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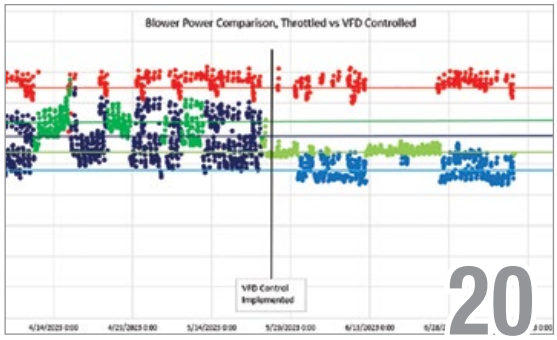

AERATION BLOWER SYSTEMS

EVERY ISSUE

From the Editor

Industrial Vacuum & Blower Systems

We'd like to thank Jackson Redline, from Rogers Machinery, for sending us an interesting article titled, "Vacuum Receivers: Full of Vacuum or Full of Myth?" As he writes, the role of vacuum receivers is often misunderstood as they are confused with compressed air storage tanks.

Aeration Blower Systems

There are many who believe multistage centrifugal blowers are not suitable for variable speed control. Refuting this, Tom Jenkins from JenTech, and Lee Pinkerton from Metropolitan Council Environmental Services, have sent us an article titled, "VFDs Improve Multistage Blower Performance." The article examines a case study, at the Eagles Point wastewater treatment plant in Cottage Grove, Minnesota, where VFD control did improve energy efficiency and the reduction in energy expense provided an ROI of less than two years.

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

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- **March 7, 2024:** Sizing Vacuum Pumps and Piping for Various Applications – *Presenter Andy Smiltneek, President, Growth Solutions Consultants*
  Sponsored by Busch Vacuum Solutions.
- **June 13, 2024:** Advanced Aeration Control for Blowers – *Presenter Tom Jenkins, P.E., President, JenTech Inc.*
  Sponsored by APG-Neuros.
- **July 25, 2024:** Instrumentation and Monitoring for Vacuum Systems – *Presenters Emma Larrabee, Marketing Manager and Todd Dunn, VP Sales & Marketing, Zorn Compressor & Equipment*
  Sponsored by Quincy Compressor

2024 MEDIA PARTNERS

Blower & Vacuum Industry News

Busch Vacuum Solutions Acquires Centrotherm Clean Solutions

Busch Vacuum Solutions, one of the largest vacuum pump manufacturers worldwide, has acquired centrotherm clean solutions, one of the technology leaders in industrial gas abatement systems. The strategic acquisition underlines the commitment of Busch Vacuum Solutions and Pfeiffer Vacuum to sustainability and will help to further strengthen the position as a proven solution provider in the semiconductor industry and other related sectors.

"The acquisition of centrotherm clean solutions is a crucial step in our long-term strategy to advance sustainable technologies and solutions together with Pfeiffer Vacuum," said Sami Busch, Co-CEO and Co-Owner of the family-run company Busch Vacuum Solutions from Maulburg. "The innovative gas abatement systems from centrotherm clean solutions are a perfect addition to the Busch and Pfeiffer Vacuum product portfolio. Integrating the companies under one umbrella will enable us to serve our customers even better in the future and offer complete sustainable vacuum solutions. Additionally, the companies already collaborate successfully on individual projects in the field of service. Therefore, the customers of centrotherm clean solutions will also benefit from our worldwide service network in more than 45 countries."

Centrotherm clean solutions has its headquarters in Blaubeuren, and is also present at other locations in Europe, America and Asia. As a provider of technologically leading gas abatement systems especially for the semiconductor and high-tech industries, the company employs over 300 people worldwide, who can draw on the experience of a thirty-year company history. The company's headquarters and production site in Blaubeuren, as well as all worldwide locations and jobs, will be retained after the acquisition.

"Centrotherm clean solutions has achieved significant growth thanks to its technological leadership in recent years. In order to continue this successful development, a strategic partner is of great benefit," emphasizes the founder and former owner of centrotherm clean solutions, Robert Hartung. "I found this partner in the Busch family and their company Busch Vacuum Solutions. The technologies and products from Busch, Pfeiffer Vacuum and centrotherm clean solutions complement each other perfectly. The timing of the acquisition is just right, as the companies can now strategically prepare for upcoming investments in new semiconductor factories."

Managing Director Dr Angela Bayler said, "The companies simply fit very well together. We share the same values and visions. This became more than clear in our initial discussions. We look forward to working and growing together!"

About Busch Vacuum Solutions

Busch Vacuum Solutions is one of the world's largest manufacturers of vacuum pumps, vacuum systems, blowers and compressors. Their extensive product portfolio includes solutions for vacuum and overpressure applications in all industries, such as chemicals, plastics, semiconductors, medical technology, and food. This also includes the design and construction of tailor-made vacuum systems and a worldwide service network. The Busch Group is a family business that is managed by the Busch family. More than 8,000 employees in 110 companies in over 45 countries worldwide work for Busch Vacuum Solutions. Busch is headquartered in Maulburg, Baden-Württemberg, in the tri-border region of Germany, France and Switzerland.

The centrotherm clean solutions campus in Blaubeuren.

Blower & Vacuum Industry News

Besides Maulburg, Busch manufactures in its own production plants in Germany, Switzerland, the USA, the United Kingdom, France, the Czech Republic, Korea, Romania, India, Vietnam and China. Pfeiffer Vacuum, a large vacuum pump manufacturer based in Middle Hesse, is also part of the international Busch group. Busch Vacuum Solutions was founded in 1963 by Dr Karl Busch and his wife Ayhan Busch, who built the company together. With the HUCKEPACK, Dr Karl Busch developed the first vacuum pump for food packaging. His follow-up product, the R5 rotary vane vacuum pump, revolutionized food packaging. For more information, visit www.buschvacuum.com.

Atlas Copco Acquires Korean Semiconductor Valve Manufacturer

Atlas Copco has agreed to acquire Presys Co., Ltd. The company provides vacuum valves for the semiconductor market. Presys Co., Ltd. is a privately owned company with 134 employees, located in Suwon, Republic of Korea. In 2022, the company had revenues of approximately MKRW 35,000 (MSEK 275*).

"Presys' products are well known within the Korean semiconductor market.", said Geert Follens, Business Area President Vacuum Technique. "They manufacture transfer and isolation vacuum valves that are highly complementary to our current semiconductor product portfolio."

The purchase price is not disclosed. The acquisition is subject to regulatory approval and is expected to close during the first quarter of 2024. The business will become part of the Semiconductor Chamber Solutions 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. In 2022, Atlas Copco Group had revenues of BSEK 141 and at year end about 49 000 employees. For more information, visit www.atlascopcogroup.com.

New CAGI Performance Test for Mobile Vane Vacuum Pumps

Vacuum trucks are used in many industrial, municipal, and construction applications and their usage is increasing as their versatility and utility become more understood. The vacuum pump dictates the performance and utility of the vac-truck, but the industry convention for reporting the performance is unreliable. The common practices are to cite the Free Air CFM under conditions of atmospheric pressure. This is basically the theoretical displacement of the pump, which may not fairly represent pump performance at actual operating vacuums down to 27 inches of mercury. Reporting Free Air CFM leaves a lot of room for gross performance manipulation.

Accordingly, there is an urgent need in the industry to standardize pump performance reporting, free from subjective user interpretation and marketing spin. To answer the need for valid and reliable standards for testing the performance of vacuum pumps, the Blower & Vacuum Section of the Compressed Air & Gas Institute (CAGI) has developed CAGI Vacpump-100: Simplified Acceptance Test for Bare Vane Vacuum Pumps for Mobile Vacuum Systems.

New CAGI Performance Acceptance Test for Bare Vane Vacuum Pumps for Mobile Vacuum Systems.

This standard prescribes in detail the testing and performance rating of positive displacement bare vane vacuum pumps at various levels of vacuum. Manufacturers of vacuum pumps that test their products to this standard will be able to demonstrate to consumers that their products will deliver the performance that they promise.

Similarly, the industry wide acceptance of the CAGI initiated Vacpump-100: Acceptance Test Standard for Bare Vane Vacuum Pumps, will go a long way to establishing a foundation of integrity to the vac-truck industry that for too long has had the reputation of being the Wild West with respect to vacuum pump performance claims.

About the Compressed Air and Gas Institute

For more than 100 years, the Compressed Air and Gas Institute has been the leading source on all matters related to compressed air. As the united voice of the industry, CAGI's activities include the development and organization of educational material, including compressed air system training programs to benefit the users of compressed air systems. For more information, visit www.cagi.org.

Pfeiffer Vacuum Welcomes Röntgen Prize Winner Dr. Roy Shiloh

The prestigious Röntgen Prize was awarded by the Justus Liebig University Giessen (JLU) to physicist Dr. Roy Shiloh from the from the Friedrich-Alexander University Erlangen-Nuremberg (FAU) and the Hebrew University of Jerusalem. The prize money, which is worth € 15,000, is donated by Pfeiffer Vacuum and the Ludwig Schunk Foundation. The JLU has awarded this prize since 1960, in memory of Nobel Prize winner Wilhelm Conrad Röntgen, who was a professor in Giessen from 1879 to 1888.

Dr. Shiloh is receiving the award for his outstanding studies around the subject of "Nanophotonic electron acceleration." X-ray sources based on the principle of electron acceleration in vacuum have been used for medical and other applications for more than 125 years now. Building on this principle, Dr. Shiloh was able to demonstrate that electrons in nanophotonic structures can be actively guided with the help of optical fields. Using a new method, he has succeeded in achieving the world's first particle accelerator on a microchip.

As a sponsor company, Pfeiffer Vacuum received a visit from Dr. Shiloh the day before the award ceremony to report on his findings. In congratulating the award winner, Pfeiffer Vacuum CEO Daniel Sälzer said, "Pfeiffer Vacuum attaches great importance to promoting cutting-edge research and to fostering the next generation of scientists. We are extremely pleased that, together with the Ludwig Schunk Foundation, we have been awarding the Röntgen Prize for some decades now." The research work conducted by the award winner requires great technical expertise, sophisticated simulations and highly precise nanofabrication. In the course of his research work, Dr. Shiloh developed a new method of electron acceleration which could

Blower & Vacuum Industry News

be of immense significance for future practical implementation and commercial use. "This method could permit innovative and extremely compact x-ray devices for clinical purposes to be built in the future," said Prof. Dr. Markus Thoma (Department of Physics) for the evaluation team at the JLU.

Dr. Shiloh studied Physics and Electrical Engineering at Tel Aviv University and graduated from there in 2018. At the FAU, he spent four years researching as a postdoctorate fellow in the group of Prof. Dr. Peter Hommelhof and is now an assistant professor at Jerusalem University.

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, vacuum 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 in the analytical, industrial, research & development, semiconductor and future technologies markets. Founded in 1890, Pfeiffer Vacuum is active throughout the world today. The company employs a workforce of some 4,000 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

Jacobs Introduces Breakthrough Biosolids Drying Technology

Wastewater utilities across the globe produce millions of tons of biosolids annually. Specifically, in England and Wales that number is over four million wet tons of biosolids annually and most of the biosolids are recycled on farmland. Biosolids are usually two-thirds water, and this causes significant issues. Storing water-laden biosolids releases greenhouse gases. The water also adds a lot of weight and volume to all the transport that is required. In England and Wales, the traditional farmland recycling route is also under pressure, but the alternatives are significantly more expensive – much of the additional cost being due to the water in the biosolids.

In a successful trial with Welsh Water, Jacobs' technology has shown significant reductions in biosolids cake water content. It works by aerating treated biosolids (sludge cake). This creates an aerobic environment in the cake, producing heat and enabling moisture to be removed. This unlocks the potential for reduced greenhouse gas emissions and greater opportunities for reduced processing time and energy use compared to current approaches. The technology is available as an augmentation to existing or planned storage barns, or as an entire new process stage. Jacobs is planning an additional operational trial to gather more data on emissions and peak performance.

Pfeiffer Vacuum receives this year's Röntgen Prize winner Dr. Roy Shiloh (pictured center).

The initial trial showed the technology may provide the following benefits:

- Reduction in air emissions such as greenhouse gases, ammonia and odors to address climate targets and emerging Industrial Emissions Directive (IED) requirements.
- Reduction of haulage movements and transport costs.
- Improvement in public general perception of biosolids-to-land due to a reduction in odor.

- Improvement in the ability to store the finished product for longer times in less space.

- Generation of a product more suitable for use in landscaping practices beyond agriculture because of the drastic change in physical characteristics of the dried biosolids material.

- Opening of new pathways for downstream processing such as carbonization.

The technology can be applied to any biosolids processed through anaerobic digestion with thermal hydrolysis – in England and Wales, this covers over 50% of the biosolids output.

Based on transport savings alone at full scale on the trial site, it is estimated the technology would pay for itself in under five years. This is only one of the benefits: there are several crucial rewards for wastewater utilities looking to build resilience in the context of increasing pressure and uncertainties with traditional recycling routes. The technology can help utilities increase biosolids storage capacity and gives the potential to reduce their greenhouse gas emissions.

About Jacobs

At Jacobs, we're challenging today to reinvent tomorrow by solving the world's most critical problems for thriving cities, resilient environments, mission-critical outcomes, operational advancement, scientific discovery, and cutting-edge manufacturing, turning abstract ideas into realities that transform the world for good. With approximately $15 billion in annual revenue and a talent force of approximately 60,000, Jacobs provides a full spectrum of professional services including consulting, technical, scientific and project delivery for the government and private sector. For more information, visit www.jacobs.com.

A trial of Jacobs' biosolids drying process has shown effective drying potential while reducing greenhouse gas emissions.

Blower & Vacuum Industry News

Shandong Zhangqiu Blower Celebrates 55th Anniversary

Eurus Blower, Inc., a wholly owned subsidiary of Shandong Zhangqiu Blower Co., Ltd. (SZB) one of the world's largest suppliers of Rotary Lobe Blowers, announces the SZB milestone 55-year anniversary in October 2023.

Shandong Zhangqiu screw blower.

Shandong Zhangqiu Blower Co., Ltd. was founded in 1968, now employing more than 1,400 people. Roger Blanton, General Manager and Marketing Director of Eurus Blower, said, "Our manufacturing area is greater than 1,000,000 square feet, and our annual production is more than 13,000 units. We own and operate our own foundry, suppling castings to meet our needs and to customers worldwide."

About Shandong Zhangqiu Blower

Established on the principles of providing superior product quality, value, and dependability; we hold QMS certifications from ISO9001, ISO14001, and GB/T28001. After 30 years of establishing a solid foundation in China, we began to export our blowers in the late 1990s. The company quickly became known as an industry leader in blower technology across international markets. In 2008, with over 40 years of blower manufacturing experience, Shandong Zhangqiu Blower Co. established Eurus Blower, Inc. in the U.S. with a vision of providing competitively priced, high-quality blowers for new or replacement blower applications to North and South American wastewater treatment and industrial marketplaces. For more information, please visit www.eurusblower.com or e-mail sales@eurusblower.com.

Black & Veatch Expands Presence in Texas with New Office

Black & Veatch, a global leader in critical infrastructure solutions, announced the opening of a new recruitment office in Deer Park, Texas (Houston). The office will serve to accelerate the company's goal to add more than 800 new craft positions in Texas within the next nine months.

Black & Veatch's increased footprint in the Houston area follows the company's recent acquisition of Texas-based Bird Electric, bringing enhanced construction capabilities to a wider client base and building upon Black & Veatch's world-class capabilities and integrated solutions offerings. In addition, clean energy mandates and the Inflation Reduction Act are expected to drive job growth in Texas and throughout the nation.

"The Deer Park office strengthens Black & Veatch's commitment to the local economy while continuing to provide craft employees with comprehensive skills training for successful careers," said Shelby Barbier, Senior Vice President and Global Construction Leader for Black & Veatch. "Expanding our construction capabilities is critical to position the company for future engineering, procurement and construction (EPC) growth."

As an all-in-one training and recruitment center designed to accelerate hiring, the Deer Park office can accommodate walk-in prospects, hire for multiple job sites, assist candidates with applications and provide onboarding. The office will also offer training services in line with the company's participation as a Registered Apprenticeship Program.

About Black & Veatch

Black & Veatch is a 100-percent employee-owned global engineering, procurement, consulting and construction company with a more than 100-year track record of innovation in sustainable infrastructure. Since 1915, we have helped our clients improve the lives of people around the world by addressing the resilience and reliability of our most important infrastructure assets. Our revenues in 2022 were US$4.3 billion. Follow us on www.bv.com and on social media.

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Hiran de Mel
Senior Project Manager and Principal Technologist, Jacobs

Tom Taranto
Owner, Data Power Services

Todd Dunn
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JAN 11
How to Boost the Energy Efficiency of Rotary Screw Air Compressors
Presenter Andrew Smith, P.E., Co-Founder, SMARTCAir – *Sponsored by FS-Curtis/FS-Elliott*
Thursday, January 11, 2024 – 2:00PM EST

JAN 25
ASME PTC13 in Action: Practical Approach to Blower System Performance Testing
Presenter Julie Gass, Lead Mechanical Process Engineer, Black & Veatch and Hiran de Mel, Senior Project Manager and Principal Technologist, Jacobs – *Sponsored by Inovair*
Thursday, Jan 25, 2024 – 2:00PM EST

FEB 08
Centrifugal vs Rotary Screw Air Compressor Performance: Full Load and Part Load Efficiency
Presenter Mike Lenti, Senior Auditor, Compressed Air Consultants – *Sponsored by Rogers Machinery*
Thursday, February 8, 2024 – 2:00PM EST

FEB 22
Storage Tank and Pipe Sizing for Large Plants: How to Meet CFM Needs
Presenter Ron Marshall, Chief Auditor, Marshall Compressed Air Consulting – *Sponsored by Unipipe*
Thursday, February 22, 2024 – 2:00PM EST

MAR 07
Sizing Vacuum Pumps and Piping for Various Applications
Presenter Andy Smiltneek, President, Growth Solutions Consultants – *Sponsored by Busch Vacuum Solutions*
Thursday, March 7, 2024 – 2:00PM EST

MAR 21
Control of Distributed Systems with Multiple Air Compressor Rooms
Presenter Tim Dugan, P.E., President, Compression Engineering Corporation – *Sponsored by CALMS Air*
Thursday, March 21, 2024 – 2:00PM EST

APR 04
Refrigerated vs Desiccant Dryers and Choosing the Right One
Presenter Don Van Ormer, Auditor, APEnergy – *Sponsored by Trace Analytics and BEKO Technologies*
Thursday, April 4, 2024 – 2:00PM EST

APR 18
CTI STD-201RS Thermal Certification for Cooling System Heat Rejection Equipment Part 2
Presenter Cooling Technology Institute
Thursday, April 18, 2024 – 2:00PM EST

MAY 09
How to Identify and Eliminate Artificial Demands
Presenter Tom Taranto, Owner, Data Power Services
Thursday, May 9, 2024 – 2:00PM EST

MAY 23
Sensors for Compressed Air Systems: Data Management and Analysis
Presenter Andrew Smith, P.E., Co-Founder, SMARTCAir – *Sponsored by VPInstruments and Kaeser Compressors*
Thursday, May 23, 2024 – 2:00PM EST

JUN 13
Advanced Aeration Control for Blowers
Presenter Tom Jenkins P.E., President, JenTech Inc. – *Sponsored by APG-Neuros*
Thursday, June 13, 2024 – 2:00PM EST

JUN 27
Heat Recovery from Chillers: How to Capture and Use Waste Heat
Presenter TBD
Thursday, June 27, 2024 – 2:00PM EST

JUL 18
How to Determine the Optimal Size of a Nitrogen Generator
Presenter Mike Flowe, President, Flowe Nitrogen Systems – *Sponsored by Pneutech*
Thursday, July 18, 2024 – 2:00PM EST

JUL 25
Instrumentation and Monitoring for Vacuum Systems
Presenters Emma Larrabee, Marketing Manager and Todd Dunn, Vice President Sales & Marketing, Zorn Compressor & Equipment – *Sponsored by Quincy Compressor*
Thursday, July 25, 2024 – 2:00PM EST

AUG 08
How to Diagnose and Fix Common Issues in Rotary Screw Air Compressors
Presenter TBD – *Sponsored by FS-Curtis/FS-Elliott*
Thursday, August 8, 2024 – 2:00PM EST

AUG 22
Thermal Performance of Evaporative and Dry Cooling Systems
Presenter Clayton Penhallegon, Jr., PE, Integrated Services Group – *Sponsored by EVAPCO*
Thursday, August 22, 2024 – 2:00PM EST

SEP 12
Aeration Blower Sizing and Selection
Presenter Tom Jenkins P.E., President, JenTech Inc. – *Sponsored by Kaeser Compressors*
Thursday, September 12, 2024 – 2:00PM EST

SEP 26
Heat Recovery from Compressed Air Systems
Presenter Don Van Ormer, Auditor, APEnergy
Thursday, September 26, 2024 – 2:00PM EST

OCT 03
Selecting PSA vs. Membrane Nitrogen Generation Systems
Presenter Mike Flowe, President, Flowe Nitrogen Systems – *Sponsored by Pneumatech*
Thursday, October 3, 2024 – 2:00pm est

OCT 10
How to Interpret Audit Data and Improve Your Compressed Air System
Presenter Mauricio Uribe, Auditor, Compressed Air Consultants – *Sponsored by Rogers Machinery and BEKO Technologies*
Thursday, October 10, 2024 – 2:00PM EST

NOV 21
Power Consumption Curves for Vacuum Pumps: Fixed-Speed vs Variable-Speed
Presenter Andy Smiltneek, President, Growth Solutions Consultants – *Sponsored by Rogers Machinery*
Thursday, November 21, 2024 – 2:00PM EST

DEC 12
Compressed Air Leak Detection: Techniques, Methods, Tips, and Tools
Presenter Ron Marshall, Chief Auditor, Marshall Compressed Air Consulting – *Sponsored by Rogers Machinery and Teledyne FLIR*
Thursday, December 12, 2024 – 2:00PM EST

DEC 19
Selection Criteria for Oil-Free Air Compressors
Presenter TBD – *Sponsored by FS-Curtis/FS-Elliott*
Thursday, December 19, 2024 – 2:00PM EST

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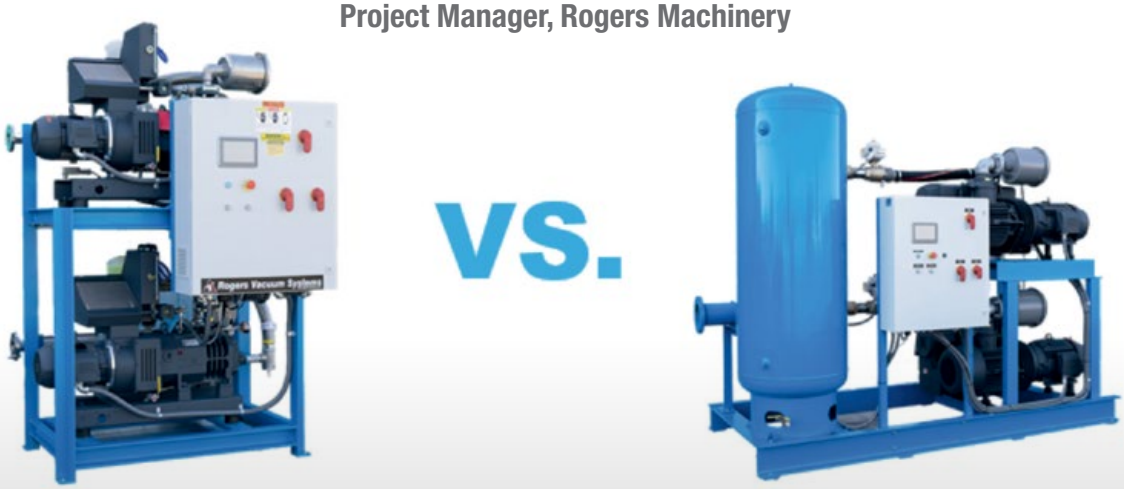
Vacuum Receivers: Full of Vacuum or Full of Myth?

By Jackson Redline, Engineered System Solutions
Project Manager, Rogers Machinery



We often get asked, "Do I need a receiver tank with my vacuum system?" or "Would my vacuum system's issues go away if I just had a bigger vacuum system?". This often leads to a great educational discussion with the customer about vacuum storage and dispelling some of the myths surrounding it that are regularly spread around without realization. Vacuum receivers are often misunderstood as they are likened to similar systems like compressed air or other compressed gases, where a host of benefits can be gained by adding storage to the system in the form of a well thought out receiver tank or storage vessel.

Receivers Tanks – What Do They Do and Why?

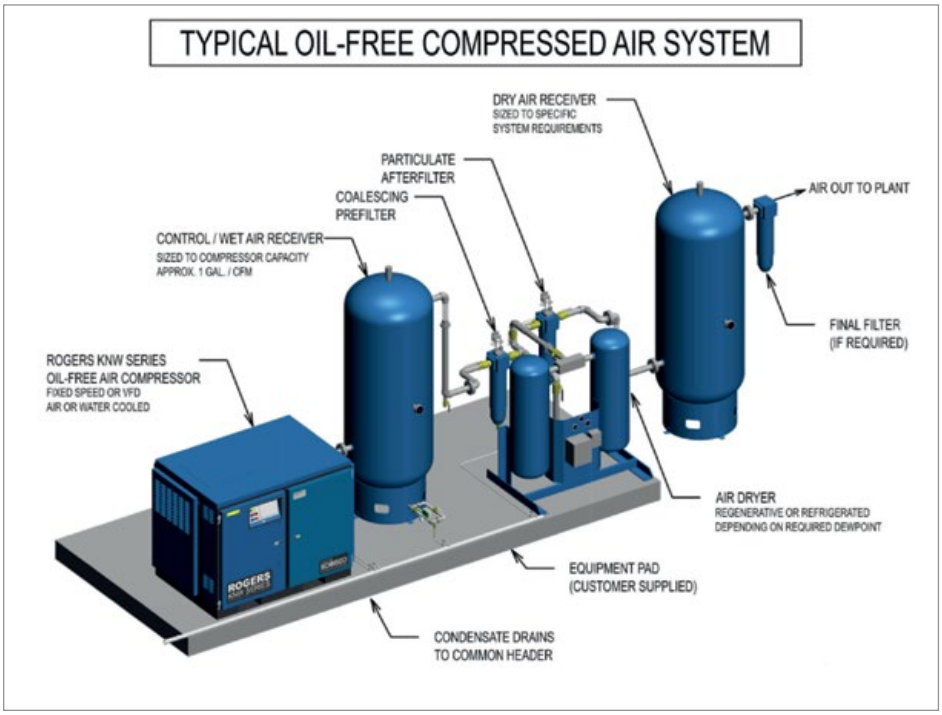
Storage vessels are everywhere in fluid and gas systems whether it's for managing an excess of product, storing gas or liquid for sudden surges in demand, providing a means to separate liquids from gas steams, or a somewhat stable location to monitor and measure pressure or temperature. They're so plentiful in their uses that they sometimes get used where they're incorrectly sized, cause restrictions in flow, or just aren't needed at all.

In this article, we'll discuss some of the uses for receiver tanks for positive pressure systems where the pressure inside the system is greater than atmospheric pressure, and the uses, or lack thereof of, receiver tanks in vacuum systems where the system pressure is less than atmospheric pressure.

Positive pressure systems, like a compressed air system, benefit a vast majority of the time from carefully placed receiver tanks. Typically, we'd recommend the use of a receiver tank on a compressed air system to act, at a minimum, as a good control point where the air is forced to slow down inside the receiver.

How Is Flow Affected by Changes In Pipe Area?

Flow is derived from the below equation where Q is the flow of your fluid/gas in terms of



volume per time (i.e., cubic feet per minute, gallons per minute, cubic meters per hour, etc.), v is the velocity of the gas or the speed at which the gas is moving, and A is the cross-sectional area of the pipe the gas is traveling through:

$$Q = v * A$$

Assuming there is not flow lost going into a receiver (no leaks) then the flow in the pipe (call it Q_1) is the same as the receiver (call it Q_2):

$$Q_1 = Q_2$$

From that we can say:

$$Q_1 = v_1 * A_1 \quad \& \quad Q_2 = v_2 * A_2$$

And go one step further:

$$v_1 * A_1 = v_2 * A_2$$

However, the cross-sectional area of the pipe is not going to be the same as the receiver. The cross-section area in the receiver is typically much larger than the piping. To keep this equation in balance, if the cross-section area $A_2 > A_1$ of the piping, then the velocities will have the opposite relationship where the velocity in the pipe (v_1) will be proportionally greater than the velocity in the receiver which can be shown as the below:

$$v_1 * A_1 = v_2 * A_2$$

Which we can show as:

$$\frac{v_1}{v_2} = \frac{A_2}{A_1}$$

To summarize – the larger the cross-sectional area of the receiver, the slower the gas will move through the receiver. If there are any liquids or solids suspended in the gas stream due to the high velocity before the receiver, they will start to fall out of the gas stream once the gas slows down inside the receiver. Commonly in compressed air systems this is seen in the wet-side receiver tank (after the compressor and before the dryer) where a significant amount of water accumulates inside the receiver and must be regularly drained or it can spill over into the other parts of the process.

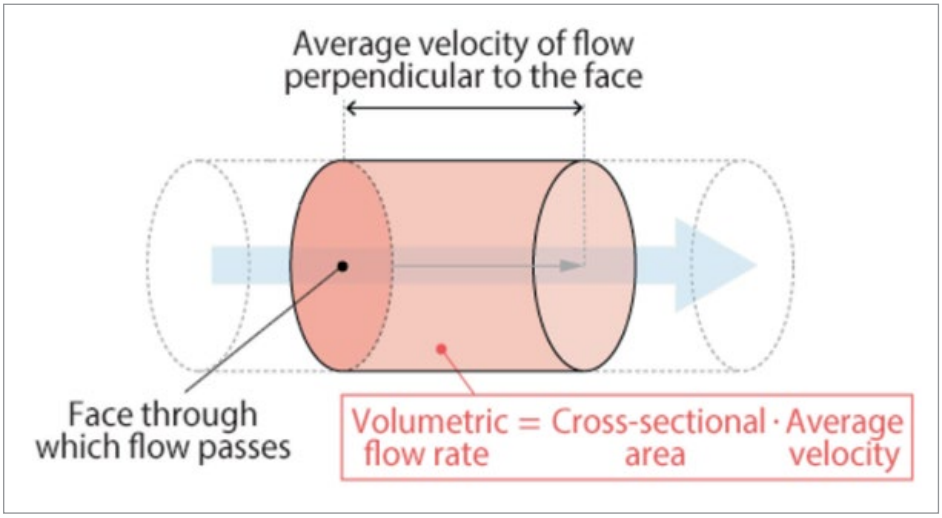


Figure 1. Volumetric flow rate through a pipe is directly proportional to the cross-sectional area of the pipe.

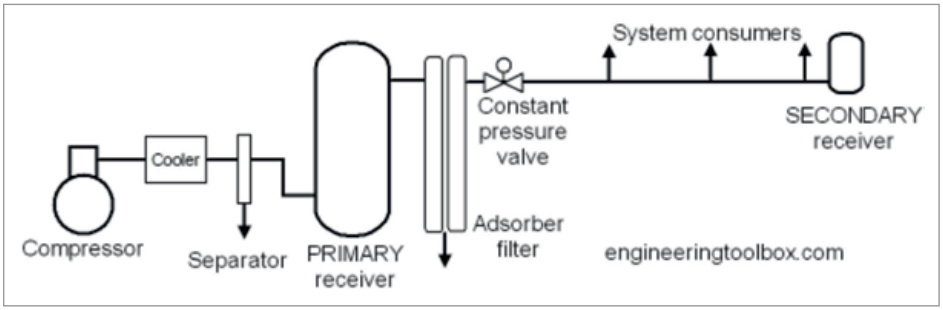


Figure 2. Note that the compressed air receiver is drawn with the inlet side on the bottom from the compressor and discharges out the top.

How To Separate Out Liquids From the Air Stream

Changing the direction of the flow also helps slow it down even further. For example, if the gas enters into the receiver tank at the bottom and discharges out the top of the receiver, not only do we get the benefit of the reduced velocity from the increase in cross-sectional area, now we also get gravity working in our favor.

Suspended liquids and solids in the gas stream need additional energy to be lifted against gravity to the discharge, and if there is not sufficient "oomph" to get them through, then they'll fall out of the stream and collect at the bottom of the receiver, ready to be drained away or collected.

Vacuum Receivers: Full of Vacuum or Full of Myth?

Pressure Drop Through Piping

There's an important facet to discuss related to change of direction of a gas stream, which is pressure drop. Gas doesn't flow neatly through a pipe like an orderly highway where all cars are staying in their lanes and not hitting one another. It's a chaotic madhouse with the gas swirling everywhere, and with each twist and turn, the gas molecules speed up and slow down colliding with the piping and one another as they make their way through the piping bends, elbows, T-fittings, going in and out of receivers, filters, etc.

This is true of compressed gas and vacuum systems. Each collision reduces the energy of the flowing gas meaning more "oomph" is needed to push or pull the gas through the pipe. This commonly shows itself as pressure drop through piping.

Receivers aren't normally thought of as areas of pressure drop, but they can be if they're not appropriately sized or plumbed to the system. For example, if you were to plumb your receiver tank into a vacuum system where you're creating a tortuous path for the gas to drop out some liquid, that same tortuous path might also be causing a notable pressure to drop in the vacuum system which could lead to other issues like not meeting the required vacuum at your end of line.

If there's not going to be liquid in the gas stream, then maybe the receiver tank should be plumbed to provide as straight through of a flow path as possible for the gas stream to reduce pressure loss. The benefit of storage from the receiver tank will still be there, but the pressure loss will not be – seems like a win-win. But how much storage does one really get from a vacuum receiver?

How Does A Receiver Tank Work With Vacuum?

Using a receiver tank with a positive pressure system is pretty self-explanatory – it provides an extra space where a compressor can shove extra gas into, increasing the pressure in the receiver, and keep that extra gas for a later

time. The receiver tank is effectively holding on to extra gas molecules (and the more there are, the higher the pressure will be in the receiver) to be used later.

Now let's think about this in terms of vacuum. Vacuum is when there's less pressure, or less gas, in a space than there is outside of that space in the atmosphere. So, if we are to use the same example of storing vacuum as we did store pressure, we would have a receiver tank where we want there to be less gas molecules than the rest of the system.

That receiver tank isn't storing anything really – in fact the only thing there is more of in that receiver would be empty space. And empty space is nothing. So, the only thing you'd be storing is – you guessed it – nothing.

Well maybe not exactly nothing since vacuum is all about the differential pressure needed between what is in the system and the atmosphere surrounding it and trying to get that "more of nothing" you've stored to

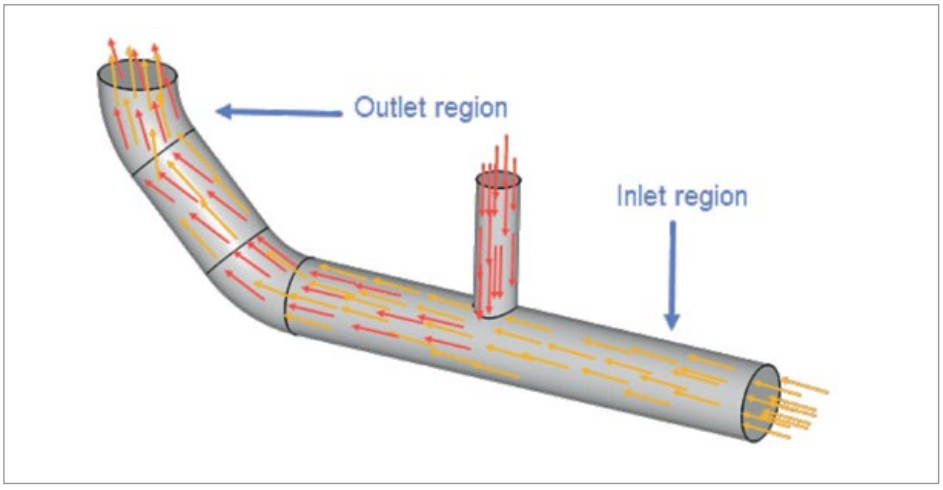


Figure 3. Pipe flow showing a T fitting inlet to a main header. Fitting arrangements like this can add higher pressure drop, especially with vacuum systems. Flow should join in the direction of flow instead of perpendicular in order to reduce system pressure drop.

work for you. In a positive pressure system, a receiver's ability to store a higher pressure than is needed and provide a source of gas for large, sudden needs OR for times when the compressor is off or unloaded, and a small amount of gas is needed, then having it come from the receiver tank instead of needing to turn on the compressor, is a huge benefit.

How Much Storage Does A Receiver Tank Really Provide?

Let's say you have an imaginary company that makes great widgets, and you have a process that needs air at 100 PSIG. You have a compressor connected to a 100-gallon receiver tank and a regulator. The compressor is controlled by a pressure switch. That means it will turn on and run until the pressure is at the upper limit and will turn off until the pressure in the receiver tank is at the lower limit (i.e., 100 PSIG). That way you will always have air at 100 PSIG ready to use. Seems easy enough. Let's complicate it.

Say your compressor makes 10 CFM at all times regardless of the discharge pressure and the receiver tank can withstand up to 10,000 PSIG (which isn't 100% realistic but we're talking about an imaginary company that makes widgets so let's not get carried away). Your process needs 20 CFM but only for one minute every 20 minutes and you can't run your compressor during that time because the power gets turned off to the compressor (I don't make the rules, just this imaginary scenario). How is this going to work? Don't forget your receiver. Just up your pressure switch control to a higher pressure. How will you know how high to turn it – just use the below equation for pump down of a vessel:

$$S = \frac{V}{t} * \ln\left(\frac{P1}{P2}\right)$$

S = Average flow in cu. ft / min.
V = volume in cubic feet
t = time in minutes
P1 = starting pressure (high pressure) PSIA
P2 = end pressure (needed pressure) PSIA

We want to solve for P1 to know how high we need to run up the pressure in the receiver, so we'll have enough to use only the air in the receiver. That turns the to the below:

$$P1 = e^{\frac{S*t}{V}} * P2$$

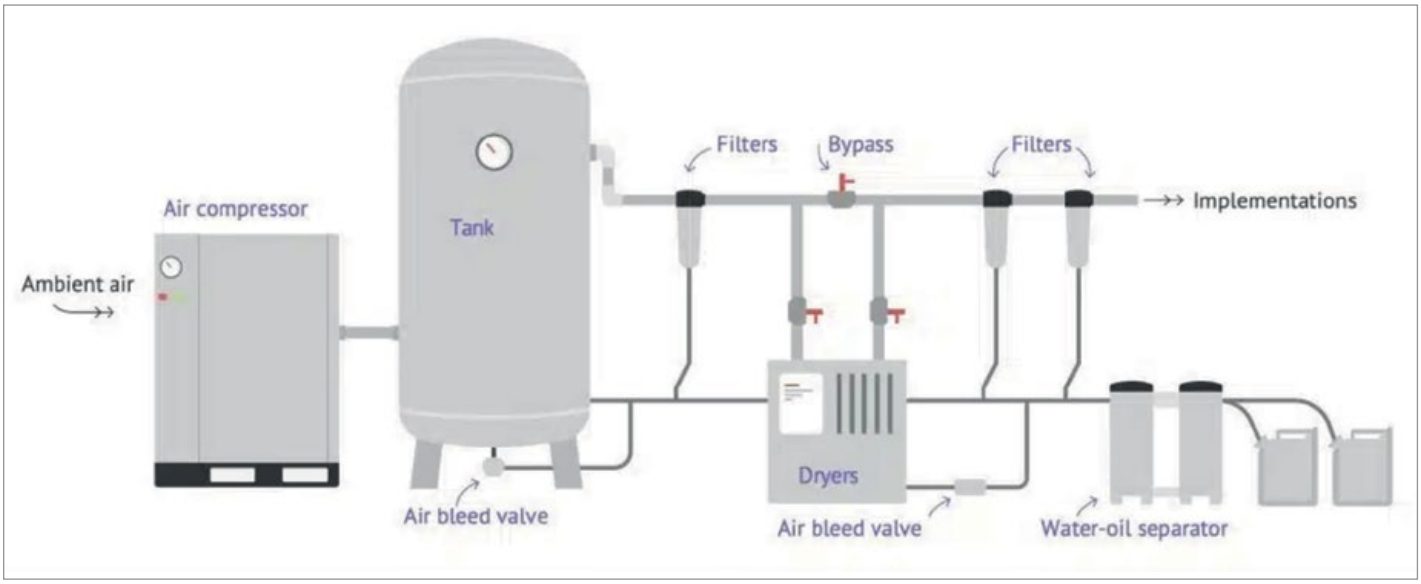
And in our case:
S = 20 cu. ft / min.
V = 100 gal OR 13.3681 cu. ft.
t = 1 minute
P2 = 100 PSIG = 114.7 PSIA

Plugging all that into your handy calculator you will get this:

$$P1 = e^{\frac{20*1}{13.3681}} * 114.7$$

$$P1 = 512\ PSIA = {\sim}497\ PSIG$$

So, you'll need to adjust your compressor to run up to 500 PSIG in order to have enough air to supply that 20 CFM load for one minute without running your compressor. Neat!



https://www.metron.energy/blog/compressed-air-industry-energy-optimization/

Vacuum Receivers: Full of Vacuum or Full of Myth?

Same example but we need air for more than one minute – say 5 minutes – where does that put us?

$$P1 = e^{\frac{20*5}{13.3681}} * 114.7$$

P1 = 203376 PSIA = A LOT

Wow – 200,000 PSI to run your system for just 5 minutes of air. Now where will you find a real compressor that can do just that? I'll save you the trouble of looking – nowhere. So how do we get around that? If that high of pressure is out of reach, then let's make our receiver bigger instead. Instead of 100 gallons, let's use 1,000 gallons.

Same equation, just increase the volume by a factor of 10 to 133.681 cu. ft. to get:

$$P1 = e^{\frac{20*5}{133.681}} * 114.7$$

P1 = 242 PSIA

Now that's way more achievable and quickly leads us to the conclusion that more storage can allow for a lower pressure operating band than a system with less storage. But how does this work for vacuum systems?

How Much Storage Does My Vacuum Receiver Provide?

Let's use a similar example but with a vacuum system. Your same company has a vacuum pump and a 100-gallon receiver. The pump can move 10 CFM of air to pull vacuum on your receiver tank. If we have a similar scenario where you need 20 CFM of vacuum for one minute with your 100-gallon receiver, and you need 20 in HgV, how much pressure differential is needed?

Using the same formula as above but keeping in mind that our pressures are inverted (P1 is our high-pressure number or ending vacuum, P2 is our lower pressure, or our beginning vacuum, which we want to solve for):

$$P2 = e^{-\frac{S*t}{V}} * P1$$

And fill in with our new information:
S = 20 cu. ft / min.
V = 100 gal OR 13.3681 cu. ft.
t = 1 minute
P1 = 20 inHgV PSIG = 9.92 inHgA

Then solve for the needed initial pressure:

$$P2 = e^{-\frac{20*1}{13.3681}} * 9.92$$

P2 = 2.22 inHgA = 27.7 inHgV

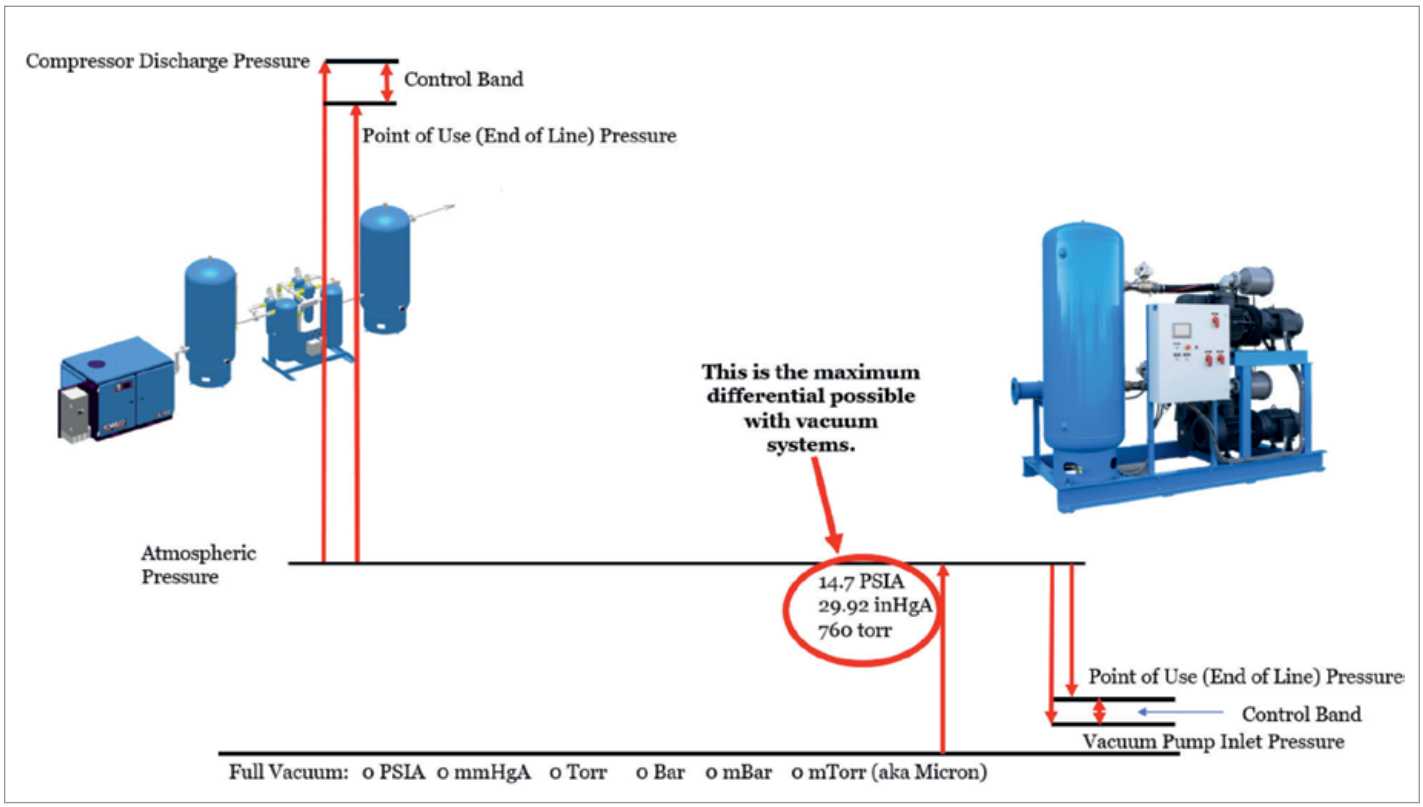
So, what does this tell us about our vacuum receiver? If we draw down our 100-gallon receiver an additional 7.7 in HgV then we get our flow. 7.7 in HgV is only 3.78 PSI. Doesn't seem like a big difference, does it? In fact, with vacuum, we only have 14.7 PSI of total differential that we could ever get. Which brings us to question, is doing all this work to draw down the vacuum receiver worth the small margin it brings us?

Now same as above – storage for 5 minutes is what starting pressure?

$$P2 = e^{-\frac{20*5}{13.3681}} * 9.92$$

P2 = 0.005594 inHgA = 29.91 inHgV

That means we'd need to draw down the receiver ~9.91 in HgV or about 4.87 PSI. Seems easy enough. But now we're running into a potential issue – how deep in vacuum can we go?



The maximum vacuum possible (absolutely no pressure) is 29.92 inHgV. So, with our last example requiring us to use 99.996% of all the differential available, we start running into some other physical barriers.

Basically, we are running out of pressure to use. There's a finite amount of gas when starting at atmosphere and pulling down into vacuum. The deeper we go in vacuum we are looking at chasing individual molecules to get the needed vacuum in order to provide the flow needed from the receiver. That is a task much easier said than done. Compressing gas is basically packing more and more molecules of gas into a finite space. Chasing down, catching, and removing single molecules of gas in a finite space is a tedious hunt and there's incredibly specialized vacuum pumps that do just that, but they're out of the price range for many people.

So, let's increase our receiver size to try and get back to where we only need to draw down an additional 7.7 inHgV since that falls within the reasonable range for most vacuum pumps out there.

Going back to our first equation for pump down, instead of solving for pressure, we'll solve for Volume (V):

$$S = \frac{V}{t} * \ln\left(\frac{P1}{P2}\right)$$

Solving for V:

$$V = \frac{S * t}{\ln\left(\frac{P1}{P2}\right)}$$

Now plug in what we know:

S = 20 cu. ft / min.

t = 20 minute

P2 = 2.22 inHgA

P1 = 9.92 inHgA

Solve for how much volume we would need:

$$V = \frac{20*20}{\ln\left(\frac{9.92}{2.22}\right)} = 267 \text{ cu. ft.}$$

$$= 1998 \text{ gallons.}$$

Woof. That's a pretty big receiver tank that you'd need, and this is a relatively small flow required as well. If we think in terms of a large industrial operation where maybe they need 2000 CFM and want storage for even just 2 minutes (just long enough for their backup system to come back online in the event of a

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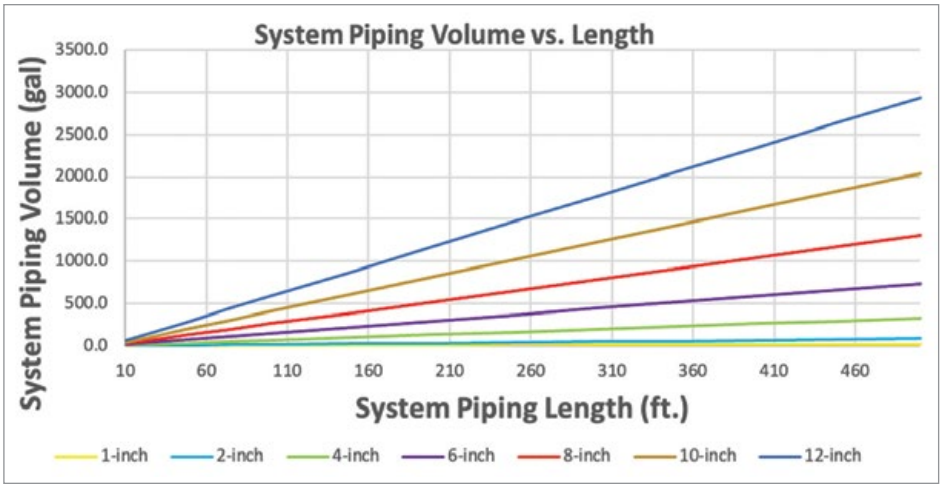
failure) then that system would require 2671 cu. ft. or 19,987 gallons of storage. That's a ton of real estate needed to store essentially an empty receiver tank or set of tanks for such a small gain of differential pressure.

Something similar to the below would be needed in order to provide that much storage – and that's just not realistic in most cases.

If adding a 20,000-gallon receiver tank isn't an option, how else can one add storage to their vacuum system? One easy way is the system piping. In this same case where we have a 2,000 CFM vacuum system, that would typically require about 8-inch piping. If that same system has approximately 500 feet of piping, the total volume of that pipe ends up being ~1300 gallons. And that's not considering all the small drops off that main header, all of which will add to the total system volume.

So, what does this tell us? Piping in vacuum systems, which is normally designed to be larger in diameter to reduce pressure drop in the system, will provide more storage than a receiver could. So simply increasing the size of the system piping will yield a significant increase in storage, decrease pressure loss, and have the additional benefit of providing some room for additional capacity. It also doesn't require a large tank to eat up valuable real estate that could be used for some other equipment that could be more profitable for the customer. This is typically our recommendation for vacuum storage due to the multiple benefits larger diameter piping will provide.



Are Vacuum Receivers Needed?

While vacuum receivers might not work as well as a positive pressure receiver in terms of providing additional capacity to deal with surges in demand or storage, they are still useful devices if used appropriately and for the right reasons. Using a receiver tank to act as a separator to remove liquids from the gas stream can be a critical use of a receiver tank to protect the respective vacuum pump system from ingesting the liquid, which can crash some types of vacuum pumps.

Liquids can also be removed from gas streams using liquid filters through centrifugal action, change of direction, and screens or meshes to collect and remove liquids – many of which have a smaller footprint than a larger receiver tank. So, if liquid removal is your goal – there may be multiple solutions available. There are specific systems designed to separate out and drain liquids under vacuum without needing to bring the whole system to a halt and vent it to atmosphere since liquids under vacuum won't drain out to atmosphere all on their own.

An inadequately sized or misplaced receiver tank can also cause significant pressure loss. If it's been sized appropriately then the pressure drop should be negligible, however, if the porting is too small it could present as

a restriction especially during a system pull down (i.e., pulling the vacuum system down from atmospheric pressure) or during high flow situations. Porting on the receiver tank should be no smaller than the inlet ports on the respective vacuum pump(s), and if there are multiple pumps then the ports should be sized for the maximum flow possible through the system.

It's always crucial to consider how your vacuum system operates – whether it's a relatively constant demand or cyclically pulls down and then vents to a lesser vacuum, when picking any component to use, whether it's the vacuum pump, system controls, variable speed drives, filters, or receiver tanks. Each component can be a great benefit if used appropriately. BP

For more information or any questions, call the Rogers Machinery Company at (503)-639-0808 or visit the custom engineered solutions page at www.rogers-machinery.com.

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VFDs Improve Multistage Blower Performance

By Tom Jenkins, JenTech and Lee Pinkerton, Metropolitan Council Environmental Services

Many designers and operators believe that multistage centrifugal blowers are not suitable for variable speed control. They also feel that multistage centrifugal blowers are an inefficient option for wastewater aeration.

The Eagles Point WWTP has demonstrated that these opinions are based on faulty assumptions. Implementing VFD control of their aeration blowers allowed the plant to improve energy efficiency. The reduction in energy expense paid for the system upgrade in less than two years.

Throttling

It is common practice to control multistage centrifugal blower air flow using an inlet throttling valve. Valves are inexpensive, the control is intuitive for operators, and throttling will reduce both discharge air flow and power. Prior to the commercialization of cost-effective Variable Frequency Drives (VFDs) inlet throttling was essentially the only feasible method for controlling vertically split multistage centrifugals. Horizontally split multistage blowers could use inlet guide vanes, but they were only available for very large blowers.

Throttling creates a pressure drop across a valve. The pressure drop varies with the valve opening and flow rate. Throttling does reduce the discharge pressure, the flow rate, and the blower power. However, at a given inlet volumetric flow rate the pressure ratio across the blower is constant. Inlet throttling simply shifts a portion of the pressure ratio to the inlet side of the blower while reducing the air density. This represents a parasitic loss of energy.

Variable Speed Control

All centrifugal blowers can be controlled by changing their speed. The affinity laws (sometimes referred to as the "fan laws") govern the behavior of blower performance when speed is changed:

$$q_{v2} = q_{v1} \cdot \left(\frac{N_2}{N_1}\right)$$

$$X = \left(\frac{p_d}{p_i}\right)^{0.283} - 1$$

$$X_2 = X_1 \cdot \left(\frac{N_2}{N_1}\right)^2$$

$$p_{d2} = p_{i1} \cdot (X_2 + 1)^{3.532}$$

$$P_2 = P_1 \cdot \left(\frac{N_2}{N_1}\right)^3$$

Where:

q_v = Volumetric flow rate, cfm

N = Speed, rpm

X = Adiabatic factor, dimensionless

p = Pressure, psia

P = Power, kW

Unlike throttling, which maintains the pressure ratio at a given flow, reducing blower speed reduces both flow and pressure directly. Throttling dissipates pressure through the valve. Reducing speed reduces the pressure created. That's why variable speed control is more efficient than throttling.

Although variable speed control can be applied to any centrifugal blower, some characteristics provide wider operating range, improved stability, and increased savings. In general, a high rise to surge and steadily rising pressure vs. flow curve are preferable to flat curves.

VFD control of multistage centrifugal aeration blowers has been used for over thirty years. Despite this, many designers are unaware that the technique is cost effective and reliable.

Eagles Point WWTP

The Eagles Point WWTP is in Cottage Grove, MN. It is one of several plants in Minnesota's seven county metro area operated by the Metropolitan Council. The Eagles Point WWTP average daily flow (ADF) is 5.2 mgd. Three identical multistage centrifugal blowers, installed in 2001, provide air for the secondary aeration basins. Two of the blowers, B1 and B3, have 400 hp motors and the standby blower B2 has a 350 hp motor. Nominal full load speed for all motors is 3550 rpm. The blowers are rated at 8,000 icfm and 10.63 psig discharge pressure. Specified inlet conditions

VFDs Improve Multistage Blower Performance

were 13.99 psia at inlet temperatures ranging from -16°F to 91°F. See Figure 1.

The blower system uses PLCs to maintain a constant discharge header pressure of 9.10 psig. B1 and B3 are alternated as the lead blower. B2, the standby, is operated when one blower cannot meet the total system air demand. The inlet valves are modulated by the blower PLC using a 4-20 mA position signal.

In 2017 the motor starters for B1 and B3 were replaced with VFDs. At that time the intent was to have the VFDs provide soft start for the motors. The system designer advised the plant staff that the multistage centrifugal blowers were not suitable for variable speed control of capacity. All three blowers continued to be controlled by inlet throttling.

The blower instrumentation package is well designed and complete. Each VFD and the B2 motor starter provide a motor power signal to the PLC system. Each blower is also equipped with a thermal mass air flow meter in its discharge piping. The blower's inlet and discharge are equipped with temperature and pressure transmitters. Performance for all three blowers is logged at ten second intervals by the plant SCADA (Supervisory Control and Data Acquisition) system.

Evaluation

It can be difficult to evaluate the blower power reduction obtained from energy conservation measures (ECMs). Percent efficiency comparisons are difficult. Aeration blowers operate across a wide range of flow and power as hydraulic and organic load to the aeration system changes. The blower efficiency is decreased as the flow rate moves away from the Best Efficiency Point (BEP). Inlet temperature and discharge pressure vary, contributing to power fluctuations.

A convenient metric is specific power, sometimes called specific energy. Typically expressed as kW/100 cfm, it is easily understood and can be used to compare different equipment under the

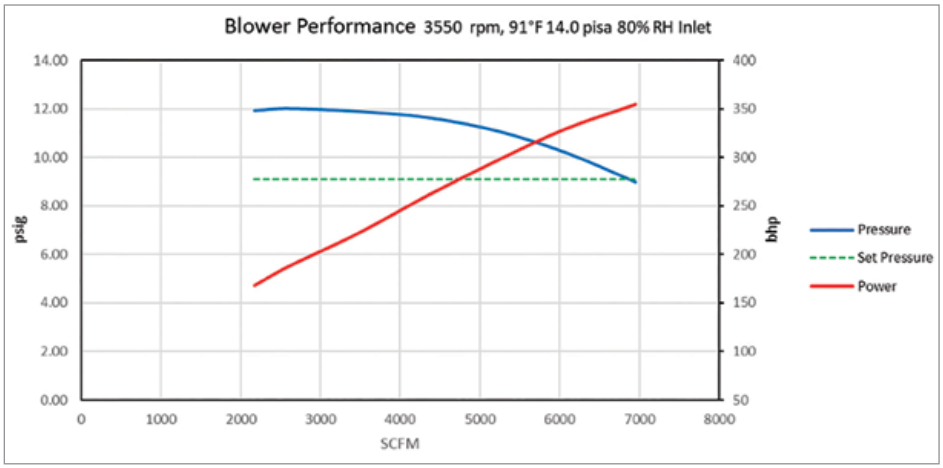

Figure 1: Constant Speed Blower Curve

same operating conditions. This parameter was chosen for performance comparisons.

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

Where:

e = Specific power, kW/100 scfm

q_v = Measured flow rate, scfm (68°F, 14.7 psia, 36% RH)

P = Measured blower power, kW

Total energy consumption and energy cost were used to evaluate the cost effectiveness of VFD control.

Initial Steps

The plant was aware that other facilities had implemented variable speed control for similar aeration blowers. Because of the designer's concerns, however, they opted to take a careful, step by step approach to utilizing the VFD's capabilities.

The staff's first step was based on the recognition that the design discharge pressure was significantly higher than the actual operating pressure. This increased the pressure loss across the inlet throttling valves. To reduce the amount of throttling, the speed of B1 and B3 was reduced to a constant 95% of nominal (3370 rpm).

Table 1: Average Specific Power, kW/100 scfm	
B1, 95% Speed, Inlet Throttled	3.93
B2, 100% Speed, Inlet Throttled	4.76
B3, 95% Speed, Inlet Throttled	4.17

Stepping down the blower speed had a very favorable effect on specific power. See Table 1.

When controlled by throttling at lower constant speed, both blowers showed significant improvement compared to B2, which continued to operate at 100% speed.

VFDs Improve Multistage Blower Performance

Variable Speed Control

The success of operating at a reduced constant speed led the plant staff to consider full variable speed control.

The next step was to use the affinity laws and blower thermodynamics to calculate the reduced speed performance for the blowers. The staff then tested the blowers by manually adjusting the speed and comparing the performance with the calculated parameters. The result was close agreement between theoretical and actual performance. The difference between measured and calculated results was less than 3%.

Encouraged by the calculations and the test results the plant made the minor modifications to the PLC program necessary to convert control from inlet throttling valve to VFDs and variable speed. The changes were implemented in May 2023.

The improvement was immediate and obvious. See Figure 2 and Table 2. The power savings were, as anticipated, substantial.

Variable speed control provided an average specific power for B1 and B3 of 3.55 kW/100 scfm. The improvement of 1.2 kW/100scfm represents a reduction of 25% compared to full speed throttling control of B2.

Concerns about the stability of the blowers under VFD control proved unfounded. The discharge pressure was maintained at the set 9.10 psig with a standard deviation of ±0.07 psig. The blower speed was steady; no hunting occurred.

The savings for full VFD control compared to throttling B1 and B3 at a constant reduced speed were 0.5 kW/100 scfm, a 12% improvement.

The plant calculated that using VFD control reduced the power cost by 17%. This resulted in annual savings of $28,100 based on the current power cost. The initial payback estimate for VFD implementation was 2.5 years. This did not include the electric utility incentive, which reduced the payback to 1.5 years.

Table 2: Average Specific Power, kW/100 scfm

B1, Variable Speed	3.40
B2, 100% Speed, Inlet Throttled	4.76
B3, Variable Speed	3.71

Conclusions

Although variable speed control of centrifugal aeration blowers is well established technology, many operators and designers are still unfamiliar with the application. The result is lost opportunities for cost effective energy conservation projects.

It is still common practice to use inlet throttling to control multistage centrifugal blowers. This is an inefficient technique which creates pressure drops across the valve and results in power loss. Using variable speed control is inherently more efficient, since

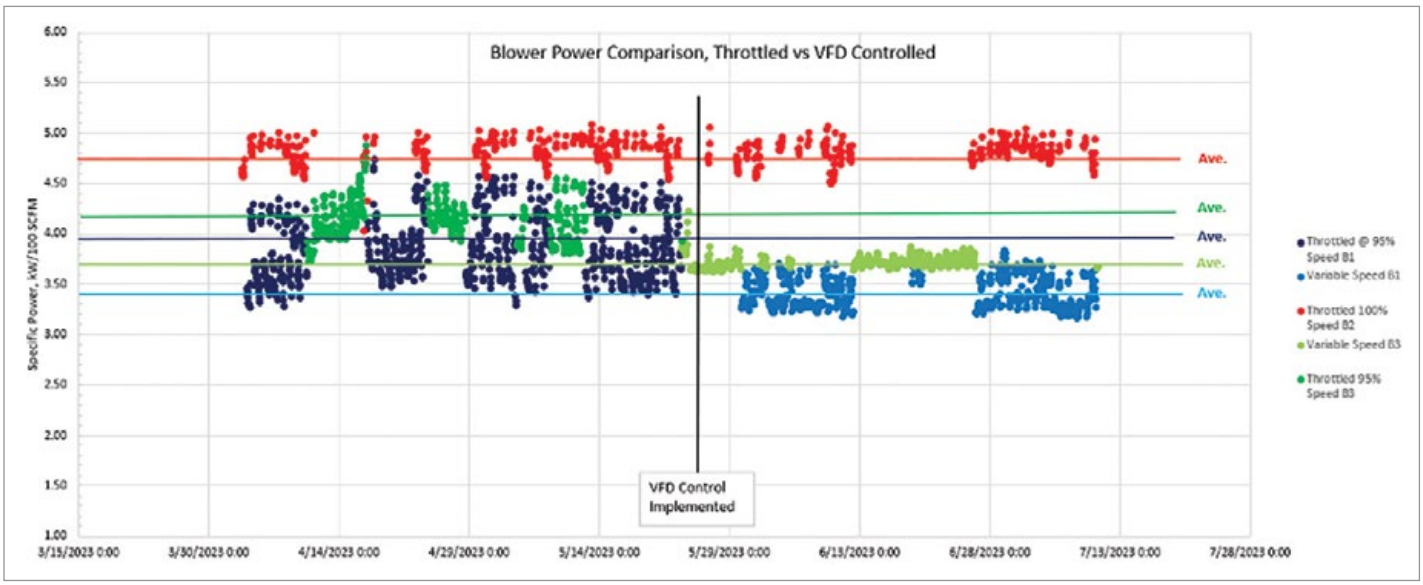

Figure 2: Specific Energy, Throttled vs. Variable Speed

flow and pressure are directly controlled and optimized.

The Eagles Point experience clearly demonstrates the advantages of variable speed control. It is an example of a retrofit application of VFDs to an existing aeration blower system. The Eagles Point experience proves that the more common approach of inlet throttling doesn't optimize energy consumption. Variable speed control is the key to high efficiency with multistage centrifugal blowers. BP

About the Authors:

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 and a WEF Fellow. Tom is the current Chair of the ASME PTC 13 Committee. For more information, visit www.jentechinc.com.

Lee Pinkerton is Senior Engineer for the Metropolitan Council Environmental Services in the Research and Development group. He has been working for the Metropolitan Council for 6 years and works on a variety of special projects from aeration, blowers, and process modeling to wastewater-based epidemiology. Lee received a B.S. in Chemical Engineering from the University of Wisconsin-Madison.

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Blower & Vacuum Technology News

Atlas Copco Introduces the DZS A Series Dry Claw Vacuum Pumps

Atlas Copco, a leading provider of innovative vacuum technology solutions announces its next generation of dry claw vacuum pumps – the DZS A series. This new series sets a benchmark for performance, efficiency, and reliability. Designed with the evolving needs of manufacturing industries in mind, the DZS A series offers significant advantages. Leveraging the latest in German engineering and cutting-edge machining, these dry claw vacuum pumps deliver exceptional performance, energy efficiency, and superior product quality.

The DZS 065-300A series is engineered to deliver superior vacuum performance, with high pumping speeds and deep ultimate vacuum levels. These dry claw vacuum pumps offer substantial energy savings, resulting in reduced operating costs and a smaller carbon footprint.

The DZS 100-400 VSD+A series are equipped with a Variable Speed Drive helping achieve increased productivity due to the pressure set point control. These compact machines with a small footprint deliver high reliability through a rugged and robust design.

Pamela Cateland, Marketing Manager Atlas Copco Vacuum West, said, "We are thrilled to present the DZS 065-300A and DZS 100-400 VSD+A series, the next step in the evolution of our dry mono claw vacuum pumps. With our focus on providing value, this second-generation series showcases our dedication to continuous improvement. With the improved

DZS 400 VSD+A - Variable Speed Dry Claw Vacuum Pump.

performance, reliability, and lower noise levels, this series brings tremendous value to our customers."

With a focus on continuous improvement, the DZS A series incorporates design enhancements that improve its capabilities.

The DZS 065-300A series delivers higher pumping speeds, enabling faster processes and increased productivity. With its improved performance, customers can expect to achieve higher throughput and meet demanding production requirements.

Understanding the importance of a quiet working environment, this latest range of pumps features a redesigned silencer. The result is significantly reduced noise levels, creating a more comfortable workplace for operators while maintaining vacuum performance.

By lowering the internal temperature of the pump, this series improves on durability by increasing the pump's lifespan, reducing downtime and maintenance costs, and providing customers with peace of mind.

The Smart Kit prevents the vacuum pump from overheating when running at ultimate vacuum. This innovation, which replaces the traditional vacuum relief valve, results in better efficiency and suction flow.

Atlas Copco's commitment to customer convenience is evident in the DZS 065-300A Series with an emphasis on ease of service and on-site maintenance.

"Our team of engineers have worked diligently to develop a pump that meets the evolving needs of our customers, while also addressing the global demand for energy efficiency and sustainability. The DZS A series is a significant advancement in dry claw vacuum pump technology," said Ahmed Elshaffie, Product Manager Dry Pumps West, Atlas Copco Vacuum. "The versatility of these pumps makes it suitable for a wide range of industries including packaging, food processing, woodworking, printing and plastics," said Ahmed.

About Atlas Copco Vacuum Technique

Great ideas accelerate innovation. At Atlas Copco Vacuum Technique we collaborate with our customers to turn industrial ideas into leading edge technology in vacuum and abatement solutions. Our passionate people, expertise and service bring sustainable value to industries everywhere. Atlas Copco is based in Stockholm, Sweden with customers in more than 180 countries and about 49,000 employees. Revenues of BSEK 141 in 2022. For more information, visit www.atlascopco.com/vacuum.

Eurus Blower Introduces the ISB Series of Screw Blowers

Eurus Blower, a wholly owned subsidiary of Shandong Zhangqiu Blower Co., Ltd. (SZB) one of the world's largest suppliers of Rotary Lobe Blowers, announces the introduction of the ISB Series of screw blowers to the North American market. These blowers are used in pneumatic conveying and wastewater treatment applications.

The ISB Series offers seven models in low, medium, and high-pressure versions. The product performance ranges from 417 cfm at 15psig to 5,645 cfm at 36psig (2.5 bar).

Roger Blanton, General Manager and Marketing Director of Eurus Blower, said, "This exciting ISB Series of screw blowers offers our customers a greater selection of high efficiency blowers. The ISB product introduction complements the recent VR Series (steam blower) introduction and growing success with our multistage centrifugal product. Building on our parent company's high-quality products, Eurus Blower's customer service focus is unmatched in the North American market as we continue meeting customer needs."

About Eurus Blower

Shandong Zhangqiu Blower Co., Ltd. (SZB) was founded in 1968, celebrating 55 year anniversary in October 2023, now employing more than 1,400 people. Our manufacturing area is greater than 1,000,000 square feet, and our annual production is more than 13,000 units. We own and operate our own foundry. Established on the principles of providing superior product quality, value, and dependability; we hold QMS certifications from ISO9001, ISO14001, and GB/T28001. After 30 years of establishing a solid foundation in China, we began to export our blowers in the late 1990s. The company quickly became known as an industry leader in blower technology across international markets. In 2008, with over 40 years of blower manufacturing experience, Shandong Zhangqiu Blower Co. established Eurus Blower, Inc. in the U.S. with a vision of providing competitively priced, high-quality blowers for new or replacement blower applications to North and South American wastewater treatment and industrial marketplaces. For more information, please visit www.eurusblower.com or e-mail sales@eurusblower.com.

Eurus Blower ISB Series Screw Blower.

Busch Vacuum Solutions Introduces New R5 RA

The proven R5 RA from Busch now comes in an improved version with a completely redesigned interior. The new vacuum pump is 25% more energy efficient than its predecessor, thanks to the optimized compression ratio, pump stage dimensions, and oil discharge path.

It is also available with ECOTORQUE, the Busch variable speed drive (VSD), that enables the pumping speed to be adapted to the exact requirements of any process. As a result, additional energy savings of up to 50% and a 20% increase in pumping speed can be achieved. The accessory extends the supply voltage range supported by the vacuum pump, making it suitable for use in almost all countries around the world. This compact and cost-effective solution is also available as a retrofit.

Compared to the previous generation, the R5 RA 0520 A has a 20% smaller footprint, is 25% lower in height, and the absence of external piping improves leak tightness. The compact and hygienic design features surfaces that repel water and dirt. The total number of spare parts

Blower & Vacuum Technology News

Busch Vacuum Solutions New R5 RA with a modern and hygienic design.

has been reduced by 40%, making maintenance fast and efficient, with all service-related parts located on one side. Heat emissions have also been decreased through an improved cooling system that combines optimal pump operating temperature with compact construction.

The new vacuum pump is made for continuous operation in the rough vacuum range with vacuum levels down to 0.1 hPa (mbar). Field tests were successfully carried out to validate performance and reliability.

The R5 RA 0520 A and the R5 RA 0520 A ECOTORQUE set a new standard in vacuum technology. The pumps are suitable for various applications in vacuum packaging, food and plastics processing, medical, coating and many other industries. They are an excellent choice for companies looking to improve their processes while minimizing energy costs and reducing their environmental impact.

About Busch Vacuum Solutions

Busch Vacuum Solutions offers vacuum and pressure solutions from individual vacuum pumps, blowers, and compressors to tailor-made vacuum systems. In addition to vacuum equipment, Busch is also a global service provider. Busch USA headquarters is in Virginia Beach, VA, and part of the global Busch family-owned company with over 3,800 employees in 45 countries. For more information, please contact Busch at info@buschusa.com or visit the Busch US website at www.buschusa.com.

Quincy Compressor Introduces the QSV E Series Vacuum Pumps

Quincy introduced the QSV E Series vacuum pumps. They are proud to release these 30–50HP machines giving the reliability customers expect from Quincy products, with advanced features able to tackle uptime and sustainability objectives.

The QSV E Series permanent mag motor is oil lubricated/cooled, eliminating the need to grease motor bearings. Improved oil mist elimination (only 1.5 PPM) ensures rotor lubrication/cooling is never compromised. These features (and others) extend the overhaul range to 100,000 hours and give Quincy the confidence to back the machines with their impressive Royal Blue 10-year warranty.

Improved pumping performance at higher pressures (lower vacuum levels), means customers will get faster pump down. Sophisticated variable speed operation with a focus on power consumption, means customers will use only what is required to meet their demand…no more, no less…thereby maximizing efficiency. Customers can reduce their carbon footprint even further by opting for the Energy Recovery option to capture otherwise wasted heat.

Quincy's QSV vacuum pumps (10HP – 125HP) include an AirLogic 3 controller, offering enhanced connectivity, customizable features, and operating modes. This means customers can remotely check run status, operating variables, and key performance metrics. Configurable operating modes allow customers to tailor the vacuum pump performance to their specific application, further maximizing performance, reliability, and energy savings. Operators and plant engineers will also enjoy the quieter operation and smaller footprint too.

Work smarter not harder with Quincy's powerful QSV product line, providing exceptional reliability and efficiency for the toughest and harshest vacuum applications.

To view a full list of benefits, please visit www.quincycompressor.com today.

About Quincy Compressor

Headquartered in Bay Minette, Alabama, Quincy Compressor is a leading designer and manufacturer of reciprocating and rotary screw air compressors, from one-third to 400 horsepower;

Quincy's QSV vacuum pumps include an AirLogic 3 controller.

vacuum pumps, and a full line of air treatment components. In business since 1920, Quincy has built its reputation on quality and rugged reliability, building tough air compressors for the most demanding applications. The Quincy brand is synonymous with quality, delivering "Performance You Demand. Reliability You Trust." Quincy's dedicated network of authorized distributors offers top-notch installation and after-sales services for reliable, efficient air year after year. Quincy has more than 600 employees worldwide, and its products are sold through multiple channels, including a network of distributors, commercial retailers, online and company-owned stores. To learn more and locate an authorized dealer, visit www.quincycompressor.com.

APG-Neuros Introduces Advanced Aeration Control System

APG-Neuros' Advanced Aeration Control System enables Water Resource Recovery Facilities to optimize their biological secondary treatment processes. The system was developed with the support of a grant from the US Department of Energy (DOE) with the primary goal of reducing energy consumption. The system uses state-of-the-art self-learning algorithms, known as Model Predictive Control, to compute the oxygen demand and deliver unprecedented performance from the entire aeration system – from the blowers to the dissolved oxygen in the tank and everything in between. The system also offers an optional Ammonia Based Aeration Control feature that unlocks further savings potential by dynamically adjusting the dissolved oxygen setpoints based on the loading. This ensures a reliable and stable ammonia treatment process at the lowest oxygen level, reducing the oxygen requirements for treatment and thus lowering the power consumption and the operating costs by up to 20%.

The Model Predictive Control (MPC) is the brain behind the Advanced Aeration Control System. Unlike traditional Proportional-Integral-Derivative (PID) control algorithms, MPC analyzes historical operational data and raw trends that it uses to enable the system to compensate for the nonlinearities inherent to

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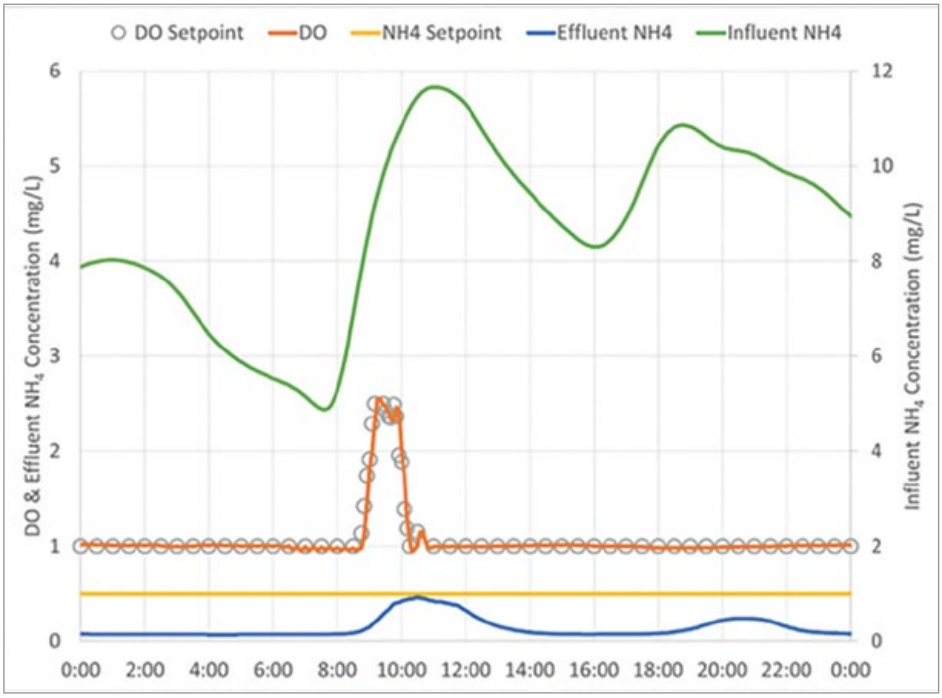

The Advanced Aeration Control System is offered for operation on all aeration systems with and without APG-Neuros Blowers.

the secondary treatment process. The result is stable and accurate control over the full range of operating conditions… all without the need for manual re-tuning.

About APG-Neuros

Founded in 2005, APG-Neuros is recognized as the force behind the successful introduction of the high speed turbo blower technology in the wastewater treatment markets in North America, Western Europe and the Middle East. APG-Neuros turbo blowers are used in a variety of industrial applications and wastewater treatment processes, with over 1,700 units installed in North America and Europe, and more than 6,000 units worldwide. APG-Neuros continues to lead the industry by constantly driving and propelling innovation forward through the most technologically advanced products and aeration solutions to achieve maximum energy efficiency and operational flexibility for our customers. APG-Neuros' headquarters are located in Quebec, Canada, and its manufacturing and testing facility in Plattsburgh, NY, USA. For more information, visit https://apg-neuros.com/.

Edwards Launches E2S Series Rotary Vane Vacuum Pumps

Edwards Vacuum, one of the world's leading designers and manufacturers of vacuum pumps, has launched a new oil-sealed rotary vane vacuum pump. The company offers a reliable product in the form of the powerful, robust E2S series for low and medium vacuum in industry and research. The E2S has a simple design and is suitable for various standard applications. "It pumps quickly, handles any vapors that arise and, with its quiet operation, helps to reduce the noise level in working environments," said Product Manager Jessie Huang, summarizing the advantages of the vacuum pump.

Thanks to the modern technical design, users increase the economic efficiency of their processes with the rotary vane pump. This is based not least on the high pumping speed of the E2S. This shortens cycle times and increases production capacity in standard processes. "An important advantage: the higher throughput is achieved without additional energy requirements, so the ecological footprint is not increased," said Edwards Product Manager Jessie Huang. According to Product Manager Jessie Huang, the pumping speed of the E2S is 90 m^3/h and enables an ultimate vacuum of 3 x 10-3 mbar. At ultimate pressure, the performance of the E2S thus meets the requirements of industrial applications. For special performances, Edwards offers optional standard combinations of two-stage E2S pumps including a mechanical booster.

The modern technology of the compact rotary vane pump is also reflected in its user-friendly design. Thus, the E2S has also been developed along the most modern needs of its users in terms of simple, intuitive handling. The operating elements are correspondingly functional and ergonomic, offering a high level of safety against operating errors. The quiet running of the E2S series is also due to its technology. The low-noise plain bearings are made of sintered steel, have a simple design and do not dry out even with low oil lubrication. Edwards has integrated an oil pump for continuous lubrication over the entire pressure range.

To prevent oil loss, the rotary vane pump contains two shaft seals. Edwards has also optimized the cylinder bore for the highest possible stable discharge pressure and increased leak tightness. In addition, a built-in oil filter prevents oil leaks and protects the inside of the pump from particles and contaminants. If the application requires it, the adjustable gas ballast function can be used to increase the water vapor tolerance of the E2S. In the standard setting, small amounts of water vapor are pumped out via this, while at the same time a good ultimate pressure is maintained.

Edwards offers the E2S series in three pump sizes – the E2S 45, E2S 65 and E2S 85. The rotary vane pump is primarily suited for vacuum drying and degassing, heat treatment and vacuum furnaces, as well as for leak testing of components and systems in automotive manufacturing, coating applications, research and development and analytical applications.

About Edwards

Edwards is a leading developer and manufacturer of sophisticated vacuum products, exhaust management systems and related value-added services. These are integral to manufacturing processes for semiconductors, flat panel displays, LEDs and solar cells; are 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 both scientific instruments and a wide range of R&D applications. Edwards has over 7,000 employees worldwide engaged in the design, manufacture and

E2S from EDWARDS VACUUM – The new series of oil-sealed rotary vane vacuum pumps.

Blower & Vacuum Technology News

support of high technology vacuum and exhaust management equipment and has state-of-the-art manufacturing facilities in Europe, Asia and North America. Edwards is part of the Atlas Copco Group. Atlas Copco is based in Stockholm, Sweden with customers in more than 180 countries and about 49,000 employees. Revenues of BSEK 141 in 2021. Further information about Edwards can be found at www.edwardsvacuum.com.

Pfeiffer Vacuum Offers OmniGrade Customized RGA System

In addition to vacuum pumps, leak detectors, measurement and analysis devices, components as well as vacuum chambers and systems, Pfeiffer Vacuum now also offers customized turn-key solutions in form of residual gas analysis systems. Fast-emerging markets with advancing technical requirements place an increasing value on superior cleanliness, as molecular contamination negatively affects the functionality of manufactured products. Therefore, more and more customers are defining higher requirements for cleanliness. For instance, in the EUV lithography market they are driven by the Generic Standards GSA 07 1221 & GSA 07 2221. Essential to securing the quality of parts is to properly determine the outgassing rates under a high vacuum environment by utilizing Pfeiffer Vacuum's new OmniGrade system.

Pfeiffer Vacuum offers a new customized RGA system for sophisticated cleanliness verification.

OmniGrade is a sophisticated residual gas analysis (RGA) system. Its design is selected to meet specific testing demands. A team of Pfeiffer Vacuum experts is dedicated to delivering the best solution to meet customer requirements, considering total cost of ownership and lead times. OmniGrade configurations include two or three chambers consisting of the spectrometer chamber in which the mass spectrometer is positioned, and a measurement chamber where the samples are placed during measurement. Options include a load lock chamber to minimize system background and an automated sample transport system. The OmniGrade system was designed for low footprint demands and easy integration with the latest interfaces. Cleanroom compatibility is possible and the mass spectrometer according to the requirements (PrismaPro or HiQuad) can be selected. Thermal heating, either of the pure system or together with the sample (bake-out), will contribute to further optimizing the measuring capability and improving sample cleanliness.

"OmniGrade incorporates energy-efficient components and advanced technologies that help to optimize cleanliness verification processes, resulting in less waste and more efficient use of resources in the customer's production environment", said Patrick Walther, Strategic Product Manager Instruments at Pfeiffer Vacuum.

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, vacuum 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 in the analytical, industrial, research & development, semiconductor and future technologies markets. Founded in 1890, Pfeiffer Vacuum is active throughout the world today. The company employs a workforce of some 4,000 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.

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Highly targeted manufacturing and process industry readers optimize the use of industrial blowers and vacuum pumps. These readers work together with 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.

"The water vapor tolerance of a vacuum pump has a direct influence on the quality of the packaged product."
— Allen Fletcher, Busch Vacuum Solutions

Aeration Blower Systems

Operators at wastewater treatment plants, process engineers at engineering firms, and municipal sales reps representing blowers receive the magazine. They turn to our editorial pages whose content is directed by noted aeration blower experts. 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.

"As you look at your industrial wastewater system, let your imagination be your guide. As they say, 'think outside the box'."
— Hank Van Ormer, APenergy

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Integrated Services Group

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