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FROM THE EDITOR

Spring was beautiful but over before I knew it and the summer season is upon us. I hope all of you have the chance to get outdoors as much as possible!

Industrial Blower & Vacuum Systems

Demanding heat-treating processes have long relied on vacuum technology. In this issue, Dave Sobiegray from Edwards, shares his process expertise on knowing which variables to examine when choosing between dry and oil-sealed vacuum pump technologies.

We view the field of industrial vacuum controls as one with great future potential. Nicolas DeDeken, from EnergAir, shares with us a vacuum system audit story where out-dated machine controls were replaced with modern master controls allowing this semiconductor plant to automate the vacuum system. The benefits are increased uptime and efficiency.

Aeration Blower Systems

We are very fortunate to receive an update on the progress of ASME PTC 13, Blowers. Committee Chair Jacque Shultz was kind enough to tell us where things stand with this "almost-finished" standard aimed at improving the performance of aeration blower systems. We recognize all the Committee Members for the years of work they've put voluntarily into this new ASME standard.

We begin a 2-part series on aeration control valves written by Tom Jenkins of JenTech, Inc. He writes, "Sizing, selection, and adjusting control valves often causes confusion for process and control system designers. Improper valve application can cause operating problems for plant staff and waste blower power." Enjoy the learning

Fall will be here all too quickly. Please consider attending the 2019 Best Practices Expo & Conference, taking place October 13-16, 2019 at the Music City Convention Center in Nashville, TN. Please consider registering for the event!

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

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BLOWER & VACUUM TECHNOLOGY PICKS

Atlas Copco Launches LRP Range of Liquid Ring Vacuum Pumps with Dual VSD Technology

Atlas Copco Compressors LLC launches its new LRP 700-1000 VSD+ range, featuring three vacuum pumps developed for wet, humid and dirty applications. A huge departure from classic liquid ring pumps, the LRP 700-1000 VSD+ is a compact, high performance, energy-efficient system enclosed in a rugged noise-attenuating canopy.

Ensuring efficiency, the dual VSD system operates in absolute harmony within the pump. The primary VSD accurately maintains required vacuum levels by controlling the operating speed of the pump, matching pump performance to process demand and saving energy. The second VSD regulates the water circulation pump in response to the operating conditions. Optimizing water flow within the pump element provides maximum performance and stability at all vacuum levels and operating speeds. The patented features and unique algorithms balance the operation of the water pump with the speed of the main motor.

The intelligent aspect of the pump comes through Atlas Copco's MkV Elektronikon® controller as standard, providing a comprehensive built-in management system. Key information on performance and maintenance is readily available and very visual. Multiple pumps can be monitored, controlled and optimized simultaneously, giving customers the most suitable product performance at all times. The pump can also be remotely monitored via Atlas Copco's SMARTLINK program.

No corner is cut when it comes to the build quality; this includes stainless steel components and set-point controls. The nature of applications where liquid ring pumps should excel means that the product has been designed for the harshest processes. The Atlas Copco LRP VSD+ series is designed for an array of tough applications, including filtration, food processing, conveying, ePS, drying, degassing and plastics calibration and rubber vulcanization, to name a few. The cubicle meets IP54 standards for repelling dirt and dust.

Atlas Copco Compressors has launched its new LRP 700-1000 VSD+ range of liquid ring vacuum pumps.

"When it comes to pump technology, we believe in taking what has been the standard for years and driving it to the next level," said Gerry Bergeron, product marketing manager for liquid ring pumps in the United States. "People that have looked at liquid ring pumps in the past and moved on to other solutions should take a look at this new innovation."

With the application being at or close to the point of use, noise and size are two essential considerations. The compact, integrated design, which includes many features usually only seen on the outside of the cubicle is still up to 70 percent smaller than comparable models – this also makes it a truly plug and play design. An operating noise level in the range of 65dB(a) makes the LRP VSD+ an extremely quiet vacuum pump.

The service needs of the customer also played a large part in the design. Importantly, service can be performed while the pump is horizontal. No oil means no regular filter exchange and all areas needed for service are easily accessible. The vessel can be easily cleaned via the dedicated access port.

The LRP VSD+ range has met the strictest quality requirements, has been classified by TÜV as completely oil-free and has achieved the industry leading Class 0 status – ensuring there is zero chance of any contamination from oil.

Atlas Copco Group & Atlas Copco Compressor Technique

Great ideas accelerate innovation. At Atlas Copco, we have been turning industrial ideas into business-critical benefits since 1873. 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 37,000 employees. In 2018, revenues were BSEK 95, approximately 10 BUSD.

Atlas Copco Compressor Technique partners with customers to turn industrial ideas into smart, connected air and gas solutions and leading edge compressed air technology. By listening to our customers and knowing their needs, we deliver value and innovate with the future in mind.

Atlas Copco Compressors

Atlas Copco Compressors LLC is part of the Compressor Technique Business Area, headquartered in Rock Hill, South Carolina. Atlas Copco

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Real innovation makes a difference in your energy bill. HST™ turbocompressors from Sulzer are designed for wastewater aeration and optimized for total efficiency, giving you more air output for every kilowatt you put in.

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For more innovation in wastewater treatment, visit www.sulzer.com

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Compressors provides innovative solutions including world-class compressors, vacuum pumps, air blowers, quality air products and gas generation systems, all backed with full service, remote monitoring and auditing services. With a nationwide service and distribution network, Atlas Copco Compressors is your local, national and global partner for all your compressed air needs. Learn more at www.atlascopco.com/air-usa.

Pfeiffer Vacuum Introduces New HiLobe® Roots Pumps

Pfeiffer Vacuum introduced the new Roots pumps of the HiLobe series. For the first time, Pfeiffer Vacuum experts will present these innovative vacuum pumps – in addition to their extensive product portfolio – which can be used for numerous industrial vacuum applications such as electron beam welding, vacuum furnaces or freeze drying. The pumps of the HiLobe series are of particular interest for fast evacuations (load-lock chambers or leak detection systems). Furthermore, they are suitable for use in coating applications.

Compact and powerful Roots pumps

The compact Roots pumps offer a wide nominal pumping speed range of 520 – 2.100 m³/h. This is made possible through the new drive concept in conjunction with frequency converters. Thanks to their individual speed control, the pumps can be precisely tailored to customer-specific requirements. Thanks to this powerful drive concept, the HiLobe achieves approximately 20 percent shorter pump-down times than conventional Roots pumps. Rapid evacuation reduces costs and increases the efficiency of the production system.

Process-reliable and cost-efficient vacuum

The maintenance and energy costs of the HiLobe are >50 percent lower compared to conventional Roots pumps. The reason for this is a drive with energy efficiency class IE4 and the special rotor geometries of the pumps. The sealing concept also contributes to this. The pumps are hermetically sealed to the atmosphere and have a maximum integral leakage rate of 1 · 10-6 Pa m³/s. Dynamic seals are eliminated and, as a result, maintenance is only required every four years. Due to the innovative sealing concept in the suction chamber, the use of sealing gas is superfluous in most applications, which also has a positive effect on the operating costs. Since the operation of the HiLobe Roots pumps is possible even at ambient temperatures of up to +40°C with flexible air cooling, cost-intensive water cooling is unnecessary.

Pfeiffer Vacuum Roots pumps of the HiLobe Series set new standards

Control and communication are the essential factors for increasing system availability. The intelligent interface technology of the HiLobe allows very good adaptation and monitoring of the processes. This facilitates anticipatory and efficient work. By integrating such condition monitoring, information about the condition of the vacuum system is always available. In addition, condition monitoring increases system availability allowing users to plan maintenance and repair measures in a useful and anticipatory way and prevent cost-intensive production downtimes. These advantages lead to a long service life and maximum operational safety. Depending on their suitability for the existing system, the HiLobe vacuum pumps can either be aligned vertically or horizontally. This allows maximum pumping speed and a more customized and efficient use of space at the customer's production site.

"With the HiLobe Roots pumps our customers are able to reduce energy and operating costs and consequently make production more cost-efficient. For a sustainable reduction of energy consumption and operating costs, it is not enough to solely base it on the energy requirements of a vacuum pump. The type of cooling, the maintenance intervals and the control also have a decisive influence on the overall energy balance. We are proud to be able to offer our customers this holistic approach," says Dr. Ulrich von Hülsen, CTO of Pfeiffer Vacuum Technology AG.

About Pfeiffer Vacuum

Pfeiffer Vacuum (stock exchange symbol PFV, ISIN DE0006916604) 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 8 manufacturing sites worldwide. For more information, please visit www.pfeiffer-vacuum.com.

Sulzer Launches Line of High-speed HSR Turbo Air Compressors

Sulzer has unveiled its new line of HSR high-speed turbo air compressors designed for production of oil-free air in applications where contamination of air must be avoided. The HSR turbo air compressor utilizes high-performance turbo and magnetic bearing technology to maximize efficiency and minimizes maintenance.

The new line offers two- or three-stage compression for maximum pressures of 4.5 and 9 bar (gauge), respectively, using state-of-the-art turbo airends, which are directly driven by a high-speed motor that utilizes permanent magnets. One or two variable frequency drives control the motors to achieve necessary speed and flow control. Adjustable diffuser vanes can be applied to extend the wide flow range. With modulating blow-off valves, the flow can be adjusted between zero and 100 percent.

The HSR turbo air compressor contains no oil, providing 00 percent safe compressed air for processes where no contamination is allowed. Examples include the production of fibrous materials, manufacturing of pharmaceutical products, and varied applications in food and beverage industries.

The use of active magnetic bearings results in no mechanical friction or wear. Together with the almost total absence of vibration, allows for product longevity. Equipment of this kind typically maintains efficiency without the need for a major overhaul for more than 20 years. With its direct drive and magnetic bearings, there is no need for mechanical gears, bearings and seals.

Sulzer's new HSR high-speed turbo air compressor line delivers oil-free air.

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There is no oil or other liquid lubricant anywhere in the turbo air compressors. There are no wearing parts to be replaced, no oil to be refilled and no consumables to be disposed of. As such, the HSR turbo air compressor is designed to reduce the need for service and parts. The turbo air compressor is water-cooled. As such, heat generated by compression and drive-related losses can be recovered as usable energy. Water-cooling also ensures optimal performance and generally extends the lifetime of the components.

About Sulzer

Sulzer's core strengths are flow control and applicators. They specialize in pumping solutions and services for rotating equipment, as well as separation, mixing and application technology. Intensive research and development in fluid dynamics, process-oriented products, and special materials as well as reliable service solutions help the company maintain its leading position in its focus market segments. Customers benefit from a network of over 180 production and service sites around the world. In 2017, Sulzer sold roughly CHF 3 billion with around 14,700 employees. Shares are traded on the SIX Swiss Exchange (SIX: SUN). For more information, visit, www.sulzer.com. To learn about the HSR turbo air compressors, www.sulzer.com/hsr.

New Busch R 5 PLUS Rotary Vane Vacuum Pump Ready for Industry 4.0

Busch is launching the new R 5 PLUS, a pioneering vacuum pump for food packaging. It can run with pressure control or at a constant speed, making it exceptionally energy-efficient. Acting either as the sole vacuum pump in a packaging machine or as a vacuum module in a central vacuum supply, the R 5 PLUS makes sure a specified pumping speed is maintained. It can also accurately sustain the required vacuum level, regardless of how the packaging volume changes. Thanks to its variable speed drive, the vacuum pump covers a pumping speed range from 440 to 760 cubic meters per hour and reaches an ultimate pressure of 0.1 millibar. All operating data is recorded and saved on a permanent basis. This data can be accessed directly on the built-in display or transferred via a Modbus TCP/IP client/server protocol. A remote control of the vacuum pump via a computer is possible. Busch's new vacuum pump is thus ready for Industry 4.0.

The R 5 PLUS can be operated in two modes. Following an intuitive menu structure on the display, users can choose between the constant speed mode or pressure control mode. The most suitable operating mode depends on the type of packaging. If you are packaging smaller units at high cycle times with just a few seconds between evacuation cycles, it makes sense to leave the vacuum pump running. Adjusting the speed directly on the display allows it to be adapted to current demand without having a negative impact on packaging quality or cycle times. This means that the pumping speed can be kept at a constant level somewhere between 440 and 760 cubic meters per hour.

When working with longer packaging cycles or when the vacuum pump is operated in a central vacuum supply, speed control is the more suitable option. In this case, the vacuum pump maintains the pre-selected vacuum level, regardless of how the pumping speed changes. Once the required vacuum level is in place, the R 5 PLUS continues to run at a minimum speed of 35 hertz, enabling it to respond to a sudden need for increased pumping speed by increasing the rotational speed. In the event of extended breaks, the vacuum pump can also switch on and off automatically thanks to Ecomode.

The R 5 PLUS vacuum pump is based on Busch's proven rotary vane vacuum technology. Thanks to its stable volume flow curve, this vacuum pump can still reach 70 percent of its pumping speed at atmospheric pressure, even at a vacuum level of just 5 millibar.

One of the fundamental benefits of rotary vane vacuum pumps is that power consumption drops as the pressure starts to fall. The rotary vane vacuum pump consumes the most power between the moment it is restarted and when it reaches a level of around 300 millibar. Within the working range between 10 millibar and the ultimate pressure of 0.1 millibar, the vacuum pump consumes a mere 40 to 60 percent of the specified rated power.

The new R 5 PLUS rotary vane vacuum pump from Busch is exceptionally energy-efficient, while its connectivity features make it ready for Industry 4.0. Photo: Busch Dienste GmbH

This feature alone makes the R 5 PLUS the most powerful and effective vacuum pump in its performance class. And the R 5 PLUS can save even more energy thanks to the two freely selectable operating modes and demand-driven power adjustment.

A standard built-in PLC records and stores all operating data on a permanent basis. This enables not only complete, uninterrupted data recording, but also warning and alarm functions, among others. Using the self-explanatory menu structure on the display, operators can decide when these warnings and alarms are displayed and/or trigger an action. All data recorded by the PLC can be transferred to other PLCs, computers or SMS control units in either analog or digital form, meaning that the R 5 PLUS rotary vane vacuum pump has full connectivity.

To learn more about Busch Vacuum Pumps & Systems products and services, please visit www.buschusa.com.

Cloud-Based LMI Connect™ – Monitoring For Water Treatment Applications

LMI, a leading manufacturer of controlled-volume metering pumps and a brand of Accudyne Industries, introduced its Cloud-Based LMI Connect™ Smart Monitoring Service for water treatment applications.

The new wireless service works with LMI's LIQUITRON™ 7000 Series Controller to bring remote monitoring and control to chemical metering pumps used in cooling towers, boiler feeds, and a wide array of industrial and municipal water treatment applications.

The LMI Connect service provides real-time remote system access from desktop or mobile devices, by connecting with the LIQUITRON 7000 Series Controller via an embedded 4G/LTE cellular modem. Everything needed to connect – including wireless data management, secure protocols, cloud storage, web portal, and the dashboard app, which works on iOS and Android devices, – is provided in a turnkey fashion, making it easy for water treatment professionals and plant operators to deploy the software seamlessly.

The LMI Connect service, developed in partnership with AMI Global, shows real-time status, and provides alerts that notify users of changes or interruptions in the process. System reports, which help operators manage applications and ensure compliance, can be customized and delivered daily, weekly or monthly as needed.

Each LIQUITRON 7000 Controller with LMI Connect service enables plant operators to see a single controller – or the entire fleet – at a glance. As a result, this remote monitoring solution offers peace-of-mind that the process is working as planned. In the event that alarms trigger as a result of a failure, or an unexpected change in flow rates, the remote data and real-time information enables maintenance professionals to respond quickly to the precise situation without delays.

"We've taken complexity out of controller applications and placed everything that operators need in the palm of their hands wherever they may be," said Eric Pittman, Global Product Manager for LMI. "By offering an integrated solution, we've streamlined set up to a few taps, to allow water treatment professionals to focus on what they do best."

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A free 90-day trial for the LMI Connect Service is available with the purchase of the LIQUITRON 7000 controller.

About LMI

With more than 40 years of industry excellence, LMI manufactures an extensive line of chemical metering pumps, pH/ORP controllers and related accessories for water and wastewater treatment industries. LMI's signature yellow and black products are recognized for excellence by water treatment professionals around the world. Electronic and motor-driven pumps are available for flow proportional applications and optional liquid handling configurations to handle slurries and high viscosity chemicals. All LMI products are in stock for immediate delivery by our distributor network. LMI is a brand of Accudyne Industries, a leading global provider of precision-engineered, process-critical and technologically advanced flow control systems and industrial compressors. For more information, visit www.lmipumps.com

ULVAC Introduces LS Series Dry Screw Pumps

ULVAC Technologies, Inc. has introduced the LS series of dry screw pumps as a high performance, more compact and lower cost replacement to multi-stage dry Roots pumps for a wide range of vacuum applications. With four pumping speeds from 120 to 1,000 m^3/h, the LS series provides high pumping speed, compact size and low power consumption in a low-cost package.

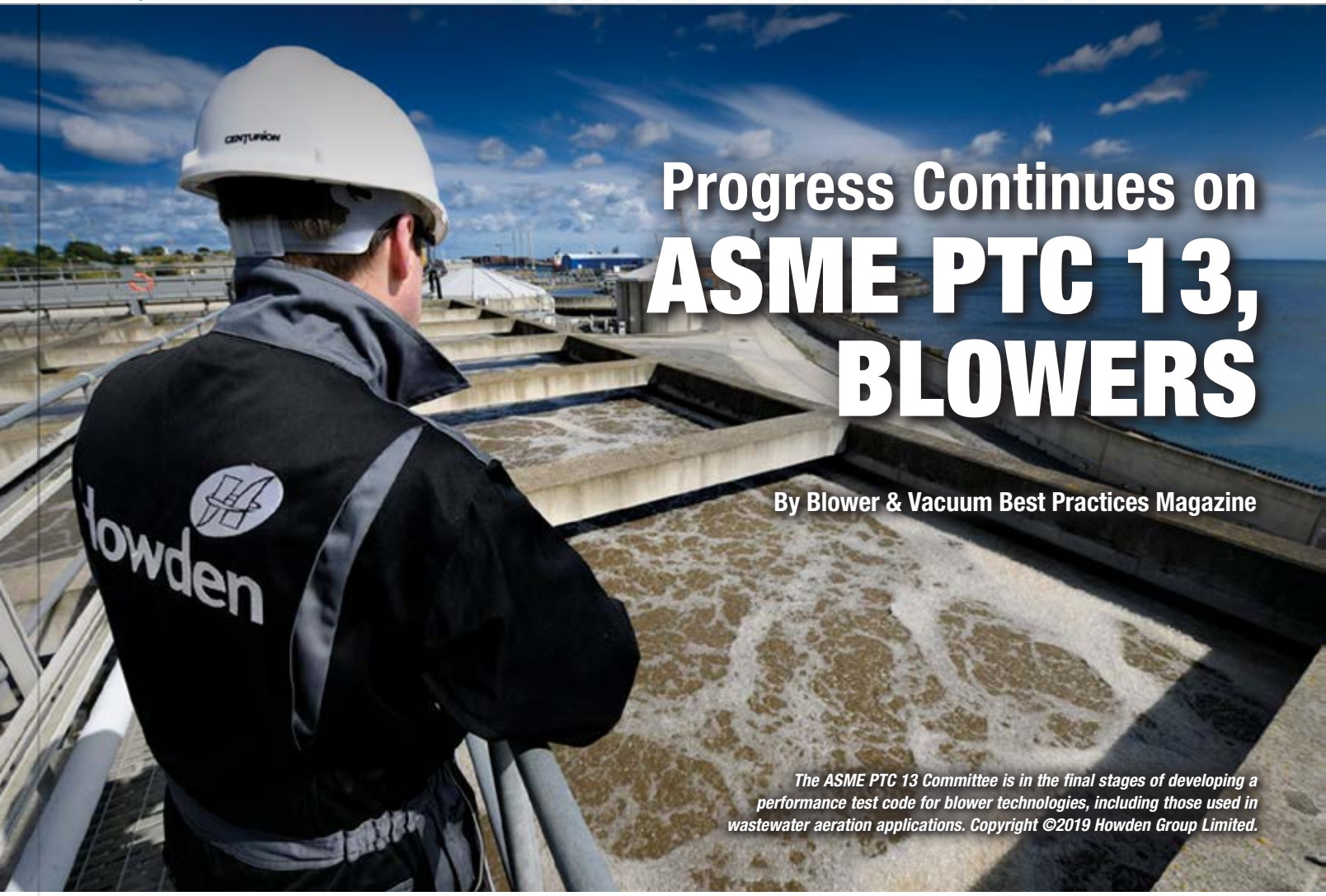
The ULVAC LS pump features a pair of conical shaped, variable pitch, deeply machined steel screws that allow the pump to be 1/3 shorter in length and 1/3 lighter in weight than other screw pumps in the same pumping speed class. The advanced screw design also increases the pumping speed near atmospheric pressure, allowing the LS pump to deliver a 20% faster pump downtime while using less power.

Power consumption of the pump is no more than 0.6 kW upon reaching ultimate pressure. A specialized built-in silencer reduces the noise level to not more than 61 dBA. The lighter weight and smaller size of the LS series pumps compared to other dry pumps makes them excellent candidates for easy retrofits. When repairs are needed, cost and time is half that of a typical multi-stage Roots dry pump.

ULVAC's LS series of dry screw pumps are offered as a lower-cost replacement to multi-stage dry Roots pumps.

About ULVAC Technologies, Inc.

ULVAC Technologies, Inc. is a leading supplier of production systems, instrumentation, vacuum pumps and components for the semiconductor, MEMS, solar, flat panel display, research, automotive, medical, electrical, and refrigeration industries. ULVAC Technologies is a subsidiary of ULVAC, Inc., which is made up of more than 50 group companies engaged in most sectors of the vacuum industry. For more information, visit www.ulvac.com



Progress Continues on ASME PTC 13, BLOWERS

By Blower & Vacuum Best Practices Magazine

The ASME PTC 13 Committee is in the final stages of developing a performance test code for blower technologies, including those used in wastewater aeration applications. Copyright ©2019 Howden Group Limited.

In 2010, the American Society of Mechanical Engineers (ASME) established the PTC 13 Committee to establish a power test code for all blower technologies. Blower & Vacuum Best Practices interviewed Committee Chair Jacque Shultz, HRO-Turbo Product Technical Leader, Howden North America, Inc., for an update on the new code.

Good afternoon! Let's start with your history in the blower industry.

I have 20-plus years of experience in the industry, which includes working with gas compression, compressor-motor-steam/combustion turbine controls, thermodynamics, structural design and vibration analysis.

I started my career as a compressor controls engineer with Hoerbiger Corporation of America, which is a leader in compression technology. I later joined the National Gas

> "End users, utilities and design engineers requested a methodology to legitimately validate manufacturers' claims for blower performance versus actual performance."
>
> — Jacque Shultz, HRO-Turbo Product Technical Leader, Howden North America, Inc.

Machinery Lab (NGML) at Kansas State University where I worked as the Manager of Laboratory Operations & Research. While at the NGML, I also earned my Master's degree in Mechanical Engineering. I was responsible for designing and maintaining the turbocharger test and research facility used to evaluate and verify turbocharger performance for large bore engines for nuclear facilities and the natural gas pipeline. This experience established the foundation needed for serving on the ASME PTC 13 Committee.

Following my work at the NGML lab, I served in a number of managerial and sales roles focused on turbo compressors and heavy industrial air compressors at Turblex, Inc., and Siemens, before joining Howden Roots.

ASME PTC 13, Blowers, has been in the works a long time. When did you first become involved with it?

I was on a Compressed Air and Gas Institute (CAGI) committee in 2010 and worked together with other colleagues to develop a performance-testing standard for compressors focused on low-pressure air. There was awareness at that time from all areas of the industry, including organizations like Consortium for Energy Efficiency (CEE), regarding a need for a new test standard for testing and verifying compressor performance. Later in 2010, I became interested in the work ASME was doing in this regard and then joined the ASME PTC 13 Committee.

What has been the biggest challenge in developing ASME PTC 13?

The challenge from the very beginning was to focus on what matters most to end users and other stakeholders. End users, utilities and design engineers requested a methodology to legitimately validate manufacturers' claims for blower performance versus actual performance. Doing so meant relying solely on the technical aspects of testing and the data available at the time rather than any number of variables that cannot be measured easily and accurately with instrumentation readily available.

Industry-wide, it seemed there was an understanding of the need to eliminate any bias toward one technology versus another, which is

PROGRESS CONTINUES ON ASME PTC 13, BLOWERS

also why the ASME PTC 13 Committee collected as a healthy cross section of persons from across the blower community – all of whom are volunteers. Toward that end, I feel we have accomplished our goal of ensuring a high level of technical integrity in everything we do as a committee.

What originally drove the need for ASME PTC 13?

The codes in existence could not be used to verify performance of newer technologies and different types of packages, including turbo blowers with high-speed synchronous motors and Variable Frequency Drive (VFD) controllers. Other technologies at the time included blowers engineered to combine dynamic and positive displacement compression, such as screw blowers. Additionally, some of the available codes at the time were not quite at the point of verifying performance in the correct wire-to-air type of strategy.

What ASME performance test codes are available, and why would these not work for this task?

ASME PTC 9 was originally written for positive displacement blowers, and was not re-affirmed by ASME so this became obsolete. ISO 1217 displaced PTC 9 for most of the industry many years ago.

ASME PTC 10 is the test standard for centrifugal blowers and it is fantastic for testing machines built for various gases, which makes this code complex and this does not cover key areas. Specifically, PTC 10 does not cover power losses for the type of driver. This also does not take different packages into consideration. Opening the doors of a package, or eliminating components, for example, changes the restriction to airflow and energy consumption by as much as 10% (approximated). ASME PTC 10 does not address these factors directly.

ASME PTC 13 includes sections that incorporate aspects of PTC 9 and PTC 10. This code also includes procedure flow charts to illustrate testing both positive displacement and centrifugal blowers based on the different methodologies these machines are designed specifically to operate to ensure the corrections in power conversions for these methodologies are accounted for during testing in the test stand, and best match the final conditions and performance in the field.

ASME PTC 13 Committee Members

The ASME PTC 13 Committee is made up of 14 representatives from across the industry. Those serving on the committee include the following:

Jacque Shultz, Chair, Howden North America, Inc.

Lloyd A. Slezak, Vice Chair, Brown and Caldwell

Fred Constantino, Secretary, The American Society of Mechanical Engineers

Andrew R. Balberg, Lone Star Blower/ GL-TURBO

Hiran de Mel, Jacobs

James Elbro, Atlas Copco

Michael J. Fischbach, Consultant

Julie V. Gass, Black & Veatch

Thomas E. Jenkins, Jen Tech Inc.

Kacy Park, TNE Global Inc.

Rajendraprasad Vagvala, Stickney Water Reclamation Plant

Ralf Weiser, Aerzen USA

Mark Addison, Alternate, Aerzen USA

Bjoern Hansen, Alternate, Howden

Shown is an example of centrifugal blower for large flow. Copyright ©2019 Howden Group Limited.

ASME PTC 13 obviously addresses the needs of the wastewater industry. Is it intended for use with other applications?

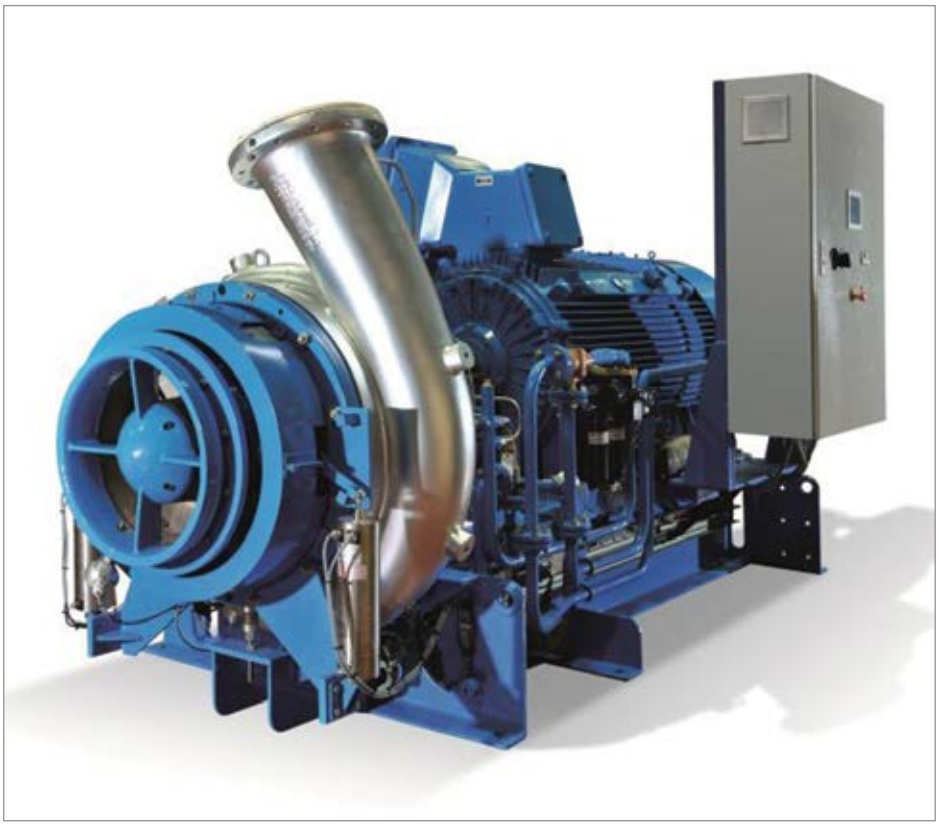
Yes, this has been designed for any application with the ratio of discharge pressure over suction pressure of 3.0 and below with air.

How does the code address the different types of blower control mechanisms, such as guide vanes, VFDs or throttling controls?

ASME PTC 13 includes Tables 3.1 and 3.2, which are very useful since they can be used to correct for performance differences that can occur between the manufacturer's test stand and the field on different types of control mechanisms.

This includes blower control technologies you mention, as well as other components: air filters or mechanical devices. We boiled everything down to provide a true wire-to-air basis where all performance losses, whether electrical, mechanical, or aerodynamic, and are included. This solidifies our main goal: the development of a fair code for all manufacturers and as accurate as possible for all technologies.

There will be situations that take place between end users and manufacturers that cannot be perfectly replicated in the field, and the code accommodates these realities. For example, if a machine at a site facility is located in a filter room with all blower inlets piped to it, and if the manufacturer's test stand uses an open inlet instead of a filter room, the inlet conditions are clearly different. In this example, the end user and the manufacturer can use the tables to plot and review data and come to an agreement on performance.



Shown is an example of centrifugal blower for medium flow. Copyright ©2019 Howden Group Limited.

Does ASME PTC 13 allow for performance testing in the field?

That is a very popular question. The code is meant strictly for use in a test stand. I have performed a lot of testing in the field over the years and there's almost nothing within accuracy and control, whether it's piping, electrical connections, instrumentation issues, etc. There are many loose ends. The best opportunity for control of performance verification is with a test performed in a controlled environment.

Will the code make manufacturer's test stands obsolete, or require the need for major upgrades to them?

As long as manufacturers have modeled their test stands around PTC 10 and ASME PTC 19.5: Flow Measurement. ASME PTC 13 has also been calibrated to accommodate the latest advancements in instrumentation and electronic data acquisition systems. Obviously there have been changes in the regard over the years, and we have attempted to accommodate these to be covered in the new code.

Speaking of changes, will PTC 13 involve new reporting requirements?

The reporting requirements, which are covered in Section Six of the code, are very similar to the requirements of PTC 9 and PTC 10. It is a simple regimented process and outlined clearly to ensure everyone has a clear understanding of where to look for information and how to report it.

This is in addition to the reporting in Tables 3.1 and 3.2, which covers information related

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JAN 24
Proper Installation & Sizing of VSD Air Compressors
Presenter Ross Orr, Systems Engineer, Compressor Energy Services
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FEB 28
Visualizing KPI's: Specific Power, Flow, Pressure, Dewpoint
Presenter Ron Marshall, Chief Auditor, Marshall Compressed Air Consulting
February 28th, 2019 – 2:00PM EST

MAR 14
How to Design a Centralized Vacuum System
Presenter Tim Dugan, P.E., President and Principal Engineer, Compression Engineering Corp.
March 14th, 2019 – 2:00PM EST

APR 04
Safety and Quality in Compressed Air: Why You Should Care
Presenter Loran Circle, Senior Consultant, Circle Training & Consulting
April 4th, 2019 – 2:00PM EST

APR 25
Techniques for Determining Savings from Aeration Blowers
Presenter Tom Jenkins, P.E., President, JenTech Inc.
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MAY 16
Selecting & Sizing Heat of Compression Desiccant Dryers
Presenter Hank van Ormer, Technical Director, Air Power USA
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JUN 06
Selecting & Sizing Oil-Free Air Compressors
Presenter Tom Taranto, Owner, Data Power Services
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JUN 27
Sizing and Operating Vacuum Pumps
Presenter Tim Dugan, P.E., President and Principal Engineer, Compression Engineering Corp.
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JUL 18
Control Strategies for Multiple VSD Air Compressors
Presenter Ron Marshall, Chief Auditor, Marshall Compressed Air Consulting
July 18th, 2019 – 2:00PM EST

AUG 22
Piping and Storage for Compressed Air Systems
Presenter Tom Taranto, Owner, Data Power Services
August 22th, 2019 – 2:00PM EST

DEC 12
Air Compressor Lubrication & Maintenance
Presenter Loran Circle, Senior Consultant, Circle Training & Consulting
December 12th, 2019 – 2:00PM EST

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PROGRESS CONTINUES ON ASME PTC 13, BLOWERS

to external equipment or other variables mentioned earlier.

How do you think the industry will react to PTC 13?

We are anticipating this will be very well received when published, which we are targeting for this year. ASME has a very strong reputation and a long history for performance test codes in the United States and internationally. ASME has a very rigorous and advanced process for developing codes. This is more advanced than I had anticipated, which is good for everyone in the industry.

How do you personally feel about the new code given the time and effort involved?

This has taken longer than we expected, however, that is because of the thoroughness of the code and the hard work invested by all members of this voluntary committee. That said, we believe to have done a very good job. This required a blended community with representatives from all areas of the industry to ensure everyone has a fair voice. In that voice, there's a democracy that occurs based on technical information, experience and data. Within this democracy that routed to where we are today, collectively. We think PTC 13 is not only fair, but we think this is a new code end users and all others will appreciate.

The photos of blowers in this article are an example of differing designs accounted for in the testing processes within PTC 13 for accuracy of comparisons.

Thank you for providing us this update, Jacque. BP

For more information, please contact Jacque Shultz, email: jacque.shultz@howden.com; tel: 765-827-9223.

All photos courtesy of Howden Group Limited.

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HOW TO CHOOSE THE RIGHT VACUUM PUMP for Demanding Heat-Treatment Applications

By Dave Sobiegray, Edwards

Many heat-treating applications put difficult demands on vacuum pumps in general and oil-sealed pumps, in particular. Byproducts from the heat-treating process can contaminate the vacuum pump oil and create higher vapor pressures that cause deteriorated vacuum levels in the heat-treating chamber, or buildup and blockages in the pump mechanism.

Whether the vacuum system in question is an oil-sealed or dry pump technology, the driving force is what works best for the heat-treatment process, the application at hand, and the needs of the customer. Here's what to know about choosing the right vacuum pump for demanding heat-treating applications.

Examine the Level of Process Contamination

The level of process contamination varies considerably from application to application within the world of heat treatment. Where brazing may be considered relatively clean, carburizing is considered very dirty.

Though it may seem counterintuitive, a dry pump is not the ideal solution for this situation; in reality, the proven solution is an Oil-Sealed Rotary Piston (OSRP) Pump, such as the Edward Stokes 412J. Its capacity to handle large amounts of soot by-product stems from the fact that it has a large oil reservoir. The large amount of oil allows

"Regardless of the situation, a reputable vacuum solutions provider will ask many questions in order to understand the vacuum pump challenges so the proposed solution will solve the problem without creating other problems."

— Dave Sobiegray, Edwards

the pump to operate for reasonable periods of time under high contamination loads. On the other hand, it produces an oil waste stream that must be dealt with which requires more time and energy.

On the opposite end of the spectrum are applications such as tempering, annealing and nitriding where cleanliness of the overall system is becoming increasingly important. Dry pumps provide a very suitable and reliable solution, especially dry screw pumps with their clean and dry swept volume and non-hydrocarbon lubrication.

Depending on the type of filler material used, brazing applications, although not considered dirty, may produce contaminants. Temporary binders, pastes and other fillers will sublimate to the vacuum system and contaminate the pump but the contamination is managed through the vacuum system using appropriate strategies.

Developments in Metal Additive Manufacturing

While there is a long history of providing suitable vacuum solutions to these heat-treat applications, this is not a static field. We've seen a number of new processes come from development of metal additive manufacturing systems for metal components manufacturing.

In these early days of metal additive manufacturing, processes were rapidly being developed for a wide range of applications. Each of these process solutions puts different demands on the vacuum systems, and in some

The Edward Stokes Microvac oil-sealed rotary piston pump.

HOW TO CHOOSE THE RIGHT VACUUM PUMP FOR DEMANDING HEAT-TREATMENT APPLICATIONS

cases, vacuum has been seen to enable metal additive manufacturing process development.

Not only do the additive manufacturing processes themselves rely on vacuum to enable the new process, but downstream heat treatment is also benefiting from the range of vacuum solutions available. These treatment processes are presenting new challenges. It's important to assess chemistries for binders, and temperature and pressure parameters as part of the possible control set for vacuum pumps as these solutions develop.

Vacuum Technologies Evolve

Heat-treating applications that require, or benefit from vacuum pumps, have used oil-sealed piston pumps for years. These durable, reliable systems are certainly a standard recognized in the industry, but new technology development has provided some additional options for vacuum solutions to address the challenges of demanding applications.

Historically, some standardization has occurred due to available pumping speeds. For example, Stokes oil-sealed vacuum pumps have a limited range, which includes only a couple of base pumps. It's likely this limitation is evolving, as more pumping speed ranges have become available. Additionally, variable speed drives are now maturing and accepted as an alternative to fixed speed systems for control and energy saving opportunities. These can provide a tuned speed alternative to the historically limited pump speed selection available.

New technology developments have provided some additional options for vacuum solutions to demanding applications. The use of dry vacuum pumps, for example, eliminate the oil in the vacuum-generating mechanism. This can introduce other undesirable attributes such as high capital cost, however, and over time the reduced maintenance expense can mean overall lower cost of ownership.

The Edwards GXS dry screw vacuum pump.

Understand the Vacuum Environment

It's important to understand the vacuum environment. Often times, that means looking at in-house vacuum applications with the same or similar process conditions and evaluating the merits of the given type of vacuum pump for the given application.

The focus of this practice is reliability and frequency of maintenance. Of course, it is important to detail the make, model and configuration of the existing vacuum pump and then consider the frequency of oil changes, or other types of maintenance, while also weighing the pros and cons. There are always trade-offs: an Oil-Sealed Rotary Piston (OSRP) Pump is very reliable but requires frequent oil changes. Sometimes the dry pump works well but needs a full rebuild after two years of operation. A simple cost of ownership model will point decision makers in the right direction.

Knowledge of the same or similar applications in a given facility and one's personal experience juxtaposed to the extent of maintenance activity/cost of ownership provides an avenue to propose alternative solutions and/or technologies.

In some instances, the frequency of oil changes is daily or weekly, so the solution may involve a change in pump technology but may also require additional equipment such as an inlet filter. Regardless of the type of pump, it may be possible to reduce cost of ownership with improved setup, looking to see if the extent of contamination can be controlled. In other instances, the vacuum pump operator is dealing with challenging vapors, which cannot be easily trapped. These may plate out in a vacuum pump resulting in gummy or sticky buildup.

It is incumbent on the user to be aware of a variety of these additional factors that affect vacuum and therefore, heat-treating performance. These can include binder chemistries in brazing applications where, for example, the high temperatures and low pressures can turn acrylic binders into a char that ends up in the pump. This can be detrimental for both oil-sealed and dry vacuum pumps.

In carburizing applications, depending on the gas source (butane or acetylene for example) deposition of degraded polymer chains can have a similar impact on the vacuum pumps in terms of maintenance requirements and/or performance.

Regardless of the situation, a reputable vacuum solutions provider will ask many questions in order to understand the vacuum pump challenges so the proposed solution will solve the problem without creating other problems. This is all part of a value add proposition users should **expect from their suppliers.**

Pump Sizing Software Aids in Selection

Size matters when it comes to investment dollars. When looking to make a large investment in vacuum, there needs to be some degree of certainty that the dollars invested will equate to desired furnace throughput.

Getting it wrong puts production targets in jeopardy and reputations on the line. It's why years of vacuum expertise in conjunction with software tools, can help ensure success. One such tool is Edwards' PumpCalc™, a software suite used for sizing vacuum pumps and systems. This advanced tool provides invaluable insight into the expected performance of a proposed vacuum system and allows for comparison of various sizes and configurations to determine what will work best. PumpCalc™ is expanded into TransCalc™, a tool within the software suite that simulates the modeling of large, distributed and dynamic vacuum systems as might be the case **on very large metallurgical furnaces utilizing large boosters and vacuum pump combinations.**

The Right Information Results in The Best Solution

Gathering the right information to select the appropriate vacuum pump for a given application is essential. In practice, however, the process of evaluating an application for vacuum pump selection is not always straightforward – the best place to start is to examine what is already known and to proceed from there.

The practice of gathering the facts, applying applications knowledge and incorporating all resources and tools to solve the problem at hand is a best practice. It's especially important when designing a customized system to best fit the needs of the specific heat-treatment process. BP

About the Author

David Sobiegray received a Bachelor's Degree in Marketing from Niagara University in 1980. He has worked in the vacuum industry for 35 years and has held various positions in industrial sales, technical, and global product management. He currently holds the position of Senior Product Manager, Industrial Vacuum Equipment and Systems, Edwards.

About Edwards

Edwards is a leading developer and manufacturer of sophisticated vacuum pumps, vacuum system products, abatement solutions and related value-added services. Our products are used for analytical instruments, a wide range of R&D applications and are integral in the manufacturing processes for semiconductors, flat panel displays, LEDs and solar cells. Edwards' products are used within a diverse range of applications including power, glass and other coating applications, steel and other metallurgy, pharmaceutical and chemical processes. For more information, visit www.edwardsvacuum.com, or email: info@edwardsvacuum.com.

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Vacuum Controls Help Semiconductor Manufacturer ENSURE UPTIME AND EFFICIENCY

By Nicolas De Deken, EnergAir

➤ In the world of semiconductor manufacturing, it's an understatement to say peak productivity and uptime are top priorities. It's why a leading semiconductor equipment manufacturer in Silicon Valley, California, relies on EnergAir's Metacentre and Airmaster modular control technology to automate the vacuum system at its plant – and in turn – significantly minimize the risks of unplanned downtime, while also ensuring peak operational efficiencies.

Audit Identifies Vacuum Control, Power Issues

At the high-tech facility, EnergAir's local team of compressed air and vacuum specialists were called in to evaluate the existing vacuum system and recommend improvements. Used predominantly for in-house wafer inspection, the system is comprised of two separate installations.

The first vacuum system is compressed of four 25 horsepower (hp) Busch vacuum pumps each rated to provide 460-490 ACFM of suction. The second system includes four 25-hp units, each of which is designed to provide 494 ACFM of suction. The system also includes a vacuum receiver. Vacuum is used to move silicon wafers during the inspection process. It also conveys small components including resistors, capacitors and inductors, during the production process. Some of the components are as small as a grain of sand. Additionally, the plant uses the system to check particulate count in its cleanroom.

"The bottom line for the semiconductor manufacturer is the ability to optimize the vacuum system for peak efficiencies, and at the same time, address maintenance issues before they turn into problems."

— Nicolas De Deken, EnergAir

As a first step, the EnergAir team conducted a detailed audit of each vacuum system and its components. The audit and discussions with plant decision-makers identified key issues to address, leading to recommendations for control improvements.

The audit identified the use of outdated machine controls. Specifically, lead-lag changing was a manual process, and the vacuum units were being controlled electro-mechanically. There were also no oil temperature monitoring, or service timing devices in place. Additionally, all of the vacuum units were being fed by one common power supply, making it impossible to isolate individual vacuum pumps when maintenance and repairs needed to be carried out.

Shown are two 25 horsepower vacuum pumps used to move silicon wafers during the inspection process at the semiconductor plant.

VACUUM CONTROLS HELP SEMICONDUCTOR MANUFACTURER ENSURE UPTIME AND EFFICIENCY

EnergAir's Metacentre V4 master controller fully integrates vacuum equipment for better overall system management.

For this semiconductor operation, proactive measures were essential to ensure system uptime. Any unscheduled downtime of the vacuum system can cost several hundred thousand dollars. As such, changes to the existing system were necessary to minimize risks in production and ensure it would continue to achieve 100 percent uptime.

Control Technologies Installed

The team recommended the installation of EnergAir's Metacentre and Airmaster technologies to automate the vacuum system, align output closely with plant demand, and allow individual units to be isolated without affecting other parts of the installation.

Metacentre consists a series of vacuum system control products, as well as integration

solutions used to control most vacuum pump types. Browser-hosted visual software complements Metacentre and provides access locally, or remotely using PC or tablet. The control products fully integrate vacuum equipment for better overall system management. The Metacentre control system works with individual Airmaster controllers to optimize the performance of individual pumps.

At Silicon Valley plant, the team installed Metacentre V4 master controllers to allow vacuum to be maintained within a very narrow band to optimize system efficiency. In the new system, each of the four vacuum units operate between 26 and 28" HgV. The pumps are now only brought on-stream when required. When not needed, they are simply shut off to match air output with demand.

The new vacuum system also includes a separate power supply and Airmaster S1 controller for each vacuum unit to offer complete control and the ability to turn off each unit while leaving others running on-stream. The new system closely monitors the system and provides key data, such as motor overload, oil temperature, number of starts per hour, downtime and other key performance indicators or evaluation. The controllers also monitor oil temperature of each pump, which was of particular importance at the facility since cotton from the area's high concentration of cottonwood trees can potentially contaminate system coolers causing oil temperature to rise dramatically.

Plant staff can use the Metacentre TX web interface using a PC or tablet to remotely check system performance and vacuum distribution at any time, and analyze data. It also automatically sends emails to the decision-makers to inform the team when servicing is due. Additionally, individual service timers alert staff whenever vacuum pumps are due for maintenance.

The advanced, yet user-friendly controls of Airmaster help optimize vacuum pump performance.

Automatically Rotated Vacuum Pumps

The Metacentre V4 controller now rotates the use of the four vacuum units using a proprietary algorithm. As such, the workload of the vacuums is evenly shared to help maximize the working life of each unit. In addition, maintenance and repairs can be carried out on any unit without the need for the rest of the system to be out of operation.

Using the technology has provided unprecedented visibility of the vacuum system throughout every shift. It has also contributed to greater operating efficiencies. Additionally, it has significantly reduced the risk of us losing production as a result of vacuum system downtime. If any one vacuum unit fails the others will keep on running. The Metacentre system will also send decision-makers an email alert about the defective unit.

Another key advantage of an advanced control system is the need for ongoing monitoring of the vacuum system and a more efficient method of routine maintenance. Now, the plant no longer needs to change the sequence of vacuum units manually, or keep track of the running hours of each unit, since the system will send the staff an e-mail when maintenance is due on any unit.

The bottom line for the semiconductor manufacturer is the ability to optimize the vacuum system for peak efficiencies, and at the same time, address maintenance issues before they turn into problems. It's another important step in the plant's ongoing efforts to achieve critical production goals. BP

About EnergAir

EnergAir designs solutions to fully integrate compressed air or vacuum equipment, allowing users to optimize performance and manage key aspects of the system. For more information about EnergAir, contact Nicolas De Deken, Chief Operating Officer, Playa Vista, California; email nicolas.de.deken@energair.com; tel: 855-289-9317, or visit www.energair.com.

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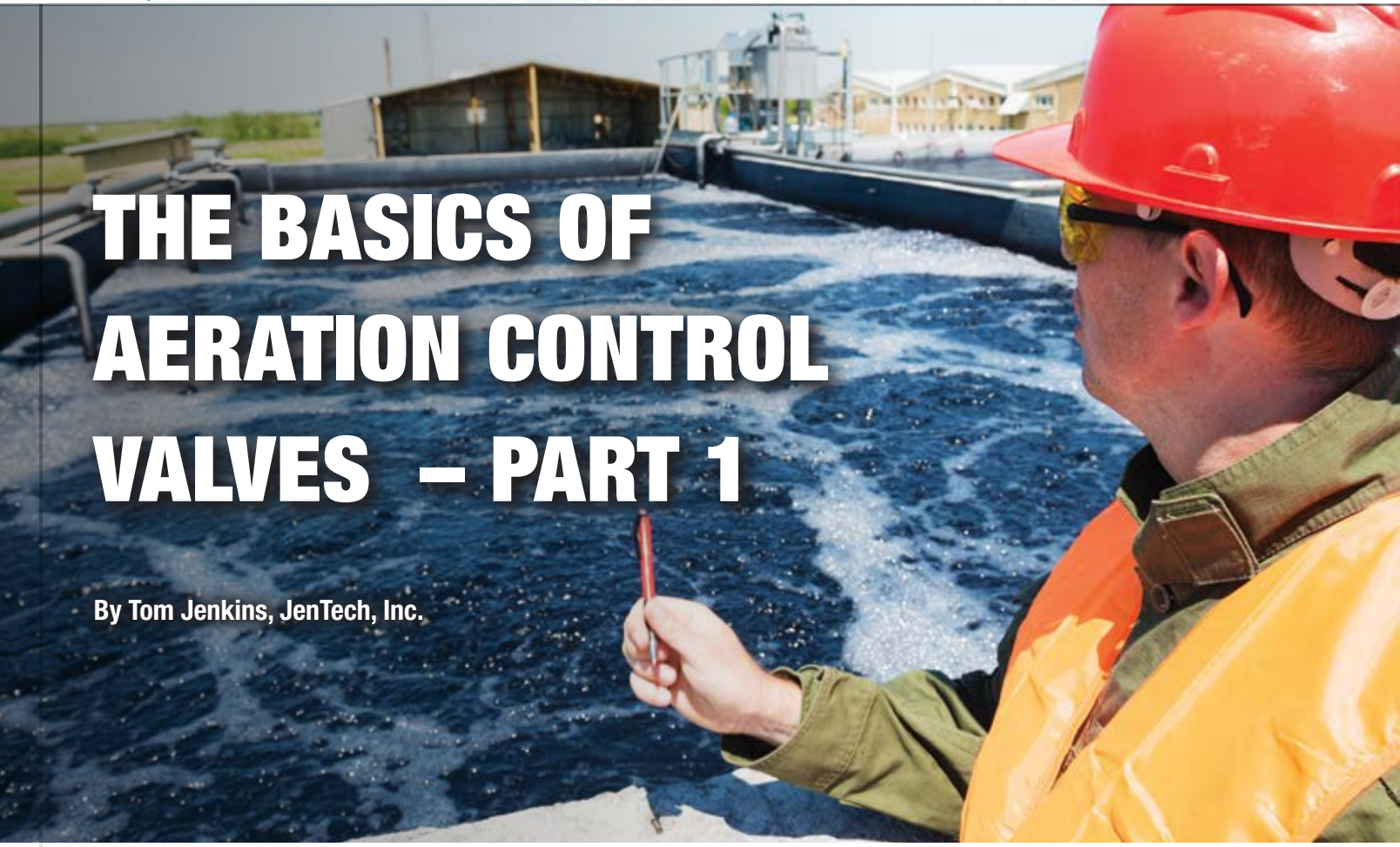

THE BASICS OF AERATION CONTROL VALVES – PART 1

By Tom Jenkins, JenTech, Inc.

Sizing, selection, and adjusting control valves often causes confusion for process and control system designers. Improper valve application can cause operating problems for plant staff and waste blower power. Basing the airflow control system design on fundamental principles will improve valve and control system performance.

The Law of Conservation of Energy and the Law of Conservation of Mass govern the behavior of control valves. When a concept or a conclusion seems questionable, or unfamiliar technology is being examined, these two fundamental principles must form the basis of the evaluation.

In this first of a two-part article, we will examine valve operating and analysis basics.

Creating Pressure Differential

The function of any valve is to create a pressure differential between the upstream and downstream piping. If the valve is employed as a shut-off device the differential is equal to the full upstream pressure. In aeration applications, valves are also used to create the pressure differential required to control airflow rates – a process known as throttling.

The pressure differential across a valve is dependent on many factors. Fluid properties are significant but are generally outside the control of the system designer. The mechanical design of the valve and the nominal diameter

> "The function of any valve is to create a pressure differential between the upstream and downstream piping. If the valve is employed as a shut-off device the differential is equal to the full upstream pressure."
>
> — Tom Jenkins, JenTech, Inc.

are also important, and they are amenable to designer selection. In most aeration applications butterfly valves (BFVs) are used for control, but alternate designs are available.

Regardless of the type of valve, or its size, the restriction to flow can be quantified by the flow coefficient, C_v. This is defined as the gallons per minute of water flowing through a valve with a pressure differential of 1.0 psi. The greater the flow coefficient the lower the restriction to flow the valve creates. The coefficient increases as valve diameter increases, or as a given valve moves open. Most valve suppliers publish the C_v data for various diameters and positions as shown in Figure 1 and Figure 2.

If the conditions of flow are known the airflow rate for a given C_v can be calculated:

$$Q_s = 22.66 \cdot C_v \cdot \sqrt{\frac{p_u \cdot \Delta p_v}{SG \cdot T_u}}$$

Where:

Q_s = airflow rate, SCFM

C_v = valve flow coefficient from manufacturer's data, dimensionless

p_u = upstream absolute air pressure, psia

Δp_v = pressure drop (differential) across the valve, psi

SG = specific gravity, dimensionless, = 1.0 for air

T_u = upstream absolute air temperature, °R

In ISO units, the flow coefficient is expressed as K_v. This is defined as the flow in cubic meters per hour of water at a pressure differential of 1 bar.

$$C_v = 1.16 \cdot K_v$$

It is often necessary to determine the pressure drop for a known flow coefficient, or to determine the flow coefficient corresponding to a known pressure drop and flow:

$$\Delta p_v = \left(\frac{Q_s}{22.66 \cdot C_v}\right)^2 \cdot \frac{SG \cdot T_u}{p_u}$$

$$C_v = \frac{Q_s}{22.66} \cdot \sqrt{\frac{SG \cdot T_u}{p_u \cdot \Delta p_v}}$$

These relationships are non-linear. The variation in C_v with position is also nonlinear for most types of valves. This non-linearity may create problems with control precision if the design or controls aren't appropriate.

There are many assumptions inherent in any set of fluid flow calculations. Accuracy better than plus or minus 10% should not be expected. This accuracy is adequate for most systems. Margins of safety and adjustment capabilities should be used in the design to accommodate uncertainties.

Bernoulli's Law in Airflow Control Analysis

In airflow control analysis, Bernoulli's Law is important. It shows that the total energy in the

Flow Coefficient, C_v									
Nominal	Disc Postion								
Diameter	10°	20°	30°	40°	50°	60°	70°	80°	90°
1	0.1	1	3	6	11	21	36	56	61
1.5	0.2	2	6	11	26	50	87	129	147
2	0.9	7	16	27	45	73	123	172	244
2.5	1	11	25	43	71	115	201	310	439
3	2	16	35	62	102	165	290	488	691
4	4	28	63	110	182	294	515	906	1,282
5	6	44	98	172	284	459	805	1,416	2,070
6	7	59	130	227	376	607	1,065	1,873	2,786
8	13	106	244	427	714	1,147	1,935	3,402	5,191
10	21	168	387	675	1,130	1,815	3,062	5,385	8,238
12	31	245	562	981	1,642	2,636	4,448	7,820	12,102
14	40	307	706	1,234	2,064	3,313	5,590	9,829	15,210
16	52	403	925	1,617	2,706	4,343	7,328	12,885	19,940
18	68	528	1,213	2,121	3,549	5,695	9,610	16,898	26,150
20	85	660	1,517	2,651	4,436	7,120	12,014	21,124	32,690

Figure 1 is an example of tabulated flow coefficient data for a butterfly valve.

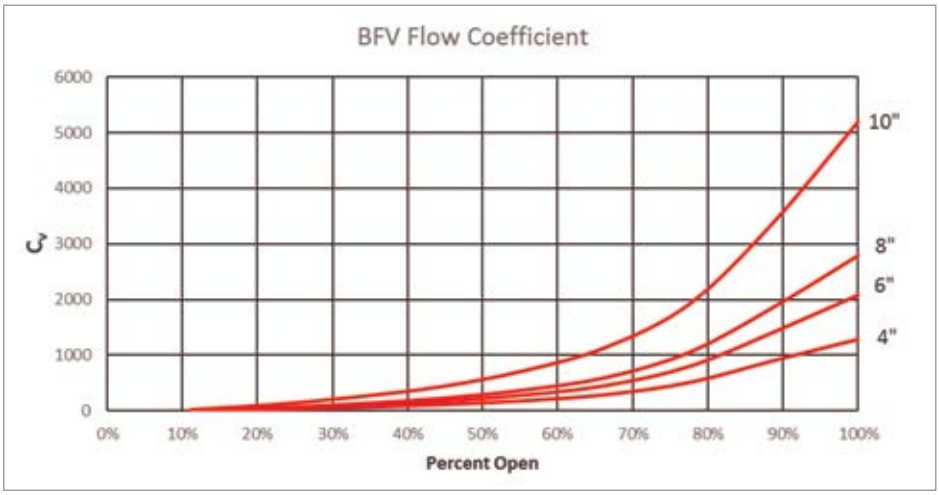

Figure 2 is an example of graphical flow coefficient data for a butterfly valve.

THE BASICS OF AERATION CONTROL VALVES – PART 1

air stream on both sides of a valve is identical. This is an extension of the Law of Conservation of Energy. The energy in the moving air consists of three components, as show in Bernoulli's Law:

$$p_1 + \frac{\rho \cdot V_1^2}{3.335 \cdot 10^7} = p_2 + \frac{\rho \cdot V_2^2}{3.335 \cdot 10^7} + \Delta p_f$$

Where:

$p_{1,2}$ = potential energy = static pressure, psi
ρ = density at airflow conditions, lb_m/ft^3
$V_{1,2}$ = air velocity, ft/min
Δp_f = pressure drop due to friction, psi

Velocity can be readily calculated based on the Law of Conservation of Mass:

$$V_1 = \frac{Q_a}{A_1}$$

The Law of Conservation of Mass shows that on both sides of a valve the velocity is equal unless pipe diameter changes:

$$Q_a = A_1 \cdot V_1 = A_2 \cdot V_2$$

Where:

Q_a = volumetric flow rate at actual conditions, ACFM (actual ft^3/min)
$A_{1,2}$ = cross sectional area of pipe, ft^2
$V_{1,2}$ = velocity, ft/min

The velocity term in Bernoulli's Law represents the kinetic energy of the airflow. It is called dynamic pressure (p_d), velocity pressure, or velocity head. In most aeration systems the dynamic pressure is negligible compared to the static pressure as depicted in Figure 3. Furthermore, unless there is a change in pipe diameter or a significant change in air density the velocity and dynamic pressure upstream and downstream of the valve are basically equal, regardless of valve type.

The blower system must create the total pressure needed to move air through the piping system and diffusers. The largest component of system pressure results from diffuser submergence. This static pressure is 80 to 90 percent of the total pressure in most aeration systems and is essentially constant.

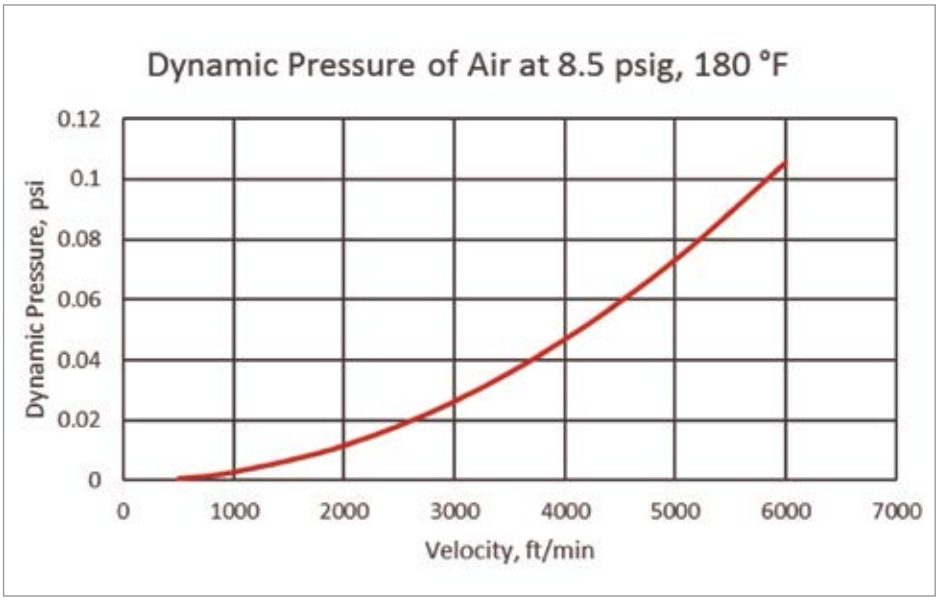

Figure 3: Dynamic pressure (velocity head) for a typical aeration application.

Valve pressure drop is typically the next largest component of blower discharge pressure. Pressure drops through a BFV or other valve represent a parasitic loss. The frictional energy from the pressure drop across the valve is converted to heat. In a typical aeration system the valves share a common distribution header with uniform upstream pressure. The downstream pressure is nearly identical at all valves because diffuser submergence is identical. Therefore, the value of Δp_f is virtually the same for all valves in a system.

The pressure drop through a valve is used to modulate flow to individual process zones. The valve is adjusted until the airflow through the valve equals the process demand. The pressure differential equals the available difference between upstream and downstream pressures.

In any system there is pressure drop through distribution piping upstream of the valve and through the piping and diffusers downstream of the valve. These losses are generally a small part of the total pressure requirement. In real systems the diffuser pressure drop and piping losses may not be negligible. However, diffuser and piping losses, like valve throttling, are a function of airflow rate. Differences from tank to tank simply reduce the amount of throttling required from the valve.

Frictional pressure drops do increase the blower discharge pressure and therefore blower power demand. Energy optimization includes minimizing valve losses. Minimizing energy with low valve losses must be balanced against the need to create pressure losses in order to control flow. These conflicting needs can make proper valve sizing a challenge. Minimizing frictional pressure drop while maintaining controllability necessitates the need to use realistic air velocities for design as outlined in Figure 4.

NOM. PIPE DIAMETER	DESIGN MAX VELOCITY, FT/MIN
1" to 3"	1,200 to 1,800
4" to 10"	1,800 to 3,000
12" to 24"	2,700 to 4,000
30" to 60"	3,800 to 6,500

Figure 4: Typical design velocity limits for aeration piping.

Control Valve Characteristics

The characteristics of control valves can be illustrated by examining a simple system with one valve, as shown in Figure 5. The system

THE BASICS OF AERATION CONTROL VALVES – PART 1

characteristics are the same regardless of control valve type. For illustrative purposes the pressure drops through the piping and aeration diffusers will be ignored.

The pressure downstream of the valve, pd1, is established by assuming diffuser submergence of 19 feet, 7 inches, equal to 8.5 psig. Air temperature T1 is 640 °R (180 °F). Pipe diameter is 8 inches nominal Schedule 10 pipe, and a BFV is used for throttling.

The system is analyzed across an airflow range of 250 SCFM to 1,500 SCFM (q_{std} TOTAL). That corresponds to volumetric flow rates downstream of the BFV between 190 ACFM and 1,100 ACFM (q_v TOTAL) and a velocity range between 500 ft/min and 3,000 ft/min. These are within normal design limits for 8-inch pipe. The blower is assumed to be a positive displacement type, and at fixed speed the flow rate is constant regardless of discharge pressure.

When the valve is throttled the pressure differential obviously changes. What isn't obvious from observing the equations is the loss of control at the upper and lower end of the BFV position range. At positions close to full open, the pressure drop changes very little as the valve closes. On the other end of the range, when the valve is nearly closed, very small position changes create dramatic changes in pressure drop as shown in Figure 6.

Two conclusions can be drawn from this. The first is that valve travel should be limited to the middle of the operating range. Control systems commonly limit travel to between 15 and 70 percent open. These values are not absolute, of course, and field experience on each system is needed to establish the most appropriate limits. Avoiding oversized valves and very low air velocities is important, since that keeps the valve opening within the controllable region.

The second conclusion is that it is necessary to have accurate control of position changes. Using actuators with slow operation is suggested, with 60 seconds or more per 90-degree rotation being common. Reducing the dead band and hysteresis on valve positioners to 1% or less also improves control.

Motor brakes on electric actuators improve accuracy. Many actuators have "self-locking" gears which prevent aerodynamic forces on the valve disc from back-driving and turning the stem when the motor is off. However, when the motor is powered to reposition the valve and then power is cut at the set position the motor will continue to spin, acting like a flywheel. This can drive the valve past the set position and induce errors and hunting. A brake on the motor engages as soon as power is cut and stops the valve at the set position.

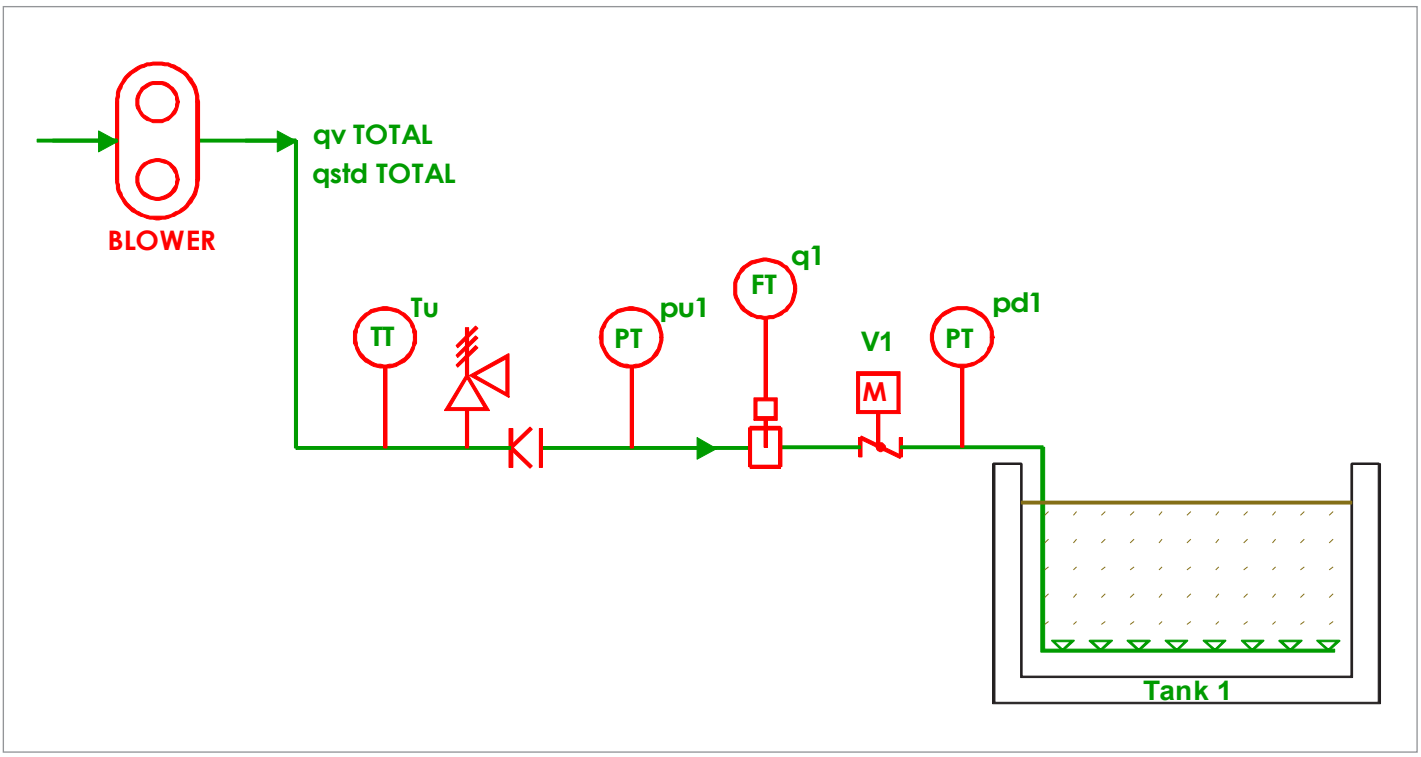

Figure 5: Shown is a simple blower system with one valve.

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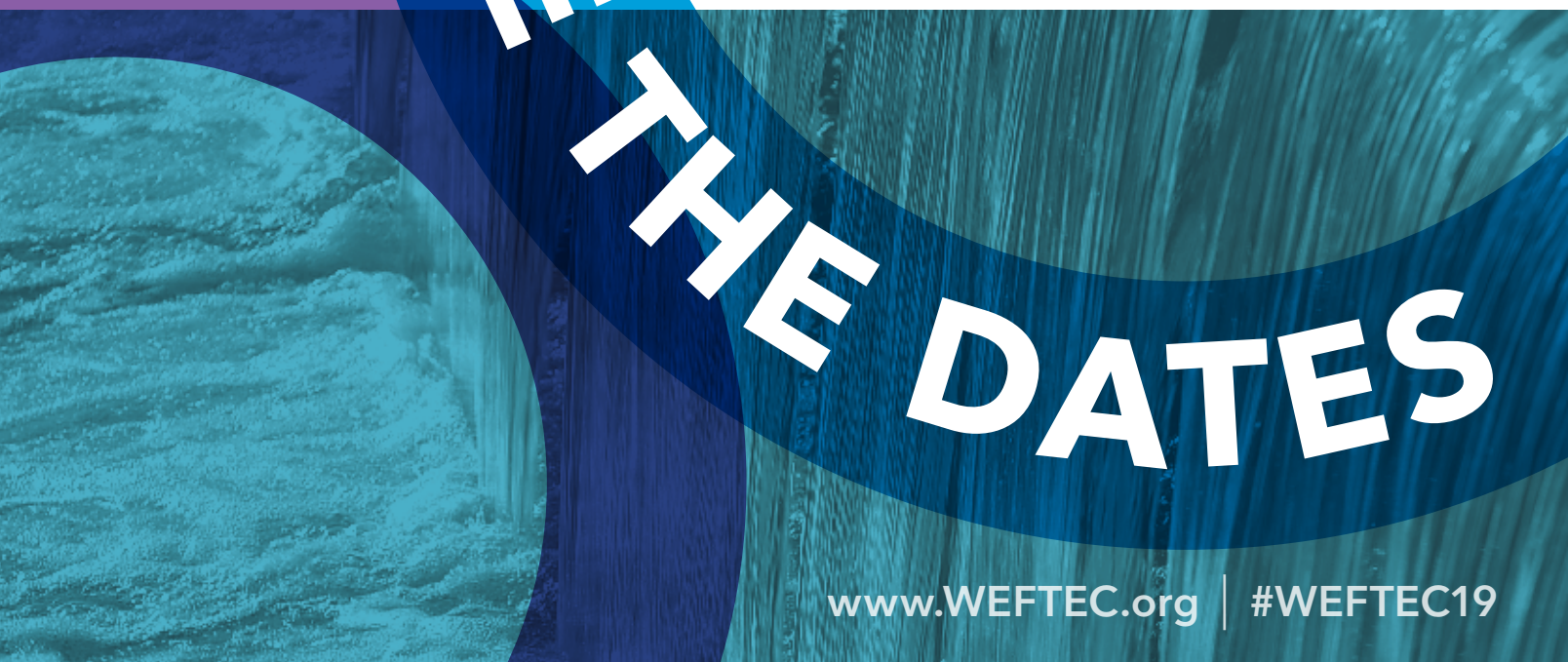

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THE BASICS OF AERATION CONTROL VALVES – PART 1

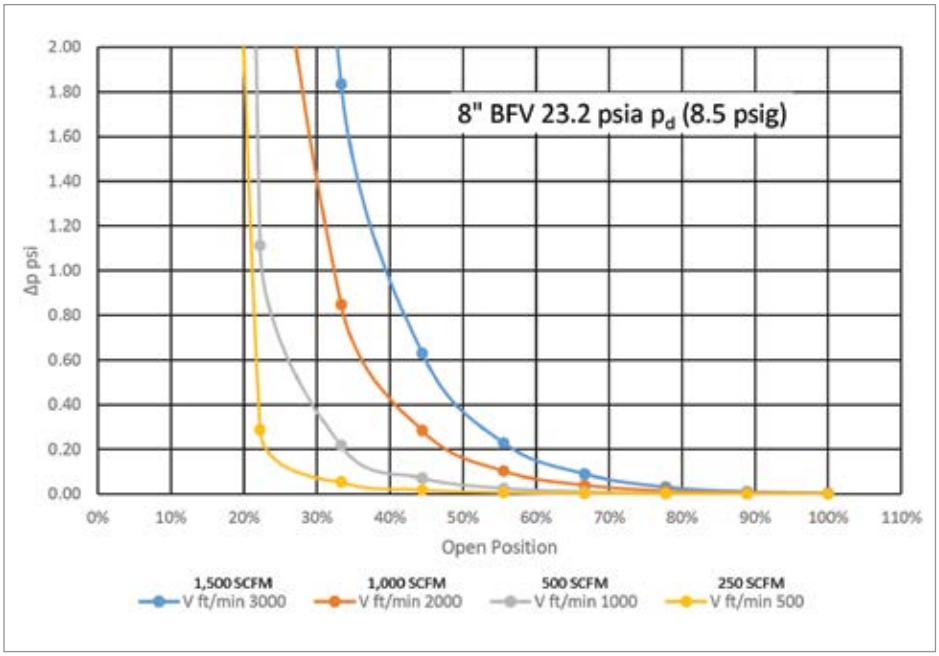

Figure 6: An example of Δp versus air velocity.

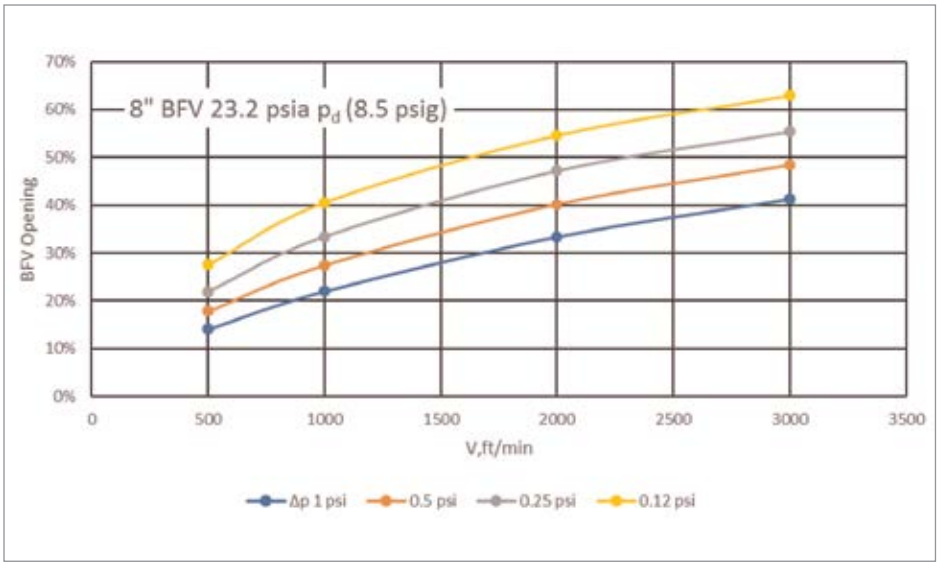

Figure 7: An example valve position to maintain constant Δp.

Many blower control systems maintain a constant discharge pressure. In these systems the BFV position needed to regulate the basin airflow rate varies with the set discharge pressure and the corresponding Δp as depicted in Figure 7. Non-linearity is apparent in this diagram, but if both the pressure and travel ranges are kept within reasonable limits adequate control can be maintained. Note that absolute airflow rate precision is not needed for most aeration applications – slight errors will not materially affect process performance.

Conclusion

Valves must create pressure drops in order to control airflow by throttling. The relationship can be expressed mathematically using the valve's C_v. For most valves the correlation between flow and pressure is nonlinear. Despite the nonlinearity, proper selection of size and actuator type will provide adequate control precision.

In the second article of this two-part series, we will examine the interaction of valves in parallel. New types of control valves and their performance will be compared to the baseline butterfly valve. BP

For more information contact Tom Jenkins, President, JenTech Inc., email: info@jentechinc.com or visit www.jentechinc.com.

To read similar articles on ***Aeration Blower Technology***, please visit www.blowervacuumbestpractices.com/technology/aeration-blower

> "Avoiding oversized valves and very low air velocities is important, since that keeps the valve opening within the controllable region."
>
> — Tom Jenkins, JenTech, Inc.

BLOWER & VACUUM SYSTEM INDUSTRY NEWS

Sulzer Offers Rotor Inspection 101 Training Course

Become a competent rotor maintenance specialist. Sulzer's course offers valuable insight into rotor inspection. In March 2019, Sulzer ran its first Rotor Inspection 101 Training. This has provided rotating equipment engineers, equipment owners, maintenance supervisors and procurement professionals with advanced and up-to-date information on how to conduct an incoming rotor inspection. The course also defined what dismantling procedures, repair techniques and best practices are required as part of the project.

Sulzer, the world's leading provider of maintenance and repair solutions for rotating equipment, shared the extensive knowledge and experience of its engineers in rotor inspection. The course proved to be extremely popular, as it saw a high attendance from a range of professionals.

Participants of this first one-day training course had the chance to learn how to perform inspections of assembled and disassembled rotors, as well as how to draw conclusions on the required repair and maintenance practices.

The workshop combined theoretical lectures, real-world scope reviews and case studies in order to help course participants understand some of the most critical issues in rotor inspection and maintenance. In addition, attendees were able to take part in a shop tour and explore the world-class engineering facilities at Sulzer's Houston Service Center.

"The intensive program aimed to train a competent workforce, able to inspect, assess and repair rotors. This resonates well with Sulzer core values, especially operational excellence, professional developments of employees and partners as well as customer experience," explained Kevin Mason, Technical Advisor at Sulzer. "The course proved extremely popular and we are pleased with the high turnout, as it attests to our level of expertise and our established role in the market."

Participants of the training course learned how to perform inspections of assembled and disassembled rotors.

Anyone interested in attending one of these courses can inquire about future trainings online by visiting Sulzer's Houston Service Center page at www.sulzer.com or by contacting your local Sulzer sales representative.

About Sulzer

Sulzer is the leading worldwide, independent service provider for the repair and maintenance of rotating machines including turbomachinery, pumps and electro-mechanical equipment. With a global network of over 180 technically advanced manufacturing and test facilities, Sulzer offers a collaborative advantage that delivers high-quality, cost-effective, customized and turnkey solutions, providing its customers with the peace of mind to focus on their core operations.

Sulzer Rotating Equipment Services, a division of Sulzer, can accommodate all brands of rotating equipment including turbines, compressors, generators, motors and pumps. With an enviable track record, dedicated teams of on-site engineers provide best-in-class solutions to ensure that the most effective service is delivered.

Sulzer is dedicated to providing superior service solutions to a range of industries including power generation, oil and gas, hydrocarbon and chemical processing, water and air separation. Every solution is customized to suit the business needs of each application – whenever or wherever that may be.

With a long history of providing engineering service support, Sulzer is headquartered in Winterthur, Switzerland where it began in 1834. Today, with sales over US$ 3 billion and with approximately 14,000 employees, the Sulzer footprint spans across the globe. The core aim is to deliver a flexible and cost-effective service that optimizes customer operational efficiency and minimizes downtime. For more information on Sulzer, visit www.sulzer.com

Integrator Trimax Systems Joins Forces with Tesco Controls, Inc.

Tesco Controls, Inc. (TESCO), a leading North American control system solutions provider for the water/wastewater industry, announced it has acquired Trimax Systems, Inc. (TRIMAX) for an undisclosed sum. TRIMAX is a Southern California-based systems integrator serving the water/wastewater market; and is also a leader in the utility, solar and renewable environmental energy industries. The transaction closed on March 31, 2019.

The union with TRIMAX will provide opportunities for TESCO to increase its water/ wastewater market share in Southern California and gain entry to additional industries served by TRIMAX. Combining the talents of both organizations will expand professional services capabilities and add technological synergies to enhance the customer experience. TESCO's financial strength and manufacturing capabilities will enable TRIMAX to take on larger projects, and the combined companies are expected to increase profitability and U.S. market share.

Shain Thomas, CEO for TESCO, commented, "TRIMAX is an impressive company and a competitor that we have come to greatly respect. We both share a customer-first philosophy to deliver industry-changing solutions while providing a healthy work environment for our employees. TRIMAX's talents and experience in multiple industries will add significantly to TESCO's long-term strategic growth initiatives."

TRIMAX will continue to provide systems integration services under the name TRIMAX, a Tesco Controls Company. TESCO's current CEO, Shain Thomas, will serve as CEO for both entities. The current TRIMAX executive team will stay on after the transaction. The combined company will now have 13 locations in the continental U.S. and Hawaii.

Dean McLaughlin, TRIMAX CEO, stated, "We have always respected TESCO's ethics and customer-focused business philosophy. Now we will be able to complement each other's competitive advantages by combining our experience and resources to pursue larger opportunities in our markets. Our employees are excited to become part of an employee-owned company and to enjoy additional opportunities for professional growth."

About Trimax Systems, Inc.

Founded in 1983, TRIMAX is a full-service control systems integrator headquartered in Brea, CA, with offices in Dallas, TX and Maui, HI. In addition to serving the water/ wastewater market, Trimax is a leader in the utility, solar and renewable environmental energy industries, with over two gigawatts of solar power commissioned globally. The Company delivers professional services and related equipment to clients in the solar, energy, water/wastewater, oil & gas, bulk material handling, manufacturing, food & beverage, entertainment and scientific industries. Trimax provides unique solutions by establishing relationships with their clients which focus on a deep understanding of the customer's processes and needs.

About Tesco Controls, Inc.

Tesco Controls, Inc., is North America's largest control systems integrator focused solely on the water/ wastewater industries. TESCO delivers comprehensive, end-to-end power and process control systems, from initial assessment and system design, to manufacturing, programming, and commissioning. The Company offers custom fabrication and OEM capabilities for most major equipment manufacturers at its U.S. facility. TESCO's ability to provide a complete suite of vertically-integrated professional services and manufacturing capabilities helps clients to manage schedule, quality, performance risk and final outcomes. www.tescocontrols.com

Leybold Extends DRYVAC Series Dry Screw Vacuum Pump Line

Leybold announced the latest addition to the industrial dry pump portfolio is the DRYVAC DV 200 and DV 300. These pump sizes complement the already existing product range of DRYVAC 450, 650 & 1200 and offer the same user benefits for applications requiring smaller sizes.

This series of dry compressing screw-type vacuum pumps is engineered for the new era of smart manufacturing. Packed with intelligent features and functions, all DRYVAC models offer benchmark energy efficiency, durability and future ready network integration.

Benchmark energy consumption

Exceptional low constant power consumption delivers world-class energy efficiency. Due to an optimized screw rotor design, the DV200/300 minimizes the power consumption, saving costs and reducing your carbon footprint. DRYVAC pumps are more cost-efficient and greener than similar models.

Durability

Just as the already known DRYVAC pumps, the DRYVAC DV 200 & DV 300 are designed for harshest industrial conditions and offer

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Sustainable Energy Savings with Blower & Vacuum Best Practices

Blower & Vacuum Best Practices is a technical magazine dedicated to discovering Energy Savings in industrial blower and vacuum systems and in municipal wastewater aeration blower systems. Our editorial focus is on case studies and technical articles where application and system knowledge drives technology selection, creating energy savings in projects delivering excellent ROI's.

"Republic prefers to couple air knives with centrifugal or regenerative blowers. These blowers are energy-efficient and inexpensive,especially when compared to compressed air as an alternative."

— Rich Leong, VP Sales & Marketing, Republic Manufacturing ("Republic Manufacturing Delivers Food Grade Blower & Air Knife Systems," April 2018 Issue)

"Without sacrificing pump performance, recoverable energy levels of up to 75 percent are even possible in some applications."

— Jerry Geenen, Atlas Copco Industrial Vacuum Division ("Rotary Screw Vacuum Pumps Benefit Meat Packaging Plants," January/February 2018 Issue)

From WWTP Aeration Blowers to Centralized Vacuum Systems

Our readers have embraced energy management practices as the next step. Our diverse key subscribers work at multi-factory manufacturing organizations and are targets to consider options such as VSD vacuum pumps in newly centralized systems. On the municipal side, over 1,000+ operators at wastewater treatment plants (WWTP's) and blower sales channels receive the magazine. Lastly, a growing group of industrial blower and vacuum OEM design engineers are looking for technologies able to improve their machines.

"The savings in power obtained by using variable speed instead of throttling centrifugal blowers are significant. Throttling creates a parasitic pressure drop, with the pressure ratio across the blower remaining essentially constant."

— Tom Jenkins, JenTech Inc. ("Proper Blower System Design for Variable Wastewater Depth Processes," July 2018 Issue)

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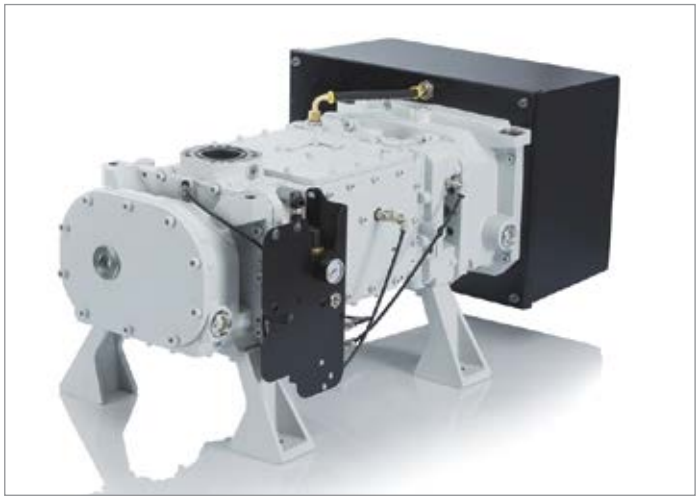
BLOWER & VACUUM SYSTEM INDUSTRY NEWS

a long life span, despite demanding parameters such as vapors, dust and particles. DRYVAC pumps also feature minimal maintenance and easy cleaning of water cooling channels. The DV200/300 is equipped with an automatic shaft seal purge control for optimal protection of shaft seals and bearings.



A Leybold DRYVAC 200 Dry Screw Vacuum Pump

Future ready-connectivity & networking

Fieldbus and PLC compatibility allow for connectivity to other devices in a network for real-time communications and control. Direct control is also possible via a computer or handheld device. Support for various fieldbus protocols ensures maximal flexibility. Plug connections for I/O and RS485 interface are available on each DV200/300. Protocol support for Ethernet/IP, ProfiNet, Profibus and EtherCAT is easy by optional cards. DRYVACs speak proverbial every language.

Characteristics

- Hermetically sealed screw vacuum pump
- Simple mechanical and electrical integration due to intelligent on board frequency converter
- Plug connections for I/O and RS485 interface outside of the pump
- Integrated protection functions of temperature, exhaust pressure and power consumption monitoring
- Small footprint due to compact design
- Low energy consumption achieved through optimized rotor geometry and innovative motor design with efficiency class IE3
- Tolerant to dust ingress
- Excellent water vapor performance
- High pumping speed also at high intake pressures
- IP54 protection level
- Made of super durable GGG40

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

BLOWER & VACUUM SYSTEM INDUSTRY NEWS

metallurgy, heat treatment, automotive industry, coating technologies, solar and thin films such as displays, research & development, analytical instruments, as well as classic industrial processes. For more information visit www.leybold.com

About Atlas Copco

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

Piab Vaculex® Lifters Aid in Lifting Kegs at Breweries

Promising to make breweries of all sizes more productive and more ergonomically friendly workplaces, Piab's Vaculex® VL will lift, rotate and stack heavy and bulky kegs or barrels in one motion. It also enables parts of the process to be handled by one staff member and without the need of a forklift.

According to Piab, booming businesses like microbreweries are characterized by heavy manual work for an often very limited number of staff. It takes two to lift and turn a barrel and a forklift truck to stack barrels ready for delivery. The result is high risk of strain injuries and expensive machine investments, but Piab said a vacuum-operated barrel handling solution could change that.

Suitable for handling half barrels (50-60 liters), the Vaculex VL has been specifically developed for the brewery industry. Powered by an electric vacuum pump it will lift any barrel allowing workers to maneuver and transfer them with ease and without fear of strain or repetitive injuries. Also enabling procedures to be carried out in space-restricted areas, Piab offers unique and flexible solutions where ceiling height, narrow and confined areas with limited available working space may be an issue. Examples of solutions include low-profile crane systems, monorails and carbon fiber arms.

Offering an ergonomic and safe working environment, Vaculex® VL enables breweries to operate more efficiently. For instance, as barrels are often filled from the underside, they need to be turned upside down as well as lifted during the process, and then lifted for stacking. Weighing up to 165 pounds each, it's a back-breaking job even for two workers, but an easy task with an ergonomic Vaculex® lifter operated by one brewery employee.

Piab also offers a complete range of spare parts and helpful accessories maintenance to go with the Vaculex® lifting solution, such as a handy remote control, a noise-reducing hood and an energy-saving system for automatic pump turn-off during inactivity. It also offers outstanding after-sales support.

About Piab

Piab provides smart solutions for the automated world, helping thousands of end users and machine producers in e-commerce logistics, food, pharma, automotive and other manufacturing industries to improve energy-efficiency, productivity and working environments. With 430 employees and SEK 1bn in sales 2017, Piab is a global organization, serving customers in almost 70 countries from a network of subsidiaries and distributors. By leveraging the ongoing technological development in automation and robotics, and targeting high-growth segments and geographies, Piab's vision is to become the global leader in gripping and moving solutions. For more information, visit www.piab.com.

Piab's ergonomic Vaculex® VL vacuum lifter helps boost productivity and saves backs.

Processors from across all major industry sectors — bakery, beverage, dairy, meat, pet food, and prepared foods — attend PROCESS EXPO to gain a competitive advantage. Update your plants with the latest technology to help meet demand and maintain compliance. Our exhibitors have a long history of working with clients to train and support those who use their equipment. At the show, you will see firsthand multiple production lines in action — starting at receiving of ingredients and running all the way through to packaging of the finished product!

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