SAFR: *Scalable and Affordable Fluoride Removal*

Andrew Z. Haddad, Katya Cherukumilli, Ashok J. Gadgil

werri.lbl.gov

Motivation

Water is essential to a good quality of life, yet lack of access to affordable safe drinking globally exposes 200 million impoverished rural populations (of this, 66 million in India) to fluoride-contaminated groundwater, where fluoride levels exceed the World Health Organization (WHO) permissible limit of 1.5 mg/L of F^-. Thus, it is imperative to find solutions to treat fluoride contaminated water that are low-cost, inexpensive, effective in the field, and culturally appropriate.

Technology Challenges

Aluminum-based adsorbents are commonly used due to fluoride's chemical affinity for aluminum. The state-of-the-art aluminum based adsorbent—Activated Alumina—is obtained from processing bauxite ore. However, production is costly, and complicated. We are developing a novel (*patented*) treatment technology for minimally processing bauxite ore for fluoride removal. This will yield a lower cost, robust, effective and culturally appropriate solution for removing fluoride from groundwater used for drinking.

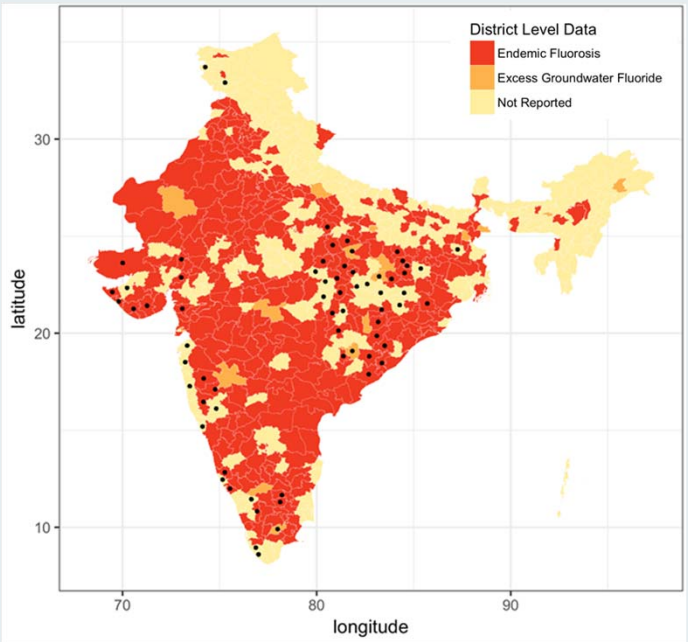

Figure 1. *Map of districts in India with endemic fluorosis (red), excess groundwater fluoride (orange), and bauxite mines locations (black dots) (from Reference 2)*

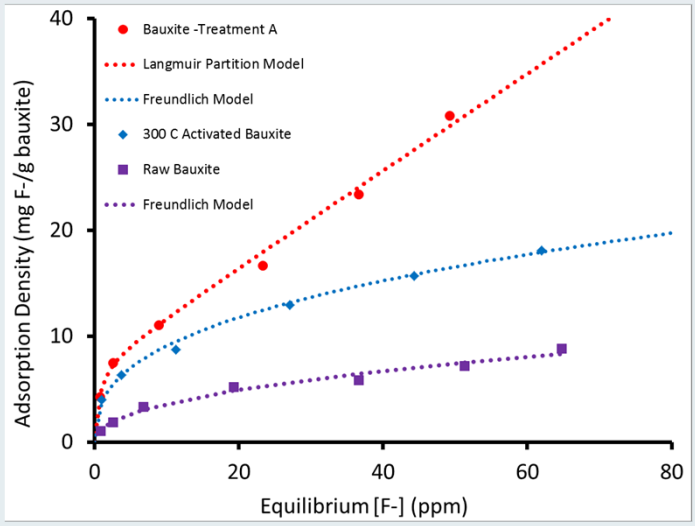

Figure 2. *Fluoride adsorption density vs equilibrium fluoride concentration for raw (purple), 300 °C (blue), and treatment A (red) Indian bauxites.*

Research

In our research, mildly processed, inexpensive bauxite ores show great promise as a new fluoride removal technology. Bauxite is highly effective at remediating wide ranges of fluoride concentrations in groundwater. Activation of raw bauxite at 300°C increases the surface area from 17.2 m^2/g to 163.4 m^2/g. This activation coincides with substantial (about 3X) increase in the ability of bauxite to remediate fluoride from contaminated waters. Loading amounts needed to remediate 10 ppm fluoride contaminated waters to below the WHO limit of 1.5 mg of F^-/L, decrease from 27 g/L when using raw bauxite, to 11 g/L using 300°C bauxite. Further chemical treatment of thermally activated bauxite enhances surface area to 401.7 m^2/g, and leads to a further increase (about 2X) of the fluoride adsorption capacity; compared to that of 300°C bauxite. So, we begin to approach adsorption capacities comparable with state-of-the-art Activated Alumina.

References

1. Cherukumilli et al. Environ. Sci. and Technol. ***2017****, 51, 2321*

2. Cherukumilli et al. Environ. Sci. and Technol. ***2018****, 52, 4711*

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