

SAVING ENERGY WHILE AVOIDING CAKING

Igor Makarenko, Solex Thermal Science, Canada, examines how an indirect plate-type heat exchanger can be used in the final fertilizer cooling step in order to avoid caking.



The cooling of different fertilizer products minimises the thermal effects and chemical reactions which can result in 'caking' – the creation of crystal bridges from small amounts of salt solutions present in the granules. Eliminating the caking mechanism allows the product to maintain easy flow characteristics in storage and downstream transportation.

In order to tackle this problem Solex Thermal Science introduced an indirect plate-type heat exchanger used in the final fertilizer cooling step before product storage or packaging. The cooling system offers several major advantages over fluid bed coolers (FBC) and rotary drum coolers.

The principal advantage is a reduction in energy consumption when compared to alternative technologies. In addition, there are also savings in installed capital cost by removing the large air handling systems needed for both FBCs and rotary coolers, which include chillers, fans, ducts, and a scrubber.

Energy consumption, specifically when fertilizer is being cooled, is an important issue for processing plants. Although fertilizer corporations do not usually disclose their process details, according to available public information the power consumption can be up to 1.7 MW for cooling 100 tph of fertilizer using either FBCs or rotary coolers.

This implies annual electrical energy costs of approximately US\$744 000.¹ By using a Solex cooler, this power consumption can be reduced by 90% to 170kW for

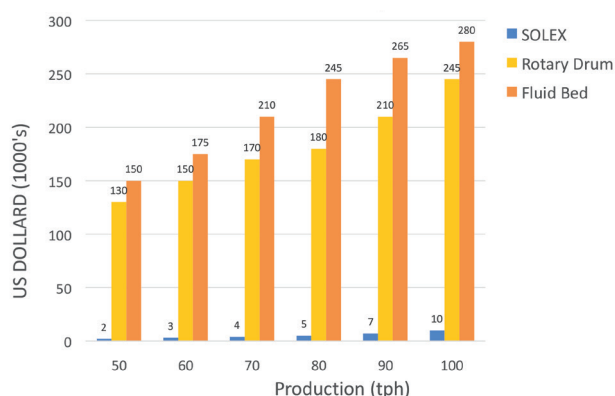


Figure 1. Annual electrical consumption costs.



Figure 2. Solex heat exchanger installation.

the same fertilizer capacity resulting in energy savings of over US\$600 000 annually.

Advantages

FBC and rotary drum technologies rely on the use of large volumes of air to fluidise the bulk solid material and/or act as the heat transfer medium to remove heat from bulk solid. Ambient air is taken in using large fans which require large amounts of input power. This air is then often chilled before being passed through the fertilizer. The air leaving the FBC or cooling drum may then require treatment to remove dusts before being emitted to the atmosphere via an emissions stack.

In either case where ambient and/or chilled air are being used, both the chilling process and the circulating fan(s) have high power requirements, and a large amount of dust laden air must be processed in an environmentally friendly manner.

The indirect cooling employed by the Solex equipment requires no large fans or blowers. Only a small cooling water circulation pump and a small air fan are needed, which operate at a fraction of the cost of a large blower. Water is a much more effective cooling medium than air, absorbing up to 24 times as much heat, resulting in lower power requirements to circulate the much lower volume of cooling medium. The technology provides an indirect method of cooling, whereby air is not used as a heat transfer medium.

Thus, the comparison reveals the inefficiency and high operating costs of FBC and rotary drum processes.

The lower operating costs of the Solex system result in a higher internal rate of return (IRR) for the customer, which drives a quick return on their investment. Installing indirect cooling equipment into a process can pay for itself in as little as 2 – 3 years. These operational savings then go directly to the operator's bottom line.

Case study 1: improved product quality

Potash (KCL)

The plant's objective was to improve cooling during summer months. Hot product entering storage resulted in caking in the bulk storage (product lump formation). Potash at the drying plant was being cooled with a fluid bed cooler using ambient air so the potash temperature leaving the cooler was dependent on the ambient temperature. Due to seasonal fluctuations, subsequent agglomeration in the warehouse caused a high number of complaints from customers, subsequent end-user potash returns, and associated reprocessing costs.

The facility needed a cooler to process 100 tph of crystalline potash product from 105°C to 42°C. Power consumption of the existing fluid bed system was unacceptably high at over 600 kW. Space restrictions in the plant made it unfeasible to install another fluid bed cooler, and construction of a tempering silo was not considered because of the high capital cost.

Outcome

The plant chose to install Solex indirect cooling technology. The Solex cooler offered low installation costs

and low energy requirements with a total electrical consumption of only 35 kW, reducing operating costs by 94%. The new system provides effective cooling of the product, removing agglomeration problems/caking, and increases customer satisfaction.

Case study 2: energy savings and recovery

Oilseeds

The production process that turns seeds into oil uses a significant amount of energy, especially in the form of steam. Thus, in order to reduce the environmental impact of its operations, an oilseeds plant started looking for ways to improve its process. Three objectives were established for this project. First, the company wanted to recover energy waste from the dryers that are used to heat oilseeds before processing. Second, it wanted to reduce odours associated with this system. The company's third objective was to improve overall process efficiency by preheating the oilseed before flaking. As a result, Solex worked closely with the company to develop a new process.

Using the bulk solids heat exchanger to recover energy

While drying and conditioning the oilseed, vapours with a temperature of approximately 95°C are generated. The oilseeds company and Solex combined their expertise to design an energy recovery system in which the hot vapours leaving the dryer are condensed in a closed-loop water stream, thereby capturing this waste heat. The heated water is then used to preheat the oilseed entering the process

through the use of a special seed preheater developed by Solex. Through this process, overall energy consumption was reduced.

This closed-loop system not only recovers energy, it also captures odours leaving the stack of the pre-heater. The reduction in odour is achieved by water-scrubbing the hot vapours.

Outcome

The staff at the plant have calculated that the company has realised an energy savings of 2 tph of steam. The company's goal was to increase heat recovery in the stack in order to decrease the temperature of the vapours and thus gain an odour reduction and to preheat the seed to an even higher temperature. This was made possible as a result of the modular design of the Solex preheater, which allowed for the easy addition of another heat exchange module.

Conclusion

The production processes in the fertilizer industry are energy-intensive. Even though gas costs represent the largest percentage of production costs, there still exists considerable potential to reduce electrical energy usage in the fertilizer cooling process. Energy savings can be achieved by analysing the power usage involved in cooling process, quantifying potential energy savings gains, and determining if a change to indirect cooling is right for the process. **WF**

Note

1. Annual cost = 1.7 MW power x 8760 hr/yr x US\$50./MWh = US\$744 600