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CUTTING THE CARBON FOOTPRINT OF POTASH COOLING

Comparing indirect and direct cooling technologies in meeting producers' evolving ESG needs

By Igor Makarenko

Once considered "nice-to-haves", sustainability metrics are now "must-haves" to do business in the potash industry.

Technology providers such as Solex are increasingly being called upon to know the respective carbon footprints of our equipment so that end users such as Nutrien and BHP know the full extent of their operations' environmental impact.

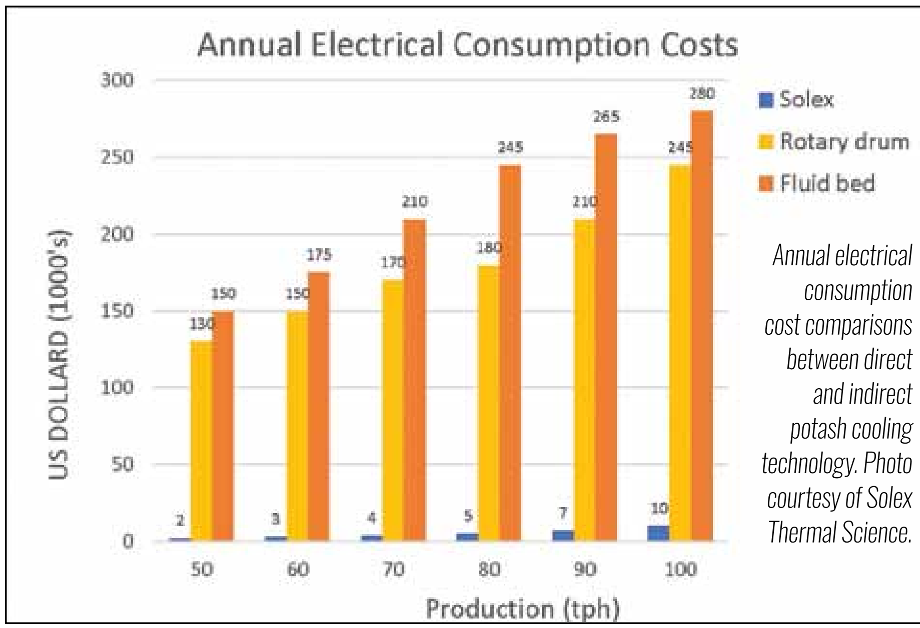
As a result, all stages of the potash production process are now under the Environmental, Social and Governance (ESG) microscope – notably the cooling stage prior to storage, packaging, and transport.

And yet not all technologies are considered equal when it comes to their respective carbon footprints. For this discussion, we will illustrate key differences between indirect and direct cooling methods and their respective roles in:

1. Emissions management
2. Energy usage
3. Water conservation

EMISSION MANAGEMENT

Indirect cooling technology relies on conduction to cool potash. In the case of vertical plate heat exchangers, free-flowing potash enters a tower-like unit at temperatures around 120°C or higher and slowly pass between a parallel series of plates that contain water or other heat transfer fluids flowing counter-current to the potash.



Annual electrical consumption cost comparisons between direct and indirect potash cooling technology. Photo courtesy of Solex Thermal Science.

The plates transfer the heat from the potash to the heat transfer fluid, and the product cools to temperatures between 40°C and 70°C at the outlet as, pulled by gravity, it slowly and uniformly moves downward, controlled by a discharge feeder.

The benefits to indirect cooling include reduced emissions, dust, and odours. With vertical plate technology, fluids flow counter-currently through the plates and never come into contact with the product. The low flow velocity (typically less than 0.3 m/min) and gentle handling of the fertilizer further prevents degradation that leads to dust from occurring and minimizes subsequent emissions.

Comparatively, direct-contact methods, such as fluid beds, use convection to cool potash, requiring air to be chilled and then passed across the product. The large quantity of air required for direct cooling results in dust and emissions that then must be cleaned and scrubbed before being dumped into the atmosphere. Even then, permits for stacks are becoming more difficult to acquire, making expansions or new installations using fluid beds more challenging to install.

As such, indirect cooling has proven to offer a significantly lower carbon footprint than direct-contact alternatives.

Vertical plate technology relies on conduction and not convection to cool potash, thereby minimizing emissions and reducing energy consumption. Photo courtesy of Solex Thermal Science.

Research by Solex shows that vertical plate technology, for example, emits just 0.42 kilograms of CO_2 emissions per 1 kWh of cooling – an estimated eight times less than comparable cooling technologies.

ENERGY USAGE

Because indirect cooling methods do not rely on air, they also do not need a lot of energy to get the job done. A vertical plate heat exchanger itself constitutes only a small additional load on the existing cooling water system, while the cooling water module, bucket elevator, and purge air fan all have low horsepower requirements. Industry estimates peg power consumption of just 170 kW per 100 tph of potash cooled.

Direct-contact cooling methods, meanwhile, require significant air-handling equipment such as high horsepower fans – for example, fluid beds often require both a forced draft fan to supply air to the cooler and an exhaust fan to move air to the scrubber – as well as air chillers and air pre-heaters. It's estimated that power consumption to cool 100 tph of potash is as much as 1.7 MW.

As a result of its high thermal efficiency and ability to accommodate capacities of up to 150 tph and higher in a single cooler, vertical plate technology can save upward of four to five kWh/tonne of fertilizer cooled compared to a fluid bed cooling system.

WATER CONSERVATION

Water plays a key role in indirect cooling methods. Yet this might conflict with producers' desire to reduce their reliance on continuous supplies of fresh water. They may also face water scarcity or cooling water source quality issues.

Indirect cooling methods that require water as the heat transfer medium offer potash producers the ability to responsibly manage their water consumption through self-contained water circuits. With vertical plate technology, the system, which does not require top-ups, operates on a secondary self-contained water circuit with a plate exchanger isolating the heat exchange unit from the primary plant cooling water supply.

A tempered water module controls the temperatures of cooling water before the water is brought into the plates of the heat exchanger. This ensures the desired steady water temperature profile is maintained regardless of different operating conditions.

An added benefit to closed-loop systems is the water does not contain organics or dissolved solids from entering the water stream. Because the water exists within a closed loop, it enters the plates clean each time. This eliminates corrosion concerns and ensures effective heat transfer over the life of the heat exchanger by preventing scaling and fouling.

FINAL THOUGHTS

The cooling stage at a potash plant continues to represent a vital part of producing a quality finished product that can safely be handled downstream. Yet it can also play an important role in meeting producers' broader sustainable initiatives.

Indirect cooling methods such as vertical plate technology offer potash producers with an energy-efficient, near-zero emissions solution that has been successfully real-world tested for more than 30 years.

By avoiding the use of energy-intensive fans, as well as the air chillers/pre-heaters scrubbers and/or ancillary equipment needed to handle the emissions, indirect cooling methods give potash producers access to a solution that can be part of further technological innovation that meets their aggressive and evolving emission-reducing targets.

Igor Makarenko, global director, fertilizer, joined Solex Thermal Science in 2010, with the past 10 years spent solidifying the brand as a globally recognized technology provider for fertilizer cooling. Makarenko has extensive end-to-end experience developing turnkey cooling solutions in various fertilizer applications.