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Process Vacuum | Air Pollution Control

Croll-Reynolds refurbished vacuum cooling system saves time and trouble for Heinz factory in Ireland

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The straight-tube condenser design is nearly twice the length of the old U-tube arrangement, but where space is available it is much easier to clean and maintain. In the mild climate of the Irish Sea, rooftop installation was feasible and offered all the space that was required.

Editorial Background
Sandvik Coromant of Fair Lawn, NJ is part of Sandvik's tooling division. The overall Sandvik Corporation employs 35,000 in one hundred and thirty (130) countries.

The Heinz Frozen Foods plant in Dundalk is located on the coast of the Irish Sea, midway between the major cities of Dublin in Ireland and Belfast in Northern Ireland -- about 80 kilometers (fifty miles) from each.

Plant production takes the form of a variety of meat (beef and lamb) and vegetable sauces with added ingredients, which become ready-made frozen dinners. Production at the plant goes on six days a week, around the clock. Two 8-hour production shifts run from 6 am to 10 pm, followed by cleaning and sanitation. Cooking begins at 12 or 1 am to be ready for the 6 am shift.

About 20 tons of product are running and another 20 tons are in preparation at any given time. Five five-ton production (cooking) kettles are in use, served by four five-ton stock tanks, which hold the sauce on line ready for filling into the kettles. The plant employs about 400 workers.

Cooling is the crux
Cooking isn't everything in the food processing industry. With many tons of product in preparation, expedited cooling is equally vital. A sluggish cooling system can be the limiting factor on production for an entire factory.

The Heinz Dundalk facility employs two 3-stage vacuum cooling systems for its five kettles. The older of the two systems was deteriorating rapidly, wasting large amounts of cooling water and ejector motive steam. Management decided to rebuild and modernize the system. The system had originally been manufactured by Croll-Reynolds Co. (Westfield, NJ, U.S.A.) Since Croll Reynolds has many years of successful experience with ejector based cooling systems for the food industry, it was a logical choice to help with the project.

Renovating the system
Ejectors, with no moving parts, are rugged and long lasting. Croll-Reynolds service engineers found that the original first (X) stage "booster" ejector replaced several years previously in good condition. A new main (X-Y) intercondenser was needed, however. It was decided to replace the failing second (Y) stage ejector, secondary (Y-Z) intercondenser, third (Z) stage ejector and (Z-A) aftercondenser with a liquid ring vacuum pump.

Croll Reynolds designed the replacement elements to fit into the existing system, with steam and water lines matching so no rebuilding would be necessary for installation. The remodeled system is larger and offers more capacity.

The final design replaced the existing two stage low vacuum ejector system with two, 30 HP single-stage Robuschi liquid ring vacuum pumps, only one of which operates at any given time. The two vacuum pumps are run on a controlled system, so if one doesn't start up or trips out, the other will automatically come on. Pump operation is staggered so that both pumps receive equal wear.

The existing U-tube vapor in shell main (X-Y) intercondenser was replaced with a straight tube vapor in tube TEMA type "NEN" intercondenser. This design is approximately 40 ft long -- nearly twice the length of the U-tube arrangement. When space is available as with this roof-mounted installation, it is easier to clean and maintain the gas side of the condenser. (In this particular instance, the gas side of the condenser was the one that fouled more readily, due to carry over of product from the process vessels.)

The condenser shell is equipped with hinged channel covers. To inspect or clean the tubes, the channel cover bolts are loosened and the channel cover is swung away on a davit hinge. The straight tubes are easily cleaned by rodding. To further simplify maintenance, designers specified large, 25 mm (1") tubes rather than the usual 19 mm, simply because they're easier to clean and can be expected to stay clean longer.

Installation of the new components was completed at CBM Engineering (Dungannon, Ireland) and went smoothly. Before the new condenser was received, plant personnel modified the platform to accommodate its longer length. The actual installation work began on a Friday afternoon. The condenser flange and piping lined up perfectly, and the new system was piped up and finished by Saturday afternoon, ready to be tested and go into operation.

Operating the system
The upgraded vacuum cooling system is in steady operation. Cooling for a typical 4½-ton batch, which in the past required 70 to 90 minutes on average, is now accomplished in 50 minutes. Controls for the new system are fully automated and easy to use.

To prepare a typical ready-made dinner, a batch is started at 0-15o C. A cycle of adding water, adding ingredients, heating to 85o C, adding more ingredients and heating back up to 85-90°C follows. Once all additions are complete the batch is heated again to 85-90°C and is held at this temperature for a short period of time before sampling for quality. The batch is then cleared for cooling.

When the batch is finished it is vacuum cooled. Typically, vacuum cooling brings the product back down to 8°C in 50 minutes.

The renovated vacuum system and the existing one supply more than adequate cooling for the five five-ton kettles. Another one or two kettles could be accommodated.

Heinz expects to run the new system for three to six months before they open the condenser inspect its internals. The flexibility to open the condenser at both ends via the hinged channel cover and head arrangement is an obvious benefit.

Simplified access is accomplished without having to disturb the water or gas piping. It eases cleaning, insurance inspection, checking the water and steam side, etc. With the davit arrangement, the tubes can be accessed without need for a crane.

Close-up details: rooftop installation of vacuum cooling system components at Heinz' Frozen Foods plant in Dundalk, Ireland**.**

Utilities savings
Plant management estimate a 13-15% steam savings for the upgraded system, as well as the great benefit of faster process time.

Water is also saved by the new arrangement. In the original system, the failing third (Z) stage ejector, and the 75 kW water pump supplying cooling water to the existing (Z-A) aftercondenser ran continuously. The renewed system circulates water on demand, so that the water pump runs only when a batch is actually being cooled. As a result, at least 16 hours at 75 kW are saved every operating day, in addition to wear and tear on the pump.

The way to go
This is virtually a complete new system. It is simple and runs a smooth, trouble-free operation. Management considers that the Croll Reynolds design improvements are definitely the way to go. Another such system will certainly be considered when additional capacity is needed at the Heinz Frozen Foods Dundalk processing plant.

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Sidebar:

Operation of a liquid ring vacuum pump
The liquid ring vacuum pump is a rotary displacement pump consisting of a multi-vaned impeller mounted eccentrically within a cylindrical casing. Before operation the pump casing is partially filled with water. When the pump is turned on the water is thrown to the periphery of the casing by the rotating impeller where it forms a liquid ring. The liquid ring moves with the rotating impeller around a center void, and acts as a seal between the casing and the pockets created by the impeller vanes.

As the impeller turns, each pocket is first filled with sealing water. Then the sealant is thrown out of the pocket and replaced by gases drawn in through a suction port. Finally the sealant reenters the impeller pocket, compressing the gas and forcing it out a discharge port. As the impeller turns, each pocket repeats these actions, creating a steady, nonpulsating vacuum.