TECHBRIEF

STREAMLINING THE PROCESS TO EXTRACT LITHIUM, RARE EARTH ELEMENTS FROM NATURAL BRINES

OPPORTUNITY:

Research is active on the development and refinement of a process for the extraction of lithium (Li) and rare earth elements (REEs) from natural brines. This invention is available for licensing and/or further collaborative research from the U.S. Department of Energy's National Energy Technology Laboratory.

CHALLENGE:

Current leading technology to generate materials from natural brines requires a series of football field-sized slow evaporation ponds, as well as lengthy leaching, which takes approximately 18-24 months after leaving the well. Concentration processes of the selected materials require repeated pumping from one evaporation pond to another, followed by long-distance transportation (added expenses and carbon emissions) to a processing plant that generates the selected compounds by multiple carbonation steps by leaching. Current carbonation processes require various solid additives, including soda ash, lime, hydrochloric acid, organic solvent, sulfuric acid and alcohol. Several tons of additives may be required to produce only a ton of targeted material. Therefore, current operations are considered to be costly and environmentally harsh.

OVERVIEW:

Geothermal brines are hydrothermal fluids naturally heated under the earth's surface and are a known source of environmentally sustainable, renewable energy. Additionally, these brines can exhibit significant concentrations of valuable minerals and critical metals. Most brines in the United States tend to contain relatively high Li content, as well as REEs.

Li is used in advanced clean energy technologies, including fuel cells, electric vehicles and renewable energy applications. Because of its importance in energy storage devices, Li has been identified as a near-critical material (second-highest ranking) in the U.S. DOE 2011 Critical Materials Strategy.

Seventeen elements in the periodic table are considered REEs (including scandium and yttrium). Rare earths are highly valuable because they are essential components of modern technological devices, such as cell phones and computer hard drives. They are also used in advanced technologies that support a broad range of industries, including health care, transportation and defense.

The technology advanced by NETL uses carbon dioxide (CO_2) as the only additive. The mixture is held at necessary pressure and temperature levels so that undesired impurities in the brine precipitate as solids, leaving a secondary brine substantially comprising the targeted materials.

NETL research enabled discoveries of required thermodynamic domains where targeted materials are stable or unstable. This makes possible high recovery rates of REEs and Li through control of CO_2 and pressure parameters in relatively small footprint and in an environmentally benign fashion.

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ADVANTAGES:

This technology provides a simplified, economical process for the recovery of Li and REEs from natural brines. Other advantages associated with the technology include:

- CO_2 used in NETL's process can be sourced from any industrial waste streams.
- Significant reduction in processing time, energy requirements and overall CO_2 emissions.
- Acid-free process.
- Process can be fully operational at the brine source, eliminating the need for heavy liquid transportation or gigantic footprint.
- Process is exothermic and complements existing geothermal technologies.
- Byproduct credits from other mineral recovery.

APPLICATIONS:

- Extraction of Li and REEs from natural brines or other sources such as sea water and oil- and gas-produced water.
- Potential extraction and recovery of dissolved elements from industrial liquid waste.
- Development of a domestic supply of Li and REEs. (Currently, the United States largely relies on foreign sources for these elements due to limited domestic production.)

PATENT STATUS:

U.S. Patent Pending (non-provisional patent application)

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