Another Side to Fluoride: Tackling Toxicity with Simplicity

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1. Excess Fluoride in Groundwater: A Global Health Crisis

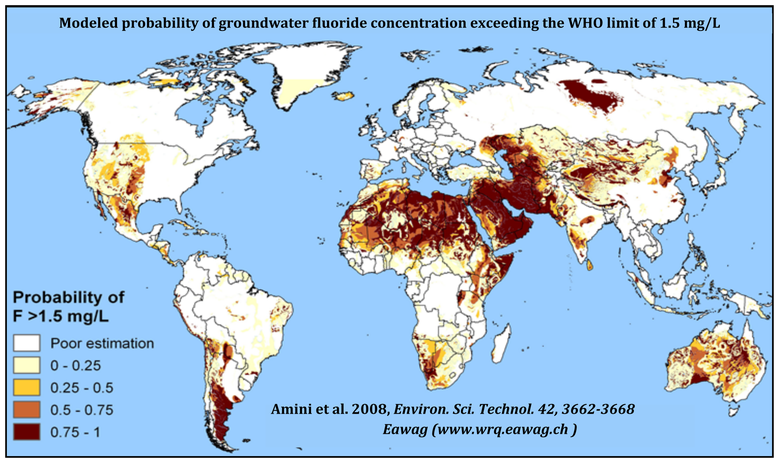


Figure 1. Fluoride contamination occurs naturally due to the presence of fluoride-rich rocks in groundwater aquifers.

Figure 2. 200 million people worldwide drink toxic levels of fluoride and are at risk of developing irreversible skeletal and dental fluorosis, anemia, and lower IQ.

2. Mildly-Processed Bauxite: An Ultra-Low Cost Defluoridation Method

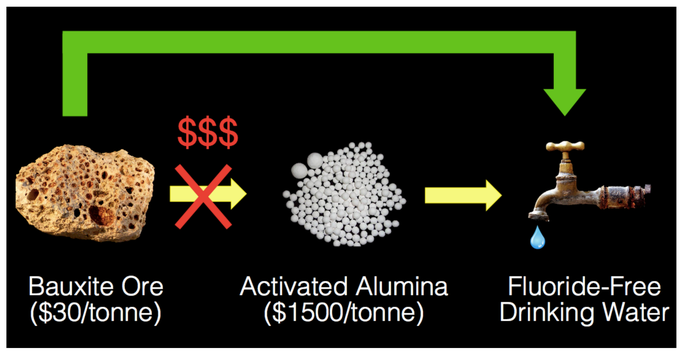


Figure 3. Refining bauxite to make activated alumina (common fluoride adsorbent) is costly, energy intensive, and polluting. Our bauxite-based defluoridation process has the potential to be locally sourced, culturally appropriate, easy to operate and maintain in a rural setting, and **50 X** cheaper than existing treatment technologies.

3. Factors Governing Fluoride Removal Performance of Bauxite

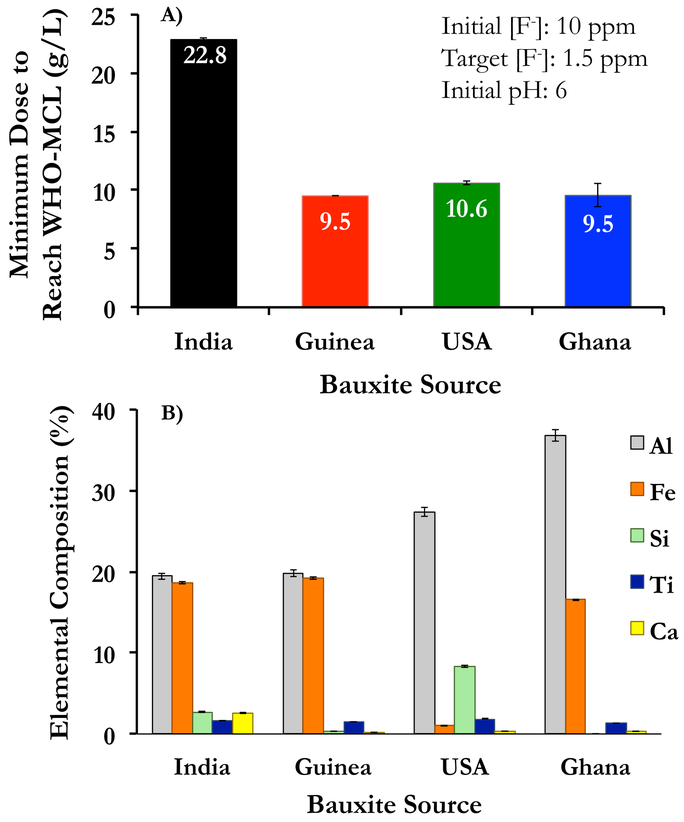


Figure 4. (A) India bauxite requires the largest dose to remediate 10 ppm F^- to the WHO limit and **(B)** Aluminum content alone cannot explain this difference in performance.

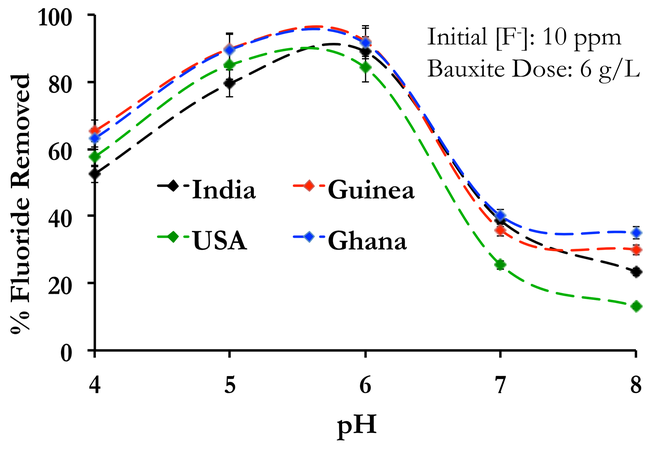
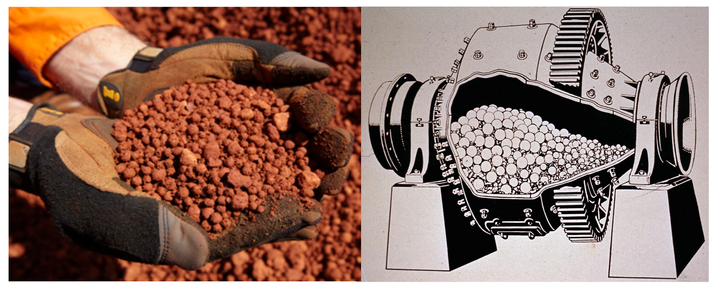


Figure 5. Fluoride removal efficiency varies dramatically with solution pH and is optimal at pH 6 for all bauxite ores.

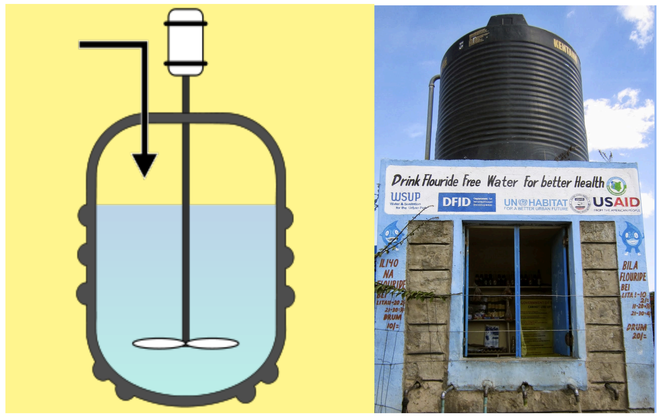
Bauxite Source	Suspension pH	$[Ca^{2+}]$ (ppm)	$[CO_3^{2-}]$ (ppm)
India	8.8	11.6	14
Guinea	6.5	<0.5	<0.5
USA	5.5	<0.5	1.3
Ghana	6.4	<0.5	.9

Table 1. India bauxite's basic suspension pH due to dissolution of $CaCO_3$ affects its defluoridation performance.

4. Future Vision for Field Implementation



Step 1: Obtain bauxite ore from mines and use proprietary inexpensive processing methods to enhance fluoride removal performance (e.g., ball milling, calcination, or controlling pH of groundwater).



Step 2: Treat fluoride-contaminated groundwater in a decentralized community-scale batch reactor using powdered bauxite as a dispersive media.

- Initial lab-scale kinetic tests demonstrate that fluoride adsorption using bauxite is rapid, but further research is required to understand the need for post-treatment processes (e.g., use of settling tanks, membranes, or rapid sand filters to remove suspended particles).

Step 3: After completing proof of concept experiments and iterating the prototype through rigorous field-testing, license technology to local implementation partners and offer technical support as the system is scaled up to provide affordable defluoridated water at community kiosks.

Please do not quote or cite information presented in this poster as it includes some unpublished data.

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