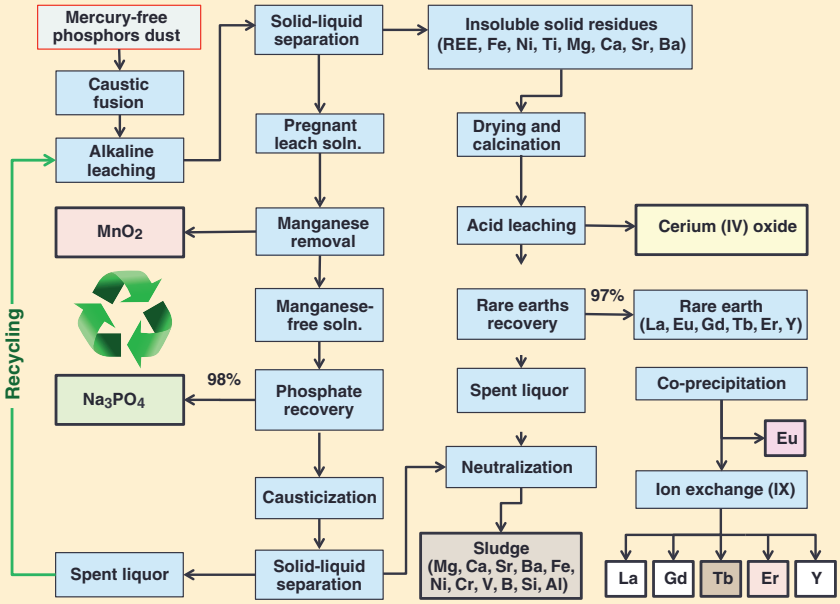
A process that recovers rare-earth elements from 'urban mining'

Electrochem Technologies & Materials Inc. (Montreal, Canada; www.electrochem-technologies.com) has recently patented a process for recovering rare-earth elements (REEs) from mercury phosphor powders — a byproduct from recyclers of fluorescent lamps and light bulbs. This technology offers a sound and profitable alternative for the production of REEs compared to the mining of low-grade ores, which requires large tonnage operations, says company president, Francois Cardarelli. Such mining operations have both high operating and capital costs, and unavoidably produce radioactive wastes, he says.



In contrast, Electrochem's "urban mining" technology can secure the supply of affordable REEs, especially coast-to-coast in North America, where several tons of REE-rich phosphor powders are generated monthly by recyclers. Moreover, because of the limited number of REEs present and the very small-scale operation required (50 to 300 kg/wk of mercury-phosphor dust), existing and well-known REE separation technologies can be used directly downstream without impacting the operating costs significantly, says Cardarelli.

In Electrochem's process (flowsheet) Hg is first removed by vacuum retorting. The Hg-free dust is then digested in a molten alkali hydroxide at 300–800°C, followed by a caustic fusion step, in which the melt resides less than 1 h in a batch furnace or a continuous rotating kiln. In this step, essentially all of the phosphate, silicates, aluminates, vanadates, chromates and borates, along with some manganese are separated. The solidified melt is then treated with an aqueous alkaline solution, which leaches out the P, Si, Al, B, Cr and V from the insoluble solid residues. Undissolved solids, including REEs with some Fe, Ni, Ti, Mg, Ca, Sr and Ba are filtered out, washed, oven dried and eventually calcined to oxidize Ce(III) to Ce(IV). The solids are then hot-acid leached, leaving behind the insoluble cerium (IV) oxide. The REEs (Y, La, Eu, Gd, Tb, and Er) remain in the pregnant leach solution, and are subsequently recovered by selective precipitation and ion exchange.

The process has been tested at a kilogram-scale prototype with materials originating from foreign and Canadian lamp recyclers, achieving 98–99% recovery of the REEs, says Cardarelli. A preliminary cost analysis indicate that REEs can be extracted for as low as $7/kg of mercury phosphor dust, while the "basket value" of REEs contained can be as high as $95/kg of dust, he says.

NEW WATER-TREATMENT SYSTEM

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a medium-pressure RO membrane system (flowrate of 600 m^3/d). The dilution of seawater with the low-concentration brine from the sewage treatment process makes it possible to use the medium-pressure RO for desalination. As a result, power savings of more than 30% are possible due to the reduction of electricity needed for pumping water, compared to a high-pressure RO system. The dilution of seawater also reduces the size of the UF treatment needed, thereby lowering investment costs by 30% says NEDO.

The produced water can be supplied to the surrounding industrial facilities and used, for example, as boiler feedwater at the Kyushu Electric Power Co.

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cess Engineering at ETH Zurich (Switzerland; www.ethz.ch), led by professor Hyung Gyu Park. The membrane is made of a double layer of graphene in which precisely defined pores are etched by a technique known as focused ion-beam milling. The beam of helium or gallium ions can be controlled to create the desired number and size of pores in the graphene. Potential applications include gas separation, water filtration and even waterproof clothing, since the light, flexible membrane is said to be a thousand times more breathable than Gore-Tex. (For more on graphene, see pp. 13–17).

Curing EPDM rubber

Researchers from Lanxess AG (Cologne, Germany; www.lanxess.com) have shown that zeolites can be used as a new co-activator for resol curing, enabling both high cure speeds and high curing efficiency. The company says resol curing opens up an

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