

# DRY SCREW VACUUM PUMP SAVES E.I. DUPONT \$75,000/YR. IN RAW MATERIALS

**E.I.** DuPont in Orange, Texas has been producing nylon intermediates at the Sabine River Works plant since the early 1970's. One part of this plant produces adiponitrile, an ingredient used in the manufacturing of nylon. DuPont nylon is used by other manufacturers to make carpet, clothing and other products.

The production of adiponitrile is accomplished through a series of reaction, stripping, flashing and distillation operations. Some of these process unit operations must be done under vacuum in order to produce a quality product, which will meet customer specifications and requirements.



There are several different sources of vacuum which can be used for these operations. Among the most common sources are steam jets, liquid ring and rotary vane vacuum pumps. The adiponitrile production area at Sabine River Works has been using steam jets because of their simplicity and low installation costs. However, using steam jets did present some problems. For example, steam jets generate large quantities of contaminated condensate which must be treated as a waste stream. Another problem with the steam jets was kickback. If the pressure at the inlet of the steam jet is deeper than 1/10th the pressure at the throat of the jet, steam will flash back

into the vessel, causing loss of vacuum and process upsets, which will affect product quality.



(Left) Bear Clanton, mechanical technician at Sabine River Works, monitoring vacuum pump system. (Above) Busch COBRA dry screw vacuum pump installation at E.I. DuPont, Sabine River Works.

The first Busch COBRA dry screw vacuum pump was installed on the adiponitrile production process in August 1994 as a test installation for replacing the steam powered vacuum jets. It was pumping nitrogen, HCN, cyclohexane, and other organics. The COBRA C200 pump ran continuously until Dec. 1994, at which time it was examined and found to be in excellent condition. This pump is unique in that DuPont is able to inject an organic fluid into the rotor cooling port, instead of the usual air or nitrogen to control the gas temperature due to the heat of compression. Injected air or nitrogen can reduce the bulk gas temperature by convection and conduction. The organic fluid flashes, absorbing the heat of compression, allowing the vacuum pump to operate at a discharge temperature of approximately 140°C. Other dry pumps cannot handle liquid injection as well as the Busch COBRA dry screw vacuum pumps.

Another advantage that the COBRA pump has over steam jets is its ability to achieve a deeper and steadier vacuum. This has the potential to reduce process upsets and increase production.

The adiponitrile production area at Sabine River Works now has a total of seven COBRA vacuum pumps. They are operating on columns which

require different flow capacities and vacuum levels. Manifold systems, attached to the inlet of the pumps, have been installed for handling several columns. Four COBRA pumps are on two manifold systems in one sub area, and three COBRA pumps are on two manifold systems in another sub area. Since the unit operates 365 days a year, 24 hours a day, each building is equipped with a swing pump which provides backup to the normal service pumps, so there is no downtime.

Sabine River Works has enjoyed an additional benefit of the COBRA dry screw vacuum pumps. They are now able to install two scrubbers; one in each building on the pump discharge manifold. By adding scrubbers to the systems, DuPont has recovered \$75,000 a year in raw materials. This was not practical with the steam jets because of water contamination.

E.I. DuPont has enjoyed the following benefits of the Busch COBRA dry screw vacuum pump: deeper vacuum for better operational control; the ability to recover solvents; reduced utility costs due to no steam consumption; and considerable savings because of the elimination of waste water.

"We felt we were out on a limb when we chose the COBRA pump to be the heart of our vacuum system," says Bear Clanton, mechanical technician at the Sabine River Works. "It had everything we hoped for mechanically, but lacked the historical endurance data that makes you feel better about your project. The COBRA has held true to everything the Busch company claimed. They also worked with us to develop the liquid injection coolant. Everyone here at Sabine is very pleased with the performance of the COBRA pump and the benefits this project has given DuPont."

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