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# Dry Screw Vacuum Pump Eliminates Contamination and Condensation in Freeze Drying System

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Hull Corporation, established in 1954, is a leading manufacturer of freeze drying systems for pharmaceutical, diagnostic, biotechnology, and fine chemical manufacturing firms throughout the world. The 70,000 sq.ft. facility has over 100 employees, and is committed to providing the most cost effective and technologically advanced freeze dryers to its customers. Over the years, Hull has become an innovative leader in freeze drying technology and has dominated the lyophilization industry for its technical leadership, product durability, and process dependability.

In September 1994, the Lyo Renewal Division of Hull Corporation was created. This division is devoted specifically to acquiring, refurbishing, upgrading, and reselling used freeze drying systems. By finding available used freeze drying equipment and upgrading it to new specifications, this division can offer buyers a rebuilt system faster and at less cost than a new system. Freeze drying, or lyophilization is a method of preservation of a wide variety of biological, pharmaceutical and fine chemical materials without altering its chemical and biological characteristics.

The freeze drying process requires three steps: freezing, primary drying (sublimation), and secondary drying (desorption). First, the material is frozen and then the solvent (water) is removed by a combination of sublimation and desorption. The result is a finished product in a preferred physical form that is stable, easily reconstituted, and is acceptable for its intended use.

Creating the environment of reduced pressures in the range where sublimation occurs at low temperatures is accomplished using a vacuum pumping system. There are a number of choices for vacuum systems. The three basic types of vacuum pumps

commonly used in freeze drying are the rotary piston, rotary vane, and mechanical blowers.

Both the rotary piston and vane pumps are oil-sealed pumps. A mechanical blower is used in conjunction with an oil-sealed pump to achieve higher pumping speeds and lower ultimate pressures. Also, a two stage pumping system consisting of a pump and a blower may be required, if the product formulation contains a solvent mixture such as water and alcohol.

The Lyo Renewal Division typically uses oil-sealed pumps. However they do have some disadvantages. There is the danger of oil migration back into the process which can contaminate the product. And there is the problem of condensation. If the water being pulled off the product during sublimation condenses and mixes with the oil, the pump could fail, causing product degradation.

One solution to these potential problems is to replace the oil-sealed pumps with dry (oil-free) vacuum pumps and that is exactly what the Lyo Renewal Division did for one of their customers. They installed a Busch dry screw vacuum pump in one of their refurbished freeze dryers. The Busch COBRA C200 dry screw vacuum pump is single stage, direct driven, requires no intercoolers and has an end pressure of  $1 \times 10^{-1}$  torr. The addition of a Busch WV500 blower to the pump increased the vacuum and capacity to  $3 \times 10^{-2}$  torr.

The COBRA operating principle is very simple. Entering gases are trapped between flights of the screws and moved axially down a short straight flow path to the exhaust where they are discharged. Product cannot accumulate in the pump. With the oil-free COBRA, there are no disposal costs; product can be recovered easily; and it is environmentally



*Chris Terwilliger, of the Lyo Renewal Division, monitoring the COBRA/blower system*

friendly. It has fewer moving parts than most other types of dry vacuum pumps which increases reliability and reduces maintenance. It has a small footprint for less space requirements, and has non-contacting parts for longer pump life.

Emil Dix, special project manager at the Lyo Renewal Division, is very pleased with the results of the COBRA/blower system. "I like the simple, straight-through construction of the pump. The design provides a noise-free, vibration-free pumping package that can be located in a controlled room environment", says Emil. The COBRA eliminates the problem of oil contamination, condensation, and solvents can be recovered. Now Hull is able to offer another option to meet their customers' needs. Being able to provide the most technologically advanced freeze dryer equipment is what has made Hull a leader in the lyophilization industry today.

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