Cooling salt in less space with less energy

SOLEX
THERMAL SCIENCE

Salt is Big Business

Salt manufacturing is among the oldest chemical industries in the world. Over the past century, annual global production has risen from 10 million tonnes to more than 200 million tonnes, with almost a quarter being produced in the United States. Of the nearly 100 countries that produce salt, China, Germany, India and Canada join the U.S. as the top five producers.

Cooling Salt During Processing

While salt is arguably the most popular food seasoning, its highest demand comes from industrial applications that range from pharmaceuticals to pulp and paper. A common method of producing salt is solution mining wherein water is injected into underground salt deposits. The resulting brine is extracted and transported to an onsite plant for processing – either an evaporating plant where dry salt is made, or a chemical processing plant where chlor-alkali is made.

Salt Cooling Solutions

As a world leader in heating and cooling bulk solids, Solex Thermal Science has been approached by salt producers about how Solex technology can enhance salt production. When a US-based producer of table salt recently installed a Solex Heat Exchanger in its solution mining facility, the result was a design that fit space limitations while delivering more consistent salt cooling, increased production and lower energy inputs than conventional technology.

The facility is typical of many solution mining operations where brine is mined from underground rock salt then fed to enclosed vessels and boiled under partial vacuum with steam. Once it crystallizes, the salt dries on rotary filters. Gas burners heat the air that passes through the cake of moist salt on the filter screen. A blade shaves the salt off the filter, then the salt goes through a drying process where the temperature is monitored to ensure all moisture evaporates. Salt leaves the drying operation at a temperature of over 93°C (199°F) and the salt must be cooled to between 66°C (151°F) and 76°C (168°F).

This salt producer approached Solex because they wanted to increase production but needed to do so within existing space restrictions. They knew that a Solex Salt Cooler installed by a nearby competitor several years before had proven effective and trouble free.

The producer had been using an open cascading type aspirator in which ambient cool air is used to reduce the temperature of the salt. One drawback to an open salt cooling system is that when air contacts the product it introduces the risk of contamination and moisture content changes. Of particular concern for this facility was the fact that typical fluid bed or rotary drum technology requires significant volumes of air to cool the salt along with large air handling equipment like ducting, motors, fans, scrubbers or chillers. The producer was unable to increase production throughput because the dust collection system was fully loaded and there was insufficient space to install a larger aspirator and its attendant air handling equipment.

The solution was to find a compact system that could be integrated within the limited space of the existing plant. Using a sophisticated combination of the two sciences of indirect heat transfer and the mass flow of bulk solids, Solex engineers customized a system that fit the space available and simultaneously enabled a 50 percent increase in product flow.

The custom system is based on the Solex Heat Exchanger which consists of water-cooled closely-spaced stainless steel plates contained in a sealed unit that prevents contamination. A discharge feeder regulates the product flow rate so that salt passes slowly by gravity in mass flow between the vertical heat transfer surface formed by the welded plates. For this producer, Solex engineers specified a mass flow vibrating feeder to control the discharge rate and maintain a uniform cross-sectional velocity. This was critical since it ensures consistent cooling of the salt as well as reliable flow downstream to the packaging facility.

Salt enters the heat exchanger at over 93°C (199°F) at a rate of up to 35 tonnes per hour and then has to cool between 15 to 25 percent to prevent sticking and discoloring. To achieve this, cooling water circulates between the plate's dimples and cools the salt to the desired temperature in three to four minutes. Once the salt is cooled, it is sprayed with iodine solution and flow enhancing additives before moving to the packaging facility.

The new system was able to incorporate existing infrastructure – for example, since the plant used wet scrubbers for dust collection, plenty of water was already available and only had to be rerouted to the Solex cooler. No additional energy was needed.

To facilitate installation, the heat exchanger was shipped in two sections to accommodate the tight location where the unit had to be installed with only 3.1 meters (10 feet) of headroom. The vertical configuration of the compact heat exchanger made for a small installation footprint. The modular design of Solex technology means that additional plate banks can be stacked for easy expansion if increased cooling capacity is required in the future.

Benefits to the production facility have been several. The system used much of the infrastructure already in place for savings in capital costs. Large volumes of air are no longer required for cooling, resulting in energy efficiencies and zero emissions. A consistent cooling temperature is maintained and the enclosed nature of the heat exchanger provides better control for a food grade product. Maintenance costs have been minimal and operating costs low.

Most importantly, the custom design created by Solex fits within the facility's existing space requirements. The combination of compact design and leading thermal and bulk flow science enabled the facility to implement a 50 percent increase in product flow and achieve enhanced productivity within the limited space available.