The Magazine for ENERGY EFFICIENCY in Blower and Vacuum Systems

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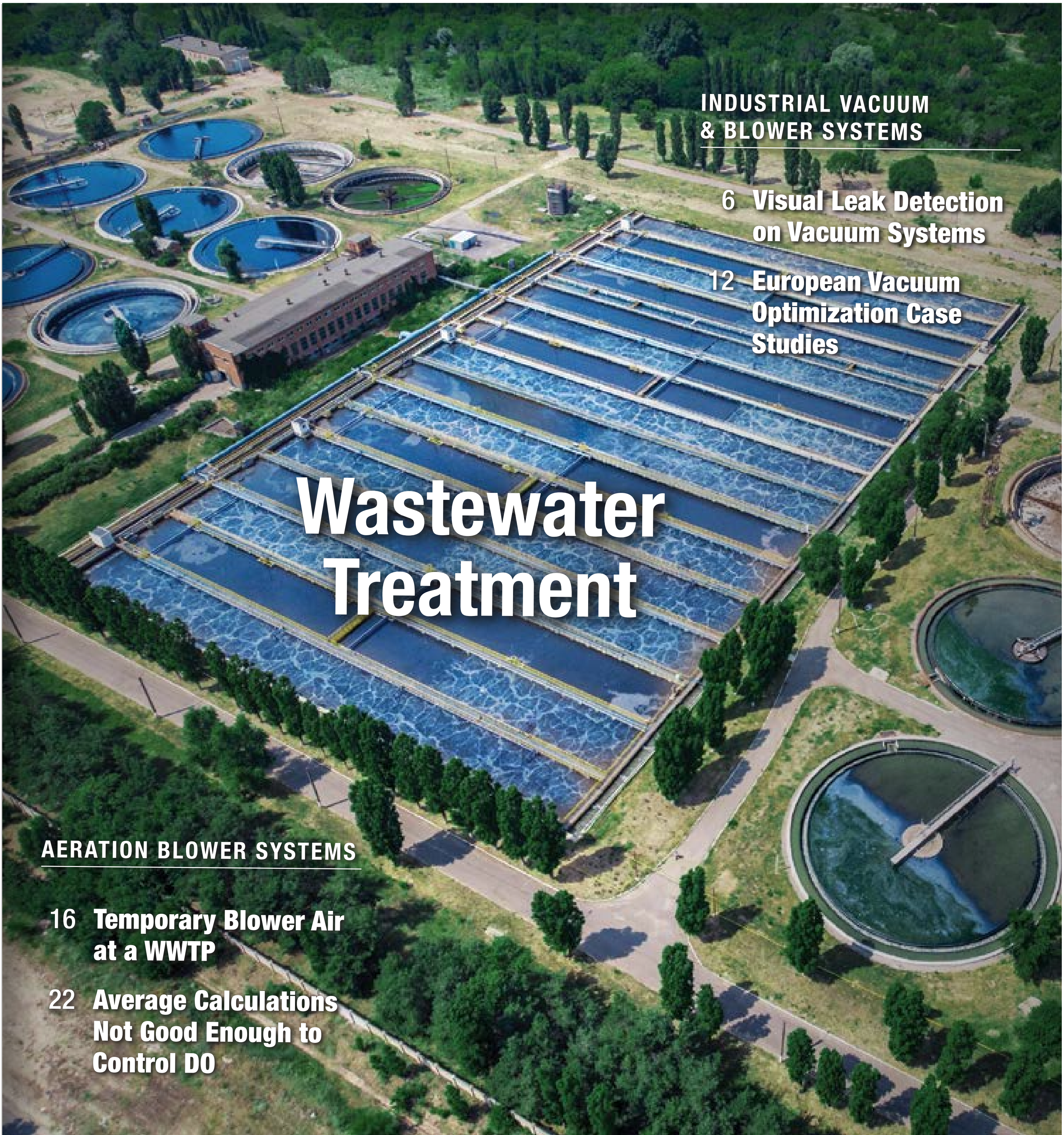
October 2021



Wastewater Treatment

INDUSTRIAL VACUUM & BLOWER SYSTEMS

AERATION BLOWER SYSTEMS

EVERY ISSUE

FROM THE EDITOR

Industrial Vacuum & Blower Systems

Industrial vacuum systems are receiving more attention from system optimization experts. Ron Marshall has sent us an excellent article about a vacuum system assessment at an envelope manufacturer. The article focuses on how leak detection, using visual imaging, was an important part of the audit and helped improve the energy efficiency of the four 75 horsepower rotary screw vacuum pumps installed.

Vacuum system optimization can reduce water consumption as well as energy consumption. We are thankful for Uli Merkel's European case studies, about the exciting results Busch Vacuum Solutions projects have provided for Rheinfelsquellen (a leader in mineral water brands) and for Vinzenz Murr (a leader in packaged meats).

Aeration Blower Systems

Wastewater treatment plants can face situations where there is a temporary surge in demand for aeration. Matt Piedmonte and Scott Werner, from Aerzen Rental USA, have sent in an interesting application story about the economics justifying the use of temporary blowers to help a plant meet a temporary demand for 7000 cfm at 6.8 psig (0.46 bar).

Get out your calculators! "Controlling DO: A Good Average Isn't Good Enough" is the title of our latest article from Tom Jenkins, from JenTech Inc. This challenging article examines several causes for fluctuating dissolved oxygen (DO) levels. You can also hear Mr. Jenkins make a presentation on this topic by visiting our Webinar Archive pages at https://www.blowervacuumbestpractices.com/magazine/webinars

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Visual Leak Detection on Vacuum Systems

By Ron Marshall, Marshall Compressed Air Consulting

Vacuum consumption during peak production requires all four of these screw type vacuum pumps.

An envelope manufacturer is upgrading their vacuum system to include a new VSD controlled pump. As part of the preparation for the installation, an energy baseline was developed, and leakage survey conducted. The auditor used a newly developed acoustic imaging camera as well as a basic ultrasonic leak detector gun. This article describes what was found and some of the challenges faced in detecting leaks in a busy plant.

Background

The facility has a vacuum system consisting of four, 75-horsepower (hp) air-cooled lubricated screw type pumps (Figure 1) rated at about 1,000 acfm each. The pumps are controlled individually with local pressure switches; however, the control of these devices is more or less manual, with personnel being trained through experience that they need to turn on more or less pumps depending on what manufacturing machines are running at any one time.

Baseline

Data loggers were placed on the system to measure vacuum levels and pump amps. Figure 2 shows the operating profile for a one-week period. The measurement determined the vacuum system was consuming about 870,000 kWh per year, costing about $70,000 per year in electrical cost.

It is interesting to note that the compressed air system consumption, which was measured at the same time, consumed 3.5 times less power. We can see by examining Figure 2 that the vacuum level is highly variable due to the manual control, swinging from a high of 26 inches Hg to a low of 16.5 inches. Surveys of the production machinery set a desired vacuum level of between 18 and 20 inches. Average level was measured at 23.5 inches, much higher than needed, causing greatly increased energy consumption.

The measurements were done to capture a baseline before a 100 hp variable speed drive vacuum pump is installed. The company anticipates a 30% reduction in energy consumption will be achieved with this change. However, extra savings can be gained if various vacuum leaks can be located and repaired. The goal is to find enough leakage so that one 75 hp vacuum pump can be turned off during peak production.

Ultrasonic Leak Detection

A leakage survey of the plant was done using ultrasonic leak detection. The plant ambient noise level is very high due to the operating characteristics of the production machinery, so leaks cannot easily be located by ear. Ultrasonic leakage detection is very commonly used on compressed air systems but can also be used to find leaks on vacuum systems.

Ultrasonic leak detection has been around for many years. From the start, equipment suppliers realized that the human ear detection has huge limitations, especially in very noisy industrial settings. Loud background noise and other compressed air uses in typical industrial plants can very quickly mask any audible sound emitted by leaks, making the hunt an almost impossible task, even during quiet times during evenings and weekends.

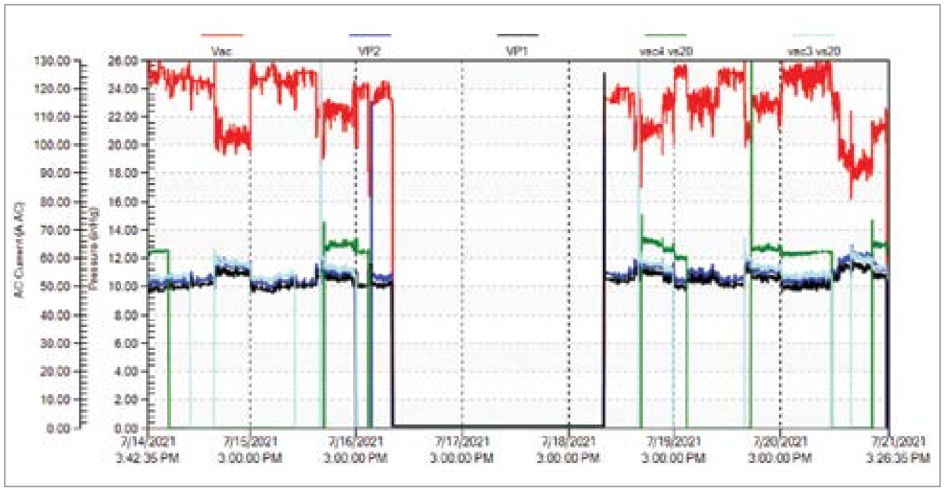
Long ago it was discovered that a flow of gas moving from one pressure to another emits sound in the ultrasonic frequency spectrum. Using electronic mixing circuits this ultrasonic signature can be brought down to a frequency range that humans can hear, but at the same time general low frequency industrial noise can be filtered out. This gives ultrasonic detector operators "superhuman" hearing that allows gas leaks, including vacuum to be easily heard in noisy factory environments, even from hundreds of feet away.

Detection using ultrasonic guns typically uses a "point and shoot" method, where a directional audible pick-up device is waved around until something is heard in a certain direction. The operator then follows

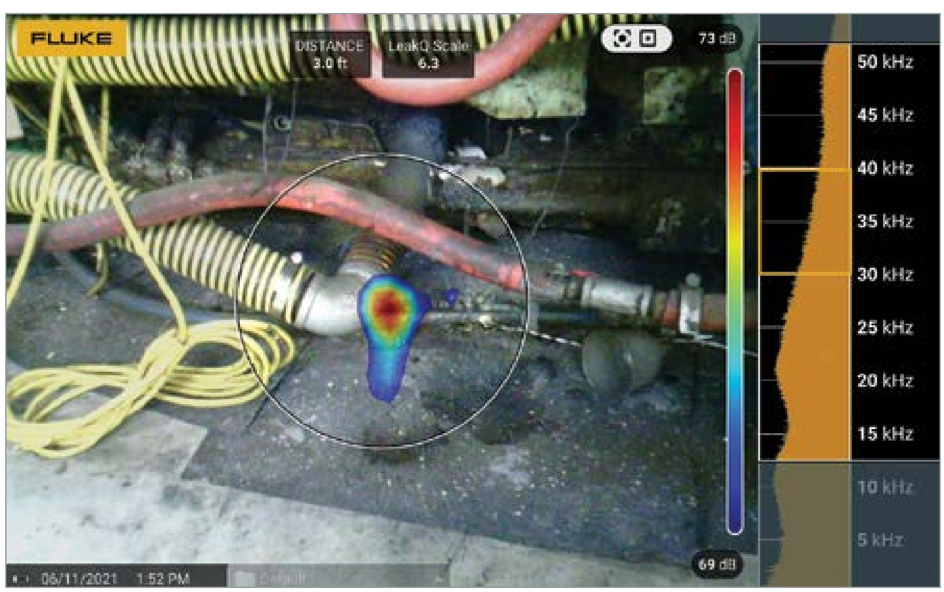
Visual Leak Detection on Vacuum Systems

the sound, with the signal getting louder and louder as the detector approaches the source. Sometimes, when very near the leak, it is difficult to pinpoint the exact location due to various factors. At times the leakage may be behind a protective barrier or up in an inaccessible location. Other times the leak might be in in a complex network of piping and hoses, requiring the operator to attempt to feel for the leakage within the many fittings, sometimes creating a safety risk.

A new, more efficient way of finding and recording leaks has recently been developed



Profile showing highly variable vacuum level due to poor control. This causes the system to consume much more energy than required.



Profile of a Fluke acoustic imager showing large vacuum leak on production machine. The compression connector was only hand tight in this case, but the vacuum force held it onto the machine.

by various instrument manufacturers. This "visual imager" method uses a video camera to provide a live image, and an array of different directional microphones to create a "heat map" of ultrasonic emissions on top of the visual display (Figure 3). This device brings new meaning to the old saying "a picture is worth a thousand words", producing an image representing both visual and audible signatures emitted by a leak, making the detection exercise a very much easier task.

When using an imager, the operator also "points and shoots", but in this case the ultrasonic emission shows up as a live feed on the onboard video screen as a colored spot, making the location identification much quicker. As the operator gets closer to the leak, the location becomes easier to identify, even when shooting through protective screens or pointing at locations out of reach in piping installed at ceiling level.

When shooting amongst other ultrasonic emitters, like a bench full of active compressed air powered tools, the leakage shows up as a consistent spot on the screen, with the tools being intermittent, so it is easy to differentiate.

Hunt for Vacuum Leaks – Challenges

Leaks on both compressed air and vacuum systems were located in the envelope plant using both an ultrasonic gun and a visual imager. The leakage detection was done both during production, when most machines were running, and at non-production times, when production was at low level during the evening.

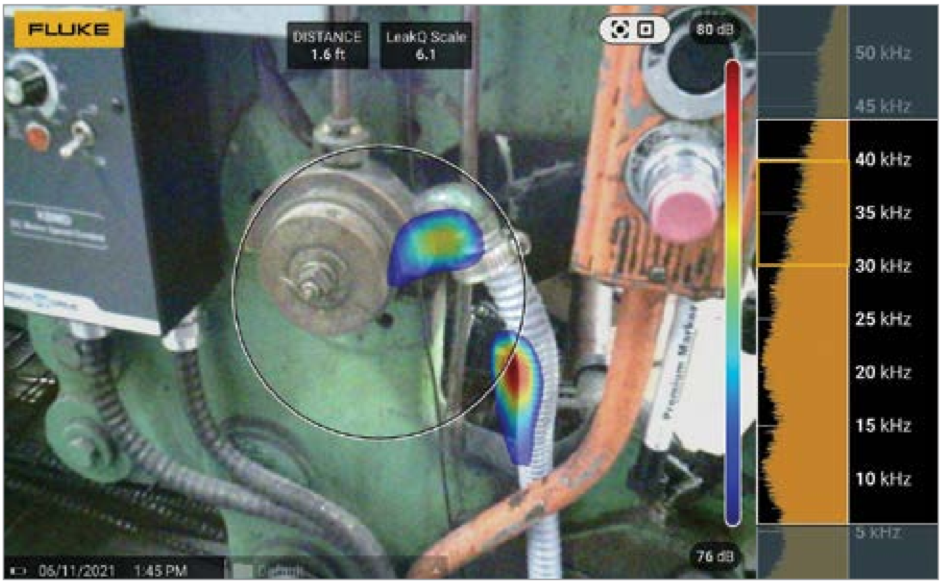
By far the most challenging time to locate leaks was during production times. The main difficulty was the fact that there are so many ultrasonic emitters in a busy plant. These are:

- Compressed air leaks and internal compressed air usage
- Vacuum leaks and internal vacuum usage
- Cooling fan blades
- Air intake from scrap collection system (low pressure vacuum pick up)

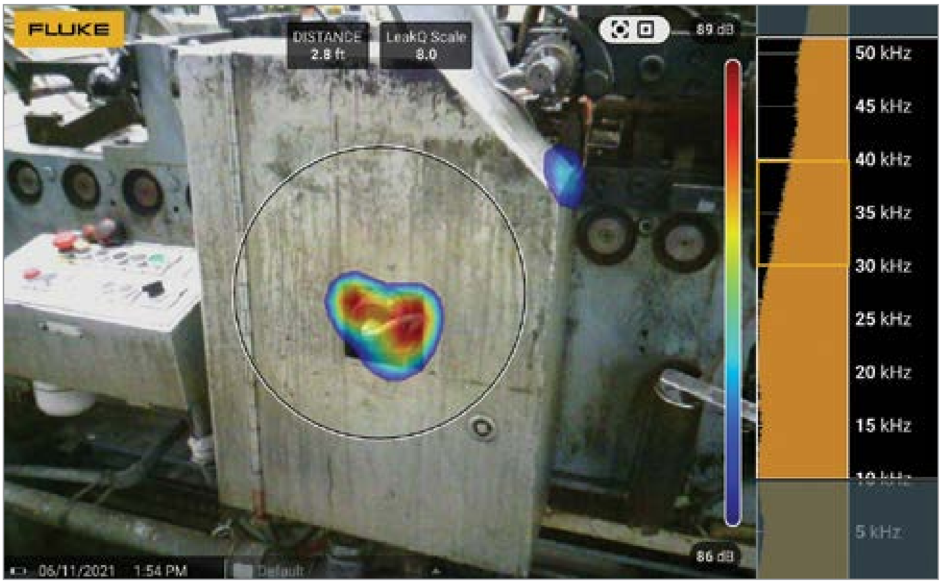
The visual imager needs line of site access to any leakage, so it was found we needed to use an ultrasonic gun to locate the general area of the leak, which might be behind cover or at the rear of a machine, and then use the imager to find the precise location. By examining the visual image, the type of leak could be determined, so we could classify it as compressed air or vacuum, or some other noisy emitter. Detecting waste due to leakage during production was definitely challenging because normal compressed air consumption within the production machines also emits an ultrasonic signal.

During non-production hours the hunt for leaks was found to be much easier, with internal compressed air and vacuum uses turned off, only the leakage remained, and was easily detected. Some challenges remained, however, due to reflections. This is an issue for both the leak detection gun and the imager, sound bouncing off the surface of a component or wall can sound and look like a leak in a completely opposite direction

Visual Leak Detection on Vacuum Systems



As with Figure 3, this connection was very loose. The colored spot on the lower part of the image from the Fluke acoustic imager is simply a reflection of the sonic signal from the leak above. This is easily resolved by moving the camera and observing which source remains fixed.



This image from the Fluke acoustic imager shows a large ultrasonic signal that turned out to be a legitimate low-pressure intake for a scrap paper collector.

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(Figure 4) but is a false signal. Of the two detection methods, the imager was the easiest to use to resolve the issue, simply by moving the camera from side to side, the reflections could be discounted.

Another difficulty, commonly a problem when detecting leakage, is low pressure ventilation. As seen in Figure 5, the visual detector is showing a large ultrasonic signal coming from a port within a machine, however, this source was determined to be a fan powered suction pickup used to collect paper scraps, not a leak.

In all, the leak detection exercise found 15 significant leaks in the vacuum system and about 30 leaks in the compressed air system. Once all these are repaired it is anticipated it will result in about $8,000 per year in energy savings. Further savings will be gained by better controlling the vacuum system with VSD control, estimated at $26,000 per year.

Conclusions

Monitoring the vacuum system with data loggers helps determine the baseline for this system, which consumes, in this case, much more than the plant compressed air system. This baseline can be used by the customer to prove electrical savings to gain a significant utility incentive. Use of both ultrasonic gun and visual imager helps track down hard to find leaks and is especially effective if done during non-production periods. BP

About the Author

Ron Marshall is an experienced compressed air and vacuum energy auditor, technical writer, and Compressed Air Challenge trainer. He can be reached at email:ronm@marshallcac.com, tel: 204-806-2085, www.compressedairaudit.com

Two Vacuum System Optimization Case Studies from Europe

By Uli Merkel, Busch Vacuum Solutions

Figure 1. Degassing tank (center of picture) at one of the filling plants at Rheinfelsquellen.

Case Study #1: Enormous Savings in Water Consumption with Modern Vacuum Technology

Sustainability and environmental protection are not just words to Rheinfelsquellen H. Hövelmann GmbH & Co. KG but, as one of Germany's largest private wells, a genuine concern. This is demonstrated, for example, by the DIN ISO 50001 energy management system already introduced in 2012 and the DIN ISO 14001 certification of the environmental management system. Saving resources is thus a high priority at Rheinfelsquellen, which was just one of the reasons for drastically reducing the consumption of water from the municipal water supply.

By using state-of-the-art vacuum technology for degassing mineral water, it has been possible to save an average of 3,000 cubic meters of water per filling plant per year. The solution was to replace the existing liquid ring vacuum pumps with MINK claw vacuum pumps from Busch Vacuum Solutions.

The roots of Rheinfelsquellen go back to 1905. The family-run business has developed into one of Germany's largest private wells, and the owners are the fourth generation of the family to run the company. Around 700 million liters of mineral water and other non-alcoholic beverages are produced each year. The product range includes the Sinalco, Aquintel and Staatl. Fachingen brands, which are sold throughout Germany, as well as brands sold in North Rhine-Westphalia such as Rheinfels Quelle, Römerwall, Burgwallbronn, Ardey Quelle, Urquell and Rheinperle.

Filling takes place at the Duisburg-Walsum site across a total of eight filling plants for returnable and non-returnable PET bottles, glass bottles, and returnable kegs with a total capacity of 210,000 bottles per hour.

Liquid ring vacuum pumps were used at all filling plants for degassing the well water in the degassing tank (Fig. 1). Their operating principle requires water as an operating fluid in order to generate vacuum. This water is drawn from the public water network and then goes into the public sewer system as waste water. The water was fed through the vacuum pumps in a partial circuit.

However, fresh water had to be supplied permanently in order to avoid a rise in the water temperature. This is necessary because the performance of liquid ring vacuum pumps depends on the water temperature. They are technically designed to achieve the highest vacuum level at an operating fluid temperature of 59°F (15°C). The warmer the water in the circuit, the poorer the vacuum. However, a certain vacuum level is required to extract all gases from the well water nebulized in the degassing tank.

Rheinfelsquellen recorded an average water consumption of 3,000 cubic meters per bottling plant per year. The costs for this amounted to an annual average of 10,000 Euro per filling plant. In order to limit or completely avoid this water consumption, the topic of dry vacuum pumps was addressed. Busch Vacuum Solutions' MINK claw vacuum pump seemed to be the perfect solution. This vacuum pump does not require any operating fluid in the compression chamber, so it runs without water – or any other operating fluid.

First, a MINK claw vacuum pump (Fig. 2) was installed in a plant on a trial basis. A liquid separator was installed upstream of it, as it can always happen that small amounts of well water are also suctioned in. This liquid separator prevents water from getting into the vacuum pump. It works completely self-sufficiently. If a certain amount of water has accumulated in it, it empties itself automatically during ongoing operation without affecting the separation performance. This means that the water is degassed completely automatically during three-shift operation on five or six working days per week.

Following the successful operation of the first MINK claw vacuum pump, Rheinfelsquellen has converted three more filling plants to this modern vacuum technology, thus drastically reducing water consumption. MINK claw vacuum pumps are nearly maintenance-free due to their operating fluid-free and contactless operating principle (Fig. 3). A maintenance contract stipulates that all vacuum pumps are checked once a year by a Busch service engineer to ensure that they are functioning properly. In addition, a 24-hour service hotline is available to customers.

Case Study #2: Vacuum Packaging with the Latest Vacuum 4.0 Technology

Vinzenz Murr GmbH has converted its existing central vacuum system to the latest Vacuum 4.0 technology to generate vacuum for packaging processes. The system now uses the latest R5 PLUS vacuum pumps, which are pressure-regulated to keep the vacuum for all packaging machines exactly and permanently at the pre-programmed level – while also being extremely energy efficient.

Vinzenz Murr GmbH has been producing meat and sausage products for almost 120 years *[2020]*. Company founder Vinzenz Murr opened his first butcher shop in Munich

Two Vacuum System Optimization Case Studies from Europe

in 1902. Today, Vinzenz Murr GmbH is not only one of the largest producing butcheries in Munich and southern Bavaria, but with over 2,000 employees also one of the largest employers in the industry. Since 1970, Vinzenz Murr has been producing its meat and sausage products in the Munich district of Obersendling. Products are sold almost exclusively through the 270 branches in Bavaria.

Since 2004, Vinzenz Murr has been using a central vacuum system from Busch Vacuum Solutions to supply vacuum to all the packaging machines in the butchery plant in Obersendling. This central vacuum supply consisted of a vacuum system with three R5 rotary vane vacuum pumps and three vacuum boosters. The vacuum system was operated using a cascade control unit. This means that only as many vacuum pumps were in operation

Figure 2. MINK claw vacuum pump for degassing the well water in the degassing tank.

Figure 3. Operating principle of the operating fluid-free MINK claw vacuum pump.

as were necessary for the current demand. The vacuum pumps involved were switched on or off as required. A vacuum chamber with a volume of two cubic meters served as a buffer so that the necessary vacuum level is immediately available in the respective packaging chambers when needed. So far, four large thermoforming machines have been supplied with vacuum.

When moving the vacuum system to another room, Managing Director Alexander Brandl decided to swap the rotary vane vacuum pumps equipped with standard motors for frequency-controlled rotary vane vacuum pumps to be able to adjust the performance of the vacuum system more precisely to the actual demand. This is because the packaging machines are used to package products ranging from several kilos in weight to small portion packs for self-service counters. This means that very different tools are used for packaging and therefore the volumes of the packaging chambers vary considerably. Due to relatively small quantities, the total volume of all packaging machines changes frequently and therefore also the vacuum system's power requirement.

Managing Director Alexander Brandl decided on the latest generation of intelligent vacuum pumps: the R5 PLUS from Busch Vacuum Solutions. The reasons for this were obvious. Not only has he had good experiences with Busch products over many years, he was also impressed by the easy handling of such systems via touchscreen.

The new system has now been in operation since June 2020. Thanks to pressure control, each individual R5 PLUS can precisely maintain the specified vacuum level and compensate for changing pumping speeds via the rotational speed. The individual integrated primary control units in each R5 PLUS communicate with each other via a higher-level secondary control unit – the PLUS Master Control. In this way, the overall performance of the vacuum system adapts precisely to the actual demand. The central vacuum system can be easily operated via the PLUS Master Control touchscreen.

Figure 4. Modern vacuum technology with the latest PLUS Master Control unit for efficient central vacuum supply according to the actual demand.

After several months of operation, it became apparent in practice that the vacuum system's control unit responds much more finely than with the previous system, which also responded to changes in demand by simply switching individual vacuum pumps on and off, but in coarser steps. The converted vacuum system can now guarantee compliance with cycle times and a precisely defined vacuum level in each individual package. The new R5 PLUS rotary vane vacuum pumps are larger than the vacuum pumps previously used. This is because in the future, even more thermoforming machines will be connected to the central vacuum supply. But the proven old R5 rotary vane vacuum pumps are not to be abandoned in the future. One or more will be used in the future on tumblers as a single unit. BP

About the Author

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About Busch Vacuum Pumps and Systems

Busch Vacuum Pumps and Systems is one of the largest manufacturers of vacuum pumps, blowers and compressors in the world. Our products are at the forefront of vacuum and low-pressure technology. For more information, visit www.buschvacuum.com.

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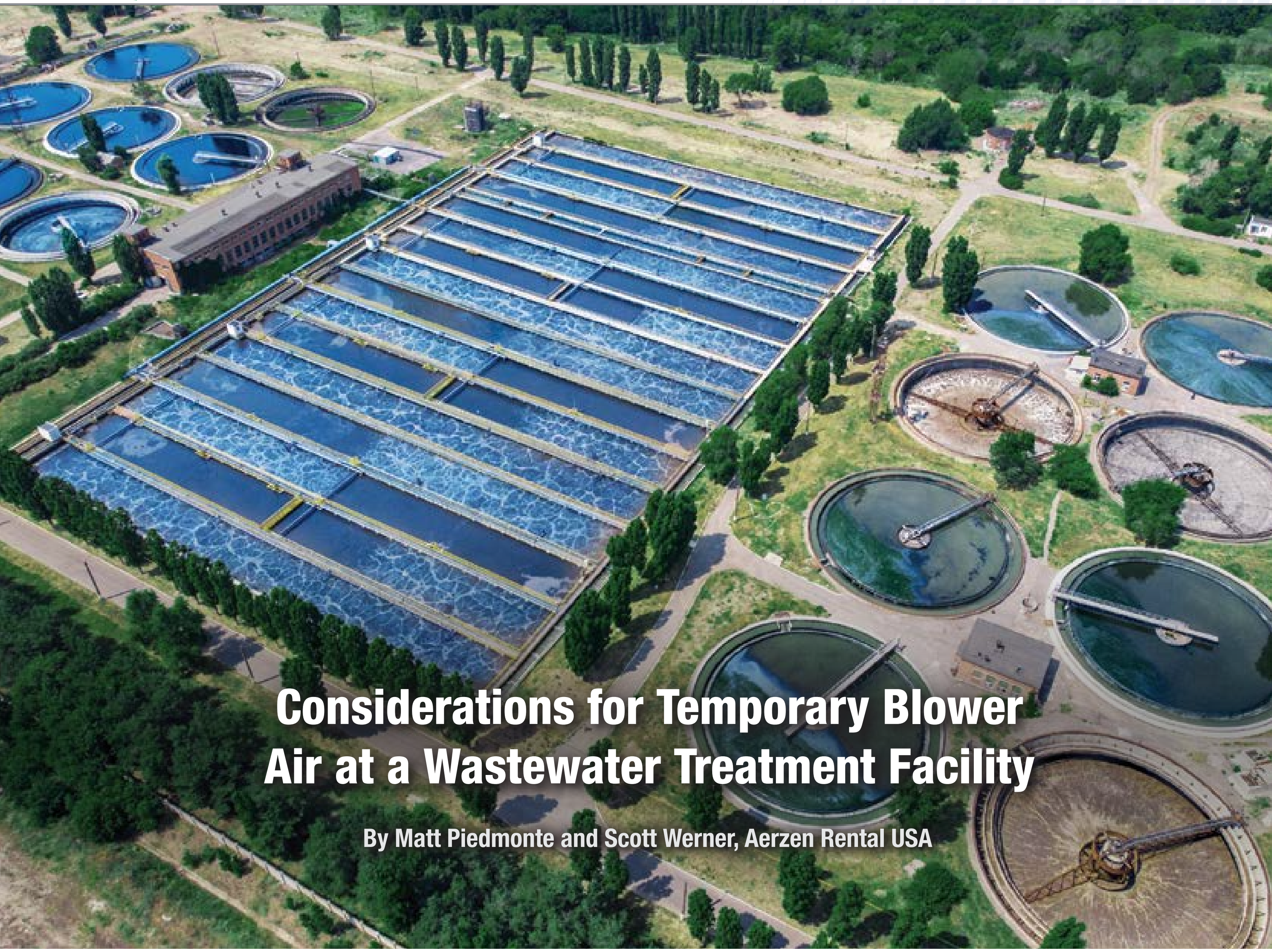

Considerations for Temporary Blower Air at a Wastewater Treatment Facility

By Matt Piedmonte and Scott Werner, Aerzen Rental USA

Executive Summary

There are many reasons why a wastewater operator may have a need to leverage temporary blowers in their facility. Emergency needs, supplemental seasonal needs, or an upgrade project to name a few. Historically, operators have relied on the local general rental industry to provide diesel driven compressors that are readily available locally and easily installed. What is often overlooked is how inefficient these compressors are when supplying air to a wastewater treatment plant and how environmentally insensitive this approach is. When selecting a solution to solve a temporary need, the operator should consider the "Total Cost of Rental" which includes recurring and one-time project costs, energy costs, as well as the environmental impact.

Introduction

The wastewater treatment process typically utilizes volumes of air in the 5-14 PSIG range for a variety of aeration and mixing functions. The volume of air required per plant will vary with the capacity of the plant and the wastewater treatment process employed. The blower technology chosen for permanent installation in a plant may vary by treatment process requirements, age of installation, and even space available for the blower installation. The various blower technologies utilized at a wastewater facility include multistage centrifugal, rotary lobe, screw blower, geared centrifugal, and high speed turbo to name a few. When the circumstance presents itself for a project that requires temporary low-pressure air, understanding the efficiency of these technologies and installation / operational costs that accompany them are key to determining the "Total Cost of Rental" for a project. This article aims to discuss the various technologies of equipment that could be presented to a wastewater operator faced with a temporary need for blower air and to help the operator understand the impact (both monetarily through a "Total Cost of Rental" approach and environmentally) of their decisions.

Plant Air Compressors and Their Efficiency

These compressors are designed to support manufacturing operations that utilize compressed air at 90-150 PSIG and are typically 1 or 2 stage rotary screw machines that employ either oil flooded or oil free technologies within the stages of compression. These units are readily available in the rental markets with diesel driven or electric driven options. When running these rental compressors in the 5-14 PSIG range required for most wastewater treatment plant applications, there is considerable waste in that the machine utilizes energy to compress the air up to the level of their minimum allowable discharge pressure before expanding via a pressure reducing regulator to the lower pressure required. The electrical energy consumption of electric drive plant air compressors varies from ~18 to 21 kW per 100 cfm. This level of energy consumption does not vary across the demand side pressure range of 5-14 PSIG. Electric driven plant air compressors are rarely utilized in temporary blower projects in wastewater treatment plants due to the considerably higher electrical power consumption as compared to a blower of any technology. Most wastewater plants don't have the necessary electrical infrastructure to supply power to an electric drive plant air compressor and can only consider a diesel driven option. For diesel driven compressor units, the most readily available units in the rental markets deliver from 1500 to 1600 cfm and consume 17-19 gallons of diesel fuel per hour to deliver their rated flow at their minimum operating discharge pressure point which can then be regulated down to the range of 5-14 PSIG. Note additional equipment such as pressure regulators and storage tanks are often required to utilize these compressors in wastewater applications.

Blowers and Their Efficiency

Blowers are designed to operate at peak efficiency at the pressure levels required for the wastewater treatment processes. The energy consumption of these blowers varies as a function of the demand side pressure range and the efficiency of the design / operations. Diesel drive blowers do not exist in the rental markets

Considerations for Temporary Blower Air at a Wastewater Treatment Facility

therefore this overview exclusively looks at energy consumption from electric motor driven blowers. If electrical power is not available, these electric driven blowers can be powered by diesel driven generators that are available locally in most markets. At a delivered pressure of 5 PSIG, blowers can consume from ~1.8 to 2.2 kW per 100 cfm. At a delivered pressure of 14 PSIG, blower energy consumption can increase to ~4.5 to 6 kW per 100 cfm.

Total Cost of Rental

When evaluating the appropriate solution to a temporary blower need, a plant operator needs to consider the "Total Cost of Rental". The total cost of a rental project includes all of the following project costs:

- Rental rates for the duration of the project inclusive of shift charges for diesel driven equipment. This shift charge is typically a multiplier of the "standard published rate" which typically allows for up to 40 hours of run time. A "double shift rate" allows for up to 80 run hours per week and a "triple shift rate" allows for unlimited usage.
- Environmental fees associated with diesel driven equipment
- Round trip freight
- Preventative Maintenance during the project to keep the equipment operating reliably (diesel engines may require service every 250 to 500 run hours)
- Installation, commissioning, and decommissioning costs
- Energy consumption whether it is from plant supplied electricity or diesel fuel (including diesel fuel drop charges and tank pump out at the completion of a project if applicable)
- Ancillary equipment rental such as pressure regulators, storage tanks, transformers, compressed air hose, pipe, fittings, external fuel tank, etc.

Environmental Impact

In addition to the monetary costs associated with various rental options, there are also environmental aspects to be considered. The ideal approach to a temporary blower project is to utilize electrically driven rental blowers that have energy consumption levels comparable to the permanently installed machines and that can be powered using the plant's existing electrical infrastructure. Any solution that fits this "ideal" criteria, will have a neutral environmental impact as compared to the plant's normal operations. Any solution

Temporary aeration blowers installed at a wastewater treatment plant.

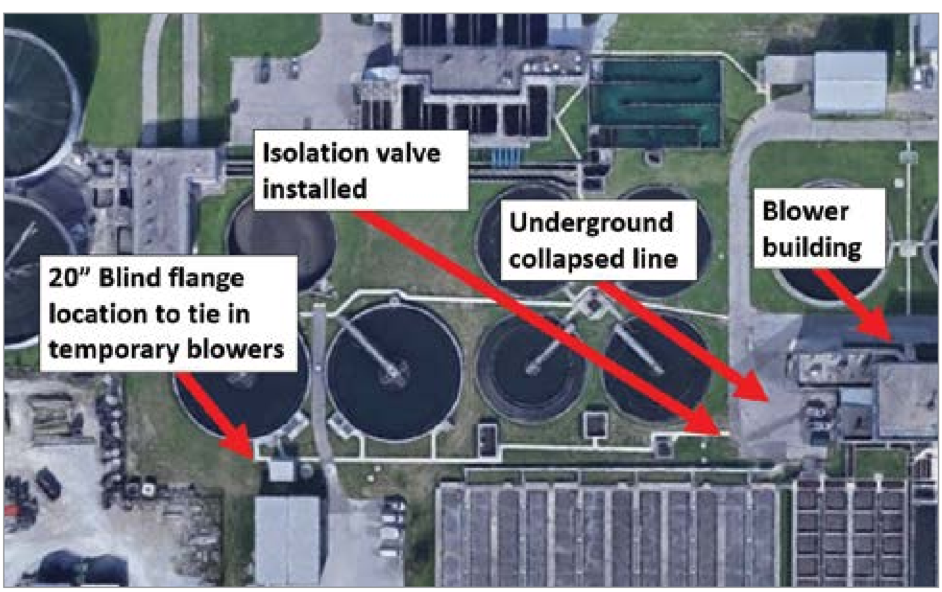

Figure 1. Facility Image.

that utilizes diesel driven equipment is putting an incremental amount of emissions into the environment. Consider a temporary blower need of 3000 cfm at 10 PSIG for 3 months. A solution utilizing diesel driven compressors will consume ~78,000 gallons of diesel fuel. A solution utilizing electric driven rental blowers powered by the site's existing electrical infrastructure will consume ~282,000 kWh of grid supplied power. When these two solutions are compared from a "Carbon Dioxide Equivalent" approach (https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator), it can be demonstrated that the diesel driven compressor solution delivers ~4 times the greenhouse gas emissions that the grid powered electric driven blower solution delivers. While there is no direct monetary cost that can be assigned to a project around greenhouse gas emissions, it is just one additional and quite significant benefit of utilizing the correct technology for a temporary air project.

Case Study

A wastewater treatment plant in the Midwest had a collapsed underground aeration supply header that was used to transport air from the blower building to the basins. See Figure 1 for a high-level overview of the facility. The site could not cease water treatment operations for the time required to compete the repair and had to continuously supply the basins with a total of 7000 cfm of air at 6.8 PSIG. To carry out the repair, the plant decided to bring in rental equipment to deliver the air needed to sustain operations and to introduce that air at the opposite end of the distribution header through an existing 20" blanked off flanged connection and to isolate the failed section of pipe by taking a short planned outage to install an isolation valve. An alternate approach evaluated was to install a temporary pipe bypass from the blower building to any point on the distribution header that is downstream of the repair area thus allowing the permanently installed blowers to be used and avoiding any rental equipment but this option was not viable due to the site layout and the time and expense associated with designing and installing a temporary piping system.

Because of the physical location where the temporary blowers needed to be installed,

Considerations for Temporary Blower Air at a Wastewater Treatment Facility

utilizing in house power via long cable runs was deemed not viable. This meant any solution chosen had to be diesel driven. The plant considered proposals from 2 different rental companies.

Company A is a general rental company with a local presence that offered 125 psi rated diesel driven plant air compressors to complete the project. To deliver the required volume of air, their proposal included 5 of these compressors, pressure regulated down to 6.8 PSIG.

Company B is a specialty rental company that recommended electric driven tri lobe blowers powered by diesel driven generators that could be supplied from Company A. Company B is almost 600 miles away from the plant. Table 1 shows the Estimated Relative Costs on each "Total Cost of Rental" project line item and is sorted from the largest cost category at the top to the smallest cost category at the bottom.

Based on a comprehensive estimate of the Total Cost of Rental, the plant went with the solution presented by Company B for an electric drive blower + diesel powered generator.

TABLE 1. ESTIMATED RELATIVE TOTAL COST OF RENTAL FOR THE SAMPLE PROJECT

TOTAL COST OF RENTAL CATEGORY Sorted by highest project cost to lowest project cost	COMPANY A (DIESEL DRIVEN PLANT AIR COMPRESSORS) VS COMPANY B (BLOWERS POWERED BY DIESEL GENERATORS)
Diesel Fuel Costs	Company A option is ~5-6 times more expensive
Rental Charges including shift adjustments for driven Diesel Units	Company A option is ~2 times more expensive
Round Trip Freight	Comparable
Installation, commissioning, and decommissioning costs	Company B option is ~ 2 times more expensive
Preventive Maintenance Costs	Company A option is ~2 times more expensive
Total	**Company A option is ~2.5 times more expensive**

Project Outcome

- The "Total Cost of Rental" for choosing the solution presented by Company B was estimated to be less than half of solution proposed by Company A.

- Company B's solution consumed almost 66,000 fewer gallons of diesel fuel as compared to Company A's proposed solution. The environmental impact was ~1.5 million lbs of CO_2 emissions avoided. That's the green house gas emission equivalent of ~1.7 million miles driven by an average passenger vehicle.

Conclusion

Over the lifecycle of a wastewater treatment plant, temporary needs for blower air are likely to arise. When these needs arise, it is critical that the plant take a "Total Cost of Rental" approach to select the solution that is the most economical and least impactful to the environment. Although equipment may be available from local suppliers with faster delivery timelines, this equipment is typically misapplied to the needs of the wastewater industry and very inefficient. Researching available suppliers of low-pressure rentals and establishing contingency plans proactively will help plant operators be prepared to make the most cost-effective and environmentally responsible decision when the need presents itself. BP

About Aerzen Rental

Specializing in temporary oil-free blower and compressor solutions under 50 psig, Aerzen Rental supplies complete solutions to customers in a wide range of industries. From rental units for immediate deployment in the event of a production failure or shortfall, to planned projects, Aerzen Rental is your expert partner. For more information about Aerzen Rental, contact sales@aerzenrental.com, tel: 1-844-400-AERZ (2379), or visit www.aerzenrentalusa.com.

All photos courtesy of Aerzen Rental.

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Controlling DO: A Good Average Isn't Good Enough

By Tom Jenkins, JenTech Inc.

Wastewater aeration is one of the most important applications for blowers. Over the years I've seen hundreds of aeration control systems in operation. Most of them rely on feedback control of dissolved oxygen (DO) in the aeration basin to optimize process performance and minimize energy consumption. In many cases the operator thinks the controls work "pretty good" because the average DO concentration is close to the setpoint.

The reality is that most of these systems exhibit significant hunting above and below the target DO. Because of the nature of oxygen transfer in diffused aeration systems, achieving a good average isn't the same as optimizing performance.

Basic Process Considerations

Most control systems use Proportional-Integral-Derivative (PID) algorithms for controlling DO, basin air flow distribution, and blower pressure or flow. These algorithms are prone to hunting – the cyclic fluctuation of the controlled variable. Fluctuations that oscillate the DO several mg/L above and below the target DO concentration are common.

There are several causes for hunting. Poor resolution of valve position cause instability in flow and pressure control that create fluctuations in DO concentration. The most common cause of DO instability is improper tuning of the control loop. PID control is particularly prone to this problem. The algorithm is well suited to linear response systems, but aeration is extremely non-linear. Among the non-linearities to contend with are:

- Airflow demand change with process load
- DO concentration change with air flow. [See Figure 1.]
- Air flow change with valve position
- Blower airflow control instability
- Blower airflow change with pressure

DO is an indirect indicator of process performance and load. Maintaining a set DO doesn't guarantee the process is acceptable – it just means that the oxygen supply isn't below the demand. Failure to maintain the proper quality and quantity of the biology or the lack of adequate hydraulic retention time will result in process failure regardless of DO concentration.

Actual oxygen demand from the process load is typically measured as oxygen uptake rate (OUR) in mg O2/L/hour. OUR is usually measured in the laboratory, but it can be measured real time in situ with offgas testing. The OUR is a function of biochemical oxygen demand (BOD) to be removed and ammonia to be converted to nitrate. OUR in turn determines the required oxygen transfer rate (ROTR) needed to meet the biology's oxygen demand.

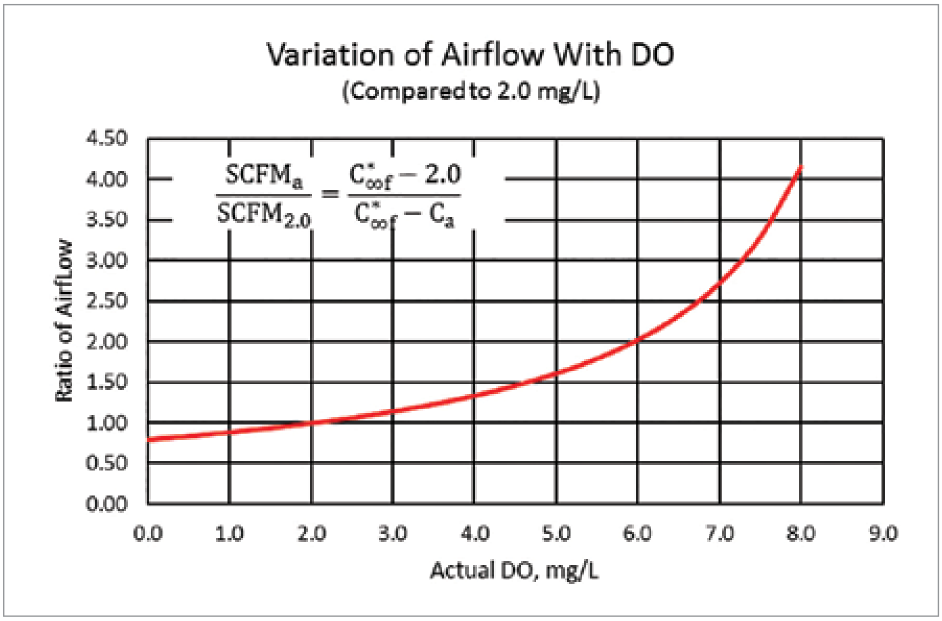

Figure 1: Non-Linear Relationship of DO and Airflow

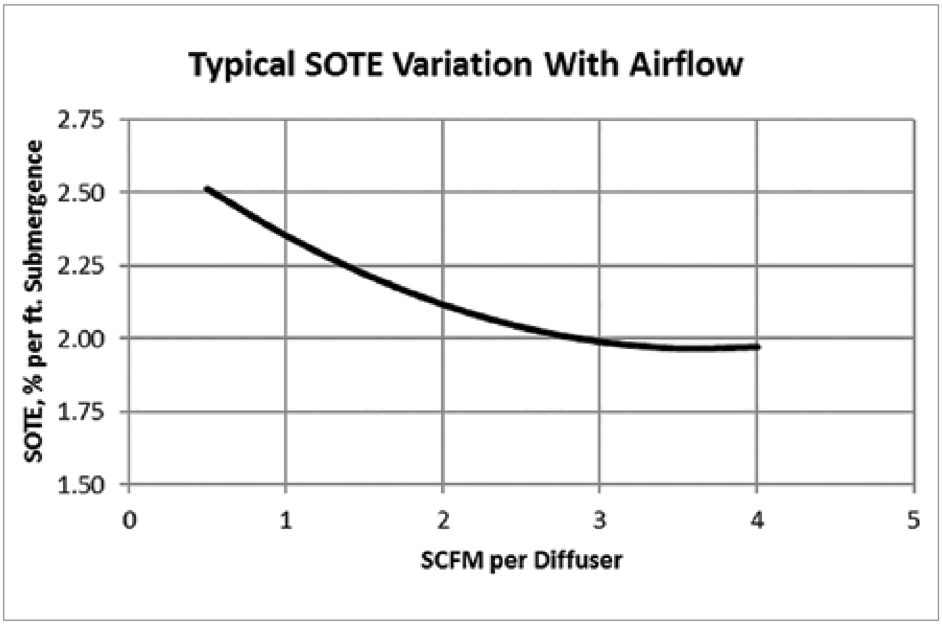

Figure 2: Relationship of DO and Airflow per diffuser

$$ROTR \approx \frac{\Delta BOD \cdot 1.1 + \Delta NH_3 \cdot 4.6}{q_{ww} \cdot 0.723}$$

ROTR = required oxygen transfer rate, lb_m/hour

q_{ww} = wastewater flow rate, million gallons per day (mgd)

ΔBOD = BOD metabolized, mg/L

ΔNH_3 = ammonia converted to NO_3, mg/L

The ROTR for a given system can be met by a range of air flows over a range of operating conditions and DO concentrations. The ROTR changes as hydraulic and organic loads to the plant vary from diurnal and slug load shifts.

Basics of Oxygen Transfer

At steady state conditions the actual oxygen transfer rate (AOTR) and ROTR are equal. If

Controlling DO: A Good Average Isn't Good Enough

a load or airflow change disturbs the steady sate equilibrium the DO concentration in the aeration basin will change until equilibrium is restored. Understanding the DO change requires an understanding of basic oxygen transfer principles.

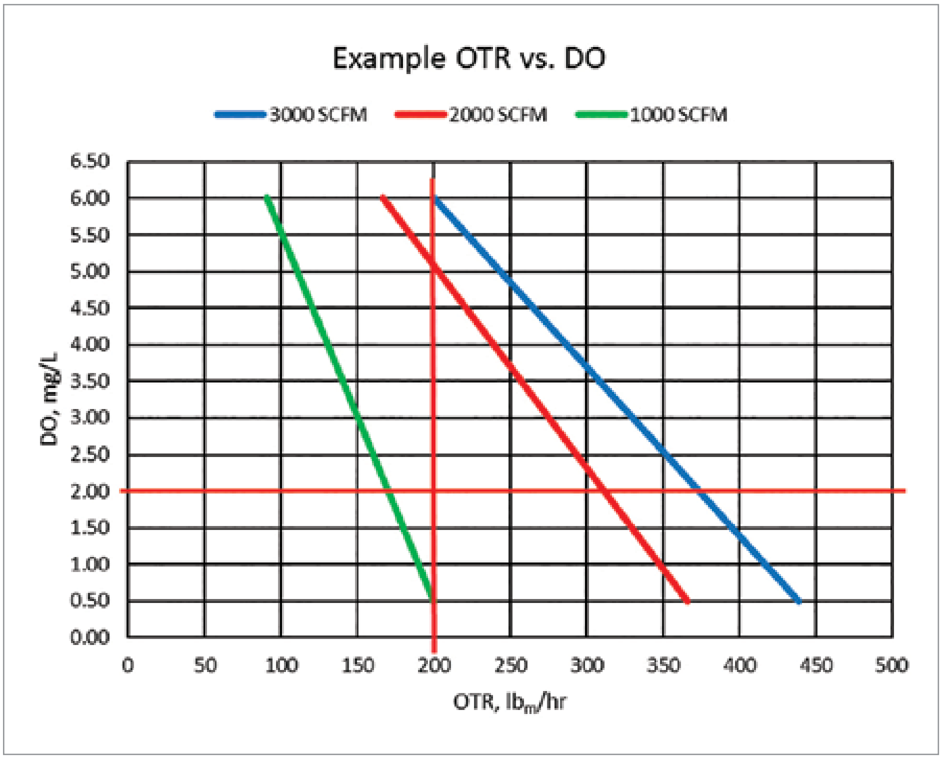

Figure 3: Relationship of OTR, DO Concentration, and Air Flow Rate

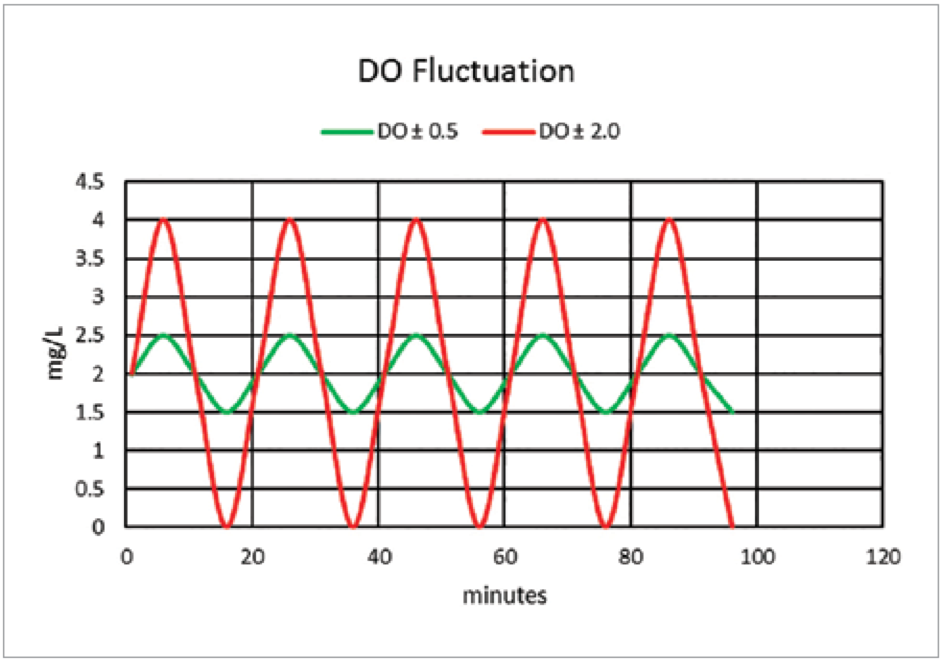

Figure 4: Examples of DO Fluctuations

AOTR is a function of airflow rate and actual field oxygen transfer efficiency (OTE_f):

$$AOTR \approx \frac{q_s \cdot OTE_f}{0.9662}$$

AOTR = actual oxygen transfer rate, lbm/hour

q_s = airflow rate, scfm (68°F, 14.7 psia, 36% RH)

OTE_f = actual field oxygen transfer efficiency, decimal

The OTE_f is a complex function and changes continuously. Many of the factors that induce changes in OTE_f are beyond the control of the operator.

Determination of OTE_f starts with the standard oxygen transfer efficiency (SOTE) measured by the manufacturer in clean water and corrected to 20°C and 0.0 mg/L DO. Factors that affect the deviation between OTE_f and SOTE include:

- α, a function of the components in the wastewater such as oils and mixed liquor suspended solids
- F, which measures the effect of diffuser fouling over time
- T, the wastewater temperature
- D, the depth of diffuser submergence; more submergence means higher SOTE
- β, a function of total dissolved solids
- Air flow per diffuser, usually expressed as scfm per diffuser; OTE decreases with higher airflow
- Ca, the actual dissolved oxygen concentration; OTE decreases with higher DO

Controlling DO: A Good Average Isn't Good Enough

Of these the last two are of interest when controlling blowers to match airflow delivered to process demand.

As the air flow rate per diffuser increases so does the size of the bubble generated. This decreases the volume to surface area ratio, and this in turn reduces the efficiency of dissolving oxygen in the wastewater. [See Figure 2.] If the air rate is increased by a control system the rate of oxygen being dissolved, AOTR, increases. However, the increase isn't directly proportional to the air flow increase because OTE_f drops. This relationship should be obtained from the diffuser supplier.

The principles of mass transfer dictate that material moves from a location of high concentration to low concentration. The greater the difference the more driving force there is for the transfer and the faster it will occur. The result is that the OTE_f will drop as the actual DO concentration rises. [See Figure 1.]

$$OTE_2 = OTE_1 \cdot \frac{C^*_{\infty f} - C_2}{C^*_{\infty f} - C_1}$$

$OTE_{1,2}$ = oxygen transfer efficiency at time 1 and 2, decimal

$C^*_{\infty f}$ = steady state DO saturation concentration at infinite time in process water, mg/L

$C_{1,2}$ = actual DO concentration at time 1 and 2, mg/L

Combining the relationships and data with OTR in a single graph demonstrates the relationships of process load changes, air flow rate changes, and actual DO concentration changes. [See Figure 3.] The graph assumes steady state equilibrium, with AOTR = ROTR. Performance is based on typical diffuser SOTE, 2 mgd flow rate, and common BOD and NH_3 loading for municipal wastewater.

In this example the ROTR can vary from 175 lb_m/hour to 375 lb_m/hour with constant 2.0 mg/L DO by increasing the air flow to the basin. This illustrates the non-linearity of aeration control, since approximately doubling the process demand requires tripling the airflow rate.

On the other hand if the process demand (ROTR) remains constant at 200 lb_m/hour the AOTR can be in equilibrium with ROTR while airflow rates range from 1,000 SCFM to 3,000 SCFM. Increased airflow causes the DO concentration in the wastewater to rise from 0.5 mg/L to 6.0 mg/L. This clearly shows that elevated DO concentrations are an indication that the airflow rate exceeds the process demand.

Biased Performance

Controlling blowers as part of controlling a secondary aeration process appears simple. If the DO is low you need to supply more air. If the DO is high, cut back on blower capacity. The biology in the basins is fairly forgiving and can accommodate some fluctuations in DO without creating process problems or developing undesirable organisms.

It would also appear that if the DO concentration averages out over time the system is a success. Many operators think their aeration and blower control is satisfactory because, on average, they hit target DO despite

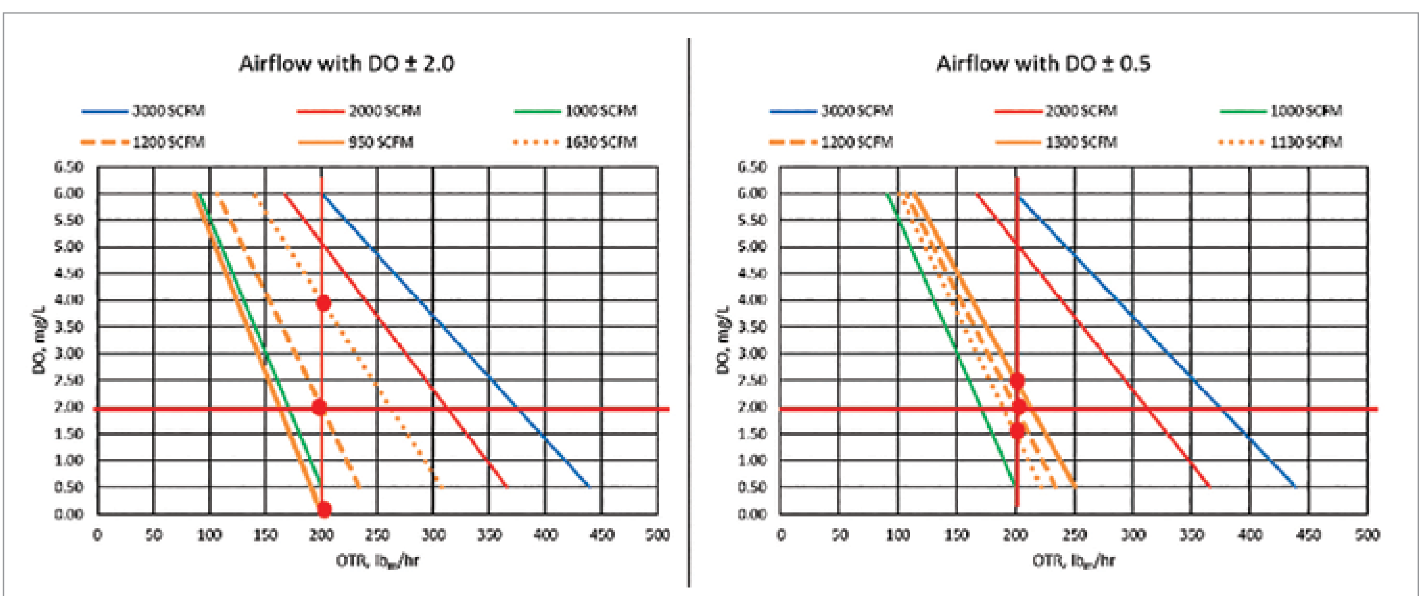

Figure 5: Determining Airflow Fluctuations

hunting. They also assume that means they are, on average, optimizing the aeration energy requirement. However, that assumption isn't correct.

The non-linearity of maintaining required DO and ROTR means that over-aerating "hurts" more than under-aerating "helps".

This bias in process airflow demand can be seen by comparing different DO fluctuations at constant ROTR. For example, compare performance with fluctuations in DO of ±0.5 mg/L and 2.0 mg/L while maintaining an average DO concentration of 2.0 mg/L. [See Figure 4.] Using the relationships above, the fluctuations in air flow that result in these DO fluctuations can be determined. [See Figure 5.] Plotting the airflow rate fluctuations shows that the airflow with DO ±2.0 mg/L is skewed higher than with DO ±0.5 mg/L. [See Figure 6.]

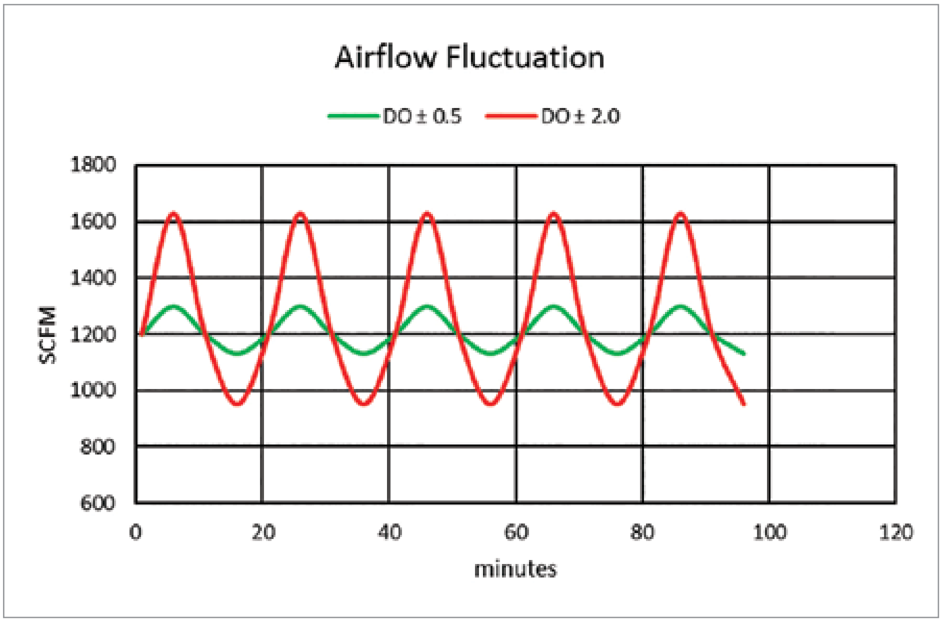

Figure 6: Airflow Fluctuations

Practical Implications

The first, and perhaps most obvious, implication of poor control creating fluctuating DO concentrations is that the cost of energy increases with larger fluctuations. The impact on the example system would be over $1,000 per year. This is based on typical blower wire-to-air efficiency and an average power cost of $0.10/kWh.

The difference in electricity consumption isn't the most significant energy cost implication. Most treatment systems pay a demand charge – a charge based on the peak kW used during a month or year. For most treatment plants one third of their electricity cost is due to demand charges. The higher fluctuation in DO results in an increased demand of 11 kW. If the demand charge is $15.00/kW the annual cost increase would be approximately $2,000 per year.

Excessive cycling of airflow will obviously accelerate wear and tear on flow control valve actuators. Of greater concern is the possibility that large fluctuations in flow will increase the start/stop cycles of the blowers. I have observed systems where the hunting induced by DO control instability resulted in very frequent starting and stopping of the blowers – often several times per hour. This causes further process upsets and shortens blower life.

It is both possible and beneficial to reduce or eliminate hunting of DO controls and the corresponding fluctuations in air flow. More precise flow control valves will increase stability. Right-sized blowers with good turndown minimize start/stop cycles. There are more effective and stable algorithms than PID. These advanced strategies include long response delays, biased control, and tolerance on error to accommodate the non-linearity in aeration systems. The resulting control provides process stability, ensures adequate oxygen supply and optimized energy demand, and reduces blower start/stop cycles. BP

About the Author

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

Busch Vacuum Partners with USPI

Busch Vacuum Solutions USA, one of the largest global manufacturers of vacuum pumps, blowers, compressors, and systems, announced a new strategic partnership with US Petrolon Industrial (USPI), a leader in industrial lubricants, oil filtration systems and comprehensive oil analysis. Through this partnership, USPI and Busch customers now have access to more service options and the Busch Exchange PLUS service in the Midwest region. The nationwide Exchange PLUS service provides quick changeovers in vacuum pump equipment breakdown situations. With this program, the customer's vacuum pump or blower that requires an overhaul is picked-up and then delivered a fully remanufactured replacement. Customers have a fast, simple, and cost-effective solution with Busch vacuum pumps and blowers stocked at the USPI Nebraska location for quick exchanges.

Busch Vacuum Solutions, www.buschusa.com

Pfeiffer Vacuum HiPace 80 Neo Turbopump

Pfeiffer Vacuum presents its new HiPace 80 Neo turbopump, which features a longer life before service and reduced vibration and noise emissions. These benefits are made possible with the new, advanced Laser Balancing™ system developed by Pfeiffer Vacuum for turbopump rotors. Thanks to this patented technology, the vacuum pump is particularly suitable for vibration-sensitive applications. Possible applications range from mass spectrometry and electron microscopy to leak detectors and RGA systems. The integrated rotor temperature measurement system ensures that the HiPace 80 Neo delivers the best performance at all times. And thanks to the integrated sensors, HiPace turbopumps guarantee maximum operational reliability. The hybrid bearing of the HiPace 80 Neo consists of an oil-lubricated, ceramic ball bearing on the fore-vacuum side and a permanent-magnet radial bearing on the high-vacuum side.

Pfeiffer Vacuum, www.pfeiffer-vacuum.com

Leybold Filament Pirani Gauges

The ability to reliably measure and control the vacuum level in each vacuum process is key in creating the highest efficiencies. Therefore, Leybold has developed the THERMOVAC TTR-RN series, a new compact filament Pirani gauge for all vacuum applications requiring a measurement range from atmosphere to 1e-4 mbar (7.5e-5torr). With compact dimensions and rugged filaments, this latest innovation from the vacuum specialist is equally well suited for analytical applications and robust industrial processes. All in all, the use of the THERMOVAC TTR-RN series from Leybold will support users to monitor small and large vacuum systems more easily and thus be able to control and scale them in a more targeted manner. The THERMOVAC TTR-RN series is globally available from today onwards.

Leybold, www.leybold.com

Sulzer Upgrades Austrian Wastewater Plant

Until the middle of last year, aging blowers were a constant headache for the operations team at the Linz-Asten sewage treatment works. The site's integrally geared, single stage centrifugal blowers were temperamental and failure-prone, with absorbing around EUR 40,000 a year in maintenance costs. The twenty year old blowers were noisy too; so loud that you could not work in this area without strong hearing protection and it was a very heavy burden for the maintenance staff. Upgrading to Sulzer turbocompressor technology has addressed both issues at a stroke while also helping the plant to reduce its energy costs and carbon footprint. The largest wastewater treatment facility in Upper Austria, the Linz-Asten sewage treatment works serves a population equivalent of 950,000.

Sulzer, www.sulzer.com

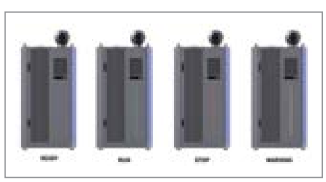
BLOWER & VACUUM INDUSTRY & TECHNOLOGY NEWS

Nash NT Series Rotary Piston Pumps

Nash has added the NT series rotary piston pumps to its comprehensive portfolio of vacuum pumps for the ever-changing industrial market. Supplementing the brand's already extensive offering of highly efficient and durable pump models, the newly launched series has been designed to meet the requirements of demanding industrial applications including heat treating, transformer oil drying, vacuum coating, evacuating refrigeration systems, and liquid gas storage. As a result of Nash's continued commitment to expanding its product portfolio and leveraging innovations within vacuum pump technology, the new NT series vacuum pumps can operate continuously from 0.01 to 100 Torr with nominal capacity ranging from 150 cfm to 778 cfm. They stand out in the constantly developing vacuum market through cutting-edge piston technology and a standard internal positive pressure lubrication system.

Gardner Denver Nash, www.gardnerdenver.com/en-us/nash.

Turbowin Smart Turbo Blower WL-i Series



Turbowin has released one of the most efficient oil-free turbo blowers in the market. Paired with high efficiency up to 57.5%, the WL Series proves to be a reliable turbo blower ranging from 10 to 1200 HP. IoT integration for real-time performance monitoring via any connected device is now offered in the WL-i Series. This allows users to simply control and monitor blower systems with just a touch of a button. Real-time performance data is analyzed and statistically maintained on the server. Notifications are sent for alarms or errors allowing a quick response to unexpected situations. Customers can leverage performance curves and historic data through the interface that allows them to reduce cost, save time and energy. The WL-i Series features an LED display on the front cover for a visual element on-site to indicate the status and condition of the equipment.

Turbowin, www.turbowin.com

Kice New Regional Sales Manager

Kice announced the appointment of Jeff Kinnunen as its Regional Sales Manager, based out of Minneapolis, MN. In this role, Kinnunen will be responsible for the oversight of sales throughout Minnesota, North and South Dakota, West Iowa, and Northwestern Wisconsin territories, providing support for this customer base for the diverse product lines offered by Kice. Kinnunen joins Kice with over 13 years of experience as a manufacturer's representative in the Minnesota area, providing customers with equipment and solutions similar to the products Kice offers. "We are excited to welcome Jeff to Kice Industries; he will help strengthen our coverage and support in this region for our customers, said Marshall Bird, Vice President of Sales, Kice Industries. We are fortunate to have Jeff join our team, and I'm confident that he will play a key role in providing and implementing industry solutions for our customers."

Kice Industries, www.kice.com

Black & Veatch 60 Years in Canada

As Black & Veatch celebrates its 60th year of innovative operations in Canada, the company recognizes the more than 1,500 completed projects that span power and energy market segments, essential water management solutions, and telecommunications advancements across the country. With the milestone, the company's experts – now at the forefront of the decarbonization and sustainability movements – see significant opportunities to accelerate Canada's deployment of advanced infrastructure assets. In a country that has long invested in resilient, reliable infrastructure to serve its broad, diverse geographical needs, Black & Veatch opened its Toronto operations in 1960 to help build power and water infrastructure capacity. Decades later, the company has broadened its footprint in Edmonton and Vancouver, growing its local workforce to deliver projects encompassing power generation to water services, grid modernization and zero-carbon transportation markets.

Black & Veatch, www.bv.com

BLOWER & VACUUM INDUSTRY & TECHNOLOGY NEWS

EXAIR New Catalog 33

EXAIR's new Catalog 33 is our best catalog yet; a full color technical guide offering solutions to common industrial conveying, cooling, cleaning, blowoff, drying, coating and static electricity problems. The greatly expanded Catalog 33 introduces new VariBlast® Precision Safety Air Guns, the Intellistat® Static Eliminators, Liquid Atomizing Spray Nozzles, and the EasySwitch® Wet-Dry vacuum. A best practices section for using compressed air products has also been added. VariBlast Precision Safety Air Guns allow you to use just the flow you want with trigger control. They are lightweight, ergonomic, comfortable and have three extension lengths available. The Intellistat Ion Air Gun Static Eliminator is built for laboratories, scientific testing, clean processes and sensitive assembly work. This catalog also introduces Liquid Atomizing Spray Nozzles in a full or hollow cone spray pattern that are used to cool, wash, rinse and suppress dust.

Exair, www.exair.com

Brown and Caldwell Receives Research Grant

The Water Research Foundation has granted $100,000 to Brown and Caldwell for the project, Developing a Framework for Quantifying Energy Optimization Reporting. The framework developed through this project will help water and wastewater utilities make informed capital expenditure decisions and increase confidence in future energy efficiency and emission reduction projects. Energy projects are often discretionary and initiated based on projected annual energy savings metrics. The water industry lacks standard energy savings estimation methods, as well as measurement and verification approaches and procedures to quantify results. This inconsistency in variables and data collection can lead to inaccurate estimations and a lack of confidence in optimistic savings and capital cost forecasts for energy projects across the One Water cycle.

Brown and Caldwell, www.brownandcaldwell.com

Atlas Copco Acquires Iberica Vacuum

Atlas Copco has acquired IBVC Vacuum, S.L.U, known as Iberica Vacuum. The company's customers are mainly industrial and scientific companies as well as universities and research institutes in Spain and Portugal. Iberica Vacuum is a privately owned company and has 10 employees. The company is located in Madrid, Spain, and is the Edwards vacuum distributor in Spain and Portugal. "We have had a successful partnership with Iberica Vacuum in Spain and Portugal since its founding in 2007," said Geert Follens, Business Area President Vacuum Technique. "Through this acquisition we will get the opportunity to better serve current customers and further strengthen our market presence for the Edwards brand in this key region of Southern Europe." The company will become part of the Vacuum Technique Service Division within the Vacuum Technique Business Area.

Atlas Copco Group, www.atlascopcogroup.com

WELTEC BIOPOWER Biogas Plant in Finland

WELTEC BIOPOWER recently commissioned a biogas plant near Turku in southwestern Finland. This region is characterized by livestock farms and therefore the 250-kW plant runs entirely on liquid manure. The energy plant belongs to a group of three pig farmers. In this project, the German plant builder cooperates with its long-standing Finnish partner Doranova. The orientation of environmental policy in the Scandinavian state is increasingly based on sustainable nutrient recycling. Agriculture in particular plays a strategically important role in regions with intensive animal husbandry. While in other parts of the world manure and slurry are seen as waste, the Fins rely on the advantages of the so-called black gold. Fertilization with this organic substance improves the structure of the soil and increases the carbon storage in the ground. Moreover, an upstream biogas process delivers climate-neutral energy and ensures even better plant availability of the fertilizer.

WELTEC BIOPOWER, www.weltec-biopower.de

BLOWER & VACUUM INDUSTRY & TECHNOLOGY NEWS

Pfeiffer Vacuum's Leak Testing Virtual Showroom

In its virtual showroom, Pfeiffer Vacuum presents a variety of different leak testing methods for pharmaceutical packaging. Visitors to the site will find information about the challenges of leak testing IV bags, syringes, blister packs, plastic bottles, vials and other non-porous containers. At the virtual trade show booth, visitors will learn about Pfeiffer Vacuum's unique portfolio of leak detectors. Informative videos explain the different technologies used – helium mass spectrometry, optical emission spectroscopy and mass extraction. A tight and reliable seal is essential in primary packaging for drugs. Contamination such as humidity, oxygen or microbiological ingress can considerably impact drug quality throughout the product life cycle. To prevent risks such as the stability failure of highly moisture-sensitive drugs or biological ingress into parenteral drugs, integrity tests with a high sensitivity are required.

Pfeiffer Vacuum, www.pfeiffer-vacuum.com

Busch Vacuum Donates Equipment to Iowa College

Busch Vacuum Solutions, in collaboration with a large food processor and equipment manufacturer, is pleased to support Western Iowa Tech Community College (WITCC). The college has recently built a simulated industrial plant floor for authentic hands-on industrial maintenance training. One area of focus within the Industrial Training Center is food packaging. The equipment donated for this area are two RA rotary vane vacuum pumps from Busch, a Cryovac rotary packaging machine from Sealed Air, and associated belts and electrical equipment from Tyson Foods. Tyson Foods offers students at WITCC their "1 plus 2" program which is one year of school and a two-year post-school employment commitment. The students enrolled in the program are exposed to actual packaging equipment, electrical circuits, automation, sensors, vacuum pumps, and more.

Busch Vacuum Solutions, www.buschusa.com

Leybold Turbomolecular Pumps

Leybold has further expanded its TURBOVAC i/iX pump family especially for industrial, coating and research applications that require robust pumps with higher pumping speeds. The new 1350 and 1450 sizes and its variants have been developed to maximize the pumping speeds. With these variants, the TURBOVAC i/iX series is now complete with 8 models ranging from 90 to 1450 l/s sizes. For light gases pumping speed of the TURBOVAC 1350 I/s is 3-5% higher than reference industry products, for heavier gases the TURBOVAC 1450 i is 10% higher than same reference products. With industrial customers in mind both pumps offer high throughput while tolerating high fore-vacuum pressures of up to 4 mbar. With DN 200 and DN 250 flange sizes to choose from these models are optimized to maximize conductance.

Leybold, www.leybold.com

Kice Industries 75th Anniversary

Kice Industries, an industry-leading provider of pneumatic conveying, dust control, and aspiration systems, is proud to be celebrating its 75th anniversary as a company. Kice Industries was initially organized as a four-way partnership in 1945 at the end of WWII when J.W. "Bill" Kice and his three sons, Jack, Russell, and Jim, started construction of the first shop building. They started operating as a business in January 1946. At that time, the business was known as Kice Metal Products Company. "I am very proud that as a family-owned company, we have been able to achieve 75 years in business," said current President and CEO Drew Kice. "We could have never achieved this without the hard work and dedication of exceptional people."

Kice Industries, www.kice.com

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A Publication of
Smith Onandia Communications LLC
37 McMurray Rd., Suite 104, Pittsburgh, PA 15241

Blower & Vacuum Best Practices is published quarterly and mailed together with Compressed Air Best Practices®. Compressed Air Best Practices® (USPS# 17130) is published monthly except January-February combined by Smith Onandia Communications LLC, 37 McMurray Rd., Suite 104, Pittsburgh, PA 15241. Periodicals postage paid at Pittsburgh, PA and additional mailing offices. POSTMASTER: Send address changes to: Compressed Air Best Practices®, 37 McMurray Rd, Suite 104, Pittsburgh, PA 15241.


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BEST PRACTICES

2021 EXPO NOVEMBER 2-4 CHICAGO, IL

COMPRESSED AIR / VACUUM / COOLING

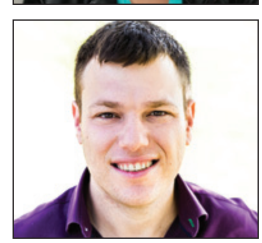

Opening Session

Tuesday, November 2, 10:15AM – 12:00PM

CAGI Remarks
Chad Larrabee, Education Committee Chair, Compressed Air & Gas Institute

Chiller Right-Sizing Projects – A Look at Perceived Demand vs. Actual Demand
Rob Kirts, Global Energy Manager, Stanley Black & Decker

Innovations in Process Cooling Design
Bert J. Wesley, P.E., Sr. Principal, Industrial Plant Engineering Practice Leader, Woodard & Curran

Digital Innovation for Smart Water, Air and Energy Management
Meredith Englund, VP Water Partnerships, Ecolab & Aviran Yaacov, CEO, Ecoplant

OPTIMIZE ON-SITE UTILITIES Powering Automation

Best Practices EXPO & Conference is devoted exclusively to optimizing the technologies powering modern plant automation. Compressed air, blower, vacuum, pneumatics, motors, steam and cooling water systems must be reliable and safe – yet all attendees learn to answer the question, "What's Your kW and Water Use-per Unit of Production?"

Two Conference Tracks (up to 14 PDH credits)

Track 1: Compressed Air Reliability, Automation & Efficiency

Track 2: Cooling System and Aeration Blower Energy/Water Conservation & Compressed Air Safety

Plenary Session Wednesday, November 3, 10:15AM – 12:00PM

Improve Production Process Through-Put, Quality and Reliability with Compressed Air Assessments
Tom Taranto, Owner, Data Power Services

Collaborative Artificial Intelligence Drives Energy Conservation to Save California Dairies
Elhay Farkash, CEO, Zira Group

Commitment to a Collaborative Culture Key to Exceeding Sustainability Goals,
Nancy McDonell, CEO, Value of the Person

Three Levels of Compressed Air Systems
John Bilsky, Facilities Specialist for Compressed Air, Purified Water and N2 Systems, Gentex Corporation

Networking Events Monday & Tuesday

Welcome Reception
Monday, November 1, 6:00–8:00PM, Reception Lounge, Renaissance Schaumburg Hotel & Conference Center

Opening Night Networking Event!
Join us Tuesday, November 2, after the EXPO, at 7:00PM at the nearby Westwood Tavern and Tap.

Sponsored by

CAGI Compressed Air & Gas Institute

Supporting Organizations

Compressed Air Challenge

Ameren Illinois Energy Efficiency Program

ComEd Energy Efficiency Program

REGISTER NOW AND SAVE! Early Bird Rates End on October 18!

cabpexpo.com

Best Practices Conference Agenda Tracks 1 and 2

Presenter and presentation titles may change without notice.

TRACK 1: Compressed Air Reliability, Automation & Efficiency

TRACK 2: Cooling System and Aeration Blower Energy/Water Conservation & Compressed Air Safety

TUESDAY, NOVEMBER 2 **8:00 AM – 10:00 AM SESSION #1**

MAXIMIZING EFFICIENCY AND RELIABILITY IN COMPRESSED AIR SYSTEMS

Chair: *Chad Larrabee, Global Product Management Leader*

Maintaining for Reliability
David Sleeman, Aftermarket Sales Manager, FS-Elliot

The Industrial Digital Revolution and Compressed Air: Part 2
Jan Pingel, Product Leader, Digital Solutions, Ingersoll Rand

Centrifugal Control Strategies to Deliver Optimum Efficiency with High Variable Demand
Chris Nacrelli, Business Development Manager, Atlas Copco Compressors

Maximize Energy Savings and Improve the Bottom Line
Chris Knuffman, Business Line Manager, Reciprocating & Rotary Screw Compressors, Quincy Compressor

CHILLER & COOLING TOWER PROCESS COOLING OPTIMIZATION

Chair: *Tom Stone, National Sales Manager-Industrial, Thermal Care*

Industrial, Variable Speed Control – Energy and Water Consumption Savings for Cooling Systems
Tom Stone, National Sales Manager-Industrial, Thermal Care

VFD Motors in Cooling Systems: Shaft Voltage Causes and Effects and Solutions
Tom Hedrick, Engineer, International Commissioning Engineers

Water Efficiency and Evaporative Cooling Systems
Dustin Cohick, Product Manager Water Systems, Evapco

Lessons Learned from Two Cooling System Audits
Tim Dugan, Principle Engineer, Compression Engineering Corporation

TUESDAY, NOVEMBER 2 **10:15 AM – 12:00 PM OPENING SESSION**

WEDNESDAY, NOVEMBER 3 **8:00 AM – 10:00 AM SESSION #2**

COMPRESSED AIR SYSTEM AUTOMATION & MEASUREMENT

Chair: *Stephen Parry, International Sales Manager, Bay Controls*

Selecting the Right Flow Meter is Vital for Compressed Air & Technical Gas Measurements
Pascal Van Putten, CEO, VPInstruments

Robotic Press Automation in Compressed Air Systems
Aviran Yaacov, CEO, Ecoplant

Batteryless Sensors Unlock the True Potential of the IoT
David Wentzloff, CEO, Everactive

The Future of Compressed Air Control – a Giant Leap Forward
Stephen Parry, International Sales Manager, Bay Controls

SAFE COMPRESSED AIR FOR THE FOOD & BEVERAGE INDUSTRY

Chair: *Brian Mann, Air Systems Business Development Manager, Sullair*

Factoring in the Sustainability Impact of Oil-Free vs Oil-Injected Compressed Air Systems
Brian Mann, Air Systems Business Development Manager, Sullair

Best Practices for Compressed Air / Process Gas Non-viable & Viable Sampling & Testing
Johnny So, Project Manager, Commissioning Agents

Energy Efficiency through Dew Point Switching for Desiccant Regeneration
Justin Walsh, Application Sales Engineer, Vaisala

Reducing Carbon Footprint Through Sustainable and Intelligent Products
Nathan Eisel, National Product Development Manager, SMC Corporation of America

WEDNESDAY, NOVEMBER 3 **10:15 AM – 12:00 PM PLENARY SESSION**

THURSDAY, NOVEMBER 4 **8:00 AM – 10:00 AM SESSION #3**

COMPRESSED AIR AUDITS AND DEMAND REDUCTION PROJECTS

Chair: *Jon Jensen, Energy Conservation Group Manager, SMC Corporation of America*

Low Hanging Fruit: Demand Side Projects for Energy Efficiency,
Jon Jensen, Energy Conservation Group Manager, SMC Corporation of America

Planning & Performing a Successful Compressed Air Leak Survey Using Ultrasound
Dean Wolever, Regional Manager, UE Systems

ASME EA-4 – 2010 Energy Assessment for Compressed Air Systems
Tom Taranto, Owner, Data Power Services

Compressed Air Challenge Training Today
Steve Briscoe, President, Compressed Air Challenge

VFD'S AND AERATION BLOWER ENERGY SAVINGS

Chair: *Tom Jenkins, President, JenTech*

Automated Solutions for Optimizing Aeration Blowers by Properly Using VFD
Bob Kisler, Sales Manager, Gardner Denver

Formulas for Sizing Aeration Blowers
Tom Jenkins, President, JenTech

Formulas for Sizing Aeration Blowers Part 2
Tom Jenkins, President, JenTech

Panel Discussion

THURSDAY, NOVEMBER 4 **10:15 AM – 12:00 PM SESSION #4**

IMPLEMENTING TURN-KEY ENERGY SYSTEM INTEGRATION PROJECTS FOR MAXIMUM SUCCESS

Chair: *Tim Dugan, Principle Engineer, Compression Engineering Corporation*

Definition, Technical Services, Models and Team Players for Successful Turn-key Energy System Integration Projects
Tim Dugan, Principle Engineer, Compression Engineering Corporation

Case Studies of a Small Firm Implementing Complex Compressed Air Piping Projects
Jason DuPriest, Principal Systems Engineer, JD Systems Integration

Case Studies of Turn-key Compressed Air Projects with Verified Energy Savings
Benjamin Mamola, Managing Director, BPT Energy

Case Studies of Comprehensive Energy Construction Projects
Brandon Adams, Owner, Vector Energy Solutions

SAFETY: COOLING WATER TREATMENT/FILTRATION AND 3-A ACCEPTED PRACTICE RELATED TO COMPRESSED AIR

Chair: *Roderick Smith, Publisher, Best Practices Magazines & Expo*

Selecting Water Filtration Devices For Your HVAC Process Cooling Loops
Keith Karl, Filtration Product Manager, AquaPhoenix Scientific

Proven Plant-Based Water Treatment Technology Assists Corporate Sustainability Goals
Justin Wihelms, Application Engineer, HW Environmental

Proposed Modifications to 3-A Accepted Practice B-604-05-A Related to Compressed Air in Contact with Food Products and Product Contact Surfaces
Craig Reinhart, Principal, Reinhart Consulting – Scott Grimes, Technical Training Manager, Donaldson – Scott Keller, Global Regulatory Manager, Donaldson

Special Workshops

REGISTER NOW AND SAVE! cabpexpo.com

Compressed Air Challenge
Level 1: Fundamentals of Compressed Air Systems*

Tuesday, 11/2 & Wednesday, 11/3 – 8:00AM–10:00AM & 2:30PM–4:30PM

This is a two-day introductory course designed to teach facility engineers, operators and maintenance staff how to achieve 15-25% cost savings through more effective production and use of compressed air.

*Compressed Air Challenge workshop only open to distributors, engineering firms/consultants and manufacturing personnel who are paid registrants of the full conference package. Not available to single-day registrants.

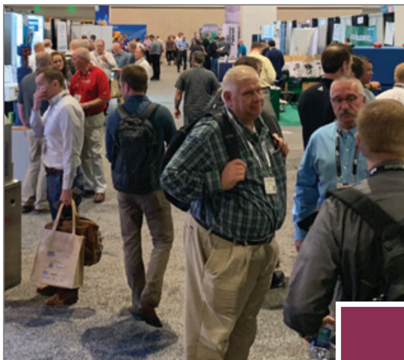
The Value of the Person-Theory R Leadership Workshop
Rooting Culture into People So People Drive Sustainability

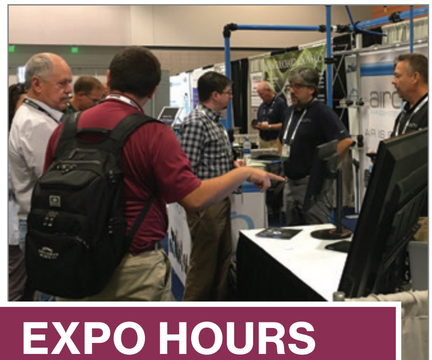
Wednesday, November 3 – 2:30PM–4:30PM

In this workshop we will introduce you to some of the basic principles behind the Value of the Person and Theory R leadership practices – what the application process would be to build a culture based on relationships and what it really means to tap into the hearts of your people.

Explore the Expo and Discover New Technologies!

Discover the latest equipment and technology powering your facilities, production and profits.





EXPO HOURS

Tuesday, November 2 12:00-6:00PM

Wednesday, November 3 12:00-6:00PM

Exhibitors *(as of 9/29/21)*

Air Compressors & Automation IoT

ACE Compressor Services
Bay Controls
Blue Storm Air
BOGE America
Case Controls/ iZ Systems
COAIRE
CompressAir
Critical Rental Solutions
EcoPlant
Edmac Compressor Parts
ENERGAIR
FS-Curtis
Hertz Kompressoren USA
Hycomp
John Henry Foster
Kaeser Compressors
PneuTech
RIEM International
Sauer Compressors
Sullair
Sullivan-Palatek
Tamturbo
Termomeccanica Industrial Compressors
VMC USA

Associations & Training

AICD
ComEd Energy Efficiency Program
Compressed Air & Gas Institute
Compressed Air Challenge
Value of the Person

Blowers & Vacuum

Aerzen Rental
Kaeser Compressors
Sullair

Chillers & Cooling Water Systems

Creative Water Solutions
Hydrothrift
nano-purification solutions

Compressed Air Purification

Air System Products
Altec AIR
BASF
BEKO Technologies
Clean Resources
Great Lakes Air
JORC Industrial
Kaeser Compressors
Kingston Valves
Mikropor
nano-purification solutions
Parker
PneuTech
Sahara Air Products
Sullair
Sullivan-Palatek
Van Air Systems

Lubrication & Intake Filtration

Isel Lubricants
KELTEC
SevAir/AMSOIL
Ultrachem

Measurement & Pneumatics

BEKO Technologies
Fluke
Midwest Control
SMC
SONOTEC
Synergys Tech. & Berg Eng.
Trace Analytics
UE Systems
Vaisala
VPInstruments

Motors & Drives

Nidec Motor
WEG Electric

Nitrogen Generation

Great Lakes Air
Mikropor
nano-purification solutions
Parker
Van Air Systems

Piping & Storage

Aircom USA
AIRpipe USA
Applied System Technologies
Asahi America
Augwind U.S.
Kaeser Compressors
Parker
PneuTech

New Technology EXPO Classroom

Daily from 1–5:30PM on the Expo Floor, exhibitors present their latest "Best Practice" technologies!

TUESDAY, NOVEMBER 2 **1:00 PM – 5:30 PM**

Saving Energy with the New EcoTurbo and NXHE 2-Stage Air Compressors
Scott Folsom, Director of Channel Development, FS-Curtis and FS-Elliott

Thermoplastic Piping for Use in Building Services Piping
Robert Marsiglia, Commercial Products Sales Manager, Asahi-America

Minimizing Downtime and Maximizing Performance with Airmatics IoT
Nicolas De Deken, President, Energair

Kingston Valves: Safely Protecting People, Processes, and Equipment
Theresa Hinkler, Regional Sales Manager, Kingston Valves

The Features and Benefits of Using Compressed Air Rentals
Jim Riley, Rental Sales Manager, Sauer Compressors USA

VPVision: the Next Level in Energy Management of Factory Utilities-Made Easy!
Pascal van Putten, CEO, VPInstruments

The Advantages of Aluminum Piping for Compressed Air Systems
Derrick Taylor, General Manager, PneuTech

Booster Compressor Sizing & Applications
Jerry Elsen, Sales Manager-Americas, BOGE America

Closed Loop Evaporative Systems
Keith Beatty, Regional Sales Manager, HydroThrift

WEDNESDAY, NOVEMBER 3 **1:00 PM – 5:30 PM**

Selecting the Right Technology for a Low Pressure Rental Project
Scott Werner, Business Development Manager, Aerzen Rental USA

Wireless Technology for Asset Monitoring
Nathan Eisel, National Product Development Manager, SMC Corporation of America

Next Generation Desiccant Dryers and Innovations in Intelligent Industrial Products in 2022
Tilo Fruth, President, BEKO Technologies

Touch-Free Technology-the Difference Between Oil-Free and Free-of-Oil
Hannu Heinonen, Vice President Americas, Tamturbo

See the Sound: Find Compressed Air System Leaks Using Fluke Acoustic Imagers
Aaron Woody, Product Specialist, Fluke

Energy Conservation with Ultrasound – A Hands On Experience
Dean Wolever, Regional Manager, UE Systems

The Advantages of VSD Controlled Refrigerated Dryers
Brian Mann, Air Systems Business Development Manager, Sullair

Oil-free Scroll Air Compressors for High Purity Air
Bob Groendyke, VP General Manager, Hertz Kompressoren USA

Maintenance Free Compressed Air Dryer
Matt Phillis, Regional Sales Manager, Van Air Systems

Technology/System Assessment Sponsors

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DIAMOND

BEKO
KAESER COMPRESSORS *Built for a lifetime.*

PLATINUM

PneuTech
JORC
hertz KOMPRESSOREN

GOLD

Sauer Compressors USA
Sullivan Palatek
Altec AIR
AST Applied System Technologies
SULLAIR
Parker

SILVER

MC midwest control an intech industries company
ECOPLANT
BAY
Nidec Nidec Motor Corporation
BASF We create chemistry
KINGSTON
FS-CURTIS Air Compressors
TRACE Analytics

Compressed Air & Gas Institute (CAGI)

Certified Compressed Air System Specialist (CCASS) Exam

Tuesday, 11/2 & Wednesday, 11/3 – 3:00PM **Thursday, 11/4 –** 8:30AM & 10:30AM

CAGI's personnel certification program for compressed air system specialists provides a means of verifying the capabilities of professionals in the compressed air systems industry. The program will allow customers, utilities, employers, and others to have confidence in the skills and abilities of the professionals in the industry who design, service, sell, and install compressed air systems and compressed air systems equipment. The program has been designed to comply with the ISO 17024 standard, Conformity Assessment – General Requirements for Bodies Operating Certification of Persons.

REGISTER NOW AND SAVE!

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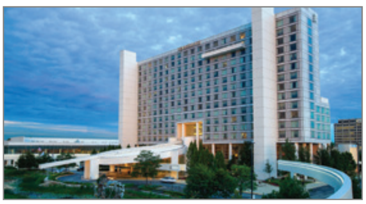
Limited Capacity – Early Bird Rates End on October 18!



Venue-Hotel-Travel

The modern Schaumburg Convention Center will host the entire event. It is a convenient 12 minute drive from Chicago O'Hare International Airport. The EXPO Hall is connected to the modern Renaissance Convention Center Hotel located in Schaumburg, Illinois. Hotel rooms can be reserved for a group rate of $179.00 per night. To make your reservation visit www.cabpexpo.com or call (847) 303-4100. Room block rate expires October 11.

The Daily EXPO $1,000 Energy Treasure Hunt RAFFLE!

The Daily EXPO $1,000 Energy Treasure Hunt Raffle is designed to reward the people who make Energy Treasure Hunts in manufacturing plants happen! We want to recognize equipment distributor sales engineers and service technicians, auditors/consultants/engineers and manufacturing plant personnel who are eligible. BE THERE, on both November 2 and 3, to WIN cash or cash equivalent prizes of:

1st Place ($500) • **2nd Place** ($250) • **3rd Place** ($250)

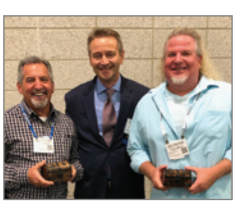
Step 1: Check Eligibility*

Step 2: Grab your Energy Treasure Hunt Raffle Card and collect a stamp from a minimum of ten (10) Energy Treasure Hunt SPONSOR BOOTHS.

Step 3: Bring your raffle card, before 5 pm, to the TREASURE HUNT RAFFLE STAGE and submit.

Step 4: BE THERE IN PERSON when names are called at 5:30 pm from the EXPO FLOOR RAFFLE STAGE on November 2 and 3.*

* Eligible to equipment distributor sales engineers/service technicians, auditors/consultants/engineers and manufacturing plant personnel who are registered attendees of the Best Practices EXPO or Conference. Contest organizer (BEST PRACTICES EXPO) reserves the right to determine contest eligibility. Winners must be physically present to claim prize.



Tate Engineering Systems had two air compressor sales engineers win treasure in 2019!

Registration Fees*

	Before 10/18/21	After 10/18/21
Expo Hall	$15	$15
Full Conference	$550	$675
Full Conference + Level 1 Compressed Air Challenge Workshop**	$550	$675
Single Day Conference	$290	$350
CAGI CCASS Exam	$450	$450

3+ GROUP DISCOUNTS

Contact Kimberly@airbestpractices.com

*Full conference registration includes access to all functions and meals. Single Day registration only includes access to functions and meals for that day. Expo Hall registration includes admission to expo floor.

**This registration is only open to distributor, engineering firm/consultant and manufacturing personnel.

Conference Schedule

MONDAY, NOVEMBER 1, 2021

6:00PM–8:00PM	Welcome Reception

TUESDAY, NOVEMBER 2, 2021

7:00AM	Registration Open
8:00AM–10:00AM	Conference Session #1 & CAC Level 1
10:15AM–12:00PM	Opening Session
12:00PM–6:00PM	**EXPO FLOOR OPEN**
1:00PM–5:30PM	New Technology EXPO Classroom
2:30PM–4:30PM	CAC Level 1
3:00PM	CAGI CCASS Exam
5:00PM–6:00PM	Show Floor Reception
5:30PM	Energy Treasure Hunt Raffle
7:00PM	Opening Night Networking Event

WEDNESDAY, NOVEMBER 3, 2021

8:00AM–10:00AM	Conference Session #2 & CAC Level 1
10:15AM–12:00PM	Plenary Session
12:00PM–6:00PM	**EXPO FLOOR OPEN**
1:00PM–5:30PM	New Technology EXPO Classroom
2:30PM–4:30PM	Value of the Person Workshop
3:00PM	CAGI CCASS Exam
5:00PM–6:00PM	Show Floor Reception
5:30PM	Energy Treasure Hunt Raffle

THURSDAY, NOVEMBER 4, 2021

8:00AM–10:00AM	Conference Session #3
8:30AM	CAGI CCASS Exam
10:15AM–12:15PM	Conference Session #4
10:30AM	CAGI CCASS Exam
12:15PM	Conference Adjourns