Mining Magazine

Tackling carbon from different angles

Carbon emissions are rising precipitously

De Beers has been trialling carbon capture at Gahcho Kue.

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And industries across the board are under pressure to cut these as soon as possible.

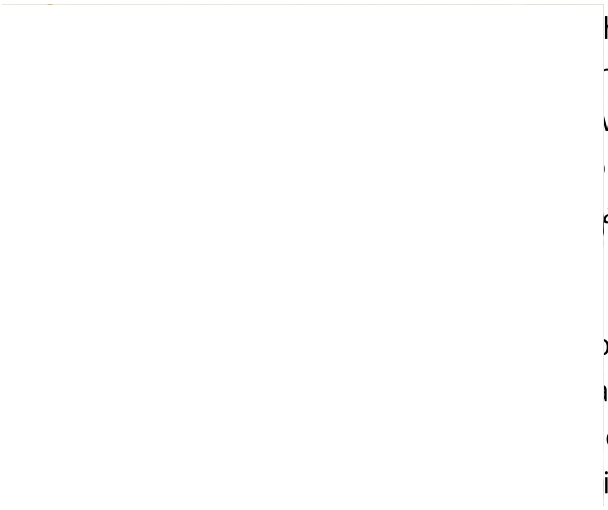
Mining is no exception. Mining is an enormously emissions-heavy industry, constituting approximately 8% of global emissions worldwide.

Jax Jacobsen

Though the industry has reacted slowly to the threat of catastrophic climate change, new drivers - including pressure from investors and local communities alike - are driving mining companies to take the threat seriously and adjust their operations to be more environmentally friendly.

There are a number of projects and initiatives underway across the industry in all areas of the world, finding different ways to lower and store carbon.

Dr Sasha Wilson, a biogeochemist, has been working on carbon capture in tailings while at Monash University and at her current academic post as professor and Canada Research Chair in Biogeochemistry of Sustainable Mineral Resources at the University of Alberta.



his is work that's been going quite a
nile, and really picked up in the last
w years due to new net-zero carbon
mmitments," she told *Mining*
agazine.

work conducted with colleagues
lton Vessey, Avni Patel, and Dr. Maiji
udsepp at UAlberta's Environmental
onomic Geology Laboratory, the
ientists found that tailings and mine waste can store carbon effectively.

Mineral waste produced by some mines, including nickel, cobalt, platinum group elements, diamonds, and chromium, are naturally reactive to carbon dioxide, Dr Wilson said. Mine tailings dissolve in rainwater, releasing carbon dioxide-fixing elements like calcium and magnesium and binds carbon to form a carbonate rock.

Dr Wilson's team is looking to accelerate that process to maximise the potential for storing carbon in mineral waste.

There are two ways of accelerating carbonation, Dr Wilson said. One involves dissolving the tailings faster using stronger acids than rainwater, while the other involves adding more concentrated carbon dioxide, either from direct air capture plants or flue gases, or using naturally occurring bacteria such as algae that concentrates CO2 in water.

"You can also change ore processing in order to increase the reactivity of minerals," she said. "If using a strong acid as part of the metallurgical process, you can try to optimise it to release magnesium and calcium, both of which are carbon dioxide binding."

Concentrated CO2 can also be added during processing or in post-processing in tailings, Dr Wilson said.

However, she noted that this process is most economical hosted by ultramafic tailings that are rich in magnesium and sometimes calcium.

In her previous research, Dr Wilson found that reactions of tailings with carbon dioxide in rainwater was able to offset 11% of greenhouse gas emissions at BHP's Mount Keith nickel mine in Australia, without requiring changes to processing.

"Mines like Mount Keith can get a lot of passive reaction and draw down carbon dioxide without intervention," Dr Wilson said. In that study, conducted with Geosciences Environment Toulouse researcher Anna Harrison, they found that only 40% of the brucite was reacting.

"We could double carbon capture just by raking the tailings and tilling them, or changing the way that tailings are distributed," Dr Wilson said.

Her research also found that changing ore processing routes to include magnesium and calcium leaching from silicate minerals, such as serpentine and smectites, and using concentrated carbon dioxide sources has potential to increase carbon dioxide sequestration in ultramafic-hosted mines by two orders of magnitude.

Elsewhere in the industry, diamond producer De Beers has been working on sequestering carbon via kimberlite with several Canadian and Australian universities.

The company plans to initiate a large-scale flue gas injection experiment at its Gahcho Kue mine in the Northwest Territories once scientists better understand the reactivity of processed kimberlite.

Canada Nickel, which is developing a nickel-cobalt deposit at the Crawford project in northern Ontario, believes its In Process Tailings Carbonation process could allow Crawford's tailings to absorb enough carbon dioxide to achieve net zero emissions in 36 hours.

The deposit contains brucite, which will help absorb carbon.

"Our active and accelerated process has the potential to operate at least 8-12 times faster than current passive approaches," chief executive Mark Selby said.

The IPT carbonation process injects carbon for a brief period, which accelerates mineral carbonation, Canadian Nickel said. This process fixes the carbon geologically while tailings are still being processed, instead of injecting carbon

when tailings are deposited in the tailings repository.

Though the process has only been demonstrated in a laboratory, the company believes it can be scaled up due to its simplicity, using only concentrated sources of carbon dioxide. The concentrated carbon can be produced by a range of industrial processing activities, green hydrogen production, or natural gas power generation. It can also be provided by carbon capture facilities, Canada Nickel said.

Carbon capture in processing

One company is working on a design which will eliminate carbon generated by energy, Delta CleanTech President and CEO Jeff Allison told *Mining Magazine*.

Delta CleanTech has adapted technology which patented decades ago, which they call post-combustion capture technology.

"This technology is probably the closest to being commercial than any other technology on the market, and the process has been used in many products and the past," Allison said.

The process relies on two columns, one being an absorber and one being a stripper, working best when not burning gas or diesel, Allison said.

The flue gas will go into the bottom of the absorber column, and a specially-developed solvent will drop down the solvent to meet the flue gas. When the solvent comes into contact with the flue gas, it will absorb carbon dioxide, so the only thing to emerge from the stack will be nitrogen and oxygen.

The process then takes the solvent that has absorbed the CO2 to transfer it to the stripper column, where it will be heated to boil off the carbon dioxide, Allison said. The solvent can then be recirculated to the other stack for future use.

"We made it a loop process to make it very simplistic," Allison said. "We reduced the amount of capital costs by building it in a factory setting, and using off-the-shelf materials. We further reduced the operational cost by designing specific solvents that can absorb carbon dioxide and strip it off at a lower temperature, so that it uses less heat and energy."

Delta CleanTech has also secured a patent for prolonged reuse of the solvent, Allison said.

"We've patented Reclaimer Technology that keeps the solvent in top operating form," he said. The solvent can be compared to a human kidney, in its role as cleaning up the body's blood. The reclaimer technology "takes all impurities out

of the solvent, disposes it, and allows customers to put clean solvent back into the system," he said.

The technology can be used across industries, beyond mining. "Anything that uses a smokestack" which emits exhaust can benefit from the technology, Allison said.

Allison foresees a jump in interest in the technology in Canada, given its carbon tax policies.

"In Canada, they have a carbon tax, which is currently 50 dollars per tonne of carbon, which is moving to 170 a tonne," Allison said.

The Canadian government is also offering "carrots" to companies to adopt carbon-friendly technology, Allison said. Companies building plants with these carbon-reducing technologies can claim up to 50% of the capital cost for the plants, he said.