Low Pressure Screw Compressor Blowers for Wastewater Aeration

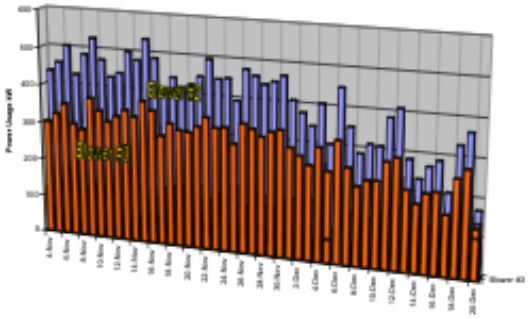
The energy required to supply low-pressure air continues to be one of the highest operating cost centers in a wastewater treatment plant. The introduction of single-stage turbo blowers into the wastewater treatment market has raised this awareness, based on initial claims of up to 30 percent power savings, when compared to standard positive displacement (PD) blowers. In some cases, turbo blowers were applied in systems where the flow and pressure variations were outside of the range of the blowers. The challenge remains to choose the technology that meets the realistic needs of the plant over the life cycle of the machinery, and also matches the specific characteristics required by the treatment system.

In the years since the introduction of high speed turbo blowers for wastewater aeration, another technology has been introduced to the market, in the form of low pressure screw compressors. The performance is comparable to turbo blowers. In addition, the machine operates much like a standard positive displacement blower, in terms of turndown (as much as 4 to 1) and the ability to handle wide pressure variations.

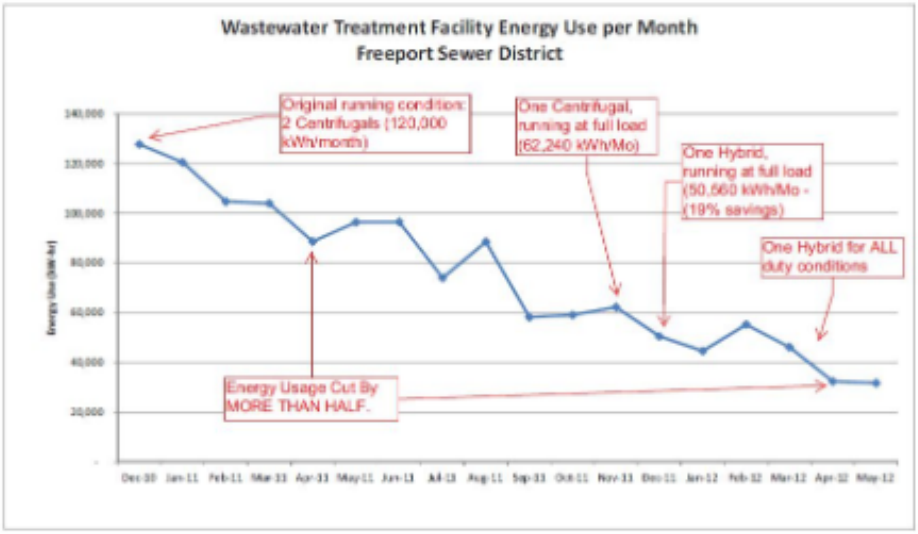
The Aerzen design for low pressure screw compressors is called the Delta Hybrid. It was introduced to the world market in 2010 after 10 years of development. The profile of the rotors is similar to that of higher pressure screw type compressors, but adapted for a lower compression ratio to meet the low pressure requirements of aeration systems without wasting power due to over-compression. (See illustration). Compressing the air inside the air-end is more efficient than simple conveyance. This is the heart of the energy savings of the Delta Hybrid and its competitors. When passing the inlet port, the volute of the female rotor fills with air. As the rotors twist, the matching lobe of the male rotor reduces the volume of the volute, compressing the air. When the volute reaches the discharge port, the air is at the discharge pressure of the system. For the Delta Hybrid, this occurs four times for each revolution of the shaft, since there are four volutes.

Packaging the Delta Hybrid is similar to the standard blower package. The goal was to make the package accessible, and as easy to install and maintain as existing blower packages.

Proving the technology to the US market included one installation in New York, and one in Maine. The site in New York (Huntington) utilized a Sequencing Batch Reactor (SBR) system, rated for 1.2 MGD. The high cost of electricity ($0.19/kWh) resulted in the plant spending approximately $230,000/year to supply power to the SBR blowers, which were conventional, 2-Lobe PD blowers. Aerzen supplied a Delta Hybrid for a side-by-side comparison. The owner installed kilowatt-hour meters on each blower, and ran the two units in parallel. Power readings were taken four times per day. The resulting power savings was 29%, which translated to annual savings of $80,000 per year. This site was unique in comparison to other regions of the country, between the high power cost and the relatively high pressure in the SBR (11.6 PSIG). However, it served as an example of the potential savings with this technology.



The installation in Maine (Village of Freeport, designed by Woodard & Curran) involved an overall upgrade of the plant, including blowers, diffusers, and controls. The project was partially funded by Efficiency Maine, based on using more efficient technologies in the plant. The blower portion of the project consisted of replacing their existing multistage centrifugal blowers with screw compressors. The existing blowers were controlled with an inlet throttling valve, and was limited in turndown. The turndown of the Delta Hybrid was a critical factor in energy savings for Freeport. As the curve below indicates, the Delta Hybrid saved approximately 19% compared to identical use of the centrifugal blower. There were many improvements that contributed to the 50% overall energy savings at the plant, but the Hybrid, and its efficient turndown range, was an important part in the overall savings.



Blowers are just one aspect of an overall wastewater treatment design. However, with the power for the blowers adding up to about 60% of the plant energy bill, providing the appropriate blower technology for the specific plant process can prove to be valuable.