The Magazine for ENERGY EFFICIENCY in Blower and Vacuum Systems

BLOWER & VACUUM BEST PRACTICES

blowervacuumbestpractices.com

April 2020

INDUSTRIAL BLOWER & VACUUM SYSTEMS

AERATION BLOWER SYSTEMS

Go ahead. Talk data to me.

Integrated controls make collecting and communicating data faster and easier than ever.

We're not shy when it comes to talking data

For years we've led the industry in providing integrated controls. With a suite of sensors for complete package monitoring and the onboard Sigma Control 2™, our compressors', blowers', and vacuum packages' advanced communications capabilities take the guesswork out of connecting with plant controls.

If you're integrating IoT technology, let's talk.
Visit www.us.kaeser.com/bvbp to learn more.

Solving your system challenges.

KAESER COMPRESSORS®

Built for a lifetime.

Kaeser Compressors, Inc. • (866) 516-6888 • us.kaeser.com/bvbp

FEATURES

INDUSTRIAL BLOWER & VACUUM SYSTEMS

AERATION BLOWER SYSTEMS

COLUMNS

FROM THE EDITOR

Industrial Blower & Vacuum Systems

Aerzen's Matt Piedmonte has supplied us with an excellent "real-world" article detailing several rental blower/vacuum case studies, at pressures ranging from 14 Hg to 25 psig. In each situation, the use of rental equipment had a unique value proposition for the client.

Our own Mike Grennier hits it out of the park again with a fascinating article on a truly new dilute-phase pneumatic conveying technology, developed by the Conair Group. Most frequently used with plastic pellets, their new patent-pending Wave Conveying™ system was explained to Mike by their Conveying Product Manager, Doug Brewster.

Aeration Blower Systems

Tom Jenkins, from JenTech Inc., and Mike Grennier had the opportunity to interview Julie Gass, a Lead Mechanical Process Engineer at Black & Veatch in Kansas City. Their wide-ranging conversation covers her experiences with blower manufacturers, when to apply different blower technologies, and the new ASME PTC 13 Test Code. Enjoy!

For all of you who actually work the formulas and do the math determining which and how many aeration blowers are installed, we continue our engineering expert-level series of articles from Tom Jenkins. His latest installment is titled, "How to Calculate Aeration Blower Energy Costs."

We have announced the 2020 Best Practices Expo & Conference, September 20-23, at the Schaumburg Convention Center located in Chicago's convenient outskirts near O'Hare International Airport. Please consider registering for the event to learn and share "Best Practices"!

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

ROD SMITH
Editor
tel: 412-980-9901
rod@airbestpractices.com

2020 MEDIA PARTNERS

PFEIFFER VACUUM

The new dry pump by Pfeiffer Vacuum

HiScroll®

The extremely quiet, compact, oil-free pump. To reduce your carbon footprint.

Dry	Ideal backing pump for low final pressures. Free of grease, oils and hydrocarbons.
Sustainable	15% higher efficiency, less heat generation and lower cooling requirements.
Quiet	Low noise emission, low vibrations, self-regulating cooling.
Intelligent	Adapted performance through intelligent use of sensor technology.

We drive sustainable solutions.

130 YEARS PFEIFFER VACUUM 1890–2020

Are you looking for a perfect vacuum solution? Please contact us:
Pfeiffer Vacuum, Inc. · USA · T 800-248-8254 · contact@pfeiffer-vacuum.com · www.pfeiffer-vacuum.com

BLOWER & VACUUM TECHNOLOGY PICKS

Busch Vacuum Pumps Operating at Hospital in Wuhan, China

The Huoshenshan Hospital attracted worldwide attention at the beginning of the month. It was built in just a few days in the Chinese city of Wuhan to accommodate patients infected with the coronavirus. The hospital has been officially in operation since February 3, 2020. Busch Vacuum Solutions supplied twelve vacuum pumps for the central vacuum supply of the entire hospital, and they were installed within two days.

In response to the coronavirus epidemic in Wuhan, the authorities quarantined the entire city on January 23. The construction of Huoshenshan Hospital started on the same day. A total of 4,000 workers were deployed during the construction phase, working around the clock in three-shift operation. Busch delivered the vacuum pumps on February 1. They were assembled on site to form a central vacuum system. Via a pipeline network, this system supplies the entire hospital with vacuum for the extraction of body secretions and virus-infected breathing air.

The hospital was officially opened on February 3. Since Monday, the hospital has been fully occupied with 1,000 patients. A total of up to 1,400 medical professionals are expected to work in this hospital. Some of them will have been recruited from the army. However, many volunteers from all over the country have also signed up to work in the hospital. The construction of a second hospital in Wuhan was started at the same time but has not yet been completed.

Vacuum pumps from Maulburg during the installation at Huoshenshan Hospital in Wuhan.

The Chinese employees who installed the vacuum pumps have either returned home after their assignment or are still staying in hotels. In both cases they are under quarantine and may only leave their accommodation with official permission. However, there have not been any cases so far of Chinese Busch employees being infected with the coronavirus. The vacuum pumps have been running day and night since February 3. The engine room in which they are housed may only be entered by authorized personnel of a state company under considerable safety precautions.

Busch has been supplying hospitals in China with vacuum pumps for a long time. Only last November, a Chinese delegation of state hospital operators and manufacturers of medical vacuum supply systems visited Busch in Maulburg to find out about the latest vacuum technology. Many Chinese hospitals are equipped with outdated vacuum pumps made in China that use water as an operating fluid. This carries the risk that viruses or bacteria can accumulate in the water circuit and escape from the pumps under unfortunate circumstances, such as leaks, or during maintenance work. Busch, on the other hand, supplies vacuum pumps that manage completely without operating fluids and are run at high temperatures that kill viruses or bacteria. But the major significance of this technical distinction was not yet apparent when the Chinese delegation visited Maulburg at that time. A vacuum specialist from Maulburg has since traveled to China to advise hospital operators there and support local Busch employees.

About Busch Vacuum Solutions

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. The Busch product range offers the largest selection of industrial vacuum pumps available in the world today. We offer more than 50 years of experience and expertise in vacuum system manufacturing and can provide customized solutions for a variety of vacuum applications. For more information, visit www.buschvaccum.com.

Leybold Launches Two Vacuum Calculation and Simulation Tools

Vacuum technology specialist, Leybold, has developed two new online tools to assist customer's pump choice and layout of complete vacuum systems: The Pump Finder and the calculation tool LEYCALC. With these new web-based tools, users can select and build their vacuum solutions online. They are designed to be used for two different use cases: The homepage leads to both the Pump Finder and LEYCALC, the vacuum system calculation tool. Users with vacuum know-how can use LEYCALC to calculate the behavior and performance of vacuum systems in detail. The Pump Finder guides even beginners to suitable products by a questionnaire.

The Pump Finder is designed to navigate vacuum users step-by-step to find the ideal pump for their application. Throughout the selection tool, pumps can be refined by entering values for chamber size, target pressure and pipe dimensions. There are two calculation options for modelling different vacuum applications: process flow and vacuum chamber pump down. A process gas flow is a continuous gas flow where the constant pressure is conveyed. A vacuum chamber pump down is an application where the chamber is pumped/evacuated to a specific target pressure. The result is a selection of vacuum pumps that meet the customer's requirements.

LEYCALC can be used for detailed engineering of vacuum systems using the same powerful algorithms as Leybold's application experts. The tool allows customers to calculate their vacuum systems fully independently and for complex scenarios, the experts offer their full support.

LEYCALC can be used for detailed engineering of vacuum systems using the same powerful algorithms as Leybold's application experts.

BLOWER & VACUUM TECHNOLOGY PICKS

"Previously, we had to adjust parameters such as chamber size, process gases, cycle times, pipe length and pressure values during the initial contact with the customer. With the help of the simulation software, the user can independently calculate configurations and get an initial idea of the vacuum performance," said Dr. Tom Kammermeier, Global Application Manager, Industrial Vacuum. "In the past, there were often lengthy dialogues about such details," says Kammermeier. Now users can perform their calculations independently – with the result that the entire process leads to a more targeted and faster selection of the right solutions for the application. "We expect LEYCALC to improve the contact quality with our customers," said Kammermeier.

Once the user of the online tool has defined the pump's chamber and the target pressure, LEYCALC performs the calculation of a pump down curve: The result is immediately displayed in a diagram. This shows exactly how long it takes to pump the air out of the chamber to a defined pressure and how the pressure develops over time. Alternatively, the user can calculate the pumping speed curve of a pump system. This shows which pumping speed is provided at a certain pressure. All calculation data is stored centrally and can be called up at any time and from any device by customers who have registered. Calculation results can also be shared with specialists at Leybold. This allows a detailed discussion about the respective vacuum application. Overall, the platform leads to considerably more efficient customer communication and faster solutions in complex projects. Leybold's vacuum experts will be happy to answer any questions regarding specific calculations in a timely fashion.

"In addition to the chambers and pumps of a vacuum system, the different influences of pipelines are also taken into account. These include the conductance effects in all pressure ranges and flow regimes, blocking and, of course, the volume of the lines," said Hannes Kamecke, the IT manager responsible for the online configurator. In some cases, it then becomes apparent that a pump with higher individual performance would not improve the overall vacuum performance because the reductions are caused by an incorrectly dimensioned pipeline. "However, the diagram immediately shows that the pipe diameter needs to be increased," said Hannes Kamecke.

Navigation through the web-based software solution is conveniently possible on all kind of devices like tablets, smartphones. Sections in need of explanation are linked to more detailed background information on vacuum technique. In future, LEYCALC will comprise the whole Leybold product portfolio, covering also high vacuum applications. "With the publication of the new calculation tools, Leybold makes its vacuum know-how collected over decades available to its customers and thus lays the foundation for modern digital customer communication. The offer thus represents an important building block in the digital customer experience strategy of the vacuum specialist," said Hannes Kamecke.

Further Information can be obtained via the homepage https://calc.leybold.com/en/lp.

About Leybold

Leybold is a part of the Atlas Copco's Vacuum Technique business area and offers a broad range of advanced vacuum solutions for use in manufacturing and analytical processes, as well as for research purposes. The core capabilities center on the development of application- and customer-specific systems for the creation of vacuums and extraction of processing gases. Fields of application are secondary metallurgy, heat treatment, automotive industry, coating technologies, solar and thin films such as displays, research & development, analytical instruments, food & packaging, as well as a multitude of other classic industrial processes. For more information, visit www.leybold.com.

EXAIR Announces Larger 303SS Air Conveyor

EXAIR's new Type 303 Stainless Steel 2-1/2 NPT Threaded Line Vac Air Operated Conveyors convert ordinary pipe into a powerful conveying system for parts, scrap, trim and other bulk materials. They are ideal for food, chemical, pharmaceutical and medical processes or areas likely to be wet and corrosive which require the benefits of 303SS including excellent chemical and corrosion resistance, performance in higher temperatures, long service life and low

The Threaded Line Vac is designed to attach to standard plumbing pipe couplers.

maintenance. Their larger size makes them perfect for conveying bigger parts and large volumes of material over long distances. The Threaded Line Vac is designed to attach to standard plumbing pipe couplers, making it easy to build a complete system using common pipe and fittings that are readily available.

Threaded Line Vac Conveyors eject a small amount of compressed air to produce a vacuum on one end with high output flows on the other. Response is instantaneous and regulating the compressed air pressure provides infinite control of the conveying rate. Applications include scrap trim removal, material conveying, part transfer, fiber tensioning and filling operations.

2-1/2 NPT 303SS Threaded Line Vacs are CE compliant and meet OSHA pressure requirements. The complete size range is 3/8 NPT through 3 NPT. Threaded Line Vac models are also available in type 316 stainless steel for even more demanding high temperature, corrosive and hygienic environments. See EXAIR for the large variety of Air Operated Conveyors available including Light Duty, Standard, Threaded, Heavy Duty, and Sanitary Flange. 303SS Threaded Line Vac prices start at $327.00.

About EXAIR Corporation

EXAIR Corporation was incorporated in 1983 as a manufacturer of compressed air-operated products to solve problems in industrial plants. Our product line includes Vortex Tubes and applied products utilizing Vortex Tubes, Air Amplifiers, Air Knives, air-operated vacuums, ionizing products for static elimination, and liquid atomizing nozzles for product cooling, coating, cleaning and painting. We are an American-owned company located in a suburb of Cincinnati, Ohio. For more information, visit www.exair.com.

Edwards New ELRi Liquid Ring Vacuum Pump

Edwards Vacuum has combined its years of comprehensive know-how and innovative technical expertise to develop a revolutionary range of new liquid ring pumps – the ELRi series. Megha Ajmal, Product Manager for Rough Vacuum products said "made for applications which are wet, humid, as well as corrosive, this product offers a range of features and benefits that will distinguish itself from other competitor pumps in the market. From the ability to optimize processes to save energy, ELRi complements our range of solutions we offer for the industrial and rough vacuum markets."

The technical features are of central importance in this new development. The stainless-steel impeller, endplates, liquid reservoir and heat exchanger makes this pump highly resilient against corrosion and harsh process gases. The internal injection channels reduce the risk of leakage while the horizontal motor flange arrangement saves precious time on maintenance. Use of mechanical seals also ensure reliable operation by preventing leaks as well as extending service intervals. All this state-of-the-art technology is contained in a compact noise cancelling sturdy canopy protecting and extending lifetime of the electronic components.

The ELRi is equipped with not just one but two VSDs. While the main VSD matches the speed of the pump to vacuum level by adjusting its speed, the second VSD regulates the water flow through the centrifugal pump

BLOWER & VACUUM TECHNOLOGY PICKS

according to the operating conditions to avoid risks of cavitation. A patented algorithm always maintains a perfect harmony between the two VSDs ensuring optimal performance. In addition, it is protected against automatic seizure, so users do not have to worry about the pump failure after long periods of inactivity.

The integrated Air logic controller not only enables the monitoring of important features and parameters of the pump but also offers the option of set-point control. This allows users to have a vacuum pump that matches the process demand saving energy. While the ECOntrol box even allows you to connect and control multiple ELRi pumps, the Icon Box enables smart monitoring and remote controlling ensures optimal servicing to get maximum uptime with your pumps. Along with this, water consumption is also reduced as the separator is only filled up when required.

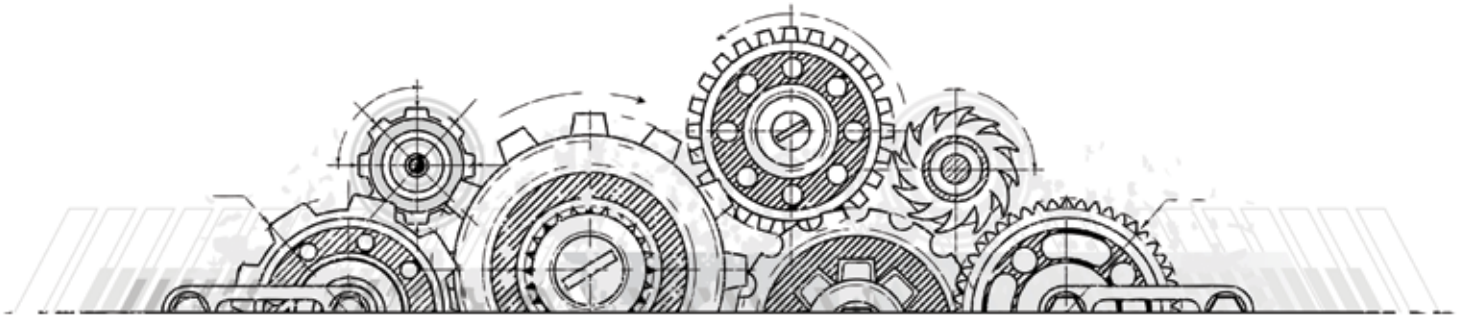
The ELRi series comes in a pumping capacity of 750-1050 m3/hr and covers a wide range of applications in the central vacuum, pharmaceutical, plastics, conveying and food applications. Speaking about the range of pumps offered, Megha Ajmal said "while the standard range of pumps is a perfect solution of general industrial applications, our Heavy-Duty range is designed with all process wetted parts to be stainless steel." All pumps are also fitted with spray nozzles as standard, which are particularly useful for high steam load applications allowing to pump an increased capacity of gas load." Moreover, the manual and automatic modes of flushing allow operation in even in the dirtiest applications with minimal downtime.

ELRi liquid ring vacuum pump by Edwards Vacuum.

About Edwards

Edwards is a leading developer and manufacturer of sophisticated vacuum products, exhaust management systems and related value-added services. Edwards solutions are integral to manufacturing processes for semiconductors, flat panel displays, LEDs and solar cells. They are also used within an increasingly diverse range of industrial processes including power, glass and other coating applications; steel and other metallurgy; pharmaceutical and chemical; and for scientific instruments in a wide range of R&D applications.

In 2019, Edwards was celebrating its 100-year birthday. The founder, FD Edwards, began by importing vacuum equipment from a small office in South London. 100 years later Edwards has over 6,000 employees worldwide engaged in the research, design, manufacture and support of high technology vacuum and exhaust management equipment. Edwards has state-of-the-art manufacturing and technology facilities in Europe, Asia and the Americas. For further information about Edwards products please visit www.edwardsvacuum.com.



BEST PRACTICES

2020 EXPO SEPTEMBER 20-23 CHICAGO, IL

COMPRESSED AIR / VACUUM / COOLING

OPTIMIZE ON-SITE UTILITIES

Powering Automation

Research and Identify Innovations

to Enhance the Efficiency and Reliability of Your Systems

Compressed Air

Air Compressors
Air Compressor Controls
Air Purification & Piping
Condensate Management
Pneumatics

Blower & Vacuum

Aeration Blowers
Industrial Blowers
Vacuum Pump Systems
Inlet Filtration/Oil Separators

HVAC & Process Cooling/Steam

Chillers
Heat Exchangers
Cooling Systems
Cooling Towers
Water Treatment
Boilers
Steam Traps

Motors & Drives • Lubricants • Measurement Instruments • IoT Automation & Monitoring

EXPO HOURS

Monday, September 21 12:00-6:00pm

Tuesday, September 22 12:00-6:00pm

SAVE THE DATES ON YOUR CALENDAR!

Located at the modern Schaumburg Convention Center just 10 minutes from Chicago O'Hare International Airport.

cabpexpo.com

Sponsored by CAGI Compressed Air & Gas Institute

AERATION BLOWER SYSTEMS

BLACK & VEATCH: ENSURING AERATION BLOWERS Meet the Needs of Wastewater Treatment Plants

BY TOM JENKINS AND MIKE GRENNIER, BLOWER & VACUUM BEST PRACTICES MAGAZINE

Julie Gass, P.E., is a Lead Mechanical Process Engineer at Black & Veatch and an industry veteran with extensive experience in mechanical equipment in wastewater treatment plants. She also served on the American Society of Mechanical Engineers (ASME) Committee responsible for ASME PTC 13, Wire-to-Air Performance Test Code for Blower Systems, which is the performance test code published in October 2019 for all blower technologies. Blower & Vacuum Best Practices Magazine interviewed Gass to gain her views on aeration blowers, PTC 13, and the firm's rigorous specification process to ensure treatment plants get the blower best suited for their application.

> "In my view, blower manufacturers have been very responsive to the needs of treatment plant owners."
>
> — Julie Gass, Lead Mechanical Process Engineer, Black & Veatch

Good morning. Please describe Black & Veatch.

Black & Veatch is a global employee-owned engineering, procurement, consulting and construction company headquartered in Overland Park, Kansas. I work in our Water building, located in Kansas City, Missouri, which is about 15 minutes from our headquarters building. Black & Veatch was founded over 100 years ago in 1915 and is ranked as one of the world's largest wastewater construction and engineering firms.

BLACK & VEATCH

Black & Veatch's design experience in the industry includes primary, secondary, and tertiary treatment; wet-weather flow treatment; effluent reuse; ozonation; ultraviolet disinfection; aerobic and anaerobic digestion; nutrient removal and recovery; and odor/air emissions control. We also have extensive experience in advanced process options, such as biological aerated filters, membrane bioreactors, moving bed biofilm reactors, and integrated fixed-film activated sludge. In addition, we excel in all aspects of biosolids management.

We engage with clients on all different types of projects, whether it's stand-alone jobs, or

Julie Gass, Lead Mechanical Process Engineer, Black & Veatch.

FREE SUBSCRIPTION

DIGITAL EDITION FREE WORLDWIDE | PRINT EDITION FREE TO U.S. SUBSCRIBERS

You'll get **FOUR ISSUES** this year!

EVERY ISSUE CONTAINS BEST PRACTICES FOR

Industrial Vacuum • Vacuum Generation • Industrial & Aeration Blowers • Blow-Off Air

Subscribe at **blowervacuumbestpractices.com**

Subscribe Now!

EVERY ISSUE CONTAINS BEST PRACTICES FOR

Cooling Towers • Central Plant Chillers • Cooling System Components

Subscribe at **coolingbestpractices.com**

Subscribe Now!

BLACK & VEATCH: ENSURING AERATION BLOWERS MEET THE NEEDS OF WASTEWATER TREATMENT PLANTS

designing, installing, and commissioning new or upgraded treatment facilities.

How would you assess blower manufacturers' ability to the meet the needs of wastewater treatment plants today?

In my view, blower manufacturers have been very responsive to the needs of treatment plant owners.

For example, gearless high-speed turbo blowers were one of the first technologies to offer better efficiency for small-to medium wastewater treatment plants when they first came out. Size classifications are rather arbitrary, but, in my mind, a small treatment plant is a facility that typically uses blowers that are each sized for 2,000 scfm or less. Medium-sized plants are operations with blowers from 2,000 to 10,000 scfm each. A larger plant is one with each blower sized for 10,000 scfm or more. The availability of gearless turbo blowers was significant because there weren't too many choices for improved energy efficiency for these plants and they tended to rely on Positive Displacement (PD) or multistage centrifugal blowers.

In terms of newer technologies – like the gearless high-speed turbo blowers with non-contact bearings – they're not perfect, but nothing ever is. We all know there were some issues with the early generations of blowers of this type. However, I have to give credit to the manufacturers. They've all made improvements and continue to make improvements in one way or another to ensure reliability and make customers happy. Some are focusing on improving Variable Frequency Drives (VFDs) and some are focusing on other parts of the machine. I think everyone is more focused on energy efficiency than even 10 years ago because, of course, electricity keeps going up in price.

On the topic of blower technologies, what determines whether a PD or centrifugal blower is best suited for a particular aeration application?

The biggest contributor to the machine's discharge pressure requirement is the depth of the water level requiring aeration.

BLACK & VEATCH: ENSURING AERATION BLOWERS MEET THE NEEDS OF WASTEWATER TREATMENT PLANTS

A PD blower is a good candidate for any application where the water level varies significantly because it will produce whatever pressure is required to overcome the backpressure of within the range of the machine. One example is an activated sludge processing using sequencing batch reactors (SBRs). We've also used high-speed turbos for SBRs and they have worked well. SBRs call for frequent starts and stops, which can be challenging for some gearless turbo air bearing machines.

In an aeration basin where you have more of a constant water level, it's often better to go with a centrifugal blower, whether it's an integrally geared, single-stage machine or a gearless turbo. While centrifugal machines have a pretty narrow pressure range, they are typically more efficient than PD machines. You can still install a centrifugal machine with some variation of water level, but that's going to require more careful blower selection and more engineering.

It's also not uncommon to see different blower technologies at the same treatment plant serving different processes, with the machine type being based on what best fits the process requirements.

Have you seen plants where mixed technologies discharge air into a common header for activated sludge aeration?

We've done that before, and usually it's a situation where a plant has an older blower technology in place and wants to add a new, more efficient technology to the mix without incurring the capital cost required to replace all of their blowers.

For example, take a plant that has a lot of older multistage centrifugal blowers. They really don't have the capital to replace all units, yet they want something more efficient. We'll look at the annual average airflow requirement, among other things, and say, "What if we put in a new technology to meet the annual average requirement by itself under normal conditions? And then, under those maximum conditions, you run the old and new technology in parallel?"

Of course, the older technology won't be as efficient as the new blowers, but if you're only running the older machines maybe one month out of the year in total it still gives the plant a lot of improvement in blower efficiency and power consumption. The plant can then quickly recover their capital outlay for the new machines in energy savings. We've done that on a few occasions.

Have you changed how you write specifications for blowers based on ongoing developments in blower technologies?

We continually revise our blower specifications. Available blowers change, we learn more about them, different features work well for some clients but not others, etc.

We like to do a lifecycle cost evaluation early in the design of a system to determine which technology will be the lowest lifecycle cost and then write our specification around the selected technology, as well as number and size of blowers. We've suggested our clients factor in the lifecycle cost of equipment, not just the capital costs by doing an evaluated bid. We're doing that more and more because end users see the benefit as electricity costs continue to increase. This is especially important if one vendor's blowers consume significantly less energy than another.

Of course, there are many complexities with performance specifications. One example is with non-contact bearing machines there are air bearing and magnetic bearing options.

"We found the best way to ensure we get an experienced integrator on the project is to have the blower manufacturer responsible for the entire aeration control system."

— Julie Gass, Lead Mechanical Process Engineer, Black & Veatch

The challenge is that clients either want, or they're required to have competition written in the spec, but there aren't a lot of vendors with a long experience list with magnetic bearing machines. Our typical policy is for a new vendor or technology to have five years of operating experience before we name them in our spec, but we have not always lived by that because there are many unique situations where the process or building limitations will work only with a new technology. In that case, we explain the risks to our client and write the specification in a manner that helps mitigate risks to the extent possible.

Another development impacting specifications is ASME PTC 13, which would allow us to bid some type of rotary positive displacement blower against a gearless turbo machine, for example, if desired. PTC 13 by intent is technology-neutral, so energy use for any type of blower can be compared to any other type. In a case such as this, the layout would need to allow for either blower type being considered so it may not be practical or cost effective to bid multiple technologies in some cases.

Speaking of PTC 13, congratulations to you and others on the PTC 13 Committee on your accomplishment.

I'm very happy to see PTC 13 published. I anticipate it will most commonly be used as a guide for an after-the-sale test to determine whether the manufacturer of the entire blower package has met power guarantees. If testing shows guarantees are not met, there are typically financial penalties written into the specification to protect the customer. That's why it's important to identify all of the components to be tested in the purchased blower package to be run at the manufacturer's test facility.

With the older technologies, you would have a blower and a motor. Often, the blower didn't even include special cooling equipment and the motor might be a NEMA premium efficiency motor for which efficiency requirements are well defined and established. With newer technologies, however, you have a lot of ancillary power

BLACK & VEATCH: ENSURING AERATION BLOWERS MEET THE NEEDS OF WASTEWATER TREATMENT PLANTS

consumers. As an example, a machine might have a high-speed permanent magnetic motor and the efficiencies of those vary from one manufacturer to another. It's not as standardized as a NEMA-rated motor and then the VFD has to be specific for that type of high-speed motor so the power losses associated with it need to be considered, as well. And then you have things like harmonic filters, silencers, air filters, and the special cooling equipment I mentioned and so forth.

PTC 13 provides guidance for testing all the components of an entire packaged system and its overall energy consumption in order to get reliable and repeatable results. The older performance test code, PTC 10, was pretty much geared for constant-speed machines without all the ancillary electrical equipment in particular. Witnessed performance tests are important to verify performance and to detect any issues before machines get into the field where they're more difficult to correct. Witnessing performance tests is especially important for large machines, new technology machines, or machines where the original equipment manufacturers have been bought out by a manufacturer who may be less familiar with the technology.

Will PTC 13 change the need for witnessed performance tests?

Years before PTC 13 existed, we typically only required witnessed performance tests on machines from 500 hp and above, due to the cost of testing and the percentage of the total equipment costs.

But we started recommending witness testing on smaller-size machines after the industry saw manufacturers buying other manufacturers with different technologies. We wanted to ensure these machines worked like they were supposed to work before they got in the field. Then, new technologies like gearless turbos came out. The manufacturers often did not yet have much of a knowledge base for how their machines would perform and there was not a standardized performance test code that addressed the technology. That's when we pretty much said we're going to recommend a witness performance test on gearless turbo machines regardless of the size, although there are some exceptions that.

I think the machine size at which we insist a witnessed performance test be performed will start to go back up again as we all become more confident with PTC 13, or maybe we see that a manufacturer has done ten projects and they've never failed a PTC 13 test. Obviously, PTC 13 just came out so that will be a few years down the road.

You mentioned the importance of knowing whether a technology is proven when writing specs. What else does Black & Veatch do to ensure things go well when specifying blowers?

As far as proving technology works in the field, we'll check references by talking with plants who have had a certain technology installed for a period of time to see what their experience has been with it.

We also like to see manufacturers with their own Research & Development department rather than a company that just does "reverse engineering" of somebody else's equipment design.

Another thing we do is carefully assess the experience of the systems integrator involved on the aeration controls. We used to allow aeration controls to go out to the low-bid integrator, but we've changed our approach. We want to see an experienced integrator on our projects. You might have an integrator who is good at programming PLCs, but what if they've never seen a wastewater treatment plant? That can cause problems.

We found the best way to ensure we get an experienced integrator on the project is to have the blower manufacturer responsible for the entire aeration control system. Many of the manufacturers now have controls people on staff to do that. If they don't, we want to see if they have an established relationship with an experienced integrator. In some cases, the specification might list three integrators and require they use one of them without exception because we've had success with them. Aeration controls have become too important to rely on a firm without the proper level of experience in wastewater treatment applications because controls are also very important for the overall efficiency of the system. BP

Thank you for these insights.

For more information, please contact Julie Gass, email: GassJV@bv.com, or visit www.bv.com.

All photos courtesy of Black & Veatch.

To read similar ***Wastewater Treatment*** articles, please visit https://blowervacuumbestpractices.com/industries/wastewater

BLOWER & VACUUM

BEST PRACTICES

blowervacuumbestpractices.com

FREE SUBSCRIPTION

DIGITAL EDITION FREE WORLDWIDE | PRINT EDITION FREE TO U.S. SUBSCRIBERS

EVERY ISSUE CONTAINS BEST PRACTICES FOR

Industrial Vacuum • Vacuum Generation
Industrial & Aeration Blowers • Blow-Off Air

Subscribe at **blowervacuumbestpractices.com**

Subscribe Now!

INDUSTRIAL BLOWER & VACUUM SYSTEMS

LEVERAGING RENTAL BLOWERS FOR Pneumatic Conveying Applications

BY MATT PIEDMONTE, AERZEN RENTAL

To avoid problems caused by flooding, a company rented a positive displacement blower with a VFD to move material and boost throughput.

Pneumatic conveying applications are critical to many facilities – when you can't move material you can't make or sell your product. Because of a historical lack of availability of specialized rental blowers and air compressors for pneumatic conveying, plants often either accepted the production outage or rented a more readily available two-stage, oil-free rotary screw air compressor designed for 90 to 150 psig plant air service that is very inefficient at the reduced pressures needed for pneumatic conveying.

Misapplying one of these plant air machines can result in an energy cost of three to 10 times greater than the appropriately applied positive displacement blower/single-stage oil-free rotary screw air compressor that is designed for pneumatic conveying applications – not to mention considerably higher rental rates and a larger footprint.

Here are examples of facilities that sustained production by renting positive displacement

> "Plants can rent equipment designed for peak efficiency in a wide range of pneumatic conveying applications and should never accept an extended outage or the wrong type of rental equipment."
>
> — Matt Piedmonte, Aerzen Rental

blowers/single-stage, oil-free rotary screw air compressors specifically built for positive pressure or vacuum pneumatic conveying applications.

Case Study No. 1 – Wrong Machine Purchased

A bakery purchased a blower to offload trucks based on design criteria of 800 cfm at up to 14.5 psig. Under these conditions, it was taking up to four hours to offload a truck. Further review revealed a higher pressure was required to speed up the offload process. A single-stage, oil-free rotary screw rental air compressor capable of 1,000 cfm at 29 psig with an onboard Variable Frequency Drive (VFD) was rented to validate the ideal compressor capability needed for the permanent installation. It was determined that at about 800 cfm and 17 psig they could reduce truck offload time to 1.5 hours. The bakery continued to utilize the rental machine to reduce offload times while the new machine was ordered and installed.

Case Study No. 2 – Production Shifted to Other Facilities

Historical flooding hit the Mississippi River in the Spring of 2019 and barge traffic was suspended. Some facilities were unable to move material in, or product out, and could not meet their contractual supply commitments. One plant creatively shifted production into another facility that was not impacted by the flooding; however, they lacked the infrastructure to offload the additional volume of railcars at that facility. The plant rented a positive displacement blower with an onboard VFD capable of 500 to 2,100 cfm at 9.8 psig for just a few months to continue moving material and increase throughput.

A bakery reduced truck offload time by replacing the wrong blower with a single-stage, oil-free rotary screw rental air compressor.

When an air compressor airend failed, a cement company didn't miss a beat by renting a single-stage, oil-free rotary screw air compressor.

LEVERAGING RENTAL BLOWERS FOR PNEUMATIC CONVEYING APPLICATIONS

Six rented positive displacement blowers allowed a ship to meet its offloading schedule when its offloading vacuum system unexpectedly failed.

A rental blower helped a plant verify the benefits of a blower system upgrade.

Case Study No. 3 – Compressed Air Airend Fails

A cement plant utilizing a single-stage, oil-free rotary screw air compressor to deliver 2,000 cfm at 25 psig to move raw material to the pre-heater tower experienced an unanticipated airend failure. With no redundancy installed, the plant faced an outage while the airend was being repaired. The plant rented a single-stage, oil-free rotary screw air compressor with an onboard VFD that matched the performance of their failed machine and allowed production to continue for several weeks until the airend was returned and reinstalled.

Case Study No. 4 – Major Rotor Failure on Vacuum System

A ship was pulling into port with 8,000 tons of aluminum to be offloaded, but the offloading vacuum system had experienced a major failure that would take three to four weeks to resolve. The ship needed to be offloaded within the planned time interval. The needs were quantified at about 16,000 cfm at about 14 inches of mercury (Hg) vacuum pressure. The facility brought in six rented positive displacement blowers set up for vacuum operation and completed the offload in the timeframe needed.

Case Study No. 5 – Product Flow Not Meeting Expectations

The plant utilizes a fixed-speed blower in a closed-loop nitrogen system to maintain the integrity of PET granules being conveyed. They were not satisfied with the flow of the product and wanted to explore the effects of different flow rates. The plant rented a blower with an onboard VFD capable of closed-loop service between about 600 cfm to 1,500 cfm and up to 14.5 psig discharge pressure. This allowed them to prove there would be a benefit in upgrading their blower system.

Rental Machines Well Worth the Investment

In all five cases, the customer rented machines ideally suited for their applications and the total cost of the rental was minuscule compared to the cost of a production interruption and at a fraction of the total rental cost associated with renting the wrong machine.

Plants can rent equipment designed for peak efficiency in a wide range of pneumatic conveying applications and should never accept an extended outage or the wrong type of rental equipment. In addition, rental machines are a great way to experiment with the effects of varying flow on a process. BP

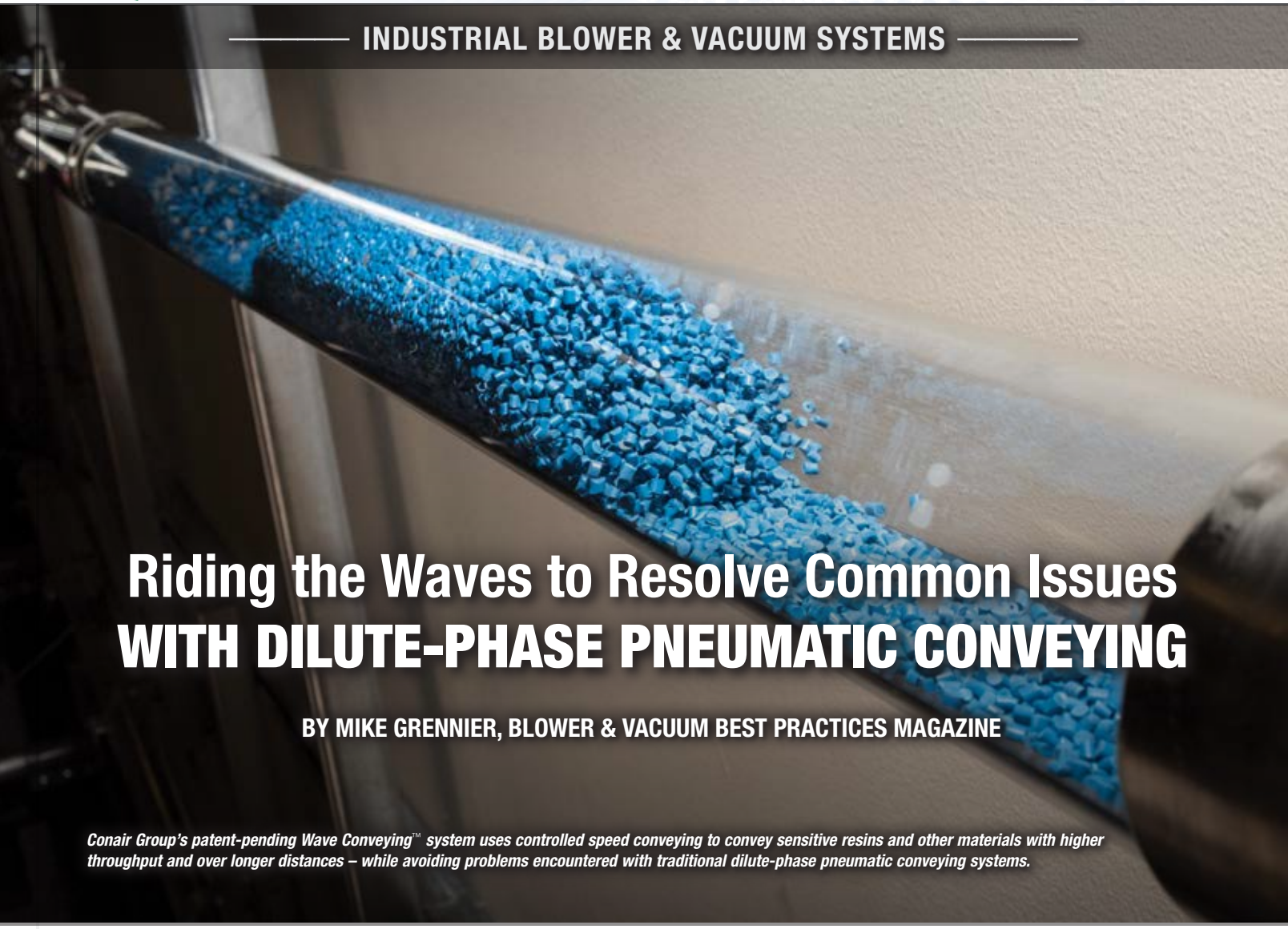
About Aerzen Rental

Specializing in temporary oil-free blower and compressor solutions under 50 psig, Aerzen Rental supplies 100% oil-free air solutions specializing in emergency response and long-term capital avoidance. Aerzen Rental provides best-in-class packages engineered for aggressive rental environments with on board VFDs, remote monitoring, and outdoor builds with sound attenuating enclosure as standard. From rental units for immediate deployment in the event of a production failure or shortfall, to operational leasing and contracting, Aerzen Rental is your expert partner. For more information About Aerzen Rental, contact Rental-USA@aerzen.com; tel: 1-844-400-AERZ (2379), or visit www.aerzenrentalusa.com

All photos courtesy of Aerzen Rental.

To read similar articles on ***Pneumatic Conveying***, please visit https://blowervacuumbestpractices.com/system-assessments/conveying

INDUSTRIAL BLOWER & VACUUM SYSTEMS



Riding the Waves to Resolve Common Issues WITH DILUTE-PHASE PNEUMATIC CONVEYING

BY MIKE GRENNIER, BLOWER & VACUUM BEST PRACTICES MAGAZINE

Conair Group's patent-pending Wave Conveying™ system uses controlled speed conveying to convey sensitive resins and other materials with higher throughput and over longer distances – while avoiding problems encountered with traditional dilute-phase pneumatic conveying systems.

A long-held practice in the plastics industry is the use of high-speed, dilute-phase pneumatic conveying to deliver plastic resins to plant processes even if those same materials are the kind that can create problems ranging from excessive dust to damaged resins and more. All the while, slower-speed conveyance is normally unthinkable given production goals and the potential for plugged conveyor lines.

Yet, Conair Group, has developed a system that emphasizes the use of varied speeds – including slow-speed, dense-phase conveying – as way to avoid common pitfalls encountered with sensitive resins and other materials conveyed at high speeds, while also increasing throughput rates and saving energy.

"Our system modulates the velocity and density of the material stream pulled through the conveying line so that a higher volume of pellets can be conveyed in slow-moving waves, or what can also be thought of as vertical pistons."

— Doug Brewster, Conveying Product Manager, Conair Group

Blower & Vacuum Best Practices Magazine visited with Doug Brewster, Conair Group's Conveying Product Manager at the company's plant in Cranberry Township, Pennsylvania, to learn how the company's system breaks with conventional practices to overcome challenges with materials that don't stand up to high-speed dilute-phase conveying.

Good morning! Tell us about Conair Group.

We're a global supplier of auxiliary equipment and solutions for plastics processors. We manufacture 450 different products, including resin-drying systems, blenders, feeders and material-conveying systems, temperature-control equipment and granulators. We also offer a variety of extrusion solutions and we excel at plastics process integration, engineering and the installation of complete manufacturing systems designed to help processors manage raw materials and manufactured parts, while improving process yield.

In addition to our Pennsylvania plant, we have manufacturing, service and sales operations throughout the United States, China and India. We also have sales and service offices in Mexico, Singapore and Taiwan.

Describe conventional, dilute-phase vacuum conveying in use today.

Dilute-phase conveying commonly involves airflow velocities as high as 5,000 to 6,000 feet per minute (fpm) with corresponding vacuum pressures from five to 12 inches of mercury (Hg).

With conventional dilute-phase conveying, materials usually enter the airstream of the system at around 3,000 fpm and then build up to velocities as high as 6,500 fpm.

Conventional dilute-phase conveying like this is very useful and used throughout the world for a wide variety of materials. However, high-speed dilute phase conveying can be problematic with sensitive materials, including common plastics resins like Polyethylene (PE), Polyethylene Terephthalate (PET), Polypropylene (PP) and Polyethylene Terephthalate Glycol (PTEG), as well as well as Long Glass Fiber (LGF) and mineral-filled resins.

RIDING THE WAVES TO RESOLVE COMMON ISSUES WITH DILUTE-PHASE PNEUMATIC CONVEYING

Issues with dilute-phase conveying led us to develop a patented dense-phase conveying system we call Wave Conveying™ because it essentially pulls pellets through the conveying line in bursts of slow velocities versus a dilute-phase conveying system where the pellets travel individually through the line at consistently high speeds. It solves a lot of these issues.

Why do problems occur with dilute-phase conveying and sensitive materials? What issues are typically encountered?

It all has to do with what's happening with materials within a high-speed dilute-phase conveying line.

With dilute-phase conveying, pellets are suspended toward the top of the airstream, while others scrape and slide along the bottom of the conveyor pipe. This creates friction, which generates heat. In turn, it causes the pellets to soften and form angel hair, which are long streamers that can clog the conveying system and block material flow.

At high speeds, there is also a lot of pellet degradation because the pellets collide with each other. They also collide with elbows in the piping. This generates dust, which leads to a number of problems such as product quality and unnecessarily frequent maintenance to clean dust collectors. It also can damage the screws and molds of plastics processing machines. This friction also causes wear in the conveyor lines.

Another issue has to do with the distance from the material pickup point to the process in the plant, which is limited with dilute-phase conveying. When you get beyond 600 feet, positive displacement vacuum pumps either run out of pressure, or the line velocities are so high they create a tremendous amount of dust and/or angel hair. It's why applications with longer distances typically require the installation of additional equipment, electrical power, and compressed air at an intermediate point to effectively convey materials to the final destination.

Describe Conair Group's solution and how it differs from a conventional dilute-phase conveying system.

Our system modulates the velocity and density of the material stream pulled through the conveying line so that a higher volume of pellets can be conveyed in slow-moving waves, or what can also be thought of as vertical pistons.

Unlike a dilute-phase system, it doesn't allow for material velocity to increase as it travels further from the source to the destination point. Instead, the operator can control the level of vacuum pressure so the material travels at a consistent velocity from the pickup point to the destination, whether the distance is 50 feet or 1,000 feet.

The system does it by generating two phases of airflow at velocities that are common in dense-phase pneumatic conveying. The velocity range of a phase we call "Wave Stream Flow" is from 300 to 1,000 fpm with vacuum pressures from 12 to 20 Hg. The velocity range of the other phase called "Wave Pulse Flow" is from 1,000 to 2,800 fpm with vacuum pressures from 10-16 Hg.

With these slower phases of airflow, the pellets don't overcome gravity as they will in a dilute-phase conveying system. Instead, they tumble along the bottom of the conveying line and roll on themselves to form waves. Each wave of pellets, which is separated by air space, results in a denser stream of material. At the end of the day, waves of pellets move fast enough to achieve high throughput but without problems common to dilute-phase conveying because they're moving at slower speeds.

With the system, dust generation is greatly reduced because there is less pellet degradation. Testing in our R&D lab has shown an 80 to 90 percent reduction in dust generation. The system also eliminates angel hair because there

With the Wave conveying system, plastic pellets are conveyed in slow-moving waves over distances of up to 1,000 feet.

is very little friction and heat build-up at slower speeds. Additionally, we've been able to increase throughput by about 10%, which is typically equates to roughly 500 to 3,000 pounds per hour using the same amount of vacuum pump horsepower. With our form of dense-speed conveying, we've achieved throughputs of up to 15,000 pounds of materials per hour.

How is the system engineered to address common problems with dilute-phase conveying systems?

I'll start with the main components of a single system. They include a Programmable Logic Controller (PLC), which serves as the brains of the system; a rotary claw Long-distance Pump (LDP) with Variable Speed Drive (VSD) for producing varied levels of deep vacuum; a materials receiver that stores pre-programmed recipes and communicates with the PLC; a patented pulse valve and a servo valve; a materials distribution box; and a speed sensor.

Users can program the wave pattern, velocity and throughput rate based on specific requirements of each materials receiver. The PLC allows the system to operate in conventional dilute-phase mode, or in both dense- and dilute-phase modes based on the LDP pump and recipe selected. It all depends on the application and what the plant wants to achieve.

The valves works in combination with the PLC and VFD-controlled vacuum pump to achieve optimum vacuum pressure and materials velocity. For example, the valve can be automatically adjusted so the system conveys materials at lower vacuum pressure and lower material velocities in waves when materials need to travel longer distances. Slow-speed conveying allows for conveying materials up to 1,000 feet with a single system.

With the VFD, the LDP pump operates at lower hertz ratings when that's all that's needed to achieve the desired materials velocity versus a dilute-phase conveying system where the pump is always running at 60 hertz. Tests in our lab showed the VFD pump saves users anywhere from 15 to 29 percent of energy per kilowatt hour when compared with fixed-speed pumps.

The speed sensor, meanwhile, verifies material is moving slowly from the source to the destination. We also recommend the installation of a clear section of piping to visually inspect materials flow.

BLOWER & VACUUM BEST PRACTICES blowervacuumbestpractices.com

COMPRESSED AIR BEST PRACTICES airbestpractices.com

CHILLER & COOLING BEST PRACTICES coolingbestpractices.com

PROUDLY PRESENTING THE 2020 EXPERT WEBINAR SERIES

Ron Marshall
Chief Auditor, Marshall Compressed Air Consulting

Tim Dugan, P.E.
President and Principal Engineer, Compression Engineering Corp.

Loran Circle
Senior Consultant, Circle Training & Consulting

Tom Jenkins, P.E.
President, JenTech Inc.

Tom Taranto
Owner, Data Power Services

Chris Gordon
President & CEO, Blackhawk Equipment

JAN 23
Compressed Air Leak Management Best Practices
Presenter Ron Marshall, Chief Auditor, Marshall Compressed Air Consulting
January 23, 2020 – 2:00PM EST
Co-Sponsors: Trace Analytics and UE Systems

FEB 20
Verifying Blower System Energy with ASME PTC 13
Presenter Tom Jenkins, P.E., President, JenTech Inc.
February 20, 2020 – 2:00PM EST
Sponsor: Inovair

MAR 19
Designing Piping Systems for Low Pressure Drop
Presenter Tom Taranto, Owner, Data Power Services
March 19, 2020 – 2:00PM EST
Exclusive Sponsor: Kaeser Compressors

APR 16
How to Correctly Size Vacuum Pumps
Presenter Chris Gordon, President & CEO, Blackhawk Equipment
April 16, 2020 – 2:00PM EST
Exclusive Sponsor: Busch Vacuum Solutions

MAY 21
Air Compressor Master Controls to Prevent Control Gap
Presenter Tim Dugan, P.E., President and Principal Engineer, Compression Engineering Corporation
May 21, 2020 – 2:00PM EST
Co-Sponsors: BEKO Technologies and VPInstruments

JUN 18
VSD Air Compressor Installation Guidelines
Presenter Loran Circle, Senior Consultant, Compressed Air System Training & Consulting
June 18, 2020 – 2:00PM EST
Sponsor: Open

JUL 20
Where Does Blower Air Go? Process Fundamentals
Presenter Tom Jenkins, P.E., President, JenTech Inc.
July 20, 2020 – 2:00PM EST
Sponsor: Open

AUG 20
Calculating Storage for Demand Events
Presenter Tom Taranto, Owner, Data Power Services
August 20, 2020 – 2:00PM EST
Sponsor: BEKO Technologies

OCT 15
Vacuum System Efficiency Projects
Presenter Chris Gordon, President & CEO, Blackhawk Equipment
October 15, 2020 – 2:00PM EST
Exclusive Sponsor: Busch Vacuum Solutions

NOV 12
Measuring KPI's: kW, Flow, Pressure, Dewpoint
Presenter Tim Dugan, P.E., President and Principal Engineer, Compression Engineering Corporation
November 12, 2020 – 2:00PM EST
Co-Sponsors: Kahn Instruments and VPInstruments

Register for Free Today at airbestpractices.com/magazine/webinars

Missed a Webinar? Register to View from our Archives at https://www.airbestpractices.com/magazine/webinars

SPONSORED BY

VP INSTRUMENTS · KAHN · BEKO · TRACE Analytics · inovair · KAESER COMPRESSORS · BUSCH · UE SYSTEMS INC

RIDING THE WAVES TO RESOLVE COMMON ISSUES WITH DILUTE-PHASE PNEUMATIC CONVEYING

Using a Wave Conveying system at its R&D laboratory in Cranberry Township, Pennsylvania, Conair Group runs sample tests of materials to prove the system's effectiveness for various customers.

The PLC can control up 128 materials receivers and virtually any combination of as many as 40 vacuum pumps, whether the system uses LDP pumps with VFDs for long distances, or standard regenerative and rotary lobe pumps for dilute-phase conveying modes.

Can a dilute-phase conveying system be converted to a wave conveying system?

Yes, and it's relatively simple since it typically involves minor changes. With an existing system, we'll usually add the PLC controller, our pulse and servo valves, and the LDP pump, which is needed to convey long distances. The system can work with existing vacuum receivers, hoppers and dust collectors, and tubing, as well as traditional aluminum or stainless steel piping. The vacuum line sizes can range in size with outside diameters from 1.5 inches to five inches. The conveying line also needs to be airtight.

Of course, any retrofit is unique to each company including those who use our brand of dilute-phase conveying systems. And adding an LDP pump still means the system can run in dilute-phase conveying mode when needed. Our engineers will typically audit the existing system to determine what's needed. The audit will assess the components of the current system and we'll forecast the advantages of a retrofit. It depends on what the plant already has in place, the materials they're using and their goals.

What went into the development of this unique approach to pneumatic conveying?

We were continuing to get calls from companies about dust generation and problems with angel hair and conveying lines wearing out and things that go along with high velocity conveying of plastics resins.

So, we started exploring options. As with any R&D project, we knew what we wanted to do but we weren't sure how we were going to accomplish it. In 2014, we began sketching out solutions. Extensive work and testing in our lab led to the development of our patented valves, the controller and other key components.

We then introduced the system in 2015. One of our first customers was having all kinds of issues with dilute-phase conveying of PET materials, and dust generation in particular. They sent us material they were conveying and we conducted tests in our lab using our wave conveying system and it solved the problem. There was literally no more dust that would for carry over to the dust collectors.

They were initially saying the system, "Just doesn't make any sense" when we explained it to them. So we brought them to our lab and showed them the system and how it worked. We also mocked-up the traditional system they had been using and showed how it generated almost nine times as much dust as the wave conveying system. At the point, they said, "We have to have this thing." They're now in the process of putting in six more systems at plants throughout the country. BP

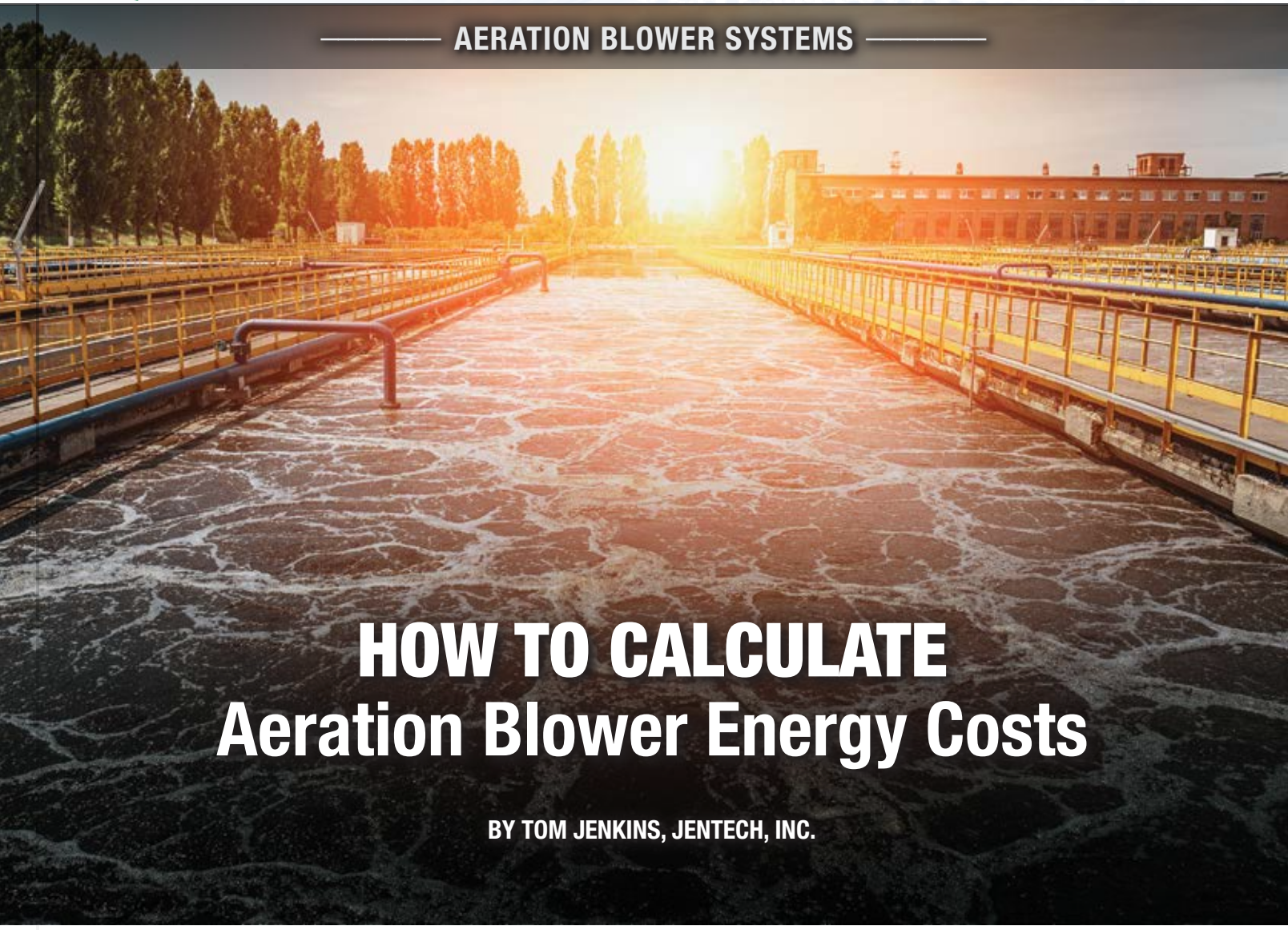
Thank you for these insights.

For more information and videos about Conair Group's Wave conveying system, visit https://www.conairgroup.com/product/wave-conveying/.

All photos courtesy of Conair Group.

To read similar articles on ***Pneumatic Conveying Technology***
visit https://blowervacuumbestpractices.com/technology/conveying

AERATION BLOWER SYSTEMS



HOW TO CALCULATE Aeration Blower Energy Costs

BY TOM JENKINS, JENTECH, INC.

An important part of developing the design for any project is determining its cost effectiveness. In most cases there are several design options considered. Deciding which option is best includes evaluating the life cycle cost of each.

Aeration blower upgrades may be part of a total plant upgrade and minimizing energy consumption is a critical consideration. Blower replacements are also a common Energy Conservation Measure (ECM) in cost-reduction programs.

Regardless of the reasons for blower and aeration system replacement, the designer faces challenges in determining the cost effectiveness of the design. Process demands and energy costs are complex and variable. Moreover, several methods for calculating cost effectiveness are available.

"The designer has several options for determining the cost effectiveness of alternate systems. The method selected should be based on the data available and the designer's confidence level in the assumptions."

— Tom Jenkins, JenTech, Inc.

Examining Actual Blower Power Cost

Aeration blowers are almost always driven by electric motors and determining the cost of electric energy is the first challenge. This seems like a simple task, but the outward simplicity may be deceptive.

Many analyses use the average cost of electricity. This is also known as the composite rate. It is simple to determine. The designer simply divides the total monthly electric bill by the total energy used. The result is a composite of the many factors that go into actual costs for electricity as shown in Table 1.

The average annual expense can be calculated as follows:

$$\text{Total\$/Year} = kW_{ave} \cdot 8760 \text{ hours/year} \cdot \text{Average \$/kWh}$$

The national average composite rate for industrial users is $0.07/kWh.

Large users, such as a water resource recovery facility, typically have a complex billing structure based on the utility's cost to generate and distribute power. The variables include time of day, day of the week, and rate of usage. Power used during the day on weekdays is more expensive than power used at night or on weekends. In addition to usage charges, most utilities also impose demand charges based on the peak power draw during a month or year using a fifteen-minute running average. Using actual time- based billing rates will provide a more accurate power cost than the composite rate. The calculation is as follows:

$$\text{OnPeak\$/Year} = kW_{OnPeak} \cdot 3120 \text{ hours/year} \cdot \text{OnPeak\$/kWh}$$

$$\text{OffPeak\$/Year} = kW_{OffPeak} \cdot 5640 \text{ hours/year} \cdot \text{OffPeak\$/kWh}$$

$$\text{Demand\$/Year} = kW_{Max} \cdot 12\text{months/year} \cdot \text{Demand\$/kW}$$

$$\text{Total\$/Year} = \text{OnPeak\$/Year} + \text{OffPeak\$/Year} + \text{Demand\$/Year}$$

Factor in Blower Duty Cycle

Establishing rates for electricity only provides half the data needed. In order to evaluate blower operating costs, the load profile, or duty cycle, needs to be established. Ideally the duty cycle of the blowers matches the process demand of the aeration basins.

Actual process loads rarely match design assumptions. Actual or near-term average daily flow is typically lower than the projected design load. Seasonal variations are significant for some facilities, and side streams can create additional loading.

Existing Electric Bill, Typical Month				
Charge	Usage		Rate	Cost
Service and Meter Charge				$ 500
On-Peak	224,866	kWh	$ 0.11	$ 24,735
Off-Peak	299,170	kWh	$ 0.08	$ 23,934
Demand	900	kW	$ 23.00	$ 20,700
Total	**524,036**			**$ 69,869**
			Composite Rate, $/kWh:	**$ 0.13**

Table 1. Sample Electric Charges

The dominant factor in process loading and blower duty cycle is the diurnal fluctuation. (See Figure 1.) The peak load is typically twice the minimum. The loads corresponding to utility billing times can be derived from the diurnal flow pattern.

Since airflow and blower kW are essentially proportional to hydraulic loading the duty cycle can be established as a function of average kW.

$$kW_{OnPeak} = 1.15 \cdot kWT/0U.V0$$

$$kW_{OffPeak} = 0.85 \cdot kWT/0U.V0$$

$$kW_{Max} = 1.20 \cdot kWT/0U.V0$$

The typical municipal facility's diurnal variation can be modeled using five different flow rates. (See Figure 2 and Table 2.) This model can be used to calculate the blower duty cycle and determine a weighted average airflow and blower power. Note this model is based on average dry weather loading. Storm events and internal slugs are short-term loads and may be ignored in total energy determinations.

The values in Table 2 can be used to determine the average power consumption over the course of typical diurnal variations. The technique is best illustrated with an example. Performance data for proposed new blowers with a design capacity of 11,000 scfm at 8.5 psig is shown in Table 3. The proposed system will employ Most-Open-Valve (MOV) logic so discharge pressure will vary with the airflow rate. The projected average total airflow is 14,000 scfm at 7.75 psig. Similar data for the existing blowers, which operate at constant 8.0 psig discharge, is shown in Table 4. Applying the factors in Table 2 the average kW is calculated for the new system and existing systems.

HOW TO CALCULATE AERATION BLOWER ENERGY COSTS

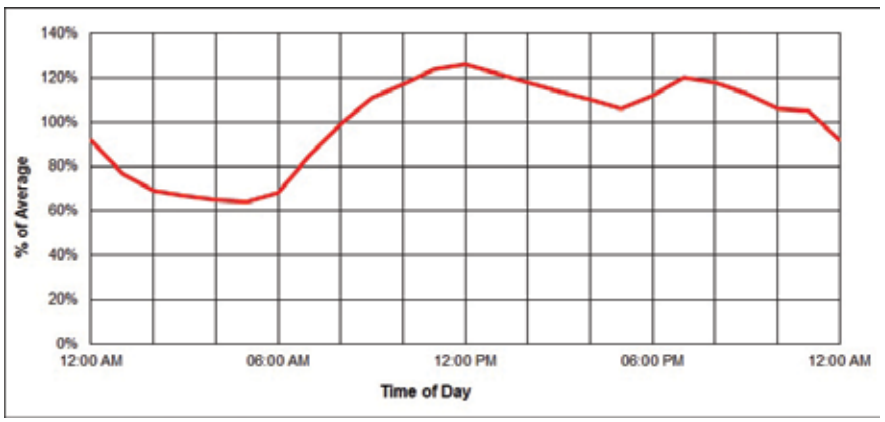


Figure 1. Typical Diurnal Loading Pattern

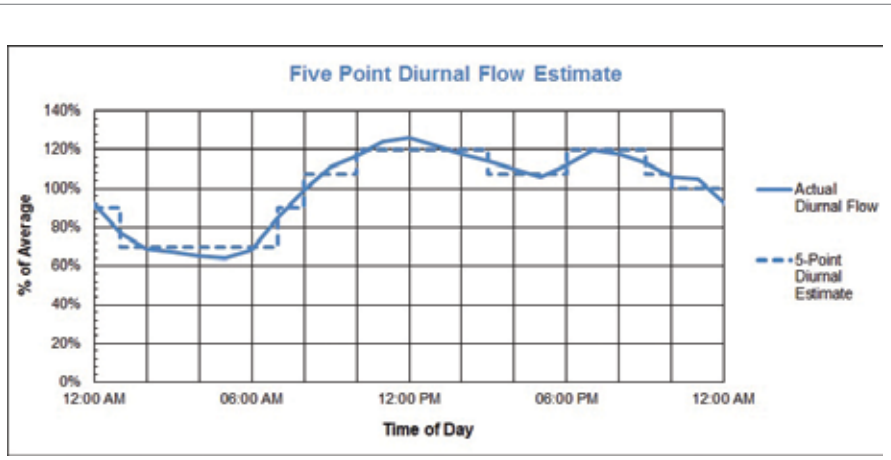


Figure 2. Five-point Diurnal Flow Model

Hours per Day	% of Time	% ADF	Time x ADF	Hours/Year
5	20.83%	70.00%	0.15	1825
3	12.50%	90.00%	0.11	1095
2	8.33%	100.00%	0.08	730
8	33.33%	107.50%	0.36	2920
6	25.00%	120.00%	0.30	2190
24	**100.00%**		**1.00**	**8760**

Table 2. Diurnal Load Variation

Evaluating Blower Life Cycle Cost

There are many methods available for evaluating the life cycle costs of blower systems. The data needed for all of them is similar. Fixed costs, or capital expense (CAPEX), includes equipment and installation.

Salvage value and utility incentives should be deducted from the CAPEX. Recurring costs, or operating expense (OPEX) identifies the annual cost of operation. This includes energy cost based on duty cycle and utility rates. OPEX also includes labor for routine maintenance and an allowance for repairs. Life cycle cost is COPEX plus accumulated OPEX over the life of the system. Some methods also consider interest on loans and inflation.

The two most common methods for comparing cost effectiveness of alternate designs are simple payback and present worth. If the system life is short there is little difference in the conclusion from either method.

Simple payback calculates the time it takes for OPEX savings to offset differences in CAPEX investment. This method is intuitive and requires few assumptions:

$$\text{Simple Payback} = \frac{\text{CAPEX Difference}}{\text{Annual OPEX Savings}}$$

Present worth analysis is more complicated than simple payback. It includes the impact of inflation and the cost of money (interest expense) in the comparison. Both the interest rate and the inflation rate should be expressed as decimals. Because interest and inflation are assumptions the result may not be more meaningful than simple payback results, even though the calculation itself is more sophisticated.

The net present worth is the difference between OPEX savings corrected for interest and inflation and the difference in CAPEX. The net present worth will be greater than zero if the project is justified.

$$r = \frac{\text{Interest} - \text{Inflation}}{1 + \text{Inflation}}$$

$$PWF = \frac{(1 + r)^n - 1}{r \cdot (1 + r)^n}$$

Where:

PWF = Present Worth Factor
n = years of system life

Net Present Worth =
PWF · OPEX Savings – CAPEX Difference

Regardless of the method chosen for the analysis the designer should keep in mind there are assumptions involved. The number of significant digits used in the calculations should reflect this fact.

Example Operating Cost Analysis

An analysis of replacing existing blowers as shown in Table 4 with new machines as shown in Table 3 illustrates the factors and options for accurately determining costs.

The combined equipment and installation cost for two new blowers and MOV control is estimated at $1.04 million. There is no CAPEX for the existing blowers. The electricity rate structure and the duty cycle are shown in Table 1 and Table 2. A twenty-year equipment life is assumed. The difference in average power consumption is 508.2 kW minus 429.6 kW = 78.6 kW. Maintenance and repair costs are assumed equal for both systems.

There are four variations presented above to consider:

- Simple payback using composite power cost.
- Simple payback using time of day power cost.
- Present worth using composite power cost.
- Present worth using time of day power cost.

HOW TO CALCULATE AERATION BLOWER ENERGY COSTS

The simple payback with composite power rate:

$$\text{CAPEX Difference} = \$1{,}040{,}000$$

$$\text{Annual OPEX Savings} = 78.6\text{kW} \cdot 0.133\ \$/\text{kWh} \cdot 8760\ \text{hours/year} = \$91{,}600/\text{year}$$

$$\text{Simple Payback} = \frac{\$1{,}040{,}000}{\$91{,}600/\text{year}} = 11.3\ \text{years}$$

If time-of-day power rates are used the annual OPEX savings is:

$$\text{Annual Savings}_{\text{OnPeak}} = 1.15 \cdot 78.6\text{kW} \cdot 3120\ \text{hours/year} \cdot 0.11\ \$/\text{kWh} = \$31{,}000/\text{year}$$

$$\text{Annual Savings}_{\text{OffPeak}} = 0.85 \cdot 78.6\text{kW} \cdot 5640\ \text{hour/year} \cdot 0.08\ \$/\text{kWh} = \$30{,}100/\text{year}$$

$$\text{Annual Savings}_{\text{Demand}} = 1.20 \cdot 78.6\text{kW} \cdot 12\text{months/year} \cdot 23 = \$26{,}000/\text{year}$$

$$\text{Annual Savings} = \$31{,}000 + \$30{,}100 + \$26{,}000 = \$87{,}100$$

The annual savings calculated using time-of-day billing is lower than the savings using the composite rate, and the payback is:

$$\text{Simple Payback} = \frac{\$1{,}040{,}000}{\$87{,}100/\text{year}} = 11.9\ \text{years}$$

The payback period is less than equipment life for both methods.

Using the present worth method requires two additional assumptions. The assumed interest rate is 5% and the assumed inflation rate is 2%.

$$r = \frac{0.05 - 0.02}{1 + 0.02} = 0.0294$$

$$PWF = \frac{(1 + 0.0294)^{20} - 1}{0.0294 \cdot (1 + 0.0294)^{20}} = 14.96$$

The present worth factor reflects the fact that a dollar today is more valuable than a the composite electricity cost:

$$\text{Net Present Worth} = 14.96 \cdot \$91{,}600 - \$1{,}040{,}000 = \$330{,}000$$

With actual time of day electricity cost:

$$\text{Net Present Worth} = 14.96 \cdot \$87{,}100 - \$1{,}040{,}000 = \$263{,}000$$

The net present worth is positive. The project could be economically justified by any of the analysis methods.

Engineering judgement and owner situations must be included in the design decision. For example, if the owner has limited bonding capacity available the low present worth of the investment may not justify depleting

Percent of Design Aeration Flow	Aeration SCFM	Miscel. SCFM	Total SCFM	Disch. Press. psig	Qty. Blowers Running	SCFM per Blower	kW per Blower	Total Blower kW	Evaluation Factor (% Time)	Pro-Rated kW
70.0%	8,400	2,000	10,400	7.58	1	10,400	312.3	312.3	20.83%	65.0
90.0%	10,800	2,000	12,800	7.69	2	6,400	194.5	389.0	12.50%	48.6
100.0%	12,000	2,000	14,000	7.75	2	7,000	214.2	428.4	8.33%	35.7
107.5%	12,900	2,000	14,900	7.80	2	7,450	229.2	458.4	33.33%	152.8
120.0%	14,400	2,000	16,400	7.89	2	8,200	254.8	509.6	25.00%	127.4
								Evaluated Average kW:		429.6

Table 3. Example Diurnal Evaluation for New Blowers

Percent of Design Aeration Flow	Aeration SCFM	Miscel. SCFM	Total SCFM	Disch. Press. psig	Qty. Blowers Running	SCFM per Blower	kW per Blower	Total Blower kW	Evaluation Factor (% Time)	Pro-Rated kW
70.0%	8,400	2,000	10,400	8.00	1	10,400	379.0	379.0	20.83%	78.9
90.0%	10,800	2,000	12,800	8.00	2	6,400	232.7	465.4	12.50%	58.2
100.0%	12,000	2,000	14,000	8.00	2	7,000	254.2	508.4	8.33%	42.3
107.5%	12,900	2,000	14,900	8.00	2	7,450	270.4	540.8	33.33%	180.2
120.0%	14,400	2,000	16,400	8.00	2	8,200	297.1	594.2	25.00%	148.6
								Evaluated Average kW:		508.2

Table 4. Example Diurnal Evaluation for Existing Blowers

the available capacity. The payback period exceeds eleven years, which is typically two permit renewals. If process changes are anticipated the anticipated savings may not be realized. On the other hand, utility incentives may be available for energy conservation measures, reducing CAPEX and improving the economics.

Strive for Accuracy

The determination of life cycle cost is essential in the design process. This is particularly true for projects where energy conservation is the primary interest. Unfortunately, the life cycle cost calculations can be intimidating.

The designer has several options for determining the cost effectiveness of alternate systems. The method selected should be based on the data available and the designer's confidence level in the assumptions.

It is important to remember these calculations are not exact. The designer should strive to obtain a reasonable level of accuracy based on the data available while recognizing the limitations of the analysis. Increasing detail in the analysis may not result in increased reliability for the conclusions. BP

For more information contact Tom Jenkins, President, JenTech Inc., email: info@jentechinc.com, or visit http://www.jentechinc.com/. Mr. Jenkins has texts now available in hardcopy and electronic versions titled Aeration Control System Design https://www.wiley.com/enus/Aeration+Control+System+Design%3A+A+Practical+Guide+to+Energy+and+Process+Optimization-p-9781118389980 and Introduction to Water Resource Recovery Facility Design https://news.wef.org/wefbook-provides-water-resource-recovery-facility-design-information/

To read similar articles on ***Aeration Blower Technology***, please visit https://blowervacuumbestpractices.com/technology/aeration-blowers

BLOWER & VACUUM SYSTEM INDUSTRY NEWS

Accessible Technologies Inc. Celebrates 25th Anniversary

Accessible Technologies Inc. (ATI), the parent company to ProCharger and Inovair, is celebrating 25 years in business. From its downhome roots in Kansas City and non-stop engineering innovation, ATI has grown ProCharger to be the market leader in the Aftermarket Performance Racing Industry. On the drag strip, countless racing championships have been won by ProCharger customers due to industry leading performance and reliability. Inovair leveraged the success of the ProCharger centrifugal supercharger to become the leading supplier of blowers and compressors for aircraft ground support equipment and then developed highly efficient and reliable geared centrifugal blower packages for Wastewater Treatment.

About Accessible Technologies Inc.

Inovair/ATI is a vertically integrated manufacturer, controlling all elements of design, production, and service. This includes in-house compressor designs, featuring impellers manufactured in-house on 5-axis CNC mills from 7075 T-6 billet aircraft aluminum. All Quality Control (including Zeiss CMM and other precision equipment), final assembly and lab testing is performed in-house by the highly experienced Inovair team. With over 7 years of continual operation and millions of dollars in documented energy savings at wastewater treatment facilities, Inovair's WWT product line continues ATI's success in the performance racing and aircraft ground support markets. If you would like more information please visit us at procharger.com or inovair.com.

Tuthill Announces Steven Westfall as Chief Executive Officer

Tuthill Corporation announced that its board of directors has appointed Steven Westfall as Chief Executive Officer and President. Over the past 4 months he transitioned from the role of President, Tuthill Fort Wayne to the Burr Ridge Corporate office.

Accessible Technologies Inc. is celebrating 25 years in business.

Westfall has more than 20 years of senior leadership experience working in the manufacturing, mechanical and industrial engineering industries. He began his career with Tuthill in 2013 as President of Tuthill Springfield. During his tenure in Springfield the focus was on operational excellence, strategic capital investment and commercialization of the business channels. In February 2018, Westfall became President of Tuthill Fort Wayne, again focused on top-line growth, operational excellence and strategic investment particularly in the Tuthill Fill-Rite product brand.

"I am excited to lead Tuthill Corporation in our continued journey towards a Top 1% company. Our focus will be on our top-line growth, while continuing our operational excellence commitment," said Steven Westfall. He said, "I believe that Tuthill's culture, dedication to employee development, and a newly aligned focus on a "One Tuthill" commercial strategy will yield the impact of a larger and more successful company."

Before joining Tuthill, Westfall held CEO roles with EaglePicher Technologies, Detroit Tool Metal Products and the President of CST Industries. He holds an MBA, Finance and Business Management degrees from Pittsburg State University.

About Tuthill Corporation

Tuthill Corporation is a privately held manufacturer of industrial goods specializing in rotating equipment. Founded in 1892, James B. Tuthill originally manufactured common brick to Chicago construction companies. Today, Tuthill manufactures fuel and chemical transfer pumps and meters at

Steven Westfall, CEO and President of Tuthill Corporation.

Tuthill Fort Wayne; vacuum pumps and positive displacement blowers and systems at Tuthill Springfield; lubrication, magnetically coupled and process pumps at Tuthill Alsip; and custom injection-molded plastics at Tuthill Clearwater. Tuthill serves markets including agriculture, construction, chemical, food and beverage, energy, pharmaceuticals and medical, and transportation. For more information, visit www.tuthill.com.

Atlas Copco Acquires M.C. Schroeder Equipment

Atlas Copco has acquired the assets of M.C. Schroeder Equipment Co., Inc. The company is a distributor of vacuum equipment and service solutions. M.C. Schroeder Equipment is based in Denver, North Carolina and has 8 employees. Its sales network covers the South East USA region.

"This acquisition will complement our existing footprint in the region", said Geert Follens, Business Area President Vacuum Technique. "The company has a strong reputation serving diverse industrial markets with vacuum equipment and service solutions".

The purchase price is not material relative to Atlas Copco's market capitalization and is not disclosed. The acquired business will operationally become part of the Industrial Vacuum Division within the Vacuum Technique Business Area.

About Atlas Copco Group

Great ideas accelerate innovation. At Atlas Copco we have been turning industrial ideas into business-critical benefits since 1873. By listening to our customers and knowing their needs, we deliver value and innovate with the future in mind. Atlas Copco is based in Stockholm, Sweden with customers in more than 180 countries and about 37 000 employees. Revenues of BSEK 95/9 BEUR in 2018. For more information: www.atlascopcogroup.com.

Pfeiffer Vacuum Receives FDA Approval for Leak Testing

Pfeiffer Vacuum, one of the world's leading providers of vacuum technology, has announced that the ATC by Pfeiffer Vacuum Mass Extraction leak testing process meets FDA standard F3287 for leak testing. This shortens the FDA approval process for pharmaceutical products that require leak testing significantly. Companies that utilize the ATC leak testing process will save hundreds of hours of paperwork for the approval application.

When a pharmaceutical company launches a new product or changes an existing product, FDA approval is required. Normally, companies have to submit extensive

BLOWER & VACUUM SYSTEM INDUSTRY NEWS

Mass Extraction test instrument ME2 from ATC by Pfeiffer Vacuum.

documentation. However, with ATC being added to the FDA standard, companies do not need to submit paperwork regarding leak test, test procedure, water ingress, and package testing manufacturers can simply declare that their product is leak tested in accordance with FDA F3287 by using ATC equipment, thus adhering to the standard.

"It is a tremendous advantage for companies in the pharmaceutical market that utilize ATC's technology since they save time and costs," said Brian Pahl, President of the ATC by Pfeiffer Vacuum product line.

USP 1207 and ASTM (F-3287-17) recognized ATC Mass Extraction Technology works on the principle of rarefied gas flow. Testing takes place in vacuum conditions to attain higher sensitivity. This patented technology is particularly suitable for pharmaceutical packaging such as IV-bags, pouches or glass vials. Larger defects and defects as small as 1 µm can be detected with this method. The technology is thereby suitable for laboratory applications as well as for use in production environments allowing stability control as well as 100% automated testing (also in inline machines). FDA laboratories in the US and major pharmaceutical companies have been using the Mass Extraction instruments for over 10 years.

About Pfeiffer Vacuum

Pfeiffer Vacuum is one of the world's leading providers of vacuum solutions. In addition to a full range of hybrid and magnetically levitated turbopumps, the product portfolio comprises backing pumps, leak detectors, measurement and analysis devices, components as well as vacuum chambers and systems. Ever since the invention of the turbopump by Pfeiffer Vacuum, the company has stood for innovative solutions and high-tech products that are used in the Analytics, Industry, Research & Development, Coating and Semiconductor markets. Founded in 1890, Pfeiffer Vacuum is active throughout the world today. The company employs a workforce of some 3,200 people and has more than 20 sales and service companies as well as 10 manufacturing sites worldwide. For more information, please visit www.pfeiffer-vacuum.com.

Atlas Copco Acquires Dekker Vacuum Technologies, Inc.

Atlas Copco is acquiring Dekker Vacuum Technologies, Inc. The company is a supplier of vacuum equipment and service solutions for industrial applications.

Dekker Vacuum Technologies, Inc., is based in Michigan City, Indiana and has approximately 70 employees. In 2019 Dekker Vacuum Technologies had revenues of approximately MUSD 23. Dekker has a 22-year history of supplying vacuum solutions to a broad range of industrial customers in the Midwest and across the USA.

"This acquisition will complement our existing portfolio in the liquid ring pump market and will enable us to serve more vacuum applications at our customers," said Geert Follens, Business Area President Vacuum Technique. "The company has a strong reputation serving diverse industrial markets in North America."

The transaction will close on February 28. The purchase price is not material relative to Atlas Copco's market capitalization and is not disclosed. The acquired business will operationally become part of the Industrial Vacuum Division within the Vacuum Technique Business Area.

About Atlas Copco Group

Great ideas accelerate innovation. At Atlas Copco we have been turning industrial ideas into business-critical benefits since 1873. By listening to our customers and knowing their needs, we deliver value and innovate with the future in mind. Atlas Copco is based in Stockholm, Sweden with customers in more than 180 countries and about 37 000 employees. Revenues of BSEK 95/9 BEUR in 2018. For more information, visit www.atlascopcogroup.com.

weftec®

the water quality event™

2020

93RD ANNUAL WATER ENVIRONMENT FEDERATION TECHNICAL EXHIBITION & CONFERENCE

New Orleans Morial Convention Center | New Orleans, Louisiana

Conference: **October 3 – 7, 2020** | Exhibition: **October 5 – 7, 2020**

WEFTEC is the one event for professionals, industry experts, and the most innovative companies from around the world. Learn from the very best thought-leaders in water quality.

BEST RATE DEADLINE: JULY 10, 2020

REGISTER NOW | www.WEFTEC.org

BLOWER & VACUUM

BEST PRACTICES

blowervacuumbestpractices.com

FREE SUBSCRIPTION

DIGITAL EDITION FREE WORLDWIDE | PRINT EDITION FREE TO U.S. SUBSCRIBERS

2020 FOCUS INDUSTRIES!

Food Processing • Food Packaging • Woodworking • Wastewater Aeration

Optimize On-Site Utilities with Blower & Vacuum Best Practices

Blower & Vacuum Best Practices is a technical magazine, reaching 15,900 subscribers, who are dedicated to optimizing industrial blower and vacuum systems and municipal wastewater aeration blower systems.

Aeration Blower Systems

Over 1,900 operators at wastewater treatment plants, 1,800 process engineers at engineering firms almost 1,000 municipal sales reps representing blowers receive the magazine. They turn to our editorial pages whose content is directed by noted aeration blower expert Tom Jenkins. Here they find ideas and advice on calculating/sizing aeration blowers, the latest specification trends from engineering firms and improve their understanding of new Blower Standards like ASME PTC 13.

"The need to control the rate of oxygen added to the aeration system has become particularly acute with the increasing application of nutrient control."

— Henryk Melcer, Senior Process Engineer/VP, Brown and Caldwell, (feature article in April 2019 Issue)

Industrial Blower & Vacuum Systems

Over 5,300 highly targeted manufacturing and process industry readers optimize the use of industrial blowers and vacuum pumps. These readers work together with 5,500 sales engineers from industrial distributors of blowers and vacuum pumps prepared to provide "Best Practice" advice. The projects include replacing compressed air with blowers for pneumatic conveying, centralizing vacuum systems, replacing liquid ring with dry vacuum pumps and deploying VSD technology to match load with demand.

"As part of our ongoing focus on sustainability, we were excited to partner with Atlas Copco to pioneer the first waterless vacuum pump in the craft beer industry. We are now saving 5,000 gallons of water per day and $35,000 per year."

— Julia Person, Sustainability Manager, Craft Brew Alliance, (feature article in April 2019 Issue)

"Many rental air compressors, designed to deliver 1,600 cfm of compressed air at 90-150 psig, are used in 50 psig applications like pneumatic conveying, fermentation and fluid catalytic cracking."

— Matthew Piedmonte, Director, Aerzen Rental (feature article in April 2019 Issue)

Subscribe Now!

To subscribe visit **blowervacuumbestpractices.com**

BLOWER & VACUUM SYSTEM INDUSTRY NEWS

Leybold Service Hub to Move from PA to New OH Facility

Leybold, the world's oldest vacuum pump manufacturer, is leading the way into the future for vacuum pump service and repair. Over the last several years the company has seen significant growth in both their field service and in-house repair business. This exponential growth has driven the need to advance technologies for managing capacity and has offered the opportunity to look for technologies to enhance the customer experience.

As a result, the Leybold North America Service Group is moving the in-house service hub to a larger and improved facility in Glenwillow (Cleveland), OH.

Leybold attributes the growth in service and repair business to their continued commitment to providing factory certified repair services and the use of exclusively OEM parts and trained service technicians. In addition, all Leybold repaired pumps will continue to be backed by a one-year warranty. The company aims to deliver even more with this move. "We recognize it is not enough to just deliver the best possible OEM service, we aim to go beyond the product guarantee and delight our customers with the experience they receive when sending in a pump for repair" said Greg Greinke, VP, Business Line Manager, Leybold Vacuum Technique Service Division.

The new Glenwillow facility is equipped with new technology that will allow customers to benefit from improved pump tracking, reduce turnaround times, access to a broader set of certified exchange pumps, additional features in LeyboldCARE agreements – service contracts that offer elite repair commitments, and advancements in failure analysis. These enhancements will allow customers to be back up and running with their vacuum pumps faster and prevent unplanned downtime in the future.

In addition to the new capabilities that will be available for Leybold in-house service, Leybold continues to expand their team of expert, OEM trained, field service technicians and flexible maintenance and service contracts to keep their industry leading vacuum pumps performing at their best.

These exciting changes for Leybold North America are aimed at enhancing customer experience while continuing to set the standard for vacuum pump manufactures worldwide.

BLOWER & VACUUM BEST PRACTICES
www.blowervacuumbestpractices.com

ADVERTISER INDEX

About Leybold North America

As a pioneer of vacuum technology, Leybold offers a wide range of vacuum components, standardized and fully customized vacuum solutions, complemented by vacuum technology accessories and instrumentation. Our core capabilities center on the development of application- and customer-specific systems for the creation of vacuums and extraction of processing gases. For more information, visit www.leybold.com.

THE MARKETPLACE

TECHNOLOGY & JOBS

Job & Product Marketplace Advertising Information

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.

Prices are $300.00 per Job Marketplace Ad and $350.00 per Product Marketplace Ad ($300 if 6 or more ads are placed). Contact Rod Smith at rod@airbestpractices.com to schedule your Marketplace Ads.

Contact Rod Smith for ad rates: **rod@airbestpractices.com, Tel: 412-980-9901**

BLOWER & VACUUM BEST PRACTICES
www.blowervacuumbestpractices.com

Advertising / Editorial — Rod Smith, rod@airbestpractices.com, Tel: 412-980-9901

Subscriptions Administration — Patricia Smith, patricia@airbestpractices.com, Tel: 412-980-9902

A Publication of — Smith Onandia Communications LLC, 37 McMurray Rd. Suite 106, 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 106, 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 106, Pittsburgh, PA 15241.

BEST PRACTICES

2020 EXPO SEPTEMBER 20-23 CHICAGO, IL

COMPRESSED AIR / VACUUM / COOLING

OPTIMIZE ON-SITE UTILITIES

Powering Automation

Research and Identify Innovations

to Enhance the Efficiency and Reliability of Your Systems

Compressed Air

Air Compressors
Air Compressor Controls
Air Purification & Piping
Condensate Management
Pneumatics

Blower & Vacuum

Aeration Blowers
Industrial Blowers
Vacuum Pump Systems
Inlet Filtration/Oil Separators

HVAC & Process Cooling/Steam

Chillers
Heat Exchangers
Cooling Systems
Cooling Towers
Water Treatment
Boilers
Steam Traps

Motors & Drives • Lubricants • Measurement Instruments • IoT Automation & Monitoring

EXPO HOURS

Monday, September 21 12:00-6:00pm

Tuesday, September 22 12:00-6:00pm

SAVE THE DATES ON YOUR CALENDAR!

Located at the modern Schaumburg Convention Center just 10 minutes from Chicago O'Hare International Airport.

cabpexpo.com

Sponsored by CAGI Compressed Air & Gas Institute