



World leaders in the science of heating and cooling bulk solids.

# TECHNICAL ARTICLE

## SOLEX HEAT EXCHANGER PROVIDES CONSISTENT COOLING OF IONISED TABLE SALT

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Annual worldwide salt production has increased over the past century from 10 million tonnes to over 200 million tonnes. Today, nearly 100 nations have salt producing facilities, ranging from primitive solar evaporation to advanced multi-stage evaporation in salt refineries. Salt is produced for use as a table salt in the home or commercial establishments such as restaurants or used for other applications such as water softeners, manufacturing, agriculture, swimming pools, meat cures or the highway industry.

The United States produces about 25 percent of the world's salt or about 46 million tonnes of salt a year. The second largest salt producer is China, followed by Germany, India, Canada, Australia, Mexico, France, Brasil and the United Kingdom.

Salt is mined using several methods. Dry salt, for example, is produced using three basic technologies: solar evaporation of seawater or salinelake water, solution mining or convention deep shaft (rock salt) mining. In the United States, nearly half of the salt produced is in the form of brines from captive brine wells to supply chloralkali to chemical companies.

A recognized market leader in heating and cooling powder and bulk solids, Solex Thermal Science, Inc. has been approached by several producers and marketers of salt products about how the Solex Heat Exchanger could be used to more uniformly cool salt leaving a drying operation or to more uniformly warm the salt for stronger pellets. Solex Thermal Science, Inc. are world leaders in the science of heating and cooling of bulk solids.

This article describes a solution mining facility that installed a Solex Heat Exchanger a little over a year ago to produce table salt. Besides salt, the Solex Heat Exchanger has been successfully applied to chemicals, fertilisers, polymers, detergents, catalysts, minerals, oilseeds, grains, food products, sugar and biosolids.

### **SOLUTION MINING SYSTEM DESCRIBED**

Typical of many solution mining operations, in the operation being described, saturated brine is boiled under partial vacuum with steam in enclosed vessels called vacuum pans. The brine is mined from underground rock salt (halite) and then fed to vacuum pans where the salt crystallises.

After it is crystallised, the salt is continuously dried on rotary filters. Gas burners heat the air that, in turn, passes through the cake of moist salt on the filter screen. A blade shaves the salt off of filter. The salt is then sent through a drying process where its temperature is monitored to make sure all the moisture evaporates. The salt leaves the drying operation still hot.

Previously, this facility used an open cascading type aspirator that used ambient cooling air to reduce the salt's temperature. An increase in production throughput using this system was not practical since the dust collection system was fully loaded and space limitations restricted expansion with a larger aspirator. The solution was to find a more compact system that could operate within a limited space.

This particular table salt producer knew of a Solex Heat Exchanger in use at a nearby competitor. The Solex system had been in operation several years and was effective and was trouble free. Based on feedback the company received, it was felt that the Solex system was the perfect solution.

### **SOLEX HEAT EXCHANGER INSTALLED**

To meet the requirements of this table salt producer in the United States, Solex Thermal Science, Inc. customised a system that was compact, met existing space requirements and used 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 required. This made the Solex system particularly attractive to the salt producer.

Solex engineers specified a mass flow screw feeder to control the control the discharge rate through the cooler and maintain a uniform cross-sectional velocity as the salt flowed through the system. With the Solex system the mass flow discharge device was critical since it ensures constant and consistent cooling of the salt as well as reliable flow down stream to the packaging facility.

To deliver the system, the Solex Heat Exchanger had to be shipped in two sections: the top or plate bank and the bottom or transfer hopper. Shipment in sections was necessary due to space restrictions in delivering the system to the required location. For example, the unit had to be installed in an area with only 3.1 meters of headroom.

### **PRODUCT FLOW DESCRIBED**

Salt enters the Solex Heat Exchanger at a temperature of over 93°C at a rate of up to 35 tonnes/hour. Equipment is contained in a totally sealed unit to prevent any dirt or contamination from entering the system.

Depending on the inbound salt temperature, the system has to cool the salt by 15 to 25 percent to prevent sticking and discoloring. The cooling takes place within minutes inside the Solex system. The desired cooling temperature is typically between 66°C to 76°C.

Cooling the table salt down to this temperature is necessary in order to spray the salt with an iodine solution that helps prevent goiters. The iodine solution has to be applied to the salt at a temperature below 76°C to prevent the iodine solution and flow enhancing additives from caramelising or discolouring.

The Solex Heat Exchanger consists of several hollow, fully welded water-cooled closely spaced stainless steel plates. Salt passes slowly by gravity between the vertical heat transfer surfaces formed by the welded plates in mass flow in from 3 to 4 minutes. Cooling water circulates between the plate's dimples and cools the salt to the desired cooling temperature.

For even cooling, the salt moves at a uniform rate over the cooler. A discharge feeder regulates the product flow, quality and temperature. Adjusting the speed to the screw feeder regulates the flow rate. After additives are mixed in, the salt moves to the packaging facility.

The Solex system is totally enclosed to provide better control for a food grade product versus the previously used system that was open and vulnerable to contamination. A consistent cooling temperature is being maintained and has resulted in a 50% increase in product flow for enhanced productivity. Maintenance costs have been minimal and operating costs low.

### **THE SOLEX HEAT EXCHANGER**

The Solex Heat Exchanger is a sophisticated combination of the two sciences of indirect heat transfer and the mass flow of bulk solids.

Heat exchanger technology, such as that from Solex offers numerous benefits over traditional fluid bed or rotary drum cooling methods that were also considered by the table salt manufacturer.

Unlike many other types of bulk solids coolers, the Solex system does not require large volumes of air to operate and instead lets gravity do the work to greatly reduce energy consumption.

Other benefits include zero emissions, lower installed capital cost, modular construction for easy expansion and a compact design that fits into tight areas.

### **CONCLUSION**

Since installing the Solex system, this table salt manufacturer has had a consistent cooling temperature and a 50% increase in product flow for enhanced productivity. The manufacturer could also install the system within the limited space requirements and used much of the infrastructure already in place for savings in capital cost.

*For more information on how the Solex Heat Exchanger can be used to cool or heat salt or other applications, contact Solex Thermal Science, Inc. at 3122-114 Avenue S.E., Calgary, Alberta, Canada T2Z 3V6 or call +(403) 254-3500; Fax: +(403) 254-3501 or e-mail [info@solexthermal.com](mailto:info@solexthermal.com). Ask for the Solex Thermal Science subsidiary or sales office closest to you. Solex Thermal Science can also be found on the web at [www.solexthermal.com](http://www.solexthermal.com)*

#### **About Solex Thermal Science, Inc.**

*Founded in 1999 as Bulkflow Technologies, Solex Thermal Science, Inc. is a privately held, primarily employee-owned, company specialising in the science of heating, cooling and drying of free flowing bulk solids such as sugar, salt, fertiliser, chemicals, plastics, biosolids, minerals and many other types of granular, crystals and powder. The original cooler technology was invented more than 20 years ago and was also acquired by Solex in 1999. Since then, Solex has risen to become the world leaders in the science of heating and cooling heating powder and bulk solids. Today, there are more than 250 successful installations in more than 30 countries in a wide variety of industries. With headquarters in Calgary, Alberta, Canada, Solex has subsidiary operations in Germany, Belgium, The Netherlands and The United Kingdom to serve the European market. It serves the Asian market through strategically located dealers in numerous countries. It is represented in Latin American by Ventura Process Equipment Company with offices in Mexico, Colombia, Argentina, Brazil, Chile and Venezuela.*