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Athens, OH, 45701 **Video: https://www.ftai.com/articles-media/sifting-lithium**

Re: U.S. Department of Energy (DOE) Challenge: Geothermal Lithium Extraction, Phase 1

***Proposal Title: LTO Ion Sieve System/Conversion of LiCl to LiOH*. Presented by: Dr. John Staser and Ted Ground**

August 23, 2021

To: The Geothermal Lithium Extraction Evaluation Team, at U.S. DOE and the American-Made Network:

We welcome this opportunity to introduce ourselves and our proposal for this Geothermal Lithium Extraction Prize competition. Ted Ground learned about the DOE Geothermal Lithium Extraction prize competition through notification by HeroX.com, via email, having participated in previous HeroX.com technical problem-solving challenges. Ted Ground contacted Ohio University research staff to collaborate on this proposal - ***LTO Ion Sieve System/Conversion of LiCl to LiOH.*** After reviewing the original idea, and his cited references, I agreed to join Ted as a Team Leader and a Professor of Chemical Engineering at Ohio University, to help refine and develop his proposal for extracting lithium from geothermal brine. Ted and I have agreed to collaborate on Phases 1, 2, and 3, and to share the awards, should we win all three stages of this American-Made prize program. We are also contemplating co-authoring a technical research note on this proposed extraction method, in a peer-reviewed chemical engineering journal. I earned my PhD in Chemical Engineering and I both teach and conduct research at Ohio University. My research interests, publications, and patents focus on Electrochemical Engineering, Materials for Energy Conversion and Storage, Electrochemical Biosensors, and Electrochemical Conversion of Biomass. Ground Analytical Services (GAS) is the title of Ted's sole-proprietor small business whereby GAS is a dba ("doing business as"). He is self-employed as a Technical Consultant and Writer, and Systems Designer for projects chiefly related to water quality, recirculation, and re-use. He has 8 years' experience as the manager of analytical laboratories. In 2020, Ted won first place in an ENEL/InnoCentive Challenge on lithium extraction from geothermal brine, and he retains his intellectual property rights to the method/process of lithium extraction that he originally proposed. We both recognize that all processes and ideas can be refined and improved upon, so we have agreed to join forces as a team to better "engineer" this proposed design, and to "reduce it to practice", so that it can be scaled up.

Brief Description This proposal can be classified as a selective ion sieve approach to extracting lithium from brines, produced by geothermal energy facilities. The title uses the term "Sifting", as the system described in the proposal selectively "sifts out" dissolved lithium ions from geothermal brine. Although selective ion sieves are known through a number of reported approaches, this proposal involves a unique, innovative combination of technologies designed to optimize lithium extraction without interrupting the production of geothermal energy. Studies on different ion sieve methods indicate that those based on titanium (Ti), such as metatitanic acid (H_2TiO_3), and its analog, $H_4Ti_5O_{12}$, offer excellent lithium adsorption capacity. These also hold greater advantages over ion sieves based on manganese (Mn), which tends to dissolve over time with repeated use of the ion sieve in the processes of intercalation and deintercalation of Li+ (Ryu, T. et al, 2016; Yang, F. et al, 2018). Titanium-based ion sieves seem to perform well, and are stable over time, with minimal loss of titanium. Some lithium ion sieve materials can have significant adsorption capacities and ion exchange rates on porous granules or beads with high surface areas. This proposal calls for packed columns of lithium ion sieve media in a relatively small footprint at a geothermal plant to adsorb and then desorb lithium ions collected and concentrated from the geothermal brine that flows through a plant before it is re-injected into the Earth. The concentrated LiCl can be sent to an electrochemical reactor, where it is converted to LiOH without intermediate formation of lithium carbonate. The electrochemical process will simplify generation of LiOH over existing multi-step process. We look forward to participating in this competition, and developing successful results.

Sincerely,
Dr. John Staser,
Department of Chemical and Biomolecular Engineering, Ohio University