2015).
- In Uganda, 6.45% of the water sources exceed the standard value of Fluoride in drinking water maximum value reported to be 3.31mg/L. The most affected areas include volcanic areas of Elgon, Mbale, Moroto and the Rift Valley of western Uganda (Malago, et al., 2017).

INTRODUCTION CONT.



- Preliminary tests showed that water from Ntabago Stream in Western Uganda contains Fluoride between 2mg/L to 3mg/L.
- This range is greater than the permissible levels of 1.5mg/L for potable untreated water (UNBS, 2008) making the water unsafe (Das & Mondal, 2016).
- Uganda National Water and Sewerage Corporation has provided piped water, but because of the cost attached, the residents prefer free stream water making them susceptible to health risks associated with Fluoride contamination
- The focus of this study is the potential for defluoridation of water from Ntabago Stream to permissible levels using crushed fired clay as an adsorbent.

MATERIALS AND METHODOLOGY



- Grab samples of stream water were collected from three locations along the Ntabago Stream for Fluoride concentration analysis.
- Pieces of fired clay bricks were crushed and sieved to obtain the particles that pass through a 300 μ m sieve and are retained on a 75 μ m sieve. After sieving, the clay was washed to eliminate very fine particles.
- Sand and gravel were washed using clean water until clean water from it was observed. Both sand and gravel were sun dried and sieved after to obtain desired particle sizes

MATERIALS AND METHODOLOGY



- The model filter layers were arranged with the gravel at the bottom, followed by coarse sand, then fine sand, and crushed fired clay at the top. The gravel and sand layers had a constant thicknesses (5cm) while the crushed fired clay had varying layer thickness (2.5cm, 5cm, 7.5cm) in each of the three model filters.
- A 3mgF/L solution comprising of Sodium Fluoride was prepared for the model filter test runs. The concentration of Fluoride ions was confirmed using SPADNS Colorimetric Method (APHA/AWWA/WEF, 1999).
- 750mL of the 3mgF/L solution was passed through the model filter in each test run, and the filtrate was analysed for Fluoride concentration.
- To determine the clay-adsorbed portion of Fluoride, the clay was removed from the filter and a homogenized sample washed using 250mL of 1M of hydrochloric acid for 1-hour in order to extract Fluoride ions in a solution. (Moon et al., 2015).
- The suspension was then filtered using a 0.45 μ m micropore filter and the filtrate was then analysed for Fluoride concentration

RESULTS AND DISCUSSION

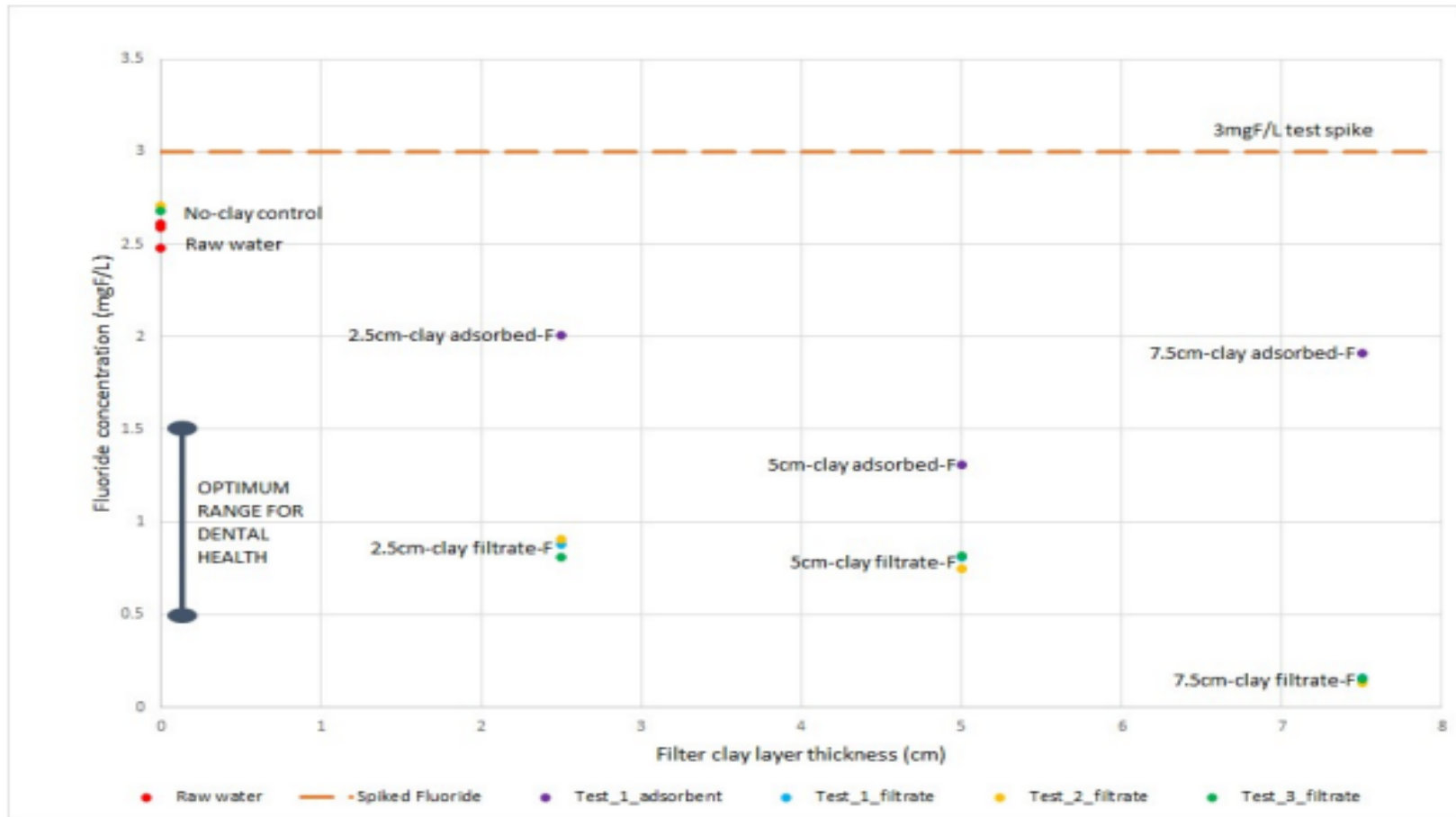


Figure 3 Defluoridation test runs show reduction of Fluoride to within and below the optimum range for dental health in filtrate from model filters with a crushed fired clay layer receiving water spiked with 3mgF/L.

RESULTS AND DISCUSSION



Table 2 Raw water quality before and after filtration.

Parameters	Units	Initial quality	Filtrate quality	Uganda National Standards for potable water	Filtered water compliance
pH		7.11	7.32	6.5 – 8.5	OK
Electrical Conductivity	μS/cm	980	348	≤ 1500	OK
Colour (apparent)	PtCo	207	74	≤ 15	High
Turbidity	NTU	39	9	≤ 5.0	High
Total Suspended Solids	mg/L	44	9	0.0	High

CONCLUSION



- Ntabago Stream has between 2-3mgF/l, which is above the national standard and above the optimum range for dental health (0.5-1.5mgF/l)
- A crushed fired clay layer of 5mm in a model filter was adequate for reducing Flouride by 74% to permissible levels.
- The filter system was also effective at reducing turbidity, apparent colour, suspended solids and Electrical conductivity.
- Further studies will be done on optimization of deflouridation model filter and process

REFERENCES

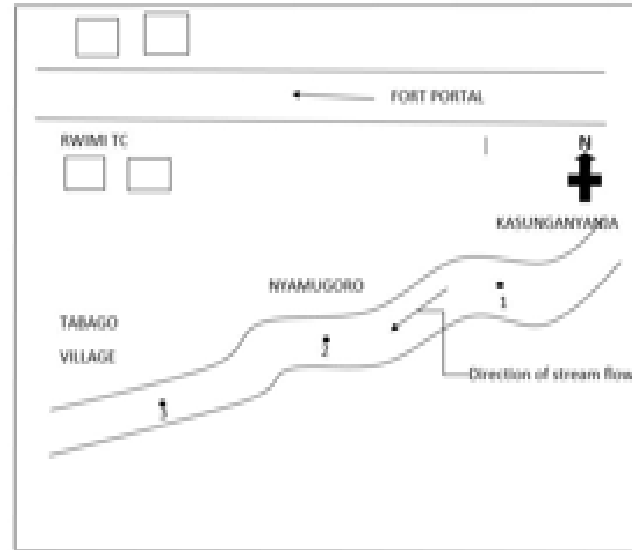


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APPENDIX



Affected residents of the study area showing teeth discolouration.



A sketch map showing location of sampling points along Ntabago Stream.



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