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FROM THE EDITOR

Industrial Blower & Vacuum Systems

A plastics manufacturing company called Wintek Corporation asking for an evaluation and replacement of their liquid ring vacuum system used in a PET solid state polymerization/drying application. Authors Michael Cicalese and Chris Halbach, from Wintek, have sent us a very interesting article sharing the evaluation and the system they ultimately installed.

Congratulations are in order for E.W. Klein & Co. for celebrating their 100th Anniversary in 2021! Based in Atlanta, one can safely say they are experienced with engineering industrial blower and vacuum systems. Their own Tie Duan has sent us an excellent fundamentals article titled, "Select the Right Vacuum Pump."

Aeration Blower Systems

As our readers know, an article from Tom Jenkins, from JenTech, never fails to provide a mathematics challenge! This month, Mr. Jenkins has collaborated with John Conover, from Tamturbo, to provide readers with another math challenge titled, "Measuring Blower Airflow in the Field."

EnviroMix has sent us a very interesting article discussing their modified approach to conventional aerobic digestion. Using both aeration blowers and air compressors, this engineering firm designs and manufactures treatment systems. I'm sure you'll like the article provided by authors David Lauer and Sarah Elger titled, "Rethinking Aerobic Digestion Resolves Frustrations, Improves Performance, and Saves Money."

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

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2021 MEDIA PARTNERS

Optimizing Booster/Liquid Ring Vacuum Pump Performance with a Plastics Manufacturer

By Michael Cicalese and Chris Halbach, Wintek Corporation

Background and Existing Vacuum System

Wintek Corporation was contacted by a plastics manufacturing company in the summer of 2015 to evaluate their process vacuum capabilities. The customer was looking to replace a recently purchased used vacuum system to be used in a PET solid state polymerization/drying application. The process required high heat and vacuum and needed to run at 1 mBarA (0.75 Torr). The customer had purchased the dryer and accompanying vacuum system from an overseas supplier. While they were happy with the dryer, the vacuum system was not delivering the desired performance. The customer asked Wintek to come on site to review the system, target improvements, and quote a replacement system.

The used vacuum system consisted of an inlet knockout pot and three vacuum boosters in series backed by a liquid ring vacuum system. None of the components had a nameplate nor make and model info on them. The customer had no information on the unit's reported capacity nor any performance operating curve detail. This obviously would have made getting replacement parts or technical support extremely difficult. In addition to the lack of information, the customer was noticing the following operational issues:

1. The inlet knockout pot was improperly designed causing excess product carryover into the liquid ring pump. This meant that the customer had to dump their contaminated sealant almost once per day. This increased water usage and created a significant volume of contaminated water that needed to be treated.

2. Additionally, the issues with the knockout pot were exacerbating design flaws with the liquid ring vacuum system. The vacuum system was not designed to promote robust, reliable, and safe operation which are normally selling points of a liquid ring-based system. A typical full recovery liquid

Figure 1: Existing System Sealant Reservoir and Cooler

Optimizing Booster/Liquid Ring Vacuum Pump Performance with a Plastics Manufacturer

ring package would contain a discharge vapor-liquid separator, as well as a sealant heat exchanger.

The customer's vacuum system had an open reservoir with a cooling coil submerged inside of it (Figure 1). This presented a few issues. For one, this container was not air-tight which meant the area was exposed to process vapors which is an obvious safety issue. Second, this was a very inefficient method of cooling the sealant leading to warmer than desirable sealant temperatures. The customer had 57˚F(14˚C) chilled water but was only seeing a sealant temperature of 85˚F(29˚C). High sealant temperature not only leads to decreased performance, but the customer was reporting that the pump always ran in cavitation. Over the long term this would cause serious damage to the vacuum pump. Summarizing, the used liquid ring vacuum system was incredibly inefficient, prone to damage, inherently unsafe and hurting production.

3. The third issue with this setup was that it was difficult to thoroughly clean the system as carryover accumulated leading to maintenance issues and decreased heat transfer. Additionally, the system had no flow sensing instrumentation to know when a significant clog could be present. This was another potential cause of high sealant temperature and reduced reliability and capacity.

4. As a result of the poor liquid ring vacuum system design and the resulting capacity deficiency, the overall system was experiencing high temperatures in the booster vacuum pumps. The temperatures were so high that the paint on the booster vacuum pumps was starting to discolor. In general, high temperatures in vacuum booster pumps is a result of a booster forced to do more compression work than is appropriate. This was caused by improper staging ratios, meaning the backing pumps capacity was insufficient for the desired overall system performance. The customer was particularly concerned with the

system shutting down mid-batch due to high booster temperatures, resulting in the loss of an entire batch at a high financial loss.

5. Lastly, poor liquid ring pump design led to shaft vibration and bearing issues, creating much more maintenance than Wintek would typically expect to see for a liquid ring vacuum pump.

Summarizing, the existing vacuum equipment was incredibly inefficient, prone to damage, inherently unsafe and hurting production. The system was most likely designed to be as inexpensive as possible, as opposed to reliability delivering the performance the customer desired.

Determining Required Capacity

With the many issues identified, Wintek transitioned to determining the required capacity for the customer's process. This was a two-step process. The first step was determining the capacity of the existing system and the second step was determining the actual process requirements. Wintek returned to the customer site to inspect the existing system to determine its capacity and performance. One method to estimate the capacity of the existing equipment would be to compare the horsepower of the existing boosters with known brands, however all three of the booster vacuum pumps had 10 horsepower motors even though they were physically different in size. The second method by which Wintek attempted to estimate the booster capacity was to measure the lobe and bearing sizes and to compare this to other known boosters. Wintek performed the measurements, consulted with a booster manufacturer, and determined the three booster vacuum pumps had estimated nominal capacities of 3000 ACFM, 1600-2500 ACFM, and 1200-1500 ACFM. For the liquid ring pump, we compared the existing 27kW (~36 horsepower) 2-stage pump to known models and estimated its capacity similar to a 40 horsepower 2-stage vacuum pump.

Wintek then installed an absolute digital pressure gauge specifically calibrated to measure deep vacuum and attached a piccolo to the system to get an overall system capacity curve. A piccolo is a device with several calibrated orifices which bleed in a precise amount of air into the system while it is running to see what pressure the system is able to achieve. One can then use the operating pressure and mass flow to calculate the ACFM capacity of the system at various pressures.

However, the curve generated in this manner is not entirely accurate as it does not incorporate the mass flow of the air that leaks into the system under vacuum. To account for this, the next thing we did was a leak-up test. This entailed pulling the system down to as deep a vacuum

Optimizing Booster/Liquid Ring Vacuum Pump Performance with a Plastics Manufacturer

as it could achieve without the customers process running. The system was then isolated, and the pump turned off. We then recorded the pressure rise over time. Knowing that pressure rise along with the system volume facilitates the calculation of air leakage given the formula:

$$\text{Required ACFM} = \frac{\Delta \text{ x System Volume}}{\text{time x } P_{\text{operating}}}$$

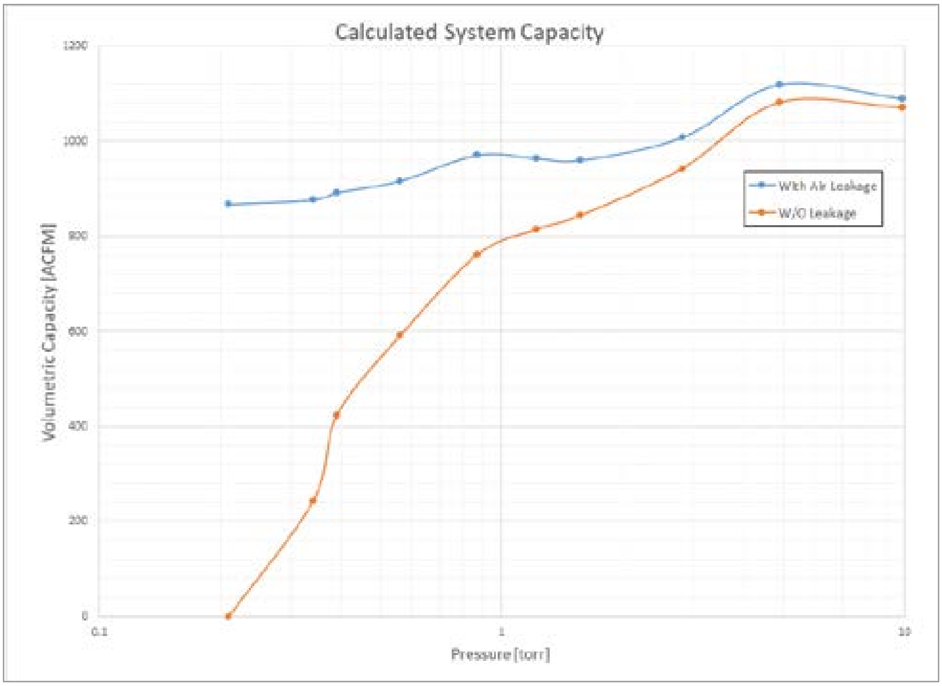

Figure 2: Calculated Existing System Capacity

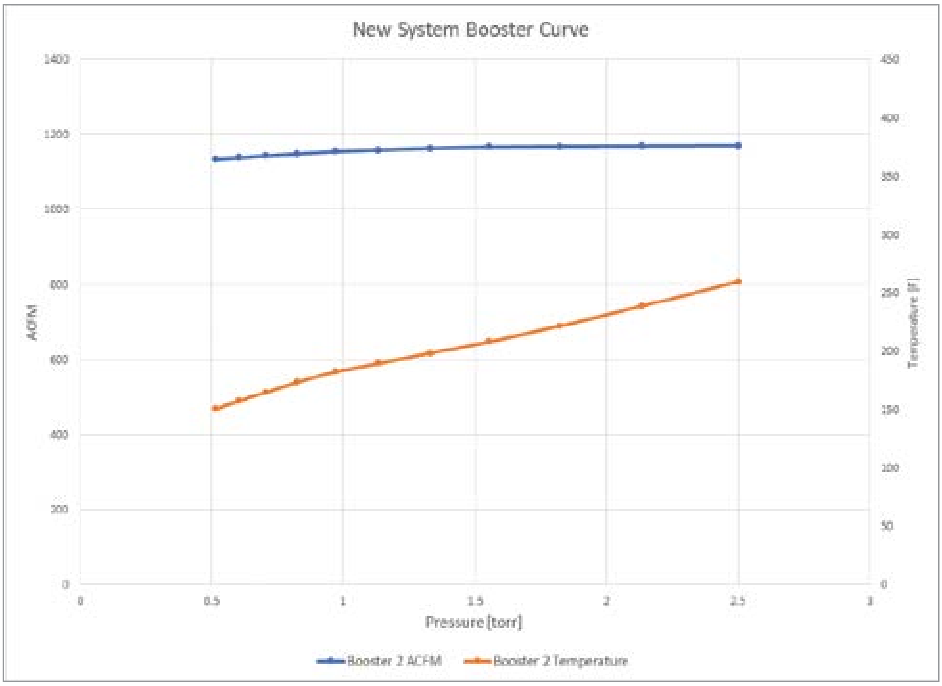

Figure 3: New System Booster Capacity

This ACFM can then be converted to lb/hr by using the operating pressure and temperature. We calculated an air leakage of ~1.1 lb/hr air. For simplicity we assumed the air leakage did not vary with operating pressure.

With the air leakage now known, we were now able to combine our measured mass flow using the piccolo and the air leakage rate. Figure 2 shows the calculated system performance before and after taking air leakage into account.

As can be seen, the incorporation of the air leakage flattened the capacity curve at the lower pressures. This matches more closely with Wintek's expectations of a typical booster capacity curve and was the final assumed capacity of the customer's existing system.

The results of the capacity testing was slightly surprising to Wintek. The customer had given us an estimated mass flow of 112 lbs of water over the course of a 22 hour batch. At 1 mBarA operating pressure, this flow rate would equate to ~2,400 ACFM of required capacity. So it would appear that the existing system was significantly undersized and would not be able to achieve 1 mbarA during operation.

While on site, Wintek had the customer run a batch and recorded the vacuum levels with our calibrated pressure gauge. The existing system operated between 0.54 and 0.72 Torr. As per the calculated capacity curve, this meant they only required ~900-950 ACFM of capacity. This meant that the customer did not have as much mass flow as expected. In speaking with the customer, we came to an agreement to add ~30% extra capacity to the existing system capacity to be safe. We set off to design a new system to deliver at least 1,200 ACFM of capacity at 1 mbarA.

Designing a New System

Frequently, the key parameter when designing a system with vacuum boosters is the booster operating temperature. Each booster has a maximum operating temperature so calculating the actual operating temperature is crucial. The factors that play into that temperature calculation are the mass flow, vapor stream composition, the temperature rise coefficient of the booster, and the staging ratio between the booster and whatever process component is backing it.

The staging ratio is critical to understand when designing boosted vacuum systems. It is defined as the ratio of the capacities of the booster itself and its backing pump. In general, the higher the staging ratio, the more compression work a booster has to do; thus, the higher the temperature rise will be. Several of the booster parameters required for sizing are all functions of operating pressure: the maximum staging ratio, volumetric efficiency and temperature rise coefficient. This makes sizing multi-booster systems quite tedious and time consuming by hand. Luckily, Wintek's internally developed proprietary software can automate the process and deliver capacity and temperature profiles for boosters with a variety of backing pumps and solvents. This allows Wintek to iterate on different designs quickly to determine the most reliable and cost effective design. Figure 3 is an example of the booster curve that was generated for this project.

Wintek is able to plot the booster vacuum pump capacity as well as its operating temperature across the entire projected operating range. This ensures stable operation when not operating at the single design point. Additionally, with the ability to analyze multiple configurations fairly quickly, we were able to experiment with different designs. One change we made was to replace the third stage booster with an air ejector using pressurized air as a motive fluid. This had several benefits:

- The air ejector is much less expensive than a vacuum booster
- It eliminated a piece of rotating equipment which saves on maintenance, and it was able to reduce the size of the liquid ring pump.

Optimizing Booster/Liquid Ring Vacuum Pump Performance with a Plastics Manufacturer

The reason Wintek decided to keep the liquid ring pump instead of transitioning to a dry vacuum pump was the presence of the process carryover. While Wintek was supplying a knockout pot in the new design, filtration is never 100% perfect and carryover had the potential to cause costly damage to a dry vacuum pump. The final system design Wintek decided on was a booster- booster-air jet-2-stage liquid ring package.

Figure 4: Picture of New System Prior to Installation

Wintek Corporation Overview

Wintek has provided process vacuum and separation systems for the biodiesel, chemical, environmental, food, pharmaceutical, and plastics industries since 1986.

Wintek's Process Vacuum and Vapor Recovery Systems utilize liquid ring, rotary vane, rotary piston dry vacuum pumps. Additionally, we engineer multi-stage hybrid designs with blowers (booster) and/or ejectors to achieve desired vacuum levels.

Our Molecular Sieve Dehydration Units (MSDUs) dehydrate of alcohols beyond azeotropic limitations and can provide considerable energy savings compared to distillation. Wintek provides these as packaged, skid-mounted systems, pre-piped and wired, which significantly minimizes installation cost and time.

Wintek also engineers Flash Tower Extraction Systems for methanol recovery from biodiesel (methyl ester) and glycerin streams.

For more information visit https://wintek-corp.com

In designing the new system, we also identified several additions to a new system that we wanted to include to improve the reliability and safety of the system. They included:

- Wintek-designed knockout pot to improve the particulate capture and better protect the system.
- Additional booster discharge temperature probes.
- Replacement of the manual temperature gauges with digital gauges reading into a panel with a PLC.
- A variable frequency drive on the first stage booster that could reduce the speed if high booster temperatures are detected. This was preferred by the customer to a system shutdown on high temperature.
- Inclusion of a well-designed vapor-liquid separator and sealant heat exchanger on the liquid ring system.
- Added safeties to the liquid ring system such as flow and level switches to ensure the liquid ring pump cannot ever run dry and damage itself. In cases where carryover is likely, these features are even more important.

Results

After submitting our proposal to the customer, they decided to move forward with the system we presented to them. It was delivered and installed in early 2016. Figure 4 is a photo of the completed system.

The system has been running reliably since installation with no major process upsets occurring. Not only was Wintek able to make a more sophisticated, reliable, and robust vacuum system that eliminated maintenance and down time, it lead to other opportunities within the plant for additional system sales and service work. BP

About the Authors

Michael Cicalese, President

Michael joined Wintek as President in 2017 after 12 years of management consulting with two Tier 1 consulting firms. Prior to this, Michael was an Aerothermal Engineer at Pratt & Whitney and a Project Engineer at an industrial refrigeration design/build contractor. Michael holds an MBA from Carnegie Mellon University, an MS in Mechanical Engineering from Drexel University, and a BS in Mechanical Engineering from Virginia Tech. Tel: 862-419-9993, Email: michael@wintek-corp.com

Chris Halbach, Senior Applications Engineer

Chris started with Wintek in 2008. At Wintek, Chris is responsible for leading Vacuum and Separation System sales and engineering design as well as overseeing the build and startup of these systems. Chris holds a BS in Chemical Engineering from the University of Delaware. Tel: 862-419-9055, Email: chris@wintek-corp.com

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Select the Right Vacuum Pump

By Tie Duan, E.W. Klein & Co.

Deciding on the most suitable vacuum technology for an industrial application can be challenging. This decision can be relatively easy if it is simply finding a drop-in replacement for an existing pump, but if a process keeps crashing an existing pump, it can get complicated when you are tasked with re-evaluating all the available options to find the best solution. I am hoping to highlight a few key factors to consider when you run into this type of scenario. Some of these key considerations are:

1. Operating vacuum depth
2. Volumetric flow rate
3. Process gas, liquid, and solids.

The first two items can be somewhat straight forward, but the last criteria can introduce a lot of nuances into this decision. A more detailed breakdown of each of these criteria is described in this article.

Operating Vacuum Depth

Figure 1 is a reference chart we frequently use to help guide our customers in choosing the right vacuum technology-based on their process' operating vacuum depth.

Different vacuum technologies have different ranges of achievable vacuum depths. This is due to the operating principle of each technology. Below is a high-level overview of these technologies' vacuum depth capabilities:

- Side channel blower (regenerative blower). These blowers are mainly designed to produce large airflow with relatively small footprint, but at the sacrifice of vacuum depth. Their designed max vacuum depth (ultimate vacuum) typically does not exceed 10 in-HgV. A look at their internal design reveals the cause behind this limitation.

  There is significant space between impeller blades and the inner surface of the housing. This space allows the inlet air to be transported between each impeller cavity which creates the vacuum, but it also acts a large air leak within the pump itself, results in slippage, preventing it from reaching deeper vacuum.

- Liquid ring vacuum pump (LRVP). Because a LRVP often uses water as the liquid to seal the clearance between

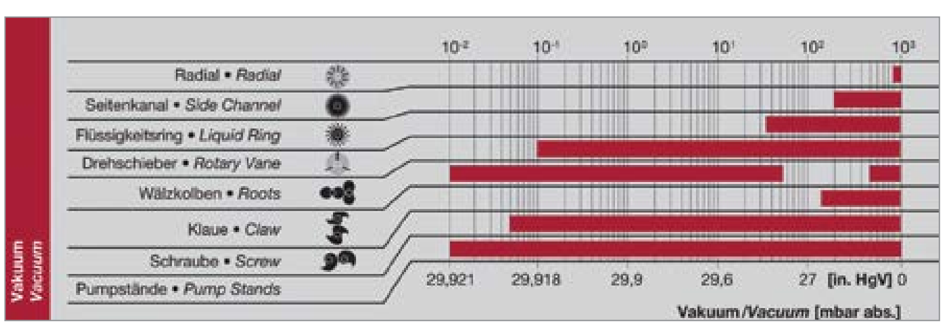

Figure 1. Vacuum Depth Chart. Image used with permission from Gardner Denver.

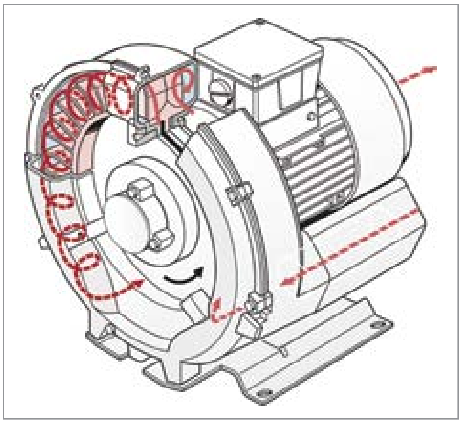

Figure 2. Cutaway View of a Side Channel Blower. Image used with permission from Gardner Denver.

the rotor blades and the housing, it minimizes air leak within the pump itself, therefore allows a single-stage LRVP to reach down to 29 in-Hg. For Nash's two stage TC pumps, they can reach even deeper than 29 in-Hg. However, the ultimate depth of a LRVP is often limited by the seal liquid used, more specifically by its vapor pressure. As vacuum deepens, the boiling temperature of the seal liquid drops, at the same time pump motor, heat from compression, and the process all add heat to the seal liquid. The ultimate vacuum of a LRVP is reached when the boiling temperature of the liquid under vacuum equals the temperature of the seal liquid, then the pump will most likely cavitate and not go any deeper in vacuum. Alternatively, oil and other liquid with different vapor pressures can be used as the seal liquid in a LRVP to achieve deeper vacuum.

- Rotary vane vacuum pump (oil-lubricated). As its name suggests, an oil-lubricated rotary vane pump uses oil to seal any gap between the vanes and the inner surface of the housing, therefore allowing a deep vacuum. Because oil is essentially used as the seal liquid, it can achieve deeper vacuum than typical LRVP using water as seal liquid.

  An oil-less rotary vane, however, can only reach about 25 to 26 in-HgV, because there is no seal liquid to prevent air leak between the vanes and inner surface of the rotor housing.

- Claw pump. Like an oil-less rotary vane pump, a claw pump can reach 26 or 27 in-HgV, but not any deeper in continuous operation. The space between the two rotary claws and the inner surface of the housing allows small amount of air leak within the pump. The heat generated from the compression cycle of the claws' rotation also limits its ultimate vacuum depth. The deeper the vacuum, the less airflow and less heat removal by inlet air, resulting in claws' thermal expansion and eventual touch off.

- Screw pump. The dry pump has a much deeper ultimate vacuum than an oil-less rotary vane, claw pump, or LRVP. This is due to the two synchronized counter-rotating screws continuously compress and cool the inlet gas along the entire axial direction. A screw pump can reach deep into 0.02 Torr (0.03 mbara) and can run completely deadheaded.

Select the Right Vacuum Pump

- Roots blower. The chart (Figure 1) shows two effective vacuum ranges for this type of blowers, one at rough vacuum like that of a side channel blower, and one at deep vacuum close to that of a screw pump. This blower is frequently used as an alternative to side channel blower for vacuum material conveying applications that requires large air flow and relatively low vacuum depth. The roots type blower is also used as a booster pump in combination with an oil-lubricated rotary vane, LRVP, or screw pump to achieve very deep vacuum with high CFM capacity.

Volumetric Flow Rate

When calculating the volumetric flow rate needed by a vacuum pump, it is important to distinguish between SCFM (Standard CFM. Standard is defined as under standard pressure and temperature conditions. The accepted standard of temperature and pressure are 68 ˚F (20˚C) and 36 percent humidity at sea level) and ACFM (Actual CFM). SCFM is typically the volumetric flow rate the process requires; ACFM is the volumetric flow the vacuum pump sees at operating vacuum depth. Because of the volumetric expansion of air under vacuum, ACFM will be equal to or greater than SCFM. The deeper the operating vacuum the larger ACFM is compared to SCFM. Figure 9 is an Expanded Air Ratio chart in relation to vacuum depth measured in in-Hg gauge.

For example, a side channel blower application that requires only 10 in-HgV vacuum, 100 CFM process needs a blower with at least 150 ACFM capacity. For a liquid ring vacuum pump running at 27 in-HgV vacuum, a 100 CFM process needs a pump with at least 1000 ACFM capacity.

Process Gas, Liquid, and Solids

While no vacuum pump is a trash can, different vacuum technologies have different levels of tolerance to accidental ingestion of process gas, liquid, and solids. If we are to put them on a scale from Crash and Burn to Keeps on Truckin', they can be arranged as shown in Figure 10.

Managing process carry-over requires a suitable strategy of inlet separation, filtration, and condensation. This is heavily process dependent and involves a lot of nuances. A simplified motto for dealing with process carry-over is to knock it out or pass it through. Either we prevent process carry-over from reaching the pump or allow the carry-over to pass through the pump without causing damage to the equipment or process. For this article, I will list a few scenarios that highlight

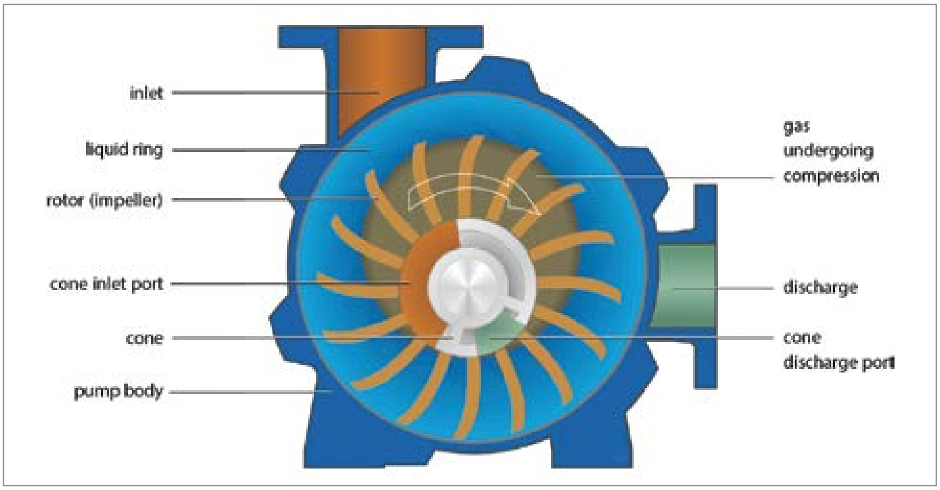

Figure 3. Cross Section View of A Liquid Ring Vacuum Pump. Image used with permission from Gardner Denver.

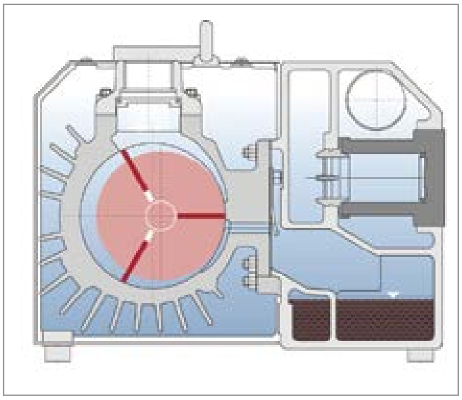

Figure 4. Oil-Lubricated Rotary Vane Pump. Image used with permission from Gardner Denver.

Figure 5. Claw Vacuum Pump. Image used with permission from Gardner Denver.

Figure 6. Cutaway view of Claw Vacuum Pump. Image used with permission from Gardner Denver.

Figure 7. VSB Screw Vacuum. Image used with permission from Gardner Denver.

Figure 8. VSB Screw Pump Internal View. Image used with permission from Gardner Denver.

each vacuum technology's interaction with potential process carry-overs.

- Use solvent or compatible chemical as seal liquid in LRVP. One recent application we worked on had the potential of introducing chemicals that can condense in the LRVP's water loop and clogging up the seal liquid line. One solution option was to substitute water with a solvent as the pump's seal liquid, which can prevent this chemical from clumping inside the pump. Another application had the concern of alcohol vapor from the process being pulled into the pump mixing with seal water, requiring secondary separation and recovery. A solution option was to seal the pump with alcohol, so discharged fluid is ready for recovery without further separation.

E.W. Klein & Co. Celebrates 100 Year Anniversary

Only a handful of companies last 100 years, and E.W. Klein is beginning the celebration of its 100th anniversary thanks to you and the great companies we represent, such as Gardner Denver, Alfa-Laval heat exchangers and other equipment. Founded in 1921, E.W. Klein & Co. is a leading manufacturer's representative of engineered vacuum and heat transfer equipment to the chemical, paper, power, and general industrial markets.

Our Roots: Based in Atlanta, E.W. Klein was selected as Nash Engineering Co's first representative in 1921. Nash's original focus was on steam heating systems common in buildings of that time. Later, Nash developed their world-famous line of Nash Hytor vacuum pumps. Still the leader in vacuum today, Nash is now part of the Gardner Denver product line recently acquired by Ingersoll-Rand.

2020 was a challenging year for us all. Since the founding of the company back in 1921, E.W. Klein & Co has come through all kinds of difficulties: wars, depression, recessions, natural disasters, stock market crashes, a pandemic, and everything in between. Through it all, it has been the people of E.W. Klein – our employees, great customers, and the equipment we represent – who have made the difference. COVID has taught us that we can make it through the tough times and make sure we celebrate the good ones too, now and for the next 100 years. Looking forward to 2021 and past COVID: A part of our overall growth plan was moving to a new location that has allowed us to stock and repair pumps and other equipment that we represent. We are excited about our new capabilities that will allow us to service the customer better than ever.

The keys to our success have always been our dedicated technical-focused staff, developing strong relationships with our diverse customer base, and capitalizing on new opportunities. For more information about E.W. Klein and the great companies we represent, please visit www.ewklein.com.

Select the Right Vacuum Pump

- Polymerization in the claw pump. Because of the claw pump's operating principle, it generates significant heat during its compression stage. This heat when met with certain monomers pulled into the pump can result in polymerization on the claws and lock up the pump. A more common solution for this is to knock out the incoming monomer using a condenser and separator.

- Oil-water emulsion in a rotary vane. In an oil-lubricated rotary vane pump, when water vapor is sucked into the pump, water can mix with oil and create an emulsion that can damage the internals of the pump. A couple of solutions: use gas ballast to eject water vapor in the compression zone; dead head the pump to boil off the water under deep vacuum periodically.

- Screw pump's temperature too low. For a screw pump, it is often used to pass through process gas or vapor without condensing it in the pump. Therefore, a screw pump needs to run at a controlled elevated temperature to prevent condensation of harmful vapors. We have seen customers where either the cooling water is too cold or the VFD is running the screw pump at too low of RPM, resulting in vapor condensing in the pump causing it to lock up or corrode. Furthermore, starting and shutting down a screw pump also requires a period of warm up and purge. These pre-programmed procedures are meant to ensure the pump reaches optimal temperature before it is exposed to condensable vapor, as well as remove any vapor left-over before the pump cools down in shutdown.

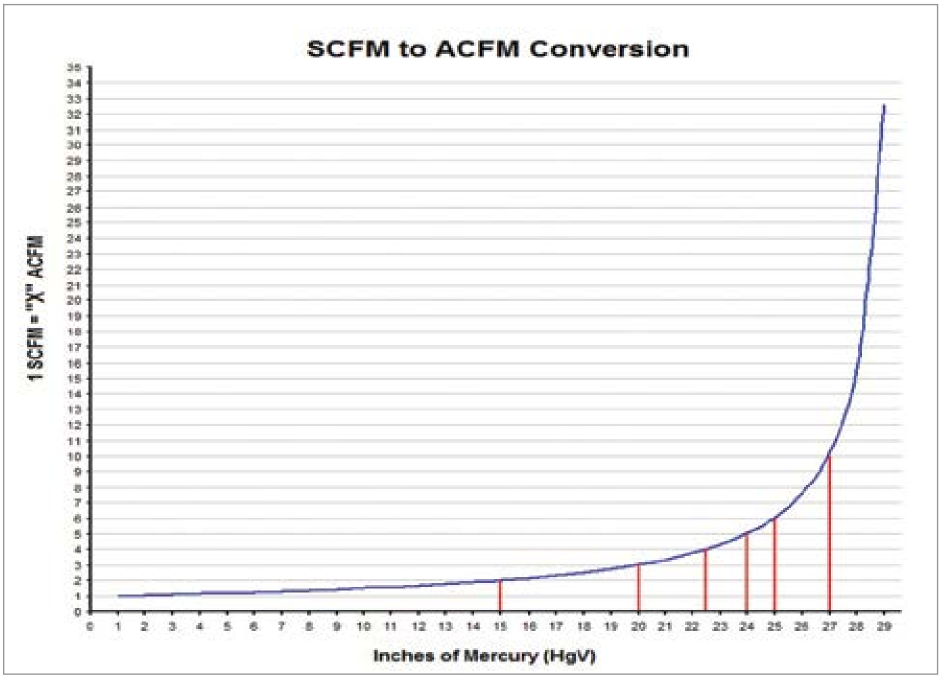

Figure 9. Expanded Air Ratio Chart

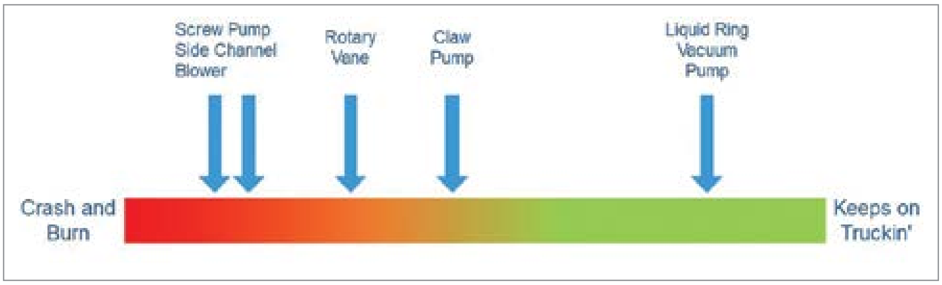

Figure 10. Levels of tolerance to accidental ingestion of process gas, liquid, and solids.

- Clogged filter crashing side channel blowers. A side channel blower generates a lot of heat as well, because of its constant compression of inlet air. It also uses the process air to cool itself down. It is not uncommon to see a side channel blower being used in a dusty application getting its inlet filter clogged, preventing fresh air from entering the blower to cool it down. The blower's impeller would eventually grow under heat and touch off the housing and crash.

Every process and application is a little bit unique, so a unique solution or solution variation is needed. BP

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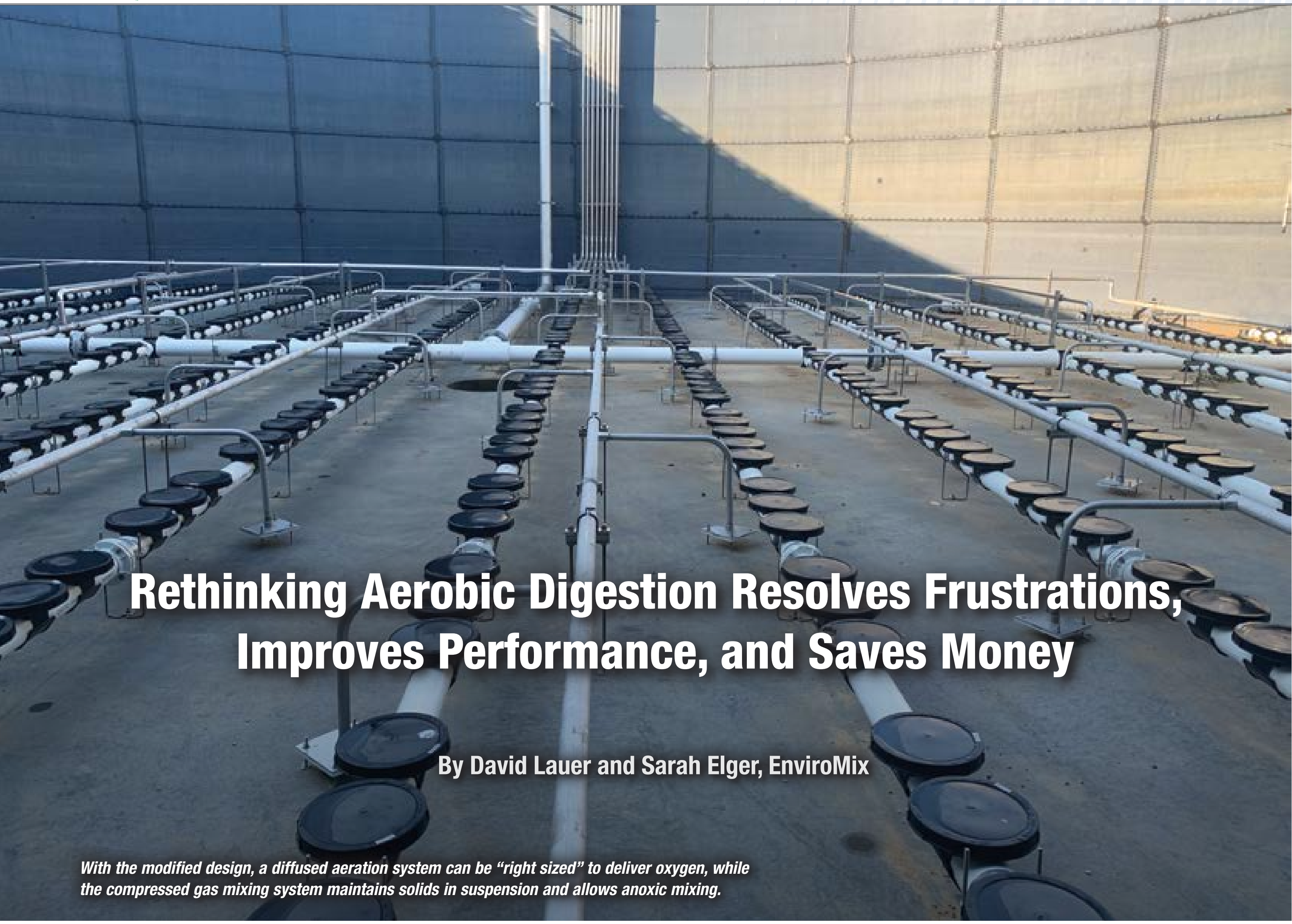

Rethinking Aerobic Digestion Resolves Frustrations, Improves Performance, and Saves Money

By David Lauer and Sarah Elger, EnviroMix

With the modified design, a diffused aeration system can be "right sized" to deliver oxygen, while the compressed gas mixing system maintains solids in suspension and allows anoxic mixing.

Aerobic digestion is a common treatment technology used at small-to medium-sized wastewater treatment plants for the treatment of waste activated sludge (WAS). The objective of aerobic digestion is to treat the sludge for disposal, and for those trying to meet Class B biosolids, further reduce volatile solids (VS) and pathogens to ensure the sludge is suitable for land application.

VS is destroyed through a process called endogenous respiration, where some of the microorganisms begin to decay and are consumed by other microorganisms. The process of endogenous respiration produces carbon dioxide and ammonia. The ammonia is then nitrified in the presence of oxygen through the nitrification process, which converts ammonia to nitrate (see Figure 1). The nitrification process consumes alkalinity, and when left unchecked results in a drop in pH.

$$BOD_{Bugs} + O_2 \rightarrow Less\ BOD_{Bugs} + CO_2 + H_2O + NH_3$$
$$NH_3 + O_2 + Alkalinity \rightarrow NO_2\text{-}$$
$$NO_2\text{-} + H_2O + Alkalinity \rightarrow NO_3\text{-}$$

Figure 1: The process of endogenous respiration.

> "Biosolids management costs for a small- to medium-sized wastewater treatment facility can account for 50% of the facilities operations and maintenance expense."
>
> — David Lauer and Sarah Elger, EnviroMix

EnviroMix's modified approach to aerobic digestion can use hybrid rotary screw blowers to provide efficient aeration, in turn, satisfying oxygen demand for VS destruction.

Figure 2: The decoupled approach allows for complete mixing, even under the aeration grid in hopper bottom tanks, enabling a "right-sized" amount of air to be delivered for VS destruction.

In a typical aerobic digestion process, air delivered by aeration blowers through a diffused aeration system is used to both provide the oxygen needed for endogenous respiration and to completely mix the contents of the aerobic digester tank, keeping the microorganisms suspended and in contact with each other. More often than not, there is little to no automated process control or instrumentation feedback in a conventional aerobic digester, and operators manually run the process.

Aerobic digestion is one of the highest energy consuming processes at a wastewater treatment plant. Most aerobic digesters are mixing limited – meaning that the energy or air demand required for the biology is far less than that required for mixing. A mixing limited digester design generally results in the following concerns or problems:

- Excess aeration – resulting in high energy consumption.
- Lack of process control – resulting in uncontrolled nitrification, pH drop, and chemical addition to control alkalinity.
- Lack of visibility into the process – resulting in uncontrolled dissolved oxygen (DO), over- or under-aeration, digester process upsets, and/or foaming.
- Excess nutrients returned to the head of the plant – resulting in secondary treatment process upsets and increased use of metal salts to meet phosphorus permits.

A Different Approach

A modified approach to conventional aerobic digestion that addresses these problems has been developed by EnviroMix, an engineering firm that designs and manufactures treatment systems. The company's BioCycle-D Optimized Aerobic Digestion Process is a comprehensive sludge treatment solution designed to meet process demands. Digester operation is based on the principal of alternating aerobic and anoxic/anaerobic conditions. Through instrumentation feedback, the process controller automatically transitions the cycles from aerobic for VS destruction to anoxic/anaerobic for facilitating **denitrification, alkalinity recovery, and energy savings.**

In a conventional aerobic digestion design, the volume of air required to satisfy the oxygen demand of the process is far less than the volume of air required to mix the digester contents. As mentioned above, this condition is commonly referred to as mixing limited. The BioCycle-D approach decouples aeration from mixing – i.e. the function of

Rethinking Aerobic Digestion Resolves Frustrations, Improves Performance, and Saves Money

mixing is no longer provided by the diffused aeration system, typically allowing for smaller horsepower blowers, a smaller aeration system, and significant turndown capability.

Separate aeration and mixing systems are included in the modified design, whereby a "right-sized" diffused aeration and blower system provides air to satisfy process oxygen demand, and an energy efficient BioMix Compressed Gas Mixing System provides the mixing function. This allows for independent control over oxygen delivery and mixing, preventing over-aeration and wasted energy (see Figure 2).

BioMix uses compressed air to uniformly mix the tank contents at 85% less energy than diffused air mixing. Decoupling aeration from mixing provides over 50% energy savings at design loading and even more when the digester is underloaded.

The central theme of the innovative aerobic digester process control logic is focused on providing complete flexibility to operate the digester based on current loading rates, rather than control strategies solely based on future-state design conditions. The process provides operational advantages in underloaded environments by adapting the process cycle to encourage energy savings, chemical reduction, and increased dewaterability of the outgoing sludge.

During both the aerobic and anoxic cycles, there are two automatic controllers that can be enabled or disabled – one based on oxidation-reduction potential (ORP) setpoints and one based on cycle time setpoints. The controllers work together to determine the best time to switch between cycle modes. Alternating between aerobic and anoxic cycles allows for destruction of soluble extracellular polymeric substances (EPS), reducing the bound water in the sludge, and therefore, improving sludge dewaterability.

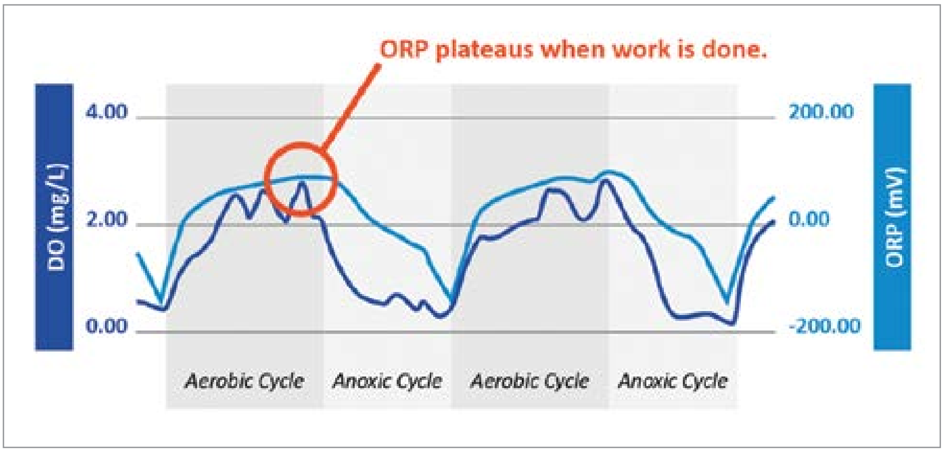

Figure 3: Transition from aerobic cycle to anoxic cycle using high ORP setpoint to detect ORP plateau.

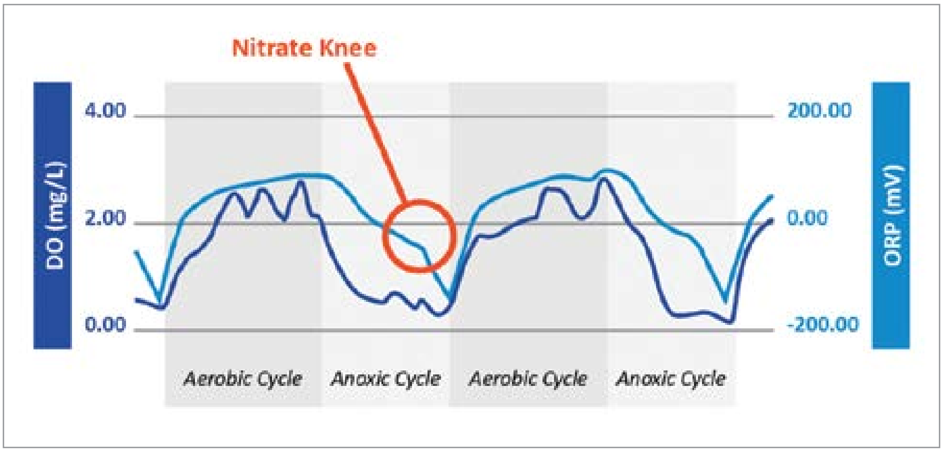

Figure 4: Transition from anoxic cycle to aerobic cycle using low ORP setpoint and nitrate knee.

During the aerobic cycle, the aeration blowers operate to deliver the right amount of air necessary to satisfy process oxygen demand without excess aeration. The amount of air is regulated to meet a DO setpoint. The process controller automatically identifies when mixing is needed to support aeration – i.e. when the airflow rate falls below what is required for keeping the contents of the tank completely mixed. Simultaneous optimal air delivery and compressed gas mixing reduce energy consumption. The system switches from the aerobic cycle to the anoxic cycle once the ORP value plateaus at the high ORP setpoint, indicating the nitrification work is done (see Figure 3).

During the anoxic cycle, aeration is disabled, and the compressed gas mixing system operates to ensure the sludge remains completely mixed, allowing for continued treatment at minimal energy consumption. Nitrate is converted to N2 gas through denitrification, which can return half of the alkalinity, eliminating the need for chemical addition to regulate pH. The system switches from the anoxic cycle to the aerobic cycle once the low ORP setpoint or nitrate knee is reached, indicating the denitrification work is done and the start of anaerobic conditions and phosphorus release (see Figure 4).

The digester alternates between aerobic cycle control and anoxic cycle control until the operations staff is ready to initiate either "manual settle" or "manual decant" as a part of an optional supernatant return mode. To thicken the sludge within the aerobic digester, this operating mode is available for settling and decanting off the supernatant for return to the main treatment plant. The supernatant return mode is initiated by an operator and ends after operator intervention or after a preset time period.

Air compressors provide high-pressure air for the compressed gas mixing system at the City of Highland's HWRF.

An optional sludge processing mode, in which sludge is completely mixed as it leaves the digester, is also available to ensure sludge is homogenous for downstream processing and to maintain phosphorus in the sludge through low oxic states. The aerobic/anoxic cycling destroys cell walls, causing cell lysing and resulting in better dewaterability of the sludge. Additionally, maximized VS destruction reduces sludge volume, thereby reducing sludge disposal costs.

Case Study

Highland, Illinois, is one of the oldest Swiss settlements in the United States. Located 35 miles east of St. Louis, Missouri, just off of Interstate 70, Highland is home to a population of approximately 10,000 and boast a highly rated school district, library, and hospital. City utilities are municipally owned and operated. The Highland Water Reclamation Facility (HWRF) treats sewage from 42 miles of sewer main within the community.

In 1998, the HWRF repurposed a former package plant originally constructed in 1976 to be an aerobic digester. The aerobic digester had four separate compartments, and each compartment was able to be wasted into and/or supernated from individually with airlifts pumps. The tank had coarse bubble air diffusers. Air was supplied by a 100-horsepower (hp) multistage centrifugal blower operated by a variable speed drive (VSD). In regard to the aerobic digester, the following concerns and frustrations were cited by plant staff:

- Could not maintain steady DO levels because of fluctuating tank levels.
- Had to manually throttle air valves to each compartment to keep air flowing to others when supernating.
- Was unable to utilize blower VSD for energy conservation with throttled air valves.
- Could not supernate all compartments at the same time because airlift pumps need the blowers running.
- Had to manually supernate the tanks, which was labor-intensive.
- Received odor complaints when air was reintroduced after supernating if air was left off too long.
- Was unable to meet the vector attraction requirements for 40CFR503 Class B regulations.

In 2020, the City of Highland upgraded their facility. The HWRF upgrade was designed to treat two million gallons of wastewater per day using an oxidation ditch which facilitates nitrification and biological phosphorus removal and an innovative aerobic digestion process to treat the waste sludge. The city selected EnviroMix's BioCycle-D Optimized Aerobic Digestion Process as an integral

Rethinking Aerobic Digestion Resolves Frustrations, Improves Performance, and Saves Money

part of the new plant design because of the significant energy savings and improved sludge digestion that the system provides.

In the aerobic digester, they were able to reduce their aeration energy from one 100-hp blower operating nearly continuously to satisfy process oxygen and mixing requirements, to one 60-hp blower operating less than three hours per day and one 25-hp air compressor operating the balance of the day at less than 50% capacity to keep the digester mixed.

The upgrade also resulted in increased VS destruction, and reduced operator intervention due to greater automation and ease of use. BioCycle-D addressed all of the plant's concerns through the convenience of automated instrumentation controls, the energy and process benefits of decoupling aeration from mixing, and the flexibility of built-in modes for supernatant return and sludge processing.

Shown is the new aerobic digester at the City of Highland's HWRF.

Lower Costs and Improve Process Performance

Biosolids management costs for a small- to medium-sized wastewater treatment facility can account for 50% of the facilities operations and maintenance expense. Upgrading the aerobic digestion process can save both time and money, while ensuring process performance to meet disposal requirements. Rethinking the conventional approach to aerobic digestion with an innovative process like EnviroMix's BioCycle-D allows plants to:

- Reduce energy costs by stopping blower operation when aeration is not required, keeping tank contents mixed with a low-energy mixing solution, and decoupling aeration from mixing to match air supply with process oxygen demand.
- Minimize sludge disposal costs by maximizing VS destruction, enabling plants to meet Class B biosolids requirements for land disposal, and reducing sludge volumes for disposal by improving dewatering results.
- Decrease operator demands by providing visibility into real-time process changes and the ability to automatically adapt operation based on that information. BP

About the Authors

David Lauer, P.E., is Vice President of Marketing and Business Development for EnviroMix. He is an accomplished sales manager with more than 30 years of technical product sales experience in the wastewater treatment equipment market. David received an MBA from Marquette University and a B.S. in environmental engineering from Michigan Technological University, and he is a Registered Professional Engineer in the State of Wisconsin.

Sarah Elger, P.E., is Director of Product Innovation and Strategy for EnviroMix. She has worked in the water and wastewater industry for more than 15 years and specializes in biological wastewater treatment and process controls. Sarah received an M.S. in environmental engineering from the Milwaukee School of Engineering and a B.S. in engineering mechanics and astronautics from the University of Wisconsin, and she is a Licensed Professional Engineer in the State of Wisconsin.

About EnviroMix

Headquartered in Charleston, South Carolina, EnviroMix designs and manufactures treatment systems to dramatically reduce energy costs and help facilities meet nutrient removal limits. Utilizing patented and proprietary technology, the company provides complete mixing systems, process controls, and energy management solutions to enhance plant performance in the water and wastewater markets. For additional information please visit www.enviro-mix.com. All photos courtesy of EnviroMix.

To read similar articles about ***Aeration Blower Systems,*** visit https://blowervacuumbestpractices.com/system-assessments/blower-systems.

Measuring Blower Airflow in the Field

By Tom Jenkins, JenTech Inc., and John Conover, Tamturbo Inc.

Most electric utilities offer customer incentives for implementing energy conservation measures (ECMs) Incentive programs pay customers to use less energy. In some cases they are mandated by legislation and in others the incentives are driven by the utility's desire to avoid building new generating capacity. Some incentives are based on reduced energy use (kWh) and some are based on lower peak demand (kW).

Electricity is a major budget item in municipal and industrial Water Resource Recovery Facilities (WRRFs). Blowers that supply air to treatment processes are the largest single use of electricity in most WRRFs. That makes them a prime target for ECMs. Many blower projects involve replacing or supplementing existing units with new energy-efficient blowers. (Although there is no universal definition, the term "blower" is generally applied to air moving equipment with a discharge pressure between one and 30 psig.)

Measurement & Verification

Most utility incentive programs require measurement and verification (M&V). This allows the utility to verify that the projected energy savings are achieved and the incentive payment is justified. There are two steps to the M&V process. Prior to implementing the ECM baseline energy measurements are taken to establish the existing system's energy use. When the ECM is implemented the new energy use is measured to confirm the improvement.

There are many metrics used for wastewater treatment energy comparisons. These include kWh per million gallons treated and kWh per pound of Biochemical Oxygen Demand (BOD) removed. In most plants process loads vary seasonally, day to day, and hour to hour. These variations inherently make timely comparison between old and new systems difficult. Blower efficiency is a problematic metric because efficiency is measured in several ways, may reflect the blower alone or the complete blower system, and does not directly identify the energy or power used by the aeration process.

A useful metric for comparisons is specific power. This is usually expressed as kilowatts per hundred scfm (kW/100 scfm).

$$e = \frac{P_E \cdot 100}{q_{std}}$$

Where:

e = specific power, kW/scfm.

P_E = electric motor power draw, kW.

q_{std} = airflow rate, scfm (standard ft^3/minute at 68°F, 14.7 psia 36% relative humidity).

The specific power is calculated using a single set of inlet conditions and discharge pressure. If the inlet temperature, inlet pressure, or discharge pressure change then the specific power will also change. For accurate comparisons of the performance before and after the ECM, or comparisons of different technologies, inlet and discharge conditions should be consistent. Calculation methods are provided in test codes such as ASME PTC 13 to convert performance at one set of conditions to performance at another set.

The Opportunities

Many existing blower technologies have been in use for decades. These include lobe-type positive displacement blowers, multistage centrifugal blowers, and geared single stage blowers. Other types of blowers, such as the screw blower and the high-speed gearless turbo blower, are more recent introductions to the wastewater treatment field. New control technologies, such as Variable Frequency Drives (VFDs), have provided additional opportunities for ECMs with any blower technology.

These opportunities for energy savings are supported by the utility incentive programs. Many pay up to 50% of the cost of new equipment and installation. Some programs will also help pay for engineering evaluation and design of upgrades.

Measurement of existing blower performance and baseline specific power establishes the potential incentive for a blower replacement. That typically requires field measurement of the critical blower performance parameters: flow, pressure, inlet temperature, and power.

The Challenge

Field measurement of airflow is usually challenging. Accurate flow measurement requires a uniform velocity profile across the diameter of the pipe. The presence of valves and fittings creates distortion in the velocity profile. The compact arrangement of the piping system in most blower rooms decreases accuracy. Flow straighteners may help but are often inadequate in compensating for existing piping arrangements. Few existing blower installations have accurate flow measurement available.

Measuring Blower Airflow in the Field

On the other hand, accurate temperature and pressure measurements are straightforward and can be accomplished with simple and inexpensive instruments. A simple pipe tap and fittings are all that is required to insert the instruments into the pipe, and instrument location is not critical. Measuring electric power is also straightforward. If permanent submetering equipment is not available power measurement can be accomplished by qualified personnel with portable instruments and clamp on connections.

Note that regardless of flow measurement method, determination of blower system power is necessary for ECM measurement and verification procedures.

Alternate Methods

There are several alternate methods for determining airflow that can replace direct measurement. These methods may be applicable to only specific blower types or control methods.

Positive Displacement (PD) blowers with known displacement and slip characteristics can use blower speed to estimate inlet volumetric flow. There are some inaccuracies with this method: slip rpm changes with discharge pressure and wear, and the relationship between inlet cubic feet per minute (icfm) and ambient or discharge airflow is affected by pressure drop through filters and silencers. Still, this method provides adequate accuracy for many applications.

Throttled centrifugal blowers often include a "calibrated" ammeter. This uses the correlation between flow and motor amperage to approximate inlet airflow rate. This method is subject to inaccuracy when motor voltage or inlet air temperature changes. This method is not suitable for blowers using variable speed or guide vane control.

Another Solution

A method based on simple measurements and thermodynamics has been used for many years to accurately determine airflow. Power draw, inlet and discharge temperature, and inlet and discharge pressure are used in conjunction with fundamental thermodynamic equations to determine flow. (See Figure 1.)

The calculation is performed in two parts. First, the efficiency of the bare blower is determined:

$$X_{AD} = \left(\frac{p_d}{p_i}\right)^{\frac{k-1}{k}} - 1$$

$$\eta_B = \frac{X_{AD} \cdot T_i}{T_d - T_i}$$

Where:
X_{AD} = Adiabatic factor, dimensionless.
p_d = Absolute discharge pressure, psia.
p_i = Absolute inlet pressure, psia.
k = ratio of specific heats, C_p/C_v, dimensionless, ≈1.395.
η_B = efficiency of bare blower, decimal.
T_d = Absolute discharge temperature, °R = °F + 460.
T_i = Absolute inlet temperature, °R = °F + 460.

The ratio of specific heats, k, is equal to 1.395 for perfect diatomic gases. For air, k varies slightly with temperature and relative humidity. Exact relationships are available in many sources, including ASME PTC 13, but in all but the most extreme cases only minor errors are introduced by using k = 1.395.

Inlet and discharge pressure may be measured directly using absolute pressure transmitters. It is more common to measure gauge pressure on the discharge of the blower. On the inlet side suction measurement identifies the pressure drop through inlet filters and piping. Barometric pressure is used to determine the absolute pressures.

$$p_d = p_{bar} + p_{gauge}$$

$$p_i = p_{bar} - \Delta p_{filter}$$

Where:
p_{bar} = site barometric pressure, psia.
p_{gauge} = discharge pressure, psig.
Δp_{filter} = inlet filter and pressure drop, psig.

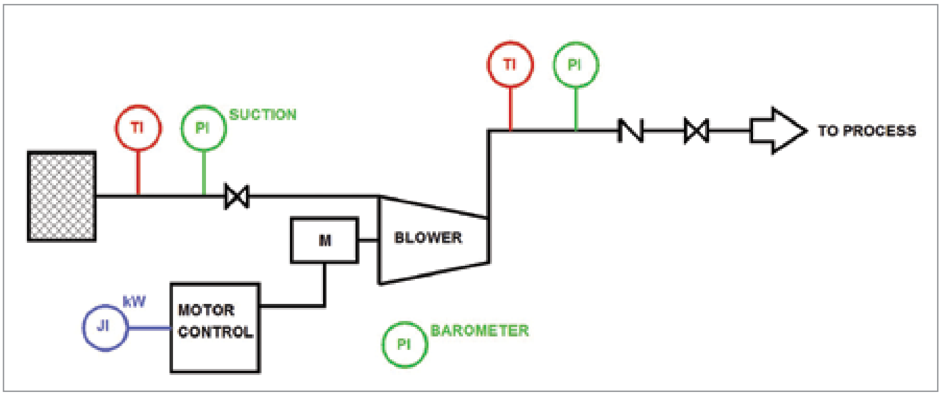

Figure 1: Example measurement system.

Barometric pressure is not a constant. It varies slightly with weather conditions and dramatically with site elevation. The average site barometric pressure can be calculated if the elevation is known.

$$p_{bar} = 14.7 - \frac{Elev}{2000}$$

Where:
Elev = site elevation, ft above sea level.

Weather conditions will cause some deviations in barometric pressure. The range is less than plus or minus 0.5 psi, even for extreme weather conditions. The variation is commonly less than plus or minus 0.25 psi.

It is possible to obtain the current barometric pressure reading from a weather station or barometer. However, most barometric readings include an adjustment so that the reading is equivalent to sea level readings. This permits direct comparison between different locations. Before using a barometer reading it should be determined if a correction has been used. If so, the appropriate value for site elevation should be applied.

Blower power draw is necessary to calculate the flow rate. Actual shaft power is difficult to measure, so generally the motor power draw is measured and the shaft power calculated from it.

$$P_B = \frac{P_E \cdot \eta_m}{0.746} - P_L$$

Where:
P_B = blower shaft power, bhp.
η_m = motor efficiency, decimal.
P_L = blower mechanical losses, hp

Blower mechanical losses from bearings, gears, lube systems, etc. are typically between one and three percent of motor power.

Three phase power measurement is not always available. In that case the electric power draw may be calculated from measured voltage and current.

$$P_E = \frac{I \cdot V \cdot 1.73 \cdot PF}{1000}$$

Where:
I = measured motor current draw, Amp, average of three phases.
V = measured motor voltage, Volts, average of three phases.
PF = motor power factor, decimal.

Motor nameplates generally include the full load motor efficiency and power factor. These values vary across the motor's power range but are nearly constant above 50% power. Values at various power draws are available from

Measuring Blower Airflow in the Field

motor data tables and should be used if available.

The final step is calculating the blower volumetric airflow.

$$q_{v,i} = \frac{\eta_B \cdot P_B}{p_i \cdot X_{AD} \cdot 0.01542}$$

Where:
$q_{v,i}$ = volumetric airflow rate, cfm (ft^3/minute).

The measured data can be used to calculate the equivalent scfm airflow at standard conditions by ignoring relative humidity.

$$q_{std} = q_{v,i} \cdot \frac{p_i \cdot 35.92}{T_i}$$

This method is similar to the widely accepted thermodynamic pump testing method identified in ISO 5198. Because the temperature rise from compressing air is much larger than the typical temperature rise in pumps the method is actually easier to implement with blowers. Accuracy of the flow value depends on the accuracy of the input data, of course, but the accuracy of this method exceeds flow meter accuracy when installation conditions are marginal.

Some precautions should be taken when the system is used for real time airflow measurement and blower control. During the time immediately following starting of a blower the temperature of the impellers and case have not stabilized. This affects the discharge air temperature and efficiency calculations. The calculated efficiency should be clamped (limited) to reasonable maximum and minimum values. This will prevent gross inaccuracy in the flow calculation. Similarly all measured values should be range checked and the blower should be stopped if signals are lost or outside reasonable ranges.

Accurate Airflow Rates

Utility incentives are based on energy savings. The energy consumption of a blower system is never constant, since flowrate and pressure and temperature are all continuously varying. In order to compare before and after energy consumption, or to compare the consumption of alternate blowers, it is common to use specific power.

Flow meter technology can be very advanced, and if proper installation techniques are used accuracy can be excellent. However, space restrictions often necessitate compromises that negate the inherent meter accuracy. It is often required to obtain measurements on existing installations that do not have flow meters installed. In these situations the thermodynamic testing method can provide accurate airflow rates using simple, inexpensive instruments. The method is suitable to portable devices and temporary instrument installations for ECM measurement and verification as well as real time control applications. BP

About the Authors

For 25 years, John Conover has worked in the field of compressors and blowers domestically and internationally. He's an expert in sales, sales management, product and business development, and marketing. John is a Regional Sales Manager for Tamturbo Inc., manufacturers of "touchless", high-speed, permanent magnet compressors. For more information, visit www.tamturbo.com.

Tom Jenkins has over forty years' experience in blowers and blower applications. As an inventor and entrepreneur he has pioneered many innovations in aeration and blower control. He is an Adjunct Professor at the University of Wisconsin, Madison. For more information, visit www.jentechinc.com.

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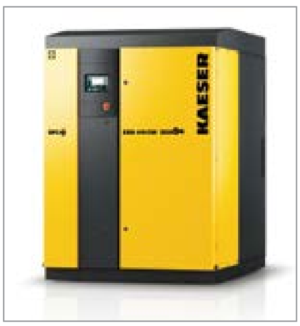
BLOWER & VACUUM INDUSTRY & TECHNOLOGY NEWS

Kaeser EBS Rotary Screw Blower

Kaeser announced the latest in EBS rotary screw blower packages. The new energy efficient EBS 410 series in 30-100 hp models expands the gear-driven range of blowers and provides up to 1448 cfm with pressures from 4 to 15 psig. With this new model, Kaeser now offers our innovative screw blower technology to an even wider range of applications with up to 35% more efficiency than conventional packages. Kaeser screw blowers are ideal for municipal and industrial wastewater, flotation, fluidization, and other low pressure applications where energy efficiency is critical. EBS blowers feature the renowned Sigma Profile airend and high efficiency gear drive technology. They are available in both STC (wye-delta start) and SFC (variable frequency drive) for superior energy performance – and unsurpassed reliability.



Kaeser Compressors, us.kaeser.com

Busch COBRA NX 0950 A PLUS Oil-Free Pump

Busch Vacuum Solutions has now launched the COBRA NX 0950 A PLUS, the second vacuum pump in the new PLUS series. It is a dry, oil-free vacuum pump, which can run with pressure control or at a constant rotational speed, making it exceptionally energy-efficient. The COBRA PLUS can thus precisely maintain the desired pumping speed at a prescribed rotational speed. It can also accurately sustain the required vacuum level, regardless of how the process conditions change. The new COBRA PLUS has a wide range of use in applications where dry vacuum technology is required, where an independent and demand-driven control system is desired and where vacuum is to be generated reliably and thus efficiently. Thanks to its variable speed drive, the vacuum pump covers a pumping speed range from 200 to 950 cubic meters per hour and reaches an ultimate pressure of 0.01 millibar.

Busch Vacuum Solutions, www.buschusa.com

Inovair IM-20 Geared Centrifugal Blower

Inovair is in volume production for the latest addition to the IM blower product family. The low profile, vertical inlet, and small footprint make the IM-20 ideal for replacing less efficient blower technologies and has shown documented energy savings as high as 45%. The IM-20 was developed with size and efficiency in mind and is available in (30-125 HP) versions. This blower's compact architecture allows it to fit through a standard 36-inch man door and be placed on most existing blower pads without modification. The vertical discharge and low profile simplify installation by allowing placement in the same location as a previous blower with minimal piping modifications. Built with Inovair's proven reliable gear case, with 99% available up-time over the past decade, the IM-20 is designed for flows as high as 2800 SCFM and pressures up to 22 psig. The Inovair IM-20 is ideal in any application where reliability and efficiency are desired.

Inovair, www.inovair.com

Ingersoll Rand Acquires Tuthill

Ingersoll Rand Inc., a global provider of mission-critical flow creation and industrial solutions, has entered into an agreement to acquire the assets of Tuthill Vacuum and Blower Systems. The all-cash transaction, valued at $184 million, is expected to close Q1 or earlier upon obtaining required regulatory approvals and necessary third-party consents.

"We are excited to welcome the Tuthill Vacuum and Blower Systems team to the Ingersoll Rand family. This transaction delivers on our commitment to significantly accelerate our growth plan and demonstrates our ability to seek out premium and iconic industrial brands with strong complementary technology and commercial growth opportunities," said Vicente Reynal, chief executive officer of Ingersoll Rand.

Ingersoll Rand Inc., www.IRCO.com

BLOWER & VACUUM INDUSTRY & TECHNOLOGY NEWS

Pfeiffer Vacuum Expands HiLobe Line

Pfeiffer Vacuum, one of the world's leading providers of vacuum technology, has expanded its HiLobe series. These Roots pumps are available in a broad spectrum of pumping speeds and applications. The innovative pumps can be used for numerous industrial vacuum applications, including electron beam welding, vacuum furnaces and freeze drying. HiLobe Roots pumps are particularly suited for rapid evacuations (lock chambers or leak detection systems) and as well for general coating applications. With their individual speed control, these vacuum pumps can be adapted to customer-specific requirements. Compact Roots pumps handle a wide range of nominal pumping speeds up to 6,200 m^3/h. Thanks to their powerful drive concept, they achieve around 20% shorter pump-down times than conventional Roots pumps. Rapid evacuation also saves costs and increases the efficiency of production systems. The HiLobe series boasts an over 50% reduction in maintenance and energy costs compared to conventional Roots pumps.

Pfeiffer Vacuum, www.pfeiffer-vacuum.com

Atlas Copco Acquires Vacuum Distributor

Atlas Copco has agreed to acquire Ehrler and Beck GmbH. The company is a distributor of vacuum equipment and vacuum services. Ehrler and Beck is based in Renningen, Germany and has 15 employees. The company's sales and service network is active in Germany and neighboring countries. "This acquisition will increase our possibilities to serve Germany and neighboring countries with industrial vacuum products and services," said Geert Follens, Business Area President Vacuum Technique. "Ehrler and Beck has a strong reputation and long tradition of serving diverse industrial markets such as packaging, printing, wood working, plastic and water treatment."

Atlas Copco Group, www.atlascopcogroup.com

Sulzer to Acquire Nordic Water

Sulzer AG has signed a binding agreement to acquire Nordic Water for a purchase price of SEK 1.2bn. Nordic Water is a leading provider of screening, sedimentation, and filtration solutions for municipal and industrial water & wastewater applications. The acquisition strengthens Sulzer's wastewater treatment offering by complementing its equipment portfolio and provides further access to the fast-growing clean water market. Nordic Water, headquartered in Gothenburg, Sweden, employs 200 people at 13 sites in 6 countries. In 2021, it is expected to achieve sales of around SEK 750m and an EBITDA of SEK 118m. Nordic Water is a pioneering innovation leader and is known for its broad application suite in primary, secondary, and tertiary water treatment as well as its global reach. The company has a fast growing and recurring aftermarket business providing a complete offering of parts and services to a large installed base built up over the last 59 years.

Sulzer, www.sulzer.com

Edwards Vacuum Service Provider for Stokes

Edwards Vacuum announced that it has proudly partnered with Innovative Vacuum Solutions as the newly Authorized Service Provider for Stokes vacuum equipment. With decades of Stokes service experience and four service centers located near Edwards' valued customers, IVS provides the additional reach and bandwidth to look after the maintenance and overhaul of one of the oldest and most trusted industrial vacuum brands. Stokes was founded in 1895 and was instrumental in the development of vacuum technology. From its Vacuum Dryer launch in 1907, through the first Piston Pump that debuted in 1903, and onto its star Microvac line that was released in the 1950s, 60s and 90s, its products have stood the test of time. Edwards acquired the brand in 2001 and has continued to expand the Stokes brand in the US with the opening of a Service Center in Glenwillow, Ohio in 2014 and an investment in a Southern California service facility in 2017 which ultimately led to a new Authorized Service Partner for Stokes, in Innovative Vacuum Solutions.

Edwards, www.edwardsvacuum.com

BLOWER & VACUUM INDUSTRY & TECHNOLOGY NEWS

Mapro Centrifugal Blowers in Thailand

Instead of anaerobic digester mixing propellers, MAPRO RF Rotary Vane Compressors were chosen to inject 100 m^3/h at 1.3 bar (60 CFM at 18.6 PSI) recirculating air/gas. When mixing digester liquor through a more uniform distribution of flow into blind areas a propeller does not reach, this results in lower energy consumption, lower maintenance, higher reliability, lower corrosion, and better system efficiency.

The MAPRO CM multistage Centrifugal Blowers were chosen over PD Blower technology to feed 2200 m^3/h at 250 mbar (1294 CFM at 3.6 PSI) gas motors. This resulted in lower maintenance, easy access to seal replacement, fewer spare parts required, higher flow flexibility, forced ventilation on the electric motor not required, no sparking materials, higher tolerance on handling condensates, higher reliability due to Aluminum impellers, and low risk of seizure. Anticorrosive treatments are also available.

Mapro International, www.maproint.com

Leybold CLAWVAC Dry Rough Vacuum Pump

Especially for rough industrial processes Leybold introduces the uncomplicated, dry rough vacuum CLAWVAC pump. Besides food processing, packaging, and environmental technology applications, it is suitable for drying and sterilization processes. The pump, which is offered in three pumping speed classes, is specially designed for continuous operation at every working pressures. Additionally, the special pump design avoids that oil meets pumped gases, what allows higher Oxygen applications. At the same moment, Leybold also offers with the CLAWVAC System series a new multiple pump system. These systems are based on CLAWVAC and offer a redundant plug-and-play solution. The daily use of CLAWVAC is uncomplicated: Thanks to the self-supporting construction, the vacuum generator is easily accessible. What allows to directly clean the pump on-site. The simple handling of the robust pump can also be attributed to its operating principle: A pair of claw rotors rotating in the pump stator completely free of contact and wear.

Leybold, www.leybold.com

Exair Larger 303SS Air Conveyor

EXAIR's new Type 303 Stainless Steel 3 NPT Threaded Line Vac Air Operated Conveyors convert ordinary pipe into a powerful conveying system for parts, scrap, trim and other bulk materials. This chemical and corrosion resistant Line Vac operates seamlessly at higher temperatures providing a long-lasting and low maintenance solution ideal for food, chemical, pharmaceutical, and medical processes. The durable construction of the Threaded Line Vac employs a larger inside diameter, aiding in conveying bigger parts and larger volumes of material over long distances with ease. In addition, it is designed for simple attachment to standard plumbing pipe couplers in order to take advantage of common pipes and fittings that are readily available. Threaded Line Vac Conveyors utilize minimal amounts of compressed air to generate an instant and powerful vacuum on one end, with high output flows on the other.

Exair, www.exair.com

Piab piSOFTGRIP 50-2

Piab once again extends the piSOFTGRIP family with a new pinch gripper developed for the automation of the food/chocolate industry. The vacuum-based soft gripper can grip sensitive and lightweight oblong objects with odd geometries and/or objects with an unusual surface. piSOFTGRIP has two gripping fingers and a sealed vacuum cavity, all made in one piece, resulting in a simple and robust product. The product is not sensitive to dust and the gripping force is easily adjusted and controlled by the applied vacuum level. The gripper can easily be put in rows (multiple mode) to support picks of extended objects. piSOFTGRIP is made from silicone which is approved for direct contact with food (in accordance with FDA 21 CFR and EU 1935/2004 regulations).

Piab, www.piab.com

BLOWER & VACUUM INDUSTRY & TECHNOLOGY NEWS

Brown and Caldwell New Pittsburgh Leader

Leading environmental engineering and construction firm Brown and Caldwell is pleased to welcome Heather Dodson as its new Pittsburgh leader. The strategic hire highlights the firm's continued expansion to better serve clients in the Northeast's municipal and private water, wastewater, and stormwater sector. With 17 years of extensive experience in water, wastewater, and stormwater management design and permitting, land development, and municipal engineering, Dodson brings a wealth of knowledge and technical expertise to the Commonwealth of Pennsylvania and the Northeast's most complex water and environmental challenges. As Pittsburgh leader, Dodson is responsible for operations management, providing exceptional client service, and expanding Brown and Caldwell's regional presence and talent pool to meet market and customer needs. She will provide marketing and technical leadership during the procurement and quality delivery of impactful water, wastewater, and stormwater projects the firm is renowned for in the environmental market.

Brown and Caldwell, www.brownandcaldwell.com

Cummins-Wagner Acquires FRMA

Cummins-Wagner Co., Inc., a leading distributor of municipal water & wastewater equipment, industrial process equipment and HVAC equipment in the mid-Atlantic region, is pleased to announce they have finalized the acquisition of F.R. Mahony & Associates, Inc. ("FRMA"). FRMA, headquartered in Rockland, MA is recognized as a leading manufacturer's representative/distributor in water & wastewater markets in New England. FRMA specializes in small wastewater systems from single family homes to large systems for commercial and municipal projects. Their featured product is the Amphidrome process that provides the highest degree of nitrogen removal available. This transaction is a key part of Cummins-Wagner's business strategy of steady, manageable growth through market penetration and acquisition. "The combination of Cummins-Wagner and FRMA creates a Company with greater scale and resources to continue and expand our ability to provide experienced engineered sales & service in water and wastewater treatment applications," said Doug Ardinger, President/CEO of Cummins-Wagner.

Cummins-Wagner, www.cummins-wagner.com.

Lontra Signs to Begin U.S. Distribution

Lontra announced an agreement has been signed with Blade Compressors® LLC, a division of Industrial Air Centers with headquarters in Jeffersonville, Indiana (USA), to be the National Distributor for Lontra Blade Compressors® and forthcoming Lontra products and services in North America. This agreement signifies the start of Lontra's distribution journey, bringing their novel technology package (the LP2 Blade Compressor®) to industry on a global scale. The package is by design a very robust unit. George Burch, C.E.O. of Industrial Air Centers said, "We strongly believe the Lontra Blade Compressor will change the blower market in the USA with its unique combination of excellent reliability and high efficiency in a modern and well-designed package. Based on industry statistical data it is estimated that the market for machines in which the LP2 blower will compete in is approximately 85,000 units per year in the USA and growing."

Lontra, www.lontra.co.uk

Xylem Sanitaire Digital Pressure Monitor

Xylem, the leader in biological wastewater treatment technologies, is introducing its new Sanitaire Digital Pressure Monitor (DPM) to transform wastewater diffusers into smart diffusers. The Sanitaire DPM maximizes diffuser operation and increases energy savings through strategic fine-bubble aeration system monitoring and intelligence. The solution offers users an enhanced digital interface that provides diffuser health data, engineering and economic calculations, and asset management recommendations. Aeration at a wastewater treatment plant is typically the largest single line item in a wastewater plant's operations budget. In today's economy, many utilities are seeking ways to reduce operating costs while maintaining treatment compliance. Sanitaire's new DPM empowers utilities with a digital solution that intelligently monitors and manages their aeration systems.

Xylem, www.xylem.com

THE MARKETPLACE

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www.blowervacuumbestpractices.com

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Howden Roots	9	https://www.howden.com/en-gb/products/blowers
Inovair	11	https://inovair.com
Busch Vacuum Pumps and Systems	13	https://www.buschvacuum.com/us/en/
Best Practices 2021 Expo & Conference	17	https://cabpexpo.com

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Reach 16,000+ readers of Compressed Air Best Practices® Magazine with Marketplace Ads every month! Job Marketplace ads are also placed for one month on www.airbestpractices.com and promoted in our three monthly e-newsletters.

Ad dimensions are 2.36" wide x 3.91" tall. We can help you design the ads. Send us your logo, product photo, and text to rod@airbestpractices.com. We recommend 20-50 total words of text.

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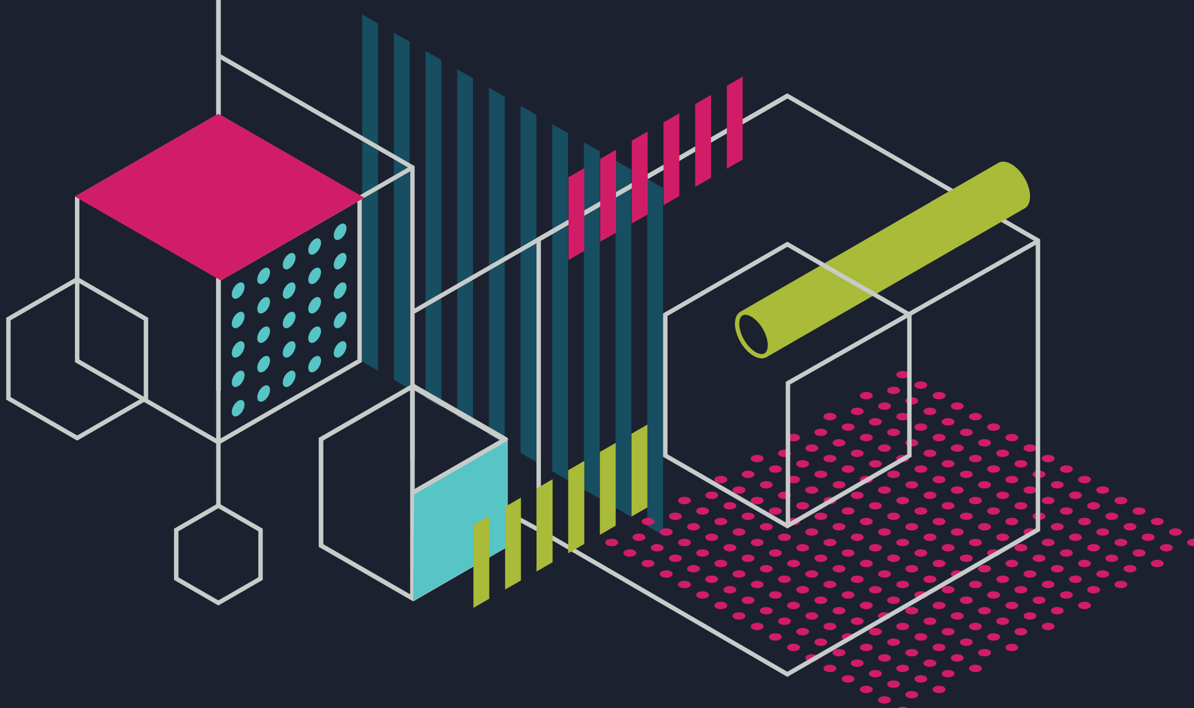


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