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CASE STUDY

The Solex Heat Exchanger for Cooling Polypropylene Powder

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Daesan, Korea – Samsung General Chemicals (SGC), a subsidiary of the global Samsung Group, is a petrochemicals company that manufactures various petrochemicals and polymers. The cooling step in their polypropylene (PP) line was a bottleneck that limited the amount of powder polypropylene that they could produce per year. The PP is used for a wide variety of applications ranging from packaging films to automotive components.

The PP is made in a multi-reactor liquid-gas phase system. In the original system, the bottleneck in the process was the cooling step. The powder was pneumatically conveyed from a reactor, and dropped into a 40 metre silo. Once the silo was filled, it was purged with nitrogen in order to cool the PP in a batch-wise, direct contact system.

Effective cooling is an essential step in the powder manufacturing process; otherwise the PP has a tendency to form lumps if it is stored and transported at elevated temperatures. These lumps can cause processing difficulties with the SGC customers downstream.

The primary difficulty with the batch type system was that the production capacity of the PP line was much higher than the cooling capacity of the direct contact purge silo. As a result, while the PP was being cooled in the silo, SGC were forced to bypass the cooler, and to pelletize the remainder of the PP production.

For years, the Samsung marketing team had been asking for additional production of PP powder in order to satisfy increasing market demand. Mr. J.B. Lim, a senior process engineer, accepted the task of debottlenecking the PP cooling system.

Lim investigated a number of traditional systems, but they were all discarded, either because of the space restrictions caused by the existing layout of the plant, or because of the installed cost.

A search of the Internet led Lim to Solex Thermal Science Inc. of Calgary, AB. Lim realized that the Solex cooler was a potential solution to the SGC cooling problem, and would reduce the compressor, and nitrogen costs of the entire plant. Lim also recognized the cooler as a compact technology, which would suit the vertical integration of the existing process equipment.

The heat exchanger consisted of a bank of hollow, evenly spaced, vertical heat transfer plates, connected to the plant cooling water system. The bulk solid passes by gravity, in mass flow, between the plates. It is cooled by conduction, as the bulk solids comes into direct contact with the stainless steel surface of the water cooled plate. The amount of cooling is controlled by the residence time of the product between the plates.

The existing batch system had the capacity to cool approximately 5% percent of the total PP production. Lim requested preliminary proposals from BFTI for various temperature profiles, and a design flow representing 50% of the total PP production. Based on the proposal, Lim prepared a capital cost justification for the SGC board of directors, which included both the design concept,

and a payback analysis. Basing on the saving in nitrogen and the associated systems, the payback on the capital proved to be less than one year. Although the board of directors was impressed with the proposal, given that Solex did not have a direct reference in the PP industry, the SGC board of directors needed to be absolutely sure that the Solex cooler was the best choice for their company.

BFTI arranged for a visit with Samsung personnel to a North American facility with a cooler installed in a similar application. BFTI also asked Samsung to send a sample of their product to its Calgary facility in order to verify the thermal properties and flow characteristics of the PP powder. Based on the visits, and the positive results of the laboratory testing, the full size production unit was ordered in March of 2000.

Craig Myers, a project manager with BFTI, participated in the commissioning of the cooler in February of 2001, during which time the installation and start up procedures were reviewed. 'The most interesting aspect of the design and commissioning of the cooler was to design a compact unit that had sufficient capacity to act as a buffer between the continuous PP production line and the batch bagging operation', says Craig Myers.

Samsung has had few maintenance problems with the heat exchanger, and the performance has been even better than expected. Lim says the cooler allows us to increase our PP powder production by approximately ten times. Product quality has improved and the cost per tonne of production has decreased because we have virtually eliminated the nitrogen use associated with the cooling process.' Based on the cost savings, increased PP powder production, and the ingenuity of the solution, Lim was nominated for a Best Practice award by Samsung General Chemicals.

SGC now ship approximately 10% of its total production in the powder form. As the market for PP compounds is increasing, so is the market for PP powder. SGC currently has the ability to cool 50% of its PP product, and is prepared for increased demand in coming years.