Colorado Science and Engineering Fair

2025 Individual Project Abstract Form

Please print 2 copies of the completed form. Sign both copies, keep 1 for your notebook and submit 1 copy to your Regional Fair Director with your other paperwork.

Title of Project: Enhanced fluoride removal from contaminated water using capacitive deionization

Finalist's Name: Varun Velmurugan

School and City: Cherry Creek High School

Sponsor's Name: Velmurugan Balaiya

Category: Environmental Engineering

Division: Senior (grades 9 - 12)

Abstract (250 words or less):

Water contamination poses significant threats to human health worldwide, with fluoride contamination emerging as a critical hazard. Although low fluoride in drinking water helps protect the teeth from decay and reduces the risk of cavities, high fluoride concentrations in water cause severe health impacts, including dental and skeletal fluorosis, neurological damage, and harm to the parathyroid gland, cardiovascular, and reproductive systems. Therefore, it is important to treat the water by removing excess fluoride, so that water becomes fit for consumption as per the set standards and contains fluoride below acceptable limits. Capacitive deionization (CDI) is a very promising water treatment technology, owing to its merits of energy efficiency, operational convenience, and facile regeneration. Previously, I examined the removal of fluoride using adsorption using low-cost adsorbents like activated carbon, alumina and ceramic. Adsorbent adsorption can achieve high adsorption capacity and selectivity for fluoride but suffers from problems in regenerating the exhausted adsorbent. Electrosorption can achieve clean regeneration, but without selectivity for fluoride. An ideal fluoride removal method would combine the superiorities of physical adsorption and electrosorption, having high adsorption selectivity, high capacity, and clean regeneration. In this study, I evaluated the combined effect of electrosoption and adsorption using graphite and coconut shell carbon in removing fluoride from water.

I hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I also attest that the above properly reflects my own work.

Finalist's Signature: Date:

In addition, all students must complete the ISEF Student Checklist (1A), Research Plan, Approval Form (1B), and Checklist for Adult Sponsor (1), and any other ISEF forms required for this type of project. See the International Rules and Guidelines for form requirements. Return COPIES of all of these forms to your Regional Fair Director with you Finalist Verification/Permission Form. **A signed copy of this form must be included in your notebook.**