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Catalyzed Organo-Metathetical (COMET) Process for Magnesium Production from Seawater

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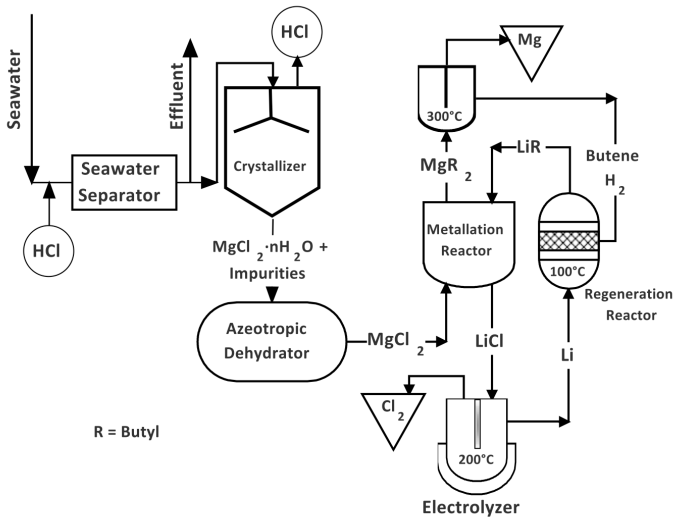
Partners: Global Seawater Extraction Technologies, U.S. Magnesium, Inc.

Critical Need

Primary production of lightweight metals, such as magnesium, is an energy-intensive and expensive process that results in significant carbon dioxide (CO_2) and other emissions. Lowering the energy consumption, cost, and emissions associated with producing magnesium and its alloys would make it competitive with incumbent structural metals, such as steel. Enabling its widespread use in vehicles in particular—without compromising performance or safety—would substantially reduce fuel consumption and CO_2 emissions from transportation.



Project Innovation + Advantages

PNNL is developing a radically new process to produce magnesium from seawater, effluent from desalination plants, and other suitable source of magnesium chloride as an alternative to today's energy intensive and expensive methods. Because the concentration of the magnesium in seawater is low, significant energy is used to evaporate the water and precipitate magnesium chloride salt. Further, conventional technologies involve heating the salt to 900°C and then using electric current to break the chemical bond between magnesium and chlorine to produce the metal.

PNNL's new process replaces brine spray drying with a low-temperature, low-energy dehydration process. That step is combined with a new process to generate an organometallic reactant directly from magnesium chloride. The organometallic can be decomposed to magnesium metal or MgH_2 via a proprietary process at temperatures less than 300°C, thus eliminating electrolysis of magnesium chloride salt completely. Moreover, the products naturally lend themselves to production of magnesium alloys through powder metallurgy routes.

U.S. DEPARTMENT OF ENERGY

Photo shows magnesium ingots produced via decomposition of dibutylmagnesium through proprietary process

Impact

The overall process could be significantly less expensive and more efficient than any conventional magnesium extraction method available today and can take advantage of abundant, free sources of magnesium.

If successful, PNNL would enable a low-cost, low-energy metal-organic process for producing magnesium without the energy intensive steps associated with conventional processes.

» SECURITY: Light-weighting vehicles to improve fuel efficiency could reduce U.S. dependence on foreign fossil fuel resources used in the transportation industry.

» ENVIRONMENT: Efficiencies in magnesium extraction technologies could offer a 50% reduction in energy consumption and result in substantially fewer CO2 emissions over conventional methods.

» ECONOMY: All the process steps in the COMET process have been demonstrated in the laboratory with no temperature above 300°C being required. Thus technical feasibility of the COMET process has been demonstrated, representing the first truly new non-pyrometallurgical method of producing Mg metal since Lloyd Montgomery Pidgeon invented the now named "Pidgeon" process in the 1940s. PNNL work is now focused on optimizing each step to further reduce energy requirements and ensure that cost targets for the COMET process can be met.

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