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To whomsoever it may concern

Subject: Fluoride removal from contaminated groundwater by adsorption

Twenty one of the 29 states and 7 union territories in India are confronted with natural fluoride contamination of groundwater and consequent suffering of people with non-skeletal, dental and skeletal fluorosis caused by drinking fluoride-contaminated groundwater. Most of the people affected by the fluoride crisis live in rural areas, and contaminated groundwater is often the only viable source of drinking water. Still worse, the rural population affected by fluoride poisoning are also relatively poor and earn less than US $2 (Rs. 120) per day.

Selective adsorption of fluoride can be an ideal treatment process provided the adsorbent is selective, robust and chemically stable. Bone char, calcite and activated alumina (AA) have been tried/used earlier. Of them, AA is the best but its chemical stability has always been a matter of concern. In addition, the permissible level of dissolved aluminum in the drinking water is an order of magnitude lower than fluoride. Thus, the presence of residual aluminum in the treated water is always a subject of concern with a potential threat to human health.

During the last six years, I have conducted extensive research with my doctoral student, Mr. M.V.V. Naga Samrat to investigate commercially available AA from Oxide (India) Ltd in Durgapur, West Bengal and HAIX-Zr or HIX-NanoZr, an adsorbent prepared and delivered to us by Prof. SenGupta of Lehigh University in Pennsylvania, USA. HAIX-Zr is an anion exchanger inside which zirconium oxide nanoparticles have been dispersed. Zirconium is innocuous with no adverse impact on human health and is unregulated in drinking water.

With simulated water roughly corresponding to the fluoride contaminated groundwater in Yellampalli village in the state of Karnataka, containing 5 mg/L fluoride, the adsorption capacities of AA and HAIX-Zr were found to be as follows in fixed bed experiments: AA: 0.33 mmol of F^- /g of AA or 6.2 mg F^- /g of AA, HAIX-Zr:

0.44 mmol of F^-/g of HAIX or 8.4 mg of F^-/g of HAIX. We also found HAIX to be a robust and durable material.

Prof. SenGupta now makes HAIX in India through his not-for-profit NGO, the Society for Technology with a Human Face (STHF), in Kolkata. Prof Arup SenGupta, the creator of the HAIX-NAnoZr technology, has cofounded one NGO (www.techhumanface.org) and one tech company (www.drinkwellsystems.com) and these organizations have been funded by the Department of Science and Technology, Government of India for field-scale validation of the technology. Currently, three community based fluoride removal systems have been installed and people are routinely drinking safe water. These plants are located in:

1. Kolakhurd village in Bhagalpur District of Bihar
2. A school premise in Nalhati, Birbhum, West Bengal
3. Anantapur district in Andhra

The plant capacities vary from 800-1200 liter per hour and can serve 500 villagers in the community

In my opinion, HAIX possesses necessary attributes to alleviate the fluoride crisis in India, particularly in a rural setting.

It is pertinent to mention that I do not have any conflicting financial interest in manufacturing, promoting, and implementing HAIX systems in India or elsewhere.

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