

Zero-Waste Water Capacitive Deionization

(OTT ID- 1592)

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- ❑ Rising global challenge for drinking water and pure water scarcity, the need for water treatment processes for zero waste discharge technology is in demand
- ❑ Increased evidence of toxic metal contamination (Cu, Cd, Ar, Hg and Pb) in drinking water pose public health risks
- ❑ A capacitive deionization (CDI) system with custom made electrode specifically designed for selective metal ion absorption offers a unique solution for current challenges in drinking water

- ❑ CDI systems are emerging methods for heavy metal ion removal in water that offer several advantages over conventional methods
- ❑ CDI systems coupled with specifically designed electrode can be successfully used in selective absorption of toxic metal ions from water
- ❑ Pilot tests indicate positive results
 - Selective removal of Pb^{2+} ion against healthy ions such as Ca^{2+} , Mg^{2+} etc. in single pass mode- Healthy water standards
 - Zero waste water generation during the process
 - Low energy consumption resulting in lower total costs
 - Retrofit to existing pipelines and easy collection of resulting lead precipitate

- ❑ Provisional patent application (PPA) filed in April 2019

Current Status

- ❑ Proposed technology is a part of active on going research program at UW-Milwaukee
- ❑ Seeking collaborative partners for development of prototype and testing to show selective removal of toxic heavy metal ions from drinking water
- ❑ Technology is currently available for licensing under exclusive or non-exclusive terms

Applications

- ❑ The proposed technology can be used in water treatments for drinking or potable water
- ❑ Point-of-Use water treatments, Healthcare (Hospitals and Dental Clinics), Analytical Laboratory, Pharmaceuticals

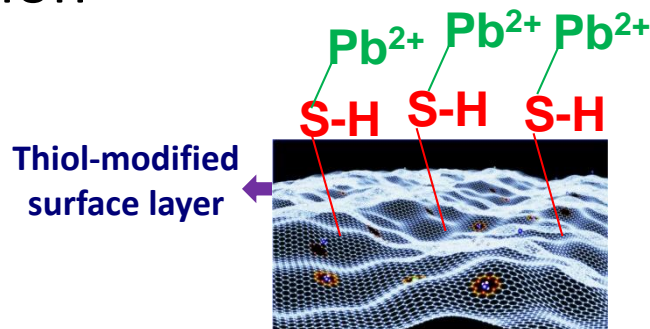
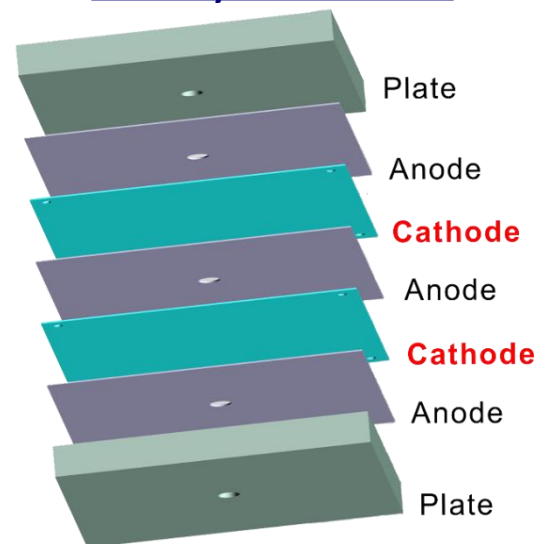
Market

- ❑ Water and wastewater treatment market is project to be worth \$ 674.72 B by 2025 – Hexa Research
- ❑ Water treatment is likely to witness a robust expansion and a steady CAGR of 7.5% throughout the forecast period, 2027 - Research Report Insights (RRI)

Composite Electrode – Design and Assembly

- ❑ A multi-layer electrode cell is employed to perform CDI
- ❑ Graphene based materials used to build electrode surface and modified with thiol groups to enhance lead ion (Pb^{2+}) selectivity
- ❑ Pilot testing done in 1 ppm Pb^{2+} ion simulated water
- ❑ Pb^{2+} selectivity is calculated by comparing to Ca^{2+} and Mg^{2+} removal

Multi layered electrode



- ❑ Lead ion removal rate retained >80% over 300 cycles and >70% over 500 cycle, for 4-layer electrodes in simulated tap water test
- ❑ Simulated tap water - 1 ppm Pb²⁺, 10 ppm Mg²⁺ and 30 ppm Ca²⁺
- ❑ The accumulated lead ions do not affect the lead removal efficiency because of the high lead adsorption capacity
- ❑ Requires 10 minutes regeneration after 24 hours of use – Automatic reset at nights
- ❑ Offers full recharge of healthy ions (Ca²⁺ & Mg²⁺) in 2 mins

- ❑ Continue the development and testing to demonstrate the use of electrode in CDI systems:
 - Develop a fully functional prototype with tunable design parameters
 - Higher percentage removal and higher selectivity of Pb^{2+} ion
- ❑ Expand the CDI system application to other toxic heavy metal ions such as Cu, Cd etc.
- ❑ Look for collaborative partners for development and research support
- ❑ Manuscript ready for publication

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