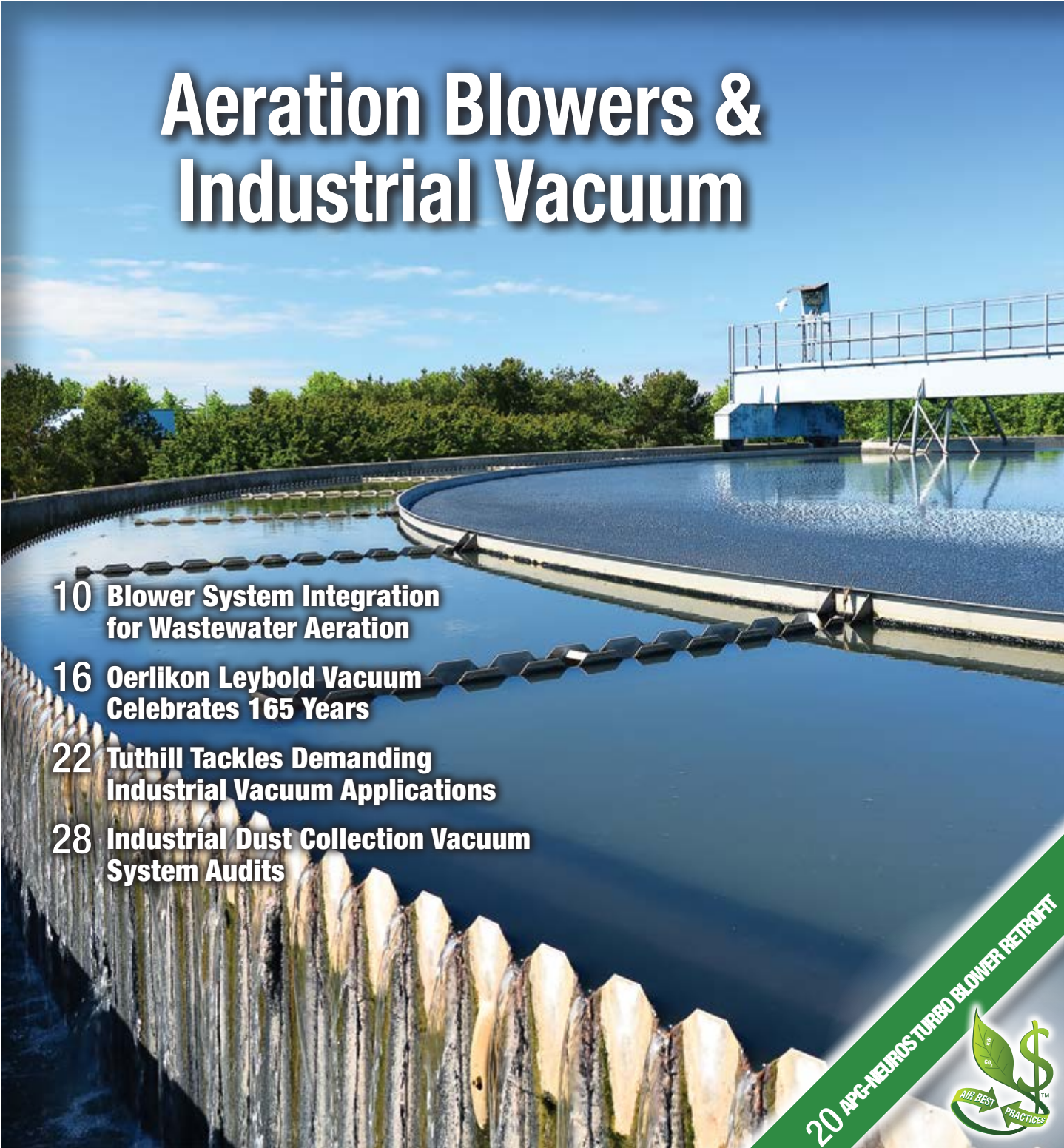


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Aeration Blowers & Industrial Vacuum

September 2015

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FROM THE EDITOR

Aeration Blowers & Industrial Vacuum



Aeration blowers are an indispensable part of biological wastewater treatment plant processes, according to Stephen Horne and Marcus Jungkunst from Kaeser Compressors. Aeration blowers normally provide oxygenation to support bacteria in the wastewater at a gauge pressure of 500 mbar (7.15 psi). Historically installed in a piecemeal manner, their article outlines the benefits of defining demand and engineering an integrated blower system.

Oerlikon Leybold Vacuum is celebrating their 165 year anniversary. CEO Dr. Martin Füllenbach commented: "As pioneers of vacuum technology for process industry, coating applications, analytical methods and applications in research and development, we belong to the four largest suppliers in the world." In this issue, Mario Vitale from their U.S. operation provides an overview of their product lines including their DRYVAC® dry-compressing screw-type vacuum pumps.

The San Bruno Water Quality Control Plant in South San Francisco, CA, uses primarily settling treatment followed by an aerated-activated sludge process for removal of organics and other constituents from the wastewater. APG-Neuros provides us with a case study on how they replaced a 300 hp blower with a turbo blower for aeration basins 5 through 7. The City of San Bruno has realized annual energy savings of \$56,000 and a simple ROI of four years with this project.

Tuthill Vacuum & Blower Systems is on the move. Our own Editorial Associate, Clinton Shaffer, was able to speak with Tuthill Application Engineering Manager Keith Webb about some of their exotic applications using industrial vacuum. "Let's say you're trying to dry lettuce after washing. One way to remove the water is to raise the temperature to 212°F at atmospheric pressure," Webb said. "In order to dry that off, you can reduce the pressure around the liquid and get it down to its saturated vapor pressure, and then add the latent heat."

Industrial vacuum systems are challenging to audit and optimize. Tim Dugan, from Compression Engineering Corporation, provides us with his experiences in his article, "Industrial Dust Collection Vacuum System Audits." He discusses the pressing need for a safety-first philosophy: "Plants will rightly always have a higher priority for compliance and safety than energy efficiency." His article presents a composite of several audits they have done, presenting a secondary wood products manufacturer.

"What is the best type of oil to use in my vacuum pump?" is a common question and one that David Mitchell, from Ultrachem Inc., answers quite well in his article. He recommends users understand lubricant viscosity, describes the different oils in the market, reviews common additives and comments on other variables (like temperature differential) users should consider when choosing a vacuum pump lubricant.

Thank you for investing your time and efforts into Blower & Vacuum Best Practices.

ROD SMITH

Editor

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BLOWER & VACUUM SYSTEM INDUSTRY NEWS

Roots™ Blowers & Compressors Acquired by Colfax

Colfax Corporation, a global manufacturer of gas- and fluid-handling and fabrication technology products and services, recently announced that it has entered into a binding agreement to acquire the Roots™ blowers and compressors business unit, also known as Industrial Air & Gas Technologies, from GE Oil & Gas for a cash consideration of \$185 million.

Roots is a leading supplier of blower and compressor technologies that service a broad range of end markets, including water treatment, chemical production and power generation. This acquisition will build on Howden's global strength in compressors and blowers, and will add important application expertise and product solutions to the portfolio. In 2014, Roots had approximate revenues of \$155 million and EBITDA of \$22 million.

In making the announcement, Steve Simms, President and CEO of Colfax, stated: "I am delighted to welcome the Roots team to Colfax. We are excited by the opportunities created by combining the Roots capabilities and application expertise with Howden's global footprint and continuous improvement culture. Like Howden, the Roots business has spent more than 150 years developing market-leading products and solutions, and we look forward to continuing to innovate and grow."

Mr. Simms continued: "Strengthening our businesses through bolt-on acquisitions is a core part of our strategy, and we continue to see a robust pipeline of opportunities."

"This transition marks another important step in the 165 year history of the Roots™ blowers and compressor heritage," said Tom Schwab, General Manager of GE's IAGT business. "Moving forward with Howden will position us for even greater success as we continue to invest in products and technology and better serve our customers globally." Closing of the acquisition is expected early in the third quarter following the fulfillment of certain conditions.

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BLOWER & VACUUM SYSTEM INDUSTRY NEWS

About Colfax Corporation

Colfax Corporation is a diversified global manufacturing and engineering company that provides gas-and fluid-handling and fabrication products and services to commercial and governmental customers around the world under the Howden, Colfax Fluid Handling and ESAB brands. Colfax believes that its brands are among the most highly recognized in each of the markets that it serves.

*For more information,
visit www.colfaxcorp.com.*

Pfeiffer Vacuum Introduces New Duo 3 Rotary Vane Pump

With the new Duo 3 DC, Pfeiffer Vacuum presents a two-stage rotary vane pump that is designed for applications with 24 volts DC. It is the only rotary vane pump on the market that can operate in a temperature range between -20°C and + 60°C.



Pfeiffer Vacuum's New Duo 3 DC Two-Stage Rotary Vane Pump

With a consumption of less than 100 watts in continuous operation, it is energy-efficient, and, thanks to its brushless motor and the optionally available magnetic coupling, it is very easy to service. The Duo 3 DC provides a pumping speed of 3 m³/h and a final pressure of 3 · 10⁻³ hPa. Due to the innovative rotation speed control, higher or lower pumping speeds can also be achieved.

With this pump, Pfeiffer Vacuum focuses on developers and providers of new vacuum-

based technologies in the automotive sector that require a 24-volt power supply. In the future, the concepts that are currently being developed in this field will play an important role in energy conservation and cost optimization in vehicles.

The Duo 3 DC creates the necessary low and medium vacuum, taking into account the specific requirements of this area of use.

Moreover, the Duo 3 DC can also be used in many fields of application in the analytical industry. Its quiet operation allows for installations close to workstations, where a 24-volt supply voltage is often available.

*For more information, visit
www.pfeiffer-vacuum.com/en/.*

APG-Neuros Expansion Continues Into the UK

APG-Neuros, a market leader of high-efficiency turbo blowers, has completed the commissioning of its product at the Thames Water and is in the process of completing three projects with other UK wastewater utility companies.

Orders from Anglian Water and Christchurch STW were delivered in March and April 2015, respectively, bringing the number of blower packages installed in the UK to 10. Installations to date include, Beddington STW with Thames Water, Christchurch STW and Portbury Wharf STW with Wessex Water, and Lowestoft STW with Anglian Water.

APG-Neuros was the preferred supplier of turbo blowers for the first phase of refurbishment at Christchurch STW in early 2014. A later site development phase led to a second purchase made with APG-Neuros for three additional units. This second order will bring the number of APG-Neuros blower packages at Christchurch STW to six.

The UK wastewater industry has for many years been looking at embracing cost-effective, reliable and technically superior aeration blowers that, through their deployment, will impart significant long-term operational cost savings. With the focus of UK's AMP6 procurement cycle being placed on matters pertaining to Total Life Cycle Cost, the utilization of the APG-Neuros product certainly captures the expressed desire of operation-driven savings.

APG-Neuros expansion into the UK and increased sales activities has seen the recent appointment of Mr. Craig Phelps, in the role of Technical Sales & Application Engineering Manager. Mr. Phelps previously held the position of Efficiency Manager at Wessex Water where he evaluated aeration technologies.

APG-Neuros is committed to the UK wastewater market and will place a continued level of investment into its customer-facing activities. APG-Neuros has gained track record and experience through its North American activities and dedicated localized representatives. It plans to roll out a similar business model in the UK.

To further increase its supplier profile within the UK/European markets, APG-Neuros has



An APG-Neuros installation at Thames Water

registered with Achilles UVDB — an online B2B community that enables companies to manage supply chain risk and comply with EU supply regulations. Through this registration process, APG-Neuros has attained a valuable ‘shop window’ with companies operating within UK wastewater sector, placing itself in the best position to be considered as a supply chain partner.

For more information, visit www.apg-neuros.com.

GD Nash Introduces New Vectra XM 150 Compressor

GD Nash recently introduced the new Vectra XM 150 compressor — an expansion of the NASH Vectra compressor range that operates at up to 4 bar G (60 psig). It is

specifically designed for the higher pressures and performance requirements found in many process applications, including vapor recovery, flare gas recovery, biogas, corrosive gas handling (e.g. VCM and chlorine) and hydrogen compression.

The NASH Vectra XM 150 compressor provides the same quality and reliability that can be expected from the existing Vectra series with the features below:

- Single, conical port design
- Single pressure boundary sealing point
- No tie rods
- API-681 compliance; API-682 shaft seal



NASH Vectra XM 150 liquid ring compressor

- Increased bearing life
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The Vectra XM 150 is designed for severe service and reliable performance. The rugged construction and easy-to-service

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* When compared to inlet throttling

BLOWER & VACUUM SYSTEM INDUSTRY NEWS

design ensures that preventative maintenance requirements are minimized and the mean time between failures is improved. This, in turn, means less maintenance than other liquid ring compressor designs.

Nash, a division of Gardner Denver, is a leading manufacturer of liquid ring vacuum pumps, compressors and engineered systems serving the chemical, petroleum, power, paper, mining, environmental and food industries. Nash also provides global service and technical support for its products through its locations around the world.

*For more information,
visit www.GDNash.com.*

Schmalz Develops New Vacuum Blocks for CNC Woodworking Machines



The VCBL-B vacuum blocks developed by Schmalz

Schmalz has developed new vacuum blocks for use with CNC wood-machining tools manufactured by the Italian company Biesse. The suction pads represent a genuine alternative to original replacement suction pads for a number of reasons: Not only are they extremely robust and able to hold the workpiece securely in the correct position, but they also cost-effective.

The new vacuum blocks VCBL-B for console systems from Biesse are compatible with the original suction pads and are just as easy-to-fix in the machine's suction block mount. Instead of having to pay for the costly

replacement of the entire vacuum block in the event of collision, wear or other damage, this innovation from Schmalz means it is possible to simply replace the suction plates. In conventional systems, the entire vacuum block has to be replaced. The solution from Schmalz therefore reduces the cost of spare parts, and means the machines are soon ready for operation again after only a short interruption.

The suction plate features a special contour with a flexible sealing lip. This enables optimum adjustment to the workpiece surface and ensures effective vacuum distribution. The fitting process is simple: The suction pads are inserted in the required position in the standard mounts from Biesse. Clamping straps on the vacuum block ring ensure they are securely fixed in the suction block mount. The vacuum block is also equipped with strong magnets for additional pre-tensioning in the mount. The smooth-running plastic sensing valve activates the vacuum automatically and gently for the workpiece. Unused suction pads can remain in the mount.

The suction pads VCBL-B from Schmalz are available in heights of 29 and 48 mm for 3- and 4-axis machines and 74 mm for 5-axis machines. They come in sizes 140 x 130, 125 x 75, 120 x 50 and 130 x 30 mm, and, depending on the version, can be up to 30 percent cheaper than comparable products on the market.

*For more information,
visit www.schmalz.com.*

FIPA Presents Flexible Lifting Solutions for Light to Heavy Loads

The new FIPALIFT tube lifter series represents the integration of all functions, ranging from picking to transporting and target placing. It is a matter of course that each part was developed with a focus on maximum optimization. The manually guided lifting

systems enable the gripping of highly diverse and bulky goods with high weights for the complete physical relief of manpower. As an intelligent supplement, FIPA also offers complete crane systems with aluminum characteristics. The high level of modularity and compatibility of all components in the FIPA standard spectrum paves the way for the rapid, professional processing of projects.

FIPA knows what's important, not only with wood processing but in general production and logistics: The rapid, simple implementation of automation projects without complex training of employees and without difficult-to-master interface complexity. The calculation also has to work out with investment and operating overheads.

*For more information,
visit www.fipa.com.*

Blower and Vacuum Technology at the NPE 2015 Plastics Showcase

The NPE 2015 International Plastics Showcase was held at the Orange County Convention Center in Orlando, Florida, March 23-27. The plastics industry, particularly extruders, is a heavy user of liquid ring vacuum pumps due to the wet environment. Atlas Copco is making a strong push, with their GHS rotary screw vacuum pumps, to replace liquid ring technology. Erik Arfalk and Brian Plotkin explained they are implementing projects



Randy Leath, Erik Arfalk, Paul Petersen and Brian Plotkin from Atlas Copco (left to right) next to the GHS 730VSD+ vacuum pump.



Mick Wentzel and Greg Braswell from Becker Pumps (left to right) announced a 20,000 hour guaranteed vane life program on oil-free rotary vane pumps.

where their 15 horsepower vacuum pumps are replacing 30 horsepower units. Their GHS VSD soft-start units have a 90% turn-down range and a patented inlet valve preventing the machine from seeing more than 400 mbar. They say the “energy-efficiency” sweet spot of the GHS is at 25" HgV.

Becker Pumps had a nice booth where Mick Wentzel and Greg Braswell said the company had launched a new 20,000 hour guaranteed vane life, available on all Becker oil-free rotary vane vacuum pumps. They discussed how their U Series oil-lubricated rotary vane pumps are popular in thermoforming applications. These direct-driven units featuring a multi-stage oil separation system provide vacuum to 29.9" Hg (0.4 Torr).

Paul Mosher and Joe Janssen, from Gardner Denver, reviewed some of the technologies in their booth including their 2BH side channel blower and the 2BV liquid ring vacuum pump. They explained how their VSi rotary screw vacuum pump is being used to remove CO₂ from the carbonation process with some bottlers. We spent a considerable amount of time reviewing their VLR claw vacuum pump rated for 43-671 cfm with an ultimate vacuum of 27" Hg. The unit features contact-less compression and lower maintenance costs as there are no carbon vanes to wear or replace.



Paul Mosher and Joe Janssen from Gardner Denver (left to right) stand next a cut-away of their VLR Claw Vacuum Pump.

FIPA is a leading German manufacturer of vacuum technology and gripper systems for assembly equipment. Their U.S. operation has been based in Cary, North Carolina since 2006. While at their booth, Jennifer Gerdhenrichs reviewed their new air-saving



Max Eason, Jennifer Gerdhenrichs and Brent Lewis from FIPA (left to right) with their EMA Series vacuum ejectors featuring an air-saving function.

EMA Series with electronic vacuum and blow-off control able to reduce compressed air consumption by 90%.

For more information on NPE 2018 visit www.npe.org



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Blower System Integration for Wastewater Aeration Applications

By Stephen Horne, Blower Product Manager, Kaeser USA and Marcus Jungkunst, Blower Product Support, Kaeser Germany

► The overall wastewater treatment process is complex, and each step is integral to ensuring water is properly purified. Effluent ends up in the plants, containing substances that must be removed before the water can be properly cleaned and returned for use. The range of potential contaminants is almost endless and can include food, pulp, waste, or other substances. Afterwards, the water requires further scrubbing, with the aid of bacteria. It is in this part of the process that compressed air (ideally provided by energy-efficient rotary lobe blowers) plays a vital role.

Blower air is an indispensable part of biological wastewater treatment plant (WWTP) processes. Integration — on the blower package level as well as the system level — is key to maximizing energy efficiency and ensuring that this critical service is readily available for the communities the WWTP serves.

Defining the Demands of a Wastewater Treatment Plant

Wastewater treatment plants mirror the biological self-cleaning process occurring in natural waters — albeit faster than Mother Nature. Bacteria are added to the wastewater

at the start of the process in order to speed up clarification. These microscopic assistants take care of the cleaning work, but need oxygen to thrive and survive. Without air, there is no life, and in the end, no clean water. Oxygenation in wastewater plants is carried out by injecting streams of fine air bubbles through the water. The best approach to oxygenation is to employ the tried-and-true method of using compressed air generated by rotary blowers because this application normally requires a gauge pressure of only approximately 500 mbar (7.25 psi).

Rotary lobe blowers are positive displacement machines and displace air rather than compress it. As a result, the pressure generated is no higher than actually needed. In other words, there is no over-compression or generation of unnecessarily high pressure. After all, greater pressure means greater costs. Since energy is the single highest operating cost in a wastewater treatment plant — with the energy to operate blowers for aeration being the largest energy consumer — it pays to be efficient.

Ensuring a dependable source of compressed air at all times is also absolutely critical. The wastewater treatment plant's biological processes require large amounts of oxygen in constant supply. The success of the water purification process depends entirely on continuity: microorganisms can only perform their work if their life cycle is uninterrupted. Simply put, if their air supply is cut off, the bacteria die. And any interruption leads to a breakdown in the clarification process. If this happens, the bacteria culture must be rebuilt from scratch. This is why it is especially important that the blowers used in the aeration process provide absolute reliability.

Given the demands of wastewater treatment plants and the importance of aeration to their processes, an ideal blower package should be energy efficient and reliable. But what is the best way to ensure efficiency and reliability? The key is integration — in terms of the individual blower packages as well as the system as a whole.

From Piecemeal Assembly to All-in-One Engineering

Historically, blower packages for the aeration portion of the wastewater treatment plant have been assembled with a piecemeal approach. Using this method, numerous individual

components are separately sourced and selected from multiple vendors and assembled into a single blower package. Primarily, the focus was on component requirements, and little regard was paid to how the different components actually worked together. These highly customized packages made the quoting and bidding processes a nightmare. Since the individual pieces were not assembled and

tested together, it was utterly impossible to clearly see how efficient these “Frankenstein” blower packages truly were.

Power losses and flow restrictions from blower blocks, silencers, filters, valves, pumps, fans, and drives all impact energy efficiency — not to mention the power consumers in the control panel. Focusing only on the stated efficiency

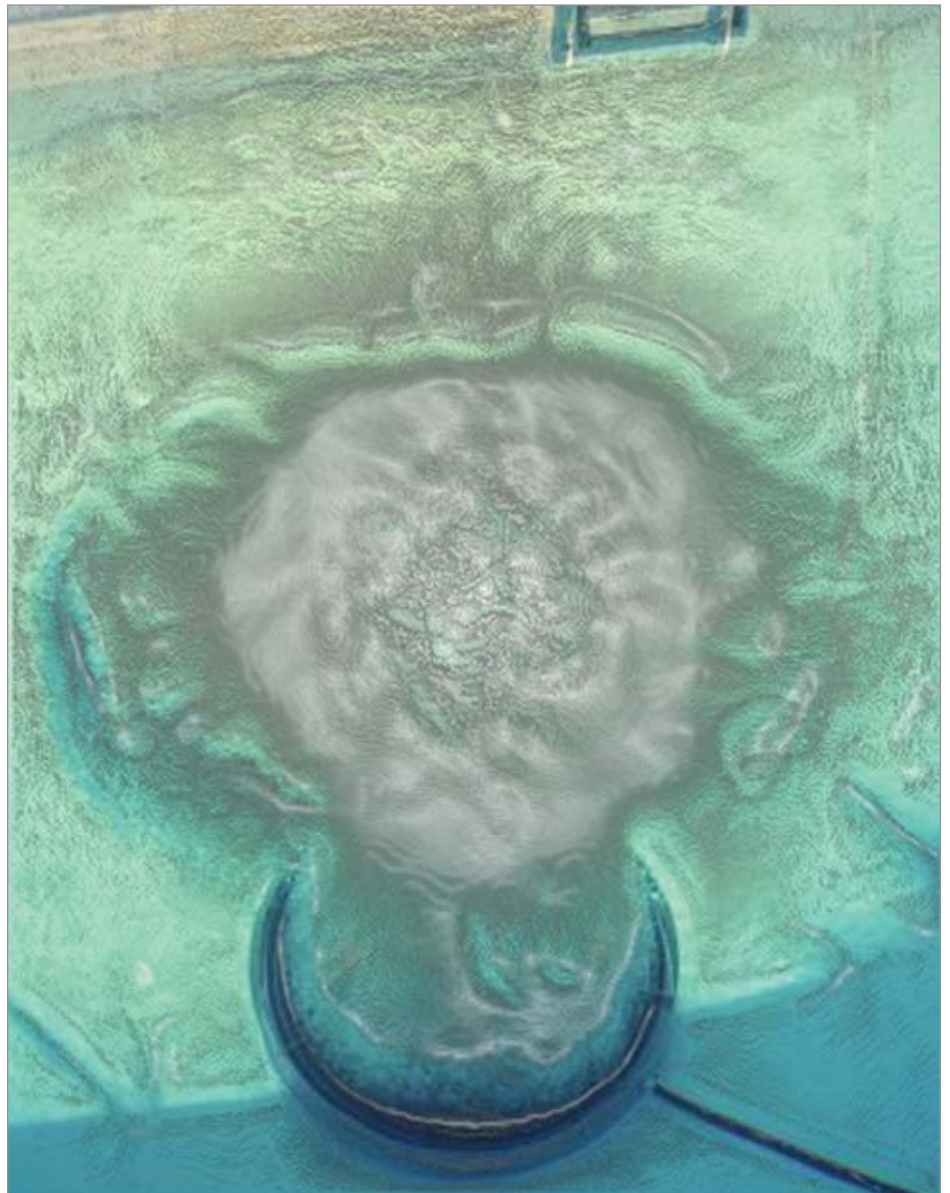


Figure 2: Oxygenation plays a critical role in the wastewater treatment process (Image courtesy of ADS).

BLOWER SYSTEM INTEGRATION FOR WASTEWATER AERATION APPLICATIONS

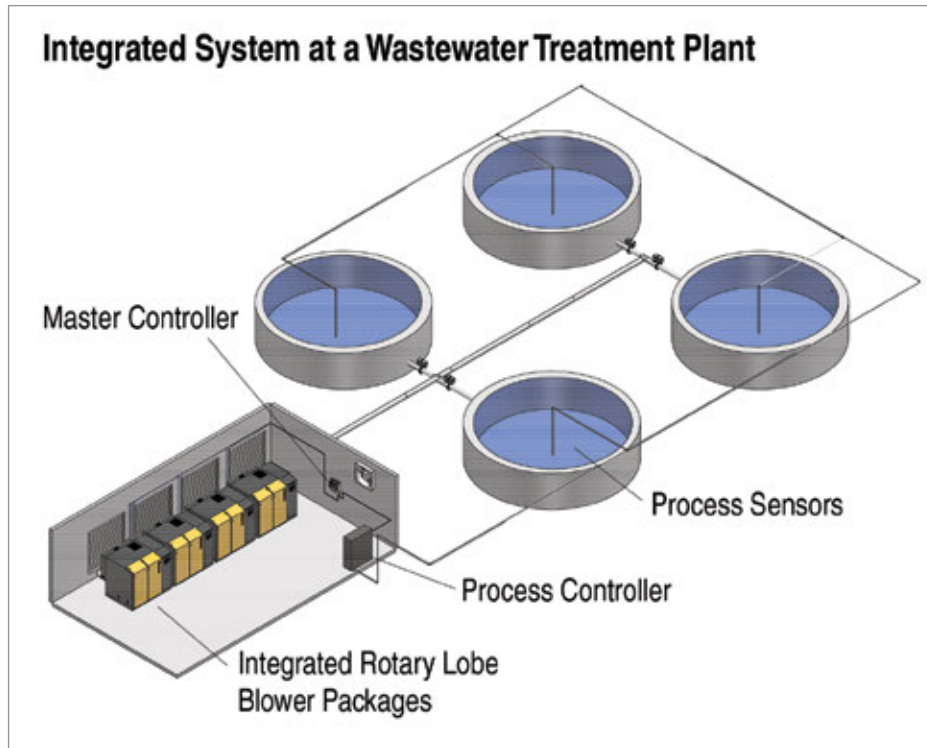


Figure 3: Package and system integration means wastewater treatment plants can track energy consumption and dissolved oxygen levels.

of each individual component does not take internal losses into account. Consequently, stated efficiencies do not paint an accurate picture of the blower package's net power consumption. The focus on individual machine componentry as opposed to complete packages resulted in custom one-off machines with great performance variations from site to site.

An Integrated Blower System is Greater Than the Sum of Its Parts

While this one-off engineering approach still happens today, the industry is moving towards package integration, or an all-in-one solution where a single manufacturer builds the complete blower unit. This offers many advantages, including significant time and

money savings on specifying the individual components and drastically reduced installation costs since the package arrives fully assembled. Further, the manufacturer has pre-selected the individual components with guaranteed performance and efficiency values. The whole package is indeed greater than the sum of its parts. A completely assembled package also makes testing to industry package performance standards possible. This is a huge benefit to the specifier and end user, as they can now more easily and accurately compare performance between competitors. The Compressed Air and Gas Institute (CAGI) is streamlining the comparison process even further by developing performance data sheets for blowers — similar to what they have already done for compressors. This would mean participating blower manufacturers would publish performance values using the same data sheets, allowing true apples-to-apples performance comparisons that specifiers and end users can clearly see. Currently, the goal is to have the data sheets finalized this year.

Additional advances with blower package integration include onboard controls. Integrating this technology helps with energy efficiency as well as reliability. While controller



“When planning a rotary blower installation, it is important to consider not only the individual blowers, but also the system as a whole.”

— Stephen Horne, Blower Product Manager, Kaeser USA

capabilities vary from manufacturer to manufacturer, the most advanced options offer data storage for analyzing energy consumption, preventive maintenance reminders, and — perhaps most importantly — communications capabilities for integrating with plant control over a BUS network. Having this built-in capability means the blower package can seamlessly communicate with a wastewater treatment plant's SCADA system. This permits precise blower control and the optimization of machine maintenance.

All Systems Go with Planned Integration

System integration offers even greater levels of energy efficiency and reliability. However, having the most energy-efficient blower packages will not deliver the anticipated efficiency gains if the blowers are not properly applied and controlled. If the blowers are not properly controlled, they can needlessly cycle, causing unnecessary wear and tear on the motor and valves. This, in turn, can lead to reduced reliability, causing unscheduled

downtime and higher maintenance costs. System integration can have a meaningful impact on how the blower packages work together and contribute to the system's efficiency and overall reliability.

Successful system integration begins with proper planning and careful equipment selection. When planning a rotary blower installation, it is important to consider not only the individual blowers, but also the system as a whole. It is well documented



Figure 4: Multiple integrated blower packages controlled with a system master controller offer an energy-efficient and reliable solution for wastewater treatment plants.

BLOWER SYSTEM INTEGRATION FOR WASTEWATER AERATION APPLICATIONS

that selecting and installing optimally matched components yields considerable gains. This is why package integration is the foundation for building an efficient system. It is important to know how to control the individual units and when to turn them on and off so that they operate at the peak of their performance and efficiency. Piping, ventilation, and layout also contribute to the system's overall performance. These additional factors are often overlooked, yet they contribute to efficiency as well. A poorly ventilated blower room, for example, will not circulate enough cooling air, causing high ambient temperatures and the blowers to overheat. This can lead to lower efficiencies, shut down, and even mechanical failure.

Of course, this requires proper planning prior to installation, and it begins by understanding the true system demand. This approach helps with selecting the best-suited blowers for the application. The aim is to establish the blower station's optimum operating point with regards to energy use and to avoid designing the system to meet the needs of a very rare operating point that only occurs a few times a year. The blowers certainly need to be selected so that they can deliver the maximum amount

of air required, but on the whole, they must ensure the best possible efficiency at the most common real-world operating point. The best solution can be determined using computer models that predict the efficiency of various suitable blower combinations and comparing them against one another with regards to maintenance costs.

Blower Controls Deliver Energy-Efficient Operation

The actual integration aspect comes from relying on a system master controller to properly control the individual blower packages. An advanced system master controller is programmed with the performance information of each blower, and it then selects the most efficient combination of blowers to meet the current demand. It can also rotate packages to balance load hours, spreading out preventive maintenance intervals. These advanced controllers can monitor both machine health and a specific system variable (in the case of a wastewater treatment plant, it is typically dissolved oxygen), and trigger an alarm if the variable falls below a specific threshold value. It's even possible to send an email

or text message to plant personnel to notify them of the alarm situation (system- or machine-related). Remote monitoring features open new avenues for system reliability — especially for installations in remote locations. System data is available in real time at the click of a mouse and can be analyzed for trending, predictive maintenance, and plant forecasting.

Now more than ever, wastewater treatment plants have the means to effectively design, install, and maintain an energy-efficient system that can reliably deliver the compressed air needed to ensure oxygenation is not interrupted. By embracing advances in blower technology and utilizing integration on both a blower package and system level, communities can rest assured that they will have a continuous and energy-efficient supply of clean water. **BP**

For more information, contact Stephen Horne, Blower Product Manager, Kaeser USA, tel: (540) 898-5500, email: stephen.horne@kaeser.com, or visit www.us.kaeser.com.

To read more about **Wastewater Aeration**, please visit www.airbestpractices.com/industries/wastewater.



“System data is available in real time at the click of a mouse and can be analyzed for trending, predictive maintenance, and plant forecasting.”

— Stephen Horne, Blower Product Manager, Kaeser USA

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Oerlikon Leybold Vacuum CELEBRATES 165 YEARS

By Mario Vitale, Oerlikon Leybold
Vacuum USA

► For 165 years, Oerlikon Leybold Vacuum has developed and supplied vacuum pumps, systems, standardized and customized vacuum solutions, and after-sales services for a wide range of industrial and research-based applications. In these fields of industry, Oerlikon Leybold Vacuum offers low, medium, high and ultrahigh vacuum pumps, vacuum systems, measuring gauges and instruments, leak detectors, valves and fittings, as well as consulting and engineering for complete vacuum solutions.

In 1850, the company's founder, Ernst Leybold, officially took over the enterprise as his own, paving the way for a comprehensive industrial use of vacuum technology. Even after selling the company again in 1870, his vision remained throughout the century to follow.

"Due to this positive development and long-standing expertise, Oerlikon Leybold Vacuum possesses the most sophisticated technological know-how of application and processes," explained Dr. Martin Füllenbach, CEO at Oerlikon Leybold Vacuum, Cologne, Germany. "As pioneers of vacuum technology for process industry, coating applications, analytical

methods and applications in research and development, we belong to the four largest suppliers in the world. We are proud to assist our customers as specialists in the early consulting phases of new applications and processes. With our ample after-sales services and our global footprint, we are reliable partners for our customers."



Oerlikon Leybold's U.S. Facility

Oerlikon Leybold Vacuum USA

Oerlikon Leybold Vacuum USA is a division of Oerlikon Leybold Vacuum GmbH based in Cologne, Germany. The USA team offers a broad range of vacuum pumps, pumping systems, leak detection and after-market services, and can design and deliver the best total vacuum solution.

Our long-standing experience in the design, manufacture and sale of vacuum pumps and related systems into analytical, industrial, and research and development applications has resulted in the standardization of dry-compression vacuum pumps and systems that offer users significant cost of ownership savings, along with environmental improvements over oil-sealed vacuum pump technology.

Standard and Customized Vacuum Pump Systems for Industry

The Oerlikon Leybold Vacuum DRYVAC® dry-compressing screw-type vacuum pumps are an environmentally friendly alternative to oil-sealed piston vacuum pumps. This innovative and robust vacuum pump line produces nominal pumping speeds up to 2945 cfm and 4×10^{-4} torr ultimate vacuum.

Available in four models, DRYVAC (Figure 1) features reduced maintenance, lower operating costs and improved environmental performance through reduced oil disposal, low energy consumption via optimized rotor geometry, and an innovative motor design. It also employs a purge gas into the compression stage to eliminate deposits, particles and condensates. A major advantage of the DRYVAC is the elimination of oil contamination into the process, as the need for lubricating oil in the pumps' compression stage has been removed. In conjunction with our RUVAC® line of vacuum boosters, pumping speeds can be significantly increased while achieving oil-free gas compression in multiple vacuum pump stages. The new Oerlikon Leybold Vacuum RUVAC WH series boosters can produce nominal pumping speeds to 5700 cfm when using the WH 7000 model.

Alternatively, the Oerlikon Leybold Vacuum line of HTS vacuum pumping systems is a cost-effective, two-stage design available in a standard close-coupled arrangement. With nominal pumping speeds to 1450 cfm and 8×10^{-3} torr ultimate vacuum, HTS vacuum pumping systems (Figure 2) are loaded with many standard features, including: simultaneous starting of vacuum booster with pump that eliminates the need for a costly vacuum switch; an all-air-cooled design, quiet operation, internal exhaust oil filter with an automatic oil recirculation system; and an internal valve that isolates the vacuum pump from the process upon planned or unplanned shutdown.



Figure 1: Steel Degassing System from Oerlikon Leybold Featuring DRYVAC® Vacuum Pumps and RUVAC boosters



Figure 2: The HTS Line of Vacuum Pumping Systems

Target applications for the aforementioned DRYVAC, RUVAC and HTS vacuum pumping systems include heat treatment furnaces, metallurgical furnaces, industrial coating, food packaging and processing, freeze drying, automotive industry, electrical industry, space simulation and many others.

PHOENIX L300i Leak Detector for Industry and Research

The PHOENIX L300i Helium Leak Detector offered by Oerlikon Leybold Vacuum is a mobile helium leak detector suited for use in quality control labs, series production and service. The PHOENIX L300i (Figure 3, Pg. 18) is qualified in industry and research applications where high vacuum engineering leak testing is required.

OERLIKON LEYBOLD VACUUM CELEBRATES 165 YEARS



Figure 3: The PHOENIX L300i Helium Leak Detector

An optional sniffer probe allows for the PHOENIX L300i to be used as a sniffer leak detector. Further mobility can be achieved through the use of the optional RC310 remote control unit that allows for remote operation of the PHOENIX L300i within a maximum distance of 300 feet. RC 310WL offers easy, one-man, wireless remote control operation when leak checking large volumes. The PHOENIX L300i is available with internal oil-sealed or oil-free vacuum pumps. The customer may also use their existing main vacuum system.

The PHOENIX L300i is easy-to-handle, offering reliable measurement results, quick readiness for operation, fast response time and automatic calibration. The on-board LCD screen shows a trend mode, bar mode, universal display, vacuum diagrams and status information.

After-Market Services

The After-Market Operations at Oerlikon Leybold Vacuum USA are part of the Oerlikon Leybold Vacuum global sales and service network.

Most vacuum pump repairs are completed at the company's USA headquarters in Export, PA, near the city of Pittsburgh. Oerlikon Leybold Vacuum also continues to expand its All Brands Repair program, enabling the company to repair most competitive vacuum pump models.

In addition, Oerlikon Leybold Vacuum USA offers a comprehensive training menu through its Vacuum Academy series where customers can select from:

- Fundamentals of Vacuum Technology
- Total Pressure Measurement Technology
- Fundamentals of Leak Detection
- Maintenance and Repair Training

Oerlikon Leybold Vacuum also offers the following Field Services for supporting our customers:

- Start-ups, installations, troubleshooting
- Leak detection services
- On-site training

The Oerlikon Leybold Vacuum USA Export, PA facility is ready to support all your vacuum technology applications with its local engineering support, pump system design, sales and service personnel, and warehousing of pumps and numerous spare parts. **BP**

For more information, and to review our current Heritage Promotion as we commemorate 165 years, contact Mario Vitale, Sr. Manager, Marketing, Oerlikon Leybold Vacuum USA, tel: 1-800-764-5369, email: info.vacuum.ex@oerlikon.com, or visit www.oerlikon.com/leyboldvacuum.

To read more about **Vacuum Technology**, please visit www.blowervacuumbestpractices.com/technology.



“The PHOENIX L300i is easy-to-handle, offering reliable measurement results, quick readiness for operation, fast response time and automatic calibration.”

— Mario Vitale, Oerlikon Leybold Vacuum USA

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APG-Neuros Retrofits San Bruno Aeration System with New Turbo Blowers

By APG-Neuros

► Wastewater Plant Background

The San Bruno Water Quality Control Plant (WQCP) in South San Francisco, CA, uses primarily settling treatment followed by an aerated-activated sludge process for removal of organics and other constituents from the wastewater. The activated sludge process has two parallel trains of activated sludge treatment. Each train has multiple aeration tanks and multiple air blowers to provide air for the treatment process.

The plant has an average of 8.6 million gallons of influent wastewater per day. The daily airflow to the basins varies from as little as 35 percent to 100 percent of the maximum flow to meet the fluctuating wastewater flow rate and strength. The activated sludge process is the single largest consumer of electrical power in the treatment plant. Newer technologies, such as the APG-Neuros high-speed turbo blowers, have since been commercialized and are significantly more energy efficient than the existing blowers.

Facility Audit Identifies Opportunities for Energy Savings

A WQCP facility audit examined the plant electrical energy consumption to find ideas to reduce plant energy use while meeting the process



The APG-Neuros turbo blower installation received an incentive rebate worth \$45,487.



Original multi-stage blower at the San Bruno Water Quality Control Plant



APG-Neuros turbo blower installed at the water quality control plant in South San Francisco, CA

demand. Based on discussions with plant staff and a brief review of the process, it was decided to focus the effort on reducing the electrical energy required to provide aeration air to the secondary activated sludge process. The aeration air blowers were the largest consumers of electrical power in the plant and significantly less efficient than the newer blowers that have been introduced to the marketplace in the recent years.

The project replaced one 300-hp blower with an APG-Neuros NX300M-C070 for aeration basins 5 through 7. To achieve the largest power reduction required, the new APG-Neuros blower operates in a permanent lead position.

Quantifying the Project's Results

The California Wastewater Process Optimization Program (CalPOP) and the WQCP confirmed that the replacement of the first blower

with the APG-Neuros NX300M-C070 saves the city \$55,673 annually, reducing power consumption by 448,525 kilowatt-hours (kWh) per year. The total project implementation cost was \$302,343. With the CalPOP incentive rebate of \$45,487 for the upgrade, the net cost of the project was \$256,856, representing a 4-year payback period.

The WQCP has recently purchased an additional APG-Neuros NX350-C080 turbo blower for aeration basins 8 and 9 to replace the existing multi-stage blower. The new APG-Neuros blower is scheduled to be commissioned by the end of 2015. [BP](#)

For more information, contact Elana Podvalniuk, tel: (866) 592-9482 ext. 2117, email: epodvalniuk@apg-neuros.com, or visit www.apg-neuros.com.

To read more about **Blower Systems**, please visit www.blowervacuumbestpractices.com/system-assessments/blower-systems.

Tuthill Tackles Demanding INDUSTRIAL VACUUM APPLICATIONS

By Clinton Shaffer, Editorial Associate, Blower & Vacuum Best Practices Magazine

► Thanks to branding, people recognize popular products and the companies behind them. Ford manufactures automobiles. Hershey makes chocolate. Dogfish Head brews some really great beer. In each example, the company and the product are nearly synonymous.

But what about the other companies that help produce those consumer goods?

There are countless tangential companies that play a key role in the multitude of processes within large manufacturing operations. Without these companies and the equipment they provide, many products would never hit the shelf.

Tuthill Vacuum & Blower Systems is one such company, and, despite its diverse list of high-profile clientele (none of which are mentioned here), it remains largely out of view. Tuthill manufactures industrial equipment that enables companies to mass-produce the products that people know — whether it's an airplane, a piece of produce, or your favorite beer.

We were fortunate enough to speak with Keith Webb, the Application Engineering Manager at Tuthill, to learn about the company and its manufacturing equipment. During our discussion, we talked about the company's blower and vacuum technologies, common markets and applications, and Tuthill's custom-engineering capabilities. Webb even touched on some trends in energy management regarding blower and vacuum systems.



Blowers vs. Vacuum Pumps

The manufacturing technology that helps produce and process even the most common products can be very complex, and industrial vacuum is one of the most complicated. Where air compressors and blowers have objective standards, vacuum remains one of the more obscure, difficult-to-understand manufacturing technologies.

“Uses of vacuum in industrial and chemical process industries is very widely misunderstood even by most engineers,” Webb told us during our interview. “There are few knowledgeable end users of vacuum, and when you talk to someone, you can tell right away whether they have experience in the vacuum industry. So it’s always good to get some education about it out there for engineers who want to understand more.”

Both Webb and David Schardt, Tuthill’s new VP of Engineering, are members of the Compressed Air and Gas Institute (CAGI), one of the



Keith Webb, Application Engineering Manager at Tuthill Vacuum & Blower Systems

Kinney[®] vacuum pumps M-D Pneumatics[™] blowers & vacuum boosters



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TUTHILL TACKLES DEMANDING INDUSTRIAL VACUUM APPLICATIONS

organizations currently creating standards for blowers. According to Webb, the blower industry seems to be more normalized when it comes to basic packages. It's the vacuum side of the business that demands more customized packages.

"In the vacuum world, it gets more exotic. Customers want a variety of different options in the way they control the system," Webb explained. "The blowers are basically two-lobe rotary or three-lobe rotary blowers, and they vary in seal construction. Then there may be some material construction differences. Technologies on the vacuum side are much more varied, and each has its own pros and cons for each application."

At Tuthill's location in Springfield, Missouri, they make an assortment of vacuum equipment in addition to their blower packages. Off the

cuff, Webb cited a slew of standard product offerings on the vacuum side, including single-stage liquid ring pumps, two-stage liquid ring pumps, single-stage oil-sealed rotary piston pumps, two-stage piston pumps, dry screw pumps, and oil-sealed rotary vane pumps.

As if that exhaustive list was not enough, Tuthill also offers a line of vacuum boosters to increase flow and provide deeper vacuum levels. Theoretically, those boosters can be paired with any of the aforementioned vacuum pumps.

Key Market Segments and Typical Applications

Whether they are using blowers or vacuum pumps, Tuthill's customers are all engaged in industrial manufacturing of some sort. A typical customer might be an engineering firm, or an engineering group within a large

company. Tuthill's primary markets include the chemical, food processing, pharmaceutical and aerospace industries — just to name a few.

"[Our customers] are all using blowers or vacuum equipment to make something, and so it's typically a very vital part of their process," Webb told us. "Reliability is very key. Because if there is no pressure or no vacuum, then production stops."

Some of the more common processes include distillation, industrial drying and evaporative processes, each of which is done in vacuum. As an example, Webb explained a common food processing application:

"Let's say you're trying to dry lettuce after washing. One way to remove the water is to raise the temperature to 212°F at atmospheric pressure," Webb said. "But no one would want to eat that lettuce afterwards."

"In order to dry that off, you can reduce the pressure around the liquid and get it down to its saturated vapor pressure, and then add the latent heat," he continued. "At a given temperature, the saturated vapor pressure of a substance is the pressure at which it is phase equilibrium between the liquid and vapor phases. By adding the latent heat of vaporization (the energy required to change phase), the liquid can change to the vapor phase and be removed from the product. You never actually have to change the temperature of the product in order to drive that moisture off. It's a very effective method for drying, evaporation and distillation."

According to Webb, there are tons of products that require this type of process. By adding latent heat and changing the phase, the product remains unaltered.

Custom Engineering Capabilities

Tuthill's diverse clientele base — and the even larger pool of varying applications — creates



Figure 1: 4500 cfm (7650 m³/hr) booster/piston system for an aircraft brake pad chemical vapor deposition (CVD) furnace

demand for custom-engineered systems. Because no one facility or process is the same, the engineers at Tuthill adapt their standard products to unique customer needs.

“Our Application Engineers are capable of taking anything blower or vacuum related in pretty much any market, application or industry you can think of, and properly choosing one of our products,” Webb said. “Customers vary in what they want in systemization from one to the next, and that’s what we have the ability to offer here.”

Variations from system to system range from measurement devices to customizations at the PLC level. According to Webb, some customers may have a preference for a certain type of temperature or pressure transmitter, since their personnel are already accustomed to using it. That is accounted for during the quotation process, and the engineers in Webb’s group can incorporate that device in the quote. Other non-standard modifications to systems include additional sensing equipment for automatic shutdown protection and bypass lines to meet various pumping scenarios, among many others.

Before the equipment gets to the customization phase, however, Tuthill exerts a level of control over their product that is uncommon among manufacturers. Save for the bearings and soft seals, the fabrication team at Tuthill machines every part that goes into their blower and vacuum products,

giving them complete control over their manufacturing process.

And, because there is not a one-size-fits-all testing requirement, Webb and his team also provide custom testing for vacuum systems. This helps them ensure the electrical and mechanical reliability of the equipment before it ever leaves the building.

Massive Vacuum System for Airplane Brake Pad Manufacturing

During our conversation, Webb walked us through several examples of custom-engineered systems that recently moved through Tuthill’s shop. The first was a large booster piston pump system for an aircraft component manufacturer (Figure 1).

Standing about 15 feet in height, the vacuum pumps in this system were designed to service four chemical vapor deposition (CVD) furnaces on an aircraft manufacturing line, providing 10 to 20 torr of vacuum.

The CVD process emits various hydrocarbons, along with some relatively toxic and flammable substances. To address those hazards, the systems also include large filtration units, knockout pads upstream for trapping liquid, and demisters.

Industrial Vacuum for Extrusion

Another custom vacuum system Webb described was a two-stage booster system

designed for an extrusion company (Figure 2, pg. 26). The client makes large extruders for a variety of industries, including plastics, ceramics and food processing. All of their extrusion processes are done in vacuum.

The required vacuum is between 5 and 10 torr for this particular application. The booster, and the liquid ring pump positioned downstream, help to move gases that are liberated during the plastic extrusion process. These include volatile chemicals and some light aromatic gases.

Brewery Requires Vacuum for Degassing Process

The third system Webb discussed was a stainless steel liquid ring system for a “very popular beer manufacturer.” The client, who is undergoing capital expansion, needed four identical systems for gas removal from bottles before the filling process. The operating range for this application is 75 to 100 torr.

As a preventative measure, and to ensure a long product life, the engineers at Tuthill designed the entire liquid ring pump as 316 stainless steel (Figure 3, pg. 27). Additionally, the system was equipped with a knockout tank system and a full sealant recovery system. A pH transmitter enables it to manipulate valve positions based on the pH level in the liquid ring sealant. The system also has interlocking devices, like shutdown switches for high-temperature conditions.

“In the vacuum world, it gets more exotic. Customers want a variety of different options in the way they control the system.”

— Keith Webb, Application Engineering Manager, Tuthill Vacuum & Blower Systems



TUTHILL TACKLES DEMANDING INDUSTRIAL VACUUM APPLICATIONS



Trends in Energy Management

Webb also shared some insights into trends across the blower and vacuum industry. On the blower side, with its larger horsepower requirements (up to 700 hp), de-centralized blower systems are becoming more common. This means that instead of having a single blower trying to supply several demand points that may or may not have a requirement, engineers are starting to use multiple units of smaller sizes to address demand points with the appropriate amount of air.

Manipulating the speed of the blower in order to better match the demand requirement is another practice becoming more common. In less efficient systems, a fixed-speed unit will run constantly, dumping the excess through a relief valve. By adjusting the speed, you can eliminate the artificial demand.

Engineers will also take advantage of soft starts to keep the demand charge of the utility bill down. Instead of hitting units with direct line voltage, leveraging soft starts helps to lessen the demand spike as the unit comes on. Facility management can then ramp the blower up at a more controlled rate.

Another trend Webb discussed involved the use of variable speed drives (VSDs). Customers have started to use VSDs to manipulate blower requirements. They mirror that on the vacuum side by utilizing a vacuum booster upstream. Both, according to Webb, are techniques used as a form of energy management.

Figure 2: 3000 cfm (5100 m³/hr) booster/liquid ring system for plastic extrusion degassing

The engineers at Tuthill also incorporated “clean-in-place” controls for the brewery’s system. The controls allow the customer to shut the system down, fill it completely with

cleaning liquid, and then open drains to flush it. Once the cleaning procedure is finished, the manufacturer can resume normal operation.



“Our Application Engineers are capable of taking anything blower or vacuum related in pretty much any market, application or industry you can think of, and properly choosing one of our products.”

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Energy Management for Vacuum

Because vacuum applications are so varied, managing energy costs in those systems depends on the process. Oftentimes, a vacuum process can run on continuous duty for days at a time, meaning that a batch or cycle may last up to 72 hours. Facility management may start a vacuum pump to pull the system down to a set pressure, and a switch will activate a vacuum booster at that set point.

To efficiently manage that type of vacuum process, the application engineering team at Tuthill makes sure to appropriately size the booster with a vacuum pump. They then size their loaded power based on the most efficient time to start that unit. According to Webb, that does a couple of things. For starters, you only invest in the capital cost of the motor that you need. Secondly, the life-cycle cost of the unit is less because you use less energy with the lower motor power.

Taking Tuthill to a New Level

Tuthill Vacuum & Blower Systems was formed in 2002 after a series of acquisitions and corporate restructuring. Currently, the company is the sole manufacturer of Kinney® vacuum pumps, along with M-D Pneumatics™ rotary blowers and vacuum boosters.

Several recent additions to the Tuthill team have helped to broaden the company's engineering capabilities. The process began with the hiring of David Schardt, the new VP of Engineering at Tuthill. He then hired two additional engineers, including Wan Zhong, who has a Ph.D. in mechanical engineering, and Shraddha Jayakumar, who has a Master's degree in mechanical engineering.

Under David's direction, Tuthill's team is looking at all existing products to identify opportunities for enhancement in performance and improvements in the manufacturing



Figure 3: All stainless steel liquid ring system for beverage filling process with “clean-in-place” control system

process. In addition, there are several blower product enhancement projects that are planned to launch later in the year. The engineering team is also focusing on new product development for both the blower packages and dry screw technology.

All of these improvements are poised to help manufacturers produce more goods at lower

costs — even though the general public will only see the finished products. **BP**

For more information, contact Keith Webb at kwebb@tuthill.com, or visit www.tuthillvacuumblower.com.

To read more about **Blower & Vacuum Technology**, visit www.blowervacuumbestpractices.com/technology.

Industrial Dust Collection Vacuum System Audits

By Tim Dugan, P.E., President, Compression Engineering Corporation

▶ Industrial vacuum systems are a challenge to optimize. They have more distribution system variables to balance than a compressed air system does. Vacuum systems conveying particulate are sensitive to velocity. If the velocity is too high, pressure drop results. If it's too low, particulate doesn't stay in suspension, and there can be compliance and safety problems. For instance, when conveying wood or other explosive dust, dropping below "critical" velocity allows dust to accumulate in the bottom of the duct, creating an explosive hazard. Entire plants have burned to the ground, and lives have been lost due to these types of incidents. According to OSHA¹, wood is not the only explosive material in dust form:

"Any combustible material can burn rapidly when in a finely divided form. If such a dust is suspended in air in the right concentration, under certain conditions, it can become explosible ... The force from such an explosion can cause employee deaths, injuries, and destruction of entire buildings. For example, 3 workers were killed in a 2010 titanium dust explosion in West Virginia, and 14 workers were killed in a 2008 sugar dust explosion in Georgia ... A wide variety of materials that can be explosible in dust form exist in many industries. Examples of these materials include: food (e.g., candy, sugar, spice, starch, flour, feed), grain, tobacco, plastics, wood, paper, pulp, rubber, pesticides, pharmaceuticals, dyes, coal, metals (e.g., aluminum, chromium, iron, magnesium, and zinc)."

The magic number in dust collection safety is the minimum transport velocity. It varies for each type of particulate. For wood dust, we typically use 4000 fpm. Table 1 offers a comprehensive list² of minimum conveyance velocities for various products.

The Energy Efficiency Challenge

Plants will rightly always have a higher priority for compliance and safety than energy efficiency. To gain efficiency in an industrial dust collection vacuum system via controls, fan speed has to be dropped sometimes. Power is proportional to the cube of speed, all other things being equal (30 percent speed reduction can deliver over 60 percent kW savings). Even if vacuum is kept constant, power is directly proportional to speed (30 percent speed reduction results in 30 percent kW savings). However, this can be seen as a risk that isn't worth it — sometimes for good reasons, sometimes for perceived reasons. Thus, optimizing dust collection systems for energy efficiency alone is not recommended. In our experience, the "hit ratio" for these kinds of audits is low. We recommend the following process:

1. Perform a system audit.
 - a. Measure all branch flows, fan speeds and static pressures before and after major components.
 - b. Add up branch flows and determine if they balance with fan flows. If not, the difference is false load or leakage.
 - c. Determine if flows and velocities are above minimum required levels for safety, air quality and process control.
 - d. Determine if vacuum is sufficient to develop needed flow at pick-up points.
 - e. Determine if pick-up points are properly designed to create velocity at the right place and do the work needed.

TABLE 1: TYPICAL MINIMUM CONVEYANCE VELOCITIES

PRODUCT	APPROX. WEIGHT (LB/FT ³)	SUCTION PRESSURE TO PICK UP (IN H ₂ O)	CARRYING VELOCITIES	
			(M/S)	(FT/MIN)
Flour			17 - 30	3500 - 6500
Grain dust			10 - 15	2000 - 3000
Sawdust and Shavings, Light	12	2.5	10 - 17	2000 - 3500
Sawdust and Shavings, Heavy			17 - 23	3500 - 4500
Shavings, Light	9	2.5	22	3500
Shavings, Heavy	24	3	20	4000

- f. Determine production needs. This can be simply adding up all individual uses and multiplying by a conservative duty cycle. It can also be done by data logging all machine centers to determine what flow is really needed.
2. If the system is not compliant or does not meet production needs, adjust flow in the most cost-effective manner. This is the “baseline” project. This can actually require more total flow — not less, thereby increasing energy requirements. It can also increase vacuum at the fan inlet, increasing energy consumption. If you are lucky, it can reduce energy consumption if there is more vacuum than needed. The improved system becomes the “baseline” for the energy efficiency effort. In most utility energy efficiency programs, the baseline can be the improved system, not the as-is system. This increases the claimed energy savings and incentives for a project. The improved system might include some of the following changes:
 - a. Fan speed change
 - b. Addition of manual balancing dampers
 - c. Fan motor size increase
 - d. Addition of blast gates, spark sensing and other safety controls

I realize the plant wants one project — not a baseline and then an energy efficiency project. But for the purposes of getting energy efficiency incentives, you might need to develop both on paper to determine the incremental benefit of the efficiency dollars. A skilled energy auditor can navigate the line between baseline and energy efficiency, and provide an incremental analysis for the energy efficiency project.

3. Develop energy efficiency opportunities to improve on the baseline. Typical opportunities include:
 - a. Excessive velocity in any particular branch or subsystem
 - b. False load, that is, air demand at a location that has no production — either part or all of the time
 - c. Low-efficiency fan
 - d. High pressure drop in cyclone, filter or ducting
 - e. Less than optimal ducting, requiring excessive flows in areas that don't need it
 - f. Machine centers that are rarely on but have flow all the time

4. Develop an energy-efficient design that can reduce velocity, flow or vacuum, and still be compliant. Opportunities include:
 - a. Changing fixed fan speed
 - b. Changing fan to higher efficiency unit
 - c. Changing filter to lower pressure drop unit and reducing speed of fan accordingly
 - d. Implementing “on-demand” controls that match the fan flow to the actual demand in real time

This article will focus on the last method, an “on-demand” system. Recent technological innovations have come to the market that control demands and fan speeds in an optimal manner to meet production, remain compliant and reduce energy. Capable plants, vacuum pump suppliers, consultants and integrators can design and install their own version of an on-demand system.

A Generic On-Demand System Description

- If not already done, split the system into subsystems that have similar hours and vacuum levels. This could require significant ducting beyond the “baseline” project.
- Modify ducting to balance systems within each set for design flows, required minimum velocities and a common static pressure. Use balancing dampers to avoid ducting replacement where possible. However, dampers are an energy loss, so avoid them where possible and practical.
- Reconfigure fan locations if needed (match fans best to subsystems).
- Install variable speed or inlet guide vane control on fans.
- Install gates on each major line.
- Install demand sensors on each machine center, like current transducers (CTs) or motion sensors. In sandblasting booths, we recommend compressed air flow meters. They should indicate that production is needed at that location.
- Install on-demand controls to determine when each major branch needs flow (first machine center on) or can be shut off (last machine center off). Controls must maintain proper velocity at each major branch and vacuum level.
- Control miscellaneous transfer fans optimally.

INDUSTRIAL DUST COLLECTION VACUUM SYSTEM AUDITS

A Fictional Audit at a Secondary Wood Products Manufacturer

We will create a fictional project that is a composite of several that we have seen. A secondary wood products manufacturer has two major areas: planing/sanding and cutting. Total flow is currently 47,000 cfm and requires a 200-hp motor to be 90 percent loaded to 141 kW. It runs 20 hours per day, 6 days a week. This costs over \$52,000 a year in electricity at \$0.06/kWh. Most of the system has excessive velocity, except the cutting area's main branch line and the planer line. It is dusty in the planer area, and OSHA has flagged it for potential explosive hazard.

Baseline Project

An energy auditor has recommended reducing fan speed and changing sheaves to drop the velocities in the system, but did not realize that the planer area was not compliant. The plant engineer rejected the idea. After further velocity measurements, the plant engineer determined that the cutting area's main line needs an increase in velocity to avoid being sub-critical.

The simplest way to become compliant is to increase fan speed by 12.4 percent. Motor power will increase by 41 percent, so the motor needs to be changed to 250 hp. A blast gate was added as well. This is the "baseline project". If no further engineering is done to develop a win-win project, the plant would have *increased* energy by 356,000 kWh/yr — or about \$21,000 per year. The energy auditor would have come back to verify the project and would not have been pleased!

Optimized Project

Fortunately, the plant hired a consulting engineer who helped them design a system that can be compliant *and* save a lot of energy. In this case, modifying the ducting was key.

An on-demand controls integrator wanted to install gates at every machine center, interlock them, and run the fan at optimal speed with a variable frequency drive (VFD). A fan supplier wanted to replace the fan and dust collection filter. However, if the branch lines are not changed, there is no fan speed reduction opportunity here. And if the fan is already at 70 percent efficiency and pressure drop across filtration is only 2 inches of water, it is pretty hard to justify equipment replacement on energy savings alone.

One good way to optimize this system cost-effectively and maintain compliance is to split up the system into two subsystems that operate at different hours — cutting and sanding/planing — and have each

of the two subsystem ducts run all the way to the cyclone. Only two gates have to be installed. That way, only the cyclone, dust collector and very short runs in between will drop to subcritical velocity when one of the branch lines is shut down. One duct needs to be reduced in size as well. All ducting is now balanced so that demands and sub-branches can all be satisfied. One manual damper in the line needing more vacuum will be needed to keep the two lines at slightly different vacuum levels. This can be done automatically with throttling gates, but that is more complicated and expensive.

A programmable logic controller (PLC) will get inputs from all machine centers, vacuum and speed (or damper position). Other input/output (I/O) might be needed. At the fundamental level, it will open each blast gate when the first machine center in that subsystem calls for air, and shut it off when the last one stops. The change in flow demand will start to change vacuum, and the fan flow (via VFD or inlet guide vanes) will be controlled to maintain proper main line velocity and vacuum level.

This project saves over \$50,000 versus the baseline project. It would probably cost about \$150,000 to \$200,000 over the baseline, a 25 to 33 percent ROI. If utility incentives of 50 percent were available, the ROI would double. The other benefit is compliance. The combined project is really the baseline plus an energy efficiency project. If the shifts change and require all areas to be operating 16 hours a day, the system will still work fine and save some energy over the baseline.

Conclusions

In conclusion, on-demand controls in industrial dust collection vacuum systems can save significant energy. Implemented properly, they are a robust, common sense design that will be able to adapt to the constantly changing production needs of the plant and still optimize for compliance and energy efficiency. But the system has to be audited first, and a baseline project should be developed to address the safety compliance issues and provide a comparison for energy savings and incentives calculations. **BP**

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Understanding Vacuum Pump Lubricants

By David Mitchell, Ultrachem Inc.

► “What is the best type of oil to use in my vacuum pump?” is a common question for sure, and one that may often yield confusing and conflicting answers. The rule of thumb is that it is always best to follow OEM recommendations, but why do they recommend the lubricants that they do? For the purpose of this article, we will focus on some of the general industrial vacuum pump applications and their lubricant choices.

Cooling, controlling contamination, reducing friction, and creating fluid seals are just a few of the many important responsibilities the lubricant serves. The chosen lubricant must fill all of these roles effectively and efficiently to promote healthy and long equipment life. Vacuum pump applications are somewhat unique due to the relationship between the oil’s volatility and vapor pressure. An oil that is more volatile is more likely to turn from a liquid to a vapor as temperatures increase. Because vacuum pumps operate with such tight tolerances in regard to pressure, any differentiating factor can be detrimental to the intended operation of the pump. Choosing a lubricant with a low vapor pressure will ensure the system operates efficiently.

How Does Viscosity Impact Pump Performance?

Often one of the first things that we look for will be the oil’s viscosity. Viscosity is the primary requirement to consider when choosing an

oil. If the lubricant is not viscous enough (too thin), it will not create the proper lubrication seal the pump requires. This can lead to loss of efficiency due to leakage or flow reversal from stage to stage. Another thing to be mindful of is a lubricant’s function of preventing metal-to-metal contact causing excessive wear and premature equipment failure.

Conversely, choosing a lubricant that is too viscous (too thick) will restrict flow and cause lubricant starvation in essential machine areas. Different vacuum pump designs have different lubrication needs. Liquid ring vacuum pumps generally require an ISO 22 or ISO 32 viscosity. Rotary vane vacuum pumps normally utilize an ISO 68 (SAE 20) or ISO 100 (SAE 30) oil. Process pumps and other vacuum pumps driven by a gearbox will require a much more viscous oil, such as an ISO 220 (SAE 50).

Types of Oils for the Industrial Market

But what about all of the different oil types in the market? Terms such as hydro-treated or hydrocracked paraffinic oils, Polyalphaolefins (PAOs), diesters, Polyolesters (POEs), petroleum oils, mineral oils and even semi-synthetic oils may be a little intimidating. While there are other fluid types used in vacuum pump applications, let’s focus on just a few, beginning with some of these base oil types with which you may

or may not be familiar. To simplify things, petroleum oils or mineral oils are one in the same. Hydro-treated, or hydrocracked oils, are simply a more refined, or further processed petroleum oil that will have some or most of the impurities removed.

PAO is short for polyalphaolefin and is a popular synthetic oil option. This is due to exhibiting excellent high and low temperature performance, good oxidative and thermal stability, and good compatibility with mineral oils and most synthetics. Esters, including both diesters and POEs, are forms of synthetic oils that are generally more thermally stable, and they are commonly used in applications where higher temperatures may be present. The high polarity of these esters helps to prevent varnish or sludge build-up. Another advantage is their cleaning ability, because they act as a natural detergent. Semi-synthetics are typically a combination of a synthetic base stock and a petroleum/mineral oil. In some cases, multiple synthetic oils may be used together to create unique blends that work best in some demanding applications.

The Importance of Additives

Now that we have covered some of the base oil types, what about some of the common additives used? This is where you may see a plethora of different options, all using the same base oils, and wonder why you would choose one or the other. Due to the wide range of applications, you will see different additive packages used. While some may require a greater amount of antioxidants, others may require additional anti-wear additives. You may see additives specifically used as a pour point depressant, corrosion inhibitor, or even an anti-foaming agent. Having the proper additive package in the proper concentrations (more is not necessarily better) is an essential focus to ensure that the finished

lubricant will perform its duty satisfactorily. This is where years of experience in formulating these products, testing in the field, and investing in research and development will really set one manufacturer apart from another.

Other Variables to Consider When Choosing a Lubricant

While this article is designed to serve as an abbreviated summary of some of the different vacuum pump lubricants commonly used in industrial applications, it is also very important to note that there may be outside variables that may influence the lubricant choice. Severe or demanding conditions, unique applications, compatibility with different process materials, and harmful contaminants may need to be taken into consideration. Extreme temperatures can often put additional strain or stress on these oils. Many manufacturers may provide a guideline indicating how long an oil “should” last, assuming it is operating under normal or ideal conditions. A 20 to 30 degree temperature differential may cut the useful oil life in half. In other situations, a petroleum oil may varnish or develop harmful sludge if run too long at too high of a temperature. A successful oil analysis program is helpful when analyzing the condition of the oil and its expected life in different applications and environments.

For some applications it will be necessary to deviate from the OEM recommendation: this is where your trusted oil supplier, technician, or engineer will come into play. Original equipment manufacturers (OEMs) spend a great deal of time choosing a lubricant that will work best for its specific piece of equipment or intended application. The goal for any aftermarket oil manufacturer is to formulate a product that will meet and/or exceed the performance requirements of these OEM oils.



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UNDERSTANDING VACUUM PUMP LUBRICANTS

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