Emerging Technologies

Turbo Blowers Offer Energy and Cost Savings

By APG-Neuros, Blainville, Québec, Canada

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When APG-Neuros came out with its revolutionary air-bearing technology in 2005, it was received with hesitation and skepticism in the wastewater market. Today, APG-Neuros' air-bearing turbo blowers are installed in 443 locations in North America, and 120 units are on order. The product has optimized aeration and increased energy efficiency in wastewater treatment plants (WWTP), where the majority of APG-Neuros' blowers are installed, bringing a much-needed technological change in the blower market.

From the time the Single Stage Centrifugal (Magnetic Driven) blower came on the market in 1985, there was little technological advancement in the blower industry until the Single Stage Neuros Turbo Blower was introduced in 2003—almost 20 years later.

APG-Neuros' turbo blower technology was founded in the aerospace and defense industry, where aero engines were used in unmanned aerial vehicles and in the F-16 military aviation program, making the technology tested and reliable. The core of the technology is the patented third-generation bump foil air bearing. It is oil-free and non-contact, needing no lubricating or associated maintenance, and results in lower vibration from the rotor during operation. It proved to have durability and endurance, which was demonstrated through 25,000 starts (the equivalent of more than 20 years lifetime in a typical operation).

Another key technology within the blower is the high-efficiency impeller, which is designed using in-house software based on aero gas turbine engine technology. It is a solid forging impeller machine with five-axis machining for higher integrity and higher fatigue life. A larger diameter and precise impeller shape, combined with optimal speed, results in higher efficiency. The Permanent Magnet Synchronous Motor (PMSM) transfers EMF to load rather than windings and slip rings with no physical contact between stator and shaft, offering high-precision motor speed control. Driven by sinusoidal PWM algorithm, it lowers motor heat rejection and minimizes cooling requirements, resulting in energy savings.

As an extra design feature, the inlet air cools the blower core, the variable frequency drive (VFD), and the control systems. Because there is no heat rejection to the blower room, users

don't require auxiliary exhaust systems or additional power consumption for cooling. The 200- to 700-Hp models have an integrated glycol cooling system for higher performance and durability with no external water supply required. Additionally, every standard turbo blower model comes with a programmable logic controller, which makes it possible to run the blower in constant pressure, flow, or DO control mode—making controlling, monitoring, and diagnostics easy. APG-Neuros' blowers can attain flow rates of up to 20,000 SCFM and a discharge pressure up to 15 PSIG. The Dual Core models NX400 (400 Hp) to NX700 (700 Hp) combine two cores within the same enclosure unit to provide flow rates ranging between 3,000 and 20,000 SCFM.

The turbo blower's innovative design results in many benefits, primarily energy and operating cost savings of up to 35%[1] when compared with a conventional positive displacement blower. "Turbo blowers operate at high speeds, 20,000 rotations per minute (rpm) to more than 40,000 rpm, which results in efficiency improvements, because dynamic efficiencies of compressors increase with increasing speed."[2] Because energy consumption is one of the biggest operating costs of a WWTP, this could represent significant operational cost savings.

A study was conducted by CDM at the Franklin, NH, WWTP. Aeration accounted for approximately 36% of the total electrical consumption at the plant,

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which used positive displacement blowers for the aeration process. The blowers were inefficient and required excessive maintenance[2]. The new APG-Neuros high-speed turbo blowers were installed in the plant for a period of nine weeks for a demonstration. During that time, draw, pressure, airflow, and DO concentration data were collected. The demonstration showed that "a 32% to 35% reduction in direct wire-to-air power consumption could be achieved through upgrading the blowers."[2]

Similar results were observed during a demonstration project at the Central Advanced WWTP in Fort Myers, FL. The plant's biosolids processing facility includes an aerobic digestion system that utilized one of three multistage centrifugal blowers installed back in 1994. Power data was collected for each of the demo turbo and the multistage centrifugal blowers over a period of approximately four days. The demonstrated test showed an average power savings of 37% when compared with the multistage blower. [3]

Savings could be improved further by automating the aeration process control system. In manually controlled systems, the controls typically are set to meet the maximum demand in a particular period of the day, and staff members adjust the equipment either daily or weekly. However, load fluctuations cause oxygen demands to change constantly. Besides wasting energy, the excess aeration may hamper treatment by shearing flocculated particles too much.[3]

Additional energy savings and operational flexibility can be achieved thanks to the turbo blower's VFD, which makes it possible to adjust the blower's speed and the blower's turndown flow rate of up to 76%. This operational flexibility allows the control of the blowers to be automated, which "typically uses DO probes and analyzers to measure DO in aeration systems and adjust airflow accordingly in real time"[3] maximizing energy efficiency.

Up to 12 APG-Neuros blowers can be controlled by a master control panel (MCP) simultaneously, operating based

on input command of DO, pressure, or flow control. The MCP gives the plant SCADA system one point of contact for all blower data, aeration control set points, and control process data. Likewise, it manages starts, stops, and speeds for all of the blowers.

Unlike the conventional blowers, the turbo blower also has low noise and vibration thanks to the no-contact air bearing and APG-Neuros' patented Noise Trapping System enclosure, which effectively controls sound propagation and reduces noise levels to 70–85 dB(A). The low vibration eliminates the need for a heavy foundation, significantly reducing the installation costs. The blower's smaller footprint (up to 55% smaller compared to technologies with similar flow rates) further reduces installation costs.

Because the turbo blower required no oil, liquid, or belts to change, maintenance costs are low. Maintenance includes periodically cleaning or changing the air filter and checking the glycol fluid levels for the models of 200Hp to 700Hp.

Finally, APG-Neuros has an extensive customer and technical support network in proximity to its customers, with in-house field service engineers in the West and East coast of the United States and more than 35 APG-Neuros factory-trained and certified technicians all around the country, providing its customers with a quick response time.

APG-Neuros' product is welcomed and accepted as the future of blowers in the wastewater market. The blowers allow WWTPs to be more environmentally sustainable, energy efficient, and cost effective, which are all growing industry concerns. "APG-Neuros' turbo blowers are the greatest things to come along in a long time," says Jonathan Lane, a Wastewater Operator from Benicia, CA. "The turbo blower is easy-to-use, runs flawlessly, and requires minimal maintenance."

END NOTES

1. Based on a third-party case study published in WE&T. Bell, K., Sciandra, J., & Wagner, K. (2010). Aerate for Less; Turbo blowers can cut energy costs by more than 35%. *WE&T.*
2. Bell, K., & Abell, S. (2011) Optimization of WWTP aeration process upgrades for energy efficiency. *International Water Association Publishing 6.2.*
3. Bell, K., Sciandra, J., & Wagner, K. (2010). Aerate for Less; Turbo blowers can cut energy costs by more than 35%. *WE&T.*

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