Mining Magazine

Mining's path towards pain-free extraction

There is growing demand for more environmentally conscious separation methods

Nanotechnology is one of the technologies being explored for cleaner extraction

Processing > Plant

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Change has come to a plethora of mining processes and technologies in recent years, and separation technologies are also seeing an influx of new ideas and approaches.

Part of the driver for these new start-ups tackling the separation space is the growing demand for more environmentally conscious methods. Mining companies are feeling mounting pressures from investors to decarbonise as

many aspects of the mining process as possible, and are starting to take a hard look at its more carbon- and energy-intensive methods for separating valuable metals from ore.

New technologies for previously unpopular minerals like lithium are also growing, as the market clamours for new materials like lithium for the coming demand explosion in electric vehicles.

"It's very important that the world cleans up its act," Destiny Copper co-founder Greg Hanna told *Mining Magazine.*

"We need these minerals, but we also need them to be sourced responsibly."

ining Magazine spoke with three ocess technology start-ups about eir technologies.

reener copper separation

anna and his team at Canada's Brock niversity have developed a copper traction process that depends on emistry instead of electricity.

"When you think of incumbent technologies of smelting, there's a huge energy release, huge amounts of greenhouse gas emissions," he said. "Our process is a lot cheaper and cleaner, and while it's not completely free of using electricity, it's a hydrometallurgical process which uses pumps and pipes as opposed to huge infrastructure."

For this reason, the technology is better suited to smaller and medium-sized copper deposits instead of large projects, he said. The technology allows smaller companies to extract copper amounts that larger mining companies may have neglected. The Destiny Copper technology can also be used to reprocess tailings waste, he added.

The company's process relies on the hydrometallurgical process of ion exchange, Hanna said. Ore is collected and brought to the lab, and is filtered through material to leach copper out of the ore. This leached liquid is now a copper sulphate solution.

Once it comes into contact with iron, granular copper is produced at 99.9% purity. Because copper granuals do not stick to the iron source, the materials can be easily separated.

Following the completion of this process, it is possible to transform the granuals into large sheets.

Destiny Copper commissioned a pilot plant for the technology in 2021, and has secured copper ore from Chile for testing.

The company is now looking to partner with a mining company to test the copper extraction process further.

Applying nanotechnology to separation

Summit Nanotech has opted to put nanotechnology to work, in a bid to eliminate the use of acids currently used by many lithium extraction processes, founder and chief executive Amanda Hall said.

"The existing evaporation pond process only works in very specific desert environments," Hall said.

These processes need a precise balance of high elevations, intense solar energy and high wind speeds to perform rapid evaporation processes over very long periods of time, she said.

It could take years for brine to evaporate enough water to concentrate the brine and achieve the needed 6% because lithium will be the last ion that stays in the solution, she added.

This process often means that some 60% of lithium from the salars will be lost to waste that precipitates in ponds.

Also, new water use restrictions in lithium-rich areas may make it difficult for existing lithium producers to expand their operations if they continue to use this water-intensive method, she said.

Summit Nanotech's technology works to pull out the lithium from its environment using a different method, Hall said.

"We can capture that lost lithium because we pull the lithium cations out of the solution first instead of last, which doubles the yield," Hall said. She compared the process of pulling out the lithium from the brine as having sandwiches with the bread spaced out just the right size for the lithium to size out.

The Summit Nanotech process also does not rely on freshwater, so it is not affected by governmental restrictions on the use of freshwater, she said. The process also works in nearly all environments, which means that it does not have to be limited to areas with high elevation, intense sun, or high wind speeds.

Hall's process can work with many different types of brine, as well as clay, she said.

"One thing that we've invented is a flexible polymer membrane which lithium sticks to like flypaper," she said. "We'll take the brine, wash it over the surface, and the lithium will stick to the membrane and hold on nice and tight. We then run an electric current, and the lithium lets go."

Renewed demand for lithium is what is propelling these new innovations, Hall said.

"The price and demand for lithium were so low in previous years that existing producers could easily supply the market," Hall said.

"However, demand has increased significantly, and so we need new projects to come online to support the growing electric vehicle market," she said. "New technologies are needed to get lithium to market fast and sustainably."

Electric current separation

One Boston-based processing technology start-up, Nth Cycle, is using an electro-extraction technology to separate metals from electronic waste and low-grade mine tailings.

The technology was developed by co-founder Chad Vecitis 10 years ago, and was initially intended for the treatment of wastewater. Vecitis and co-founder and chief executive Megan O'Connor worked together to use the technology to extract metals and minerals from environmental waste and scrap recycling.

The process relies on the use of electric currents to separate the materials.

"We like to think of it as an electrified vertical," O'Connor said.

She compares the process to an electrified Brita filter for water purification.

"In that system, you have a carbon filter that filters all heavy metals that you find in drinking water," she said. "We figured out a way to electrify a carbon filter to selectively remove metals based on an electrical current that we apply."

The process works for nearly every metal on the periodic table, O'Connor said.

"For metals that are easier to reduce, we need a certain type of electrical current, and that can actually collect some metals as pure metal products," O'Connor said. "For metals that are harder to reduce, we can produce them as metal oxides and hydroxides."

Recovery rates using the Nth Cycle are comparable to existing processes for ore recoveries. The real advantage of the Nth Cycle technology is its ability to process low-grade ore right on site.

"This means that mining companies will not have to pay for the transportation of that ore," O'Connor said. "This presents a savings in cost as well as big greenhouse gas savings in transport."

The Nth Cycle process also uses much fewer chemicals than more traditional metal separation processes, reducing chemical usage to minimal in the pre-processing steps and none at all in the core separation process, O'Connor said.

For the moment, the company is focusing on extraction of cobalt, nickel, and copper in North America, given how critical these metals are in lithium-ion batteries and in the electric vehicle market.

The company is also looking to expand beyond North America in 2023 and is also undertaking research to use the process on rare earth metals as well, O'Connor said.