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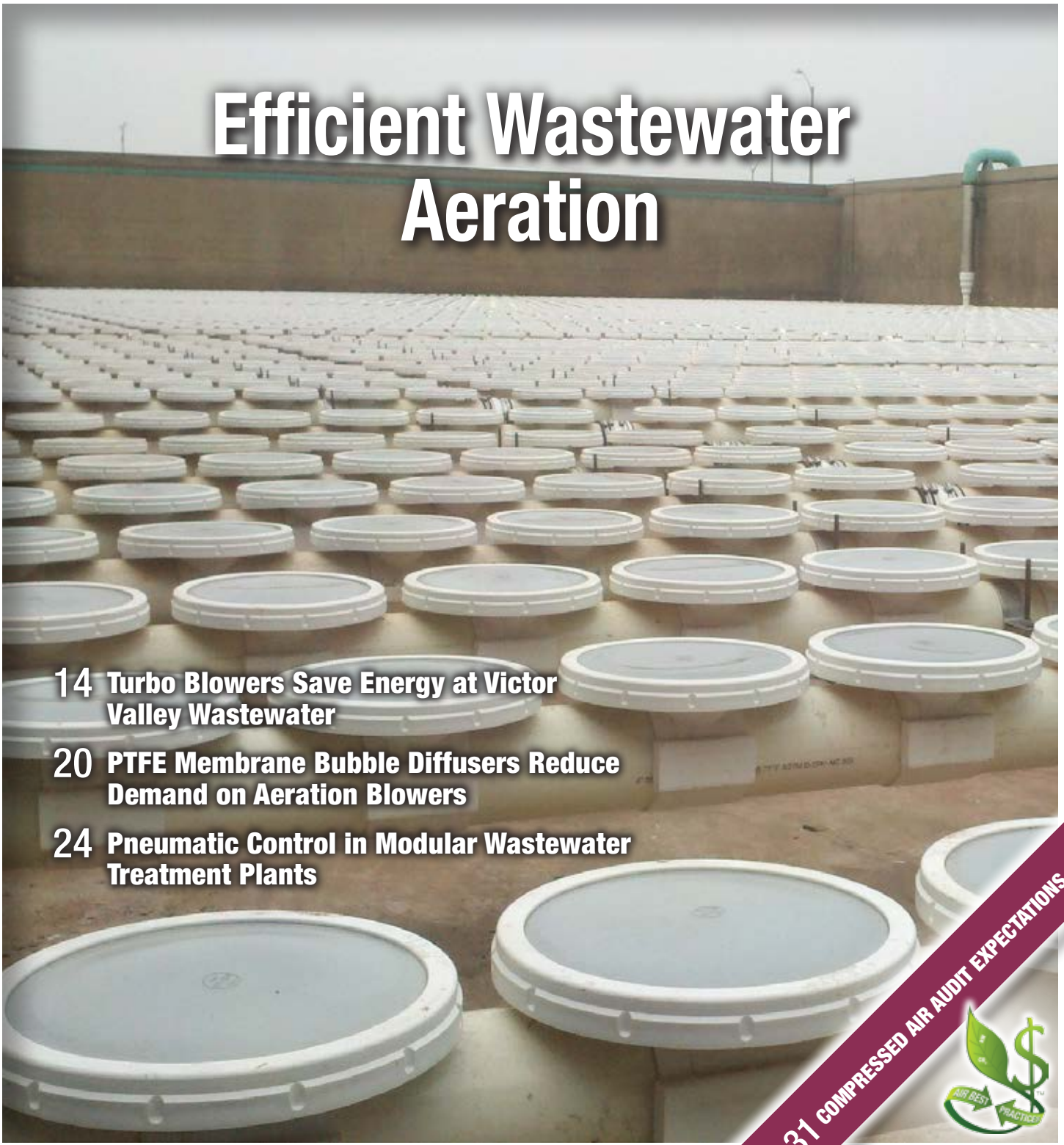
September 2015



Efficient Wastewater Aeration

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Pictured are their patented PTFE Membrane fine bubble diffusers installed in an aeration tank.

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FROM THE EDITOR | Efficient Wastewater Aeration

The Victor Valley Wastewater Reclamation Authority (Victorville, California) operates one wastewater treatment plant using an activated sludge process to treat approximately 13 million gallons of sewage per day. The plant operates 24 hours a day and was equipped with two 500-hp centrifugal blowers serving the secondary phase of the activated sludge treatment process, in which 3000 to 8700 scfm of 8 psig air was supplied to the bacteria breaking down organic waste. This Issue features an article — provided by the U.S. Department of Energy's Advanced Manufacturing Office Better Plants program — describing how a blower replacement project yielded annual energy savings of more than 928,000 kWh and $98,000 in energy costs.

The largest demand component for low-pressure air at a wastewater treatment plant (WWTP) is the fine bubble diffuser system. Aeration tanks use bubble diffusers, normally featuring membranes allowing airflow to pass from the piping into the wastewater. Stamford Scientific has developed and patented multiple advanced membrane technologies. "As a membrane fouls and loses its initial shape, many plant operators find they need to increase the airflow rate of their blowers to overcome the fouling on the membrane and achieve the same oxygen transfer rates," writes Stamford's Doreen Tresca. Stamford patented PTFE membrane diffusers grace the cover of our magazine this month, and we hope you enjoy her article detailing how their membranes help reduce aeration blower demand.

How does this 7 to 8 psi air reach the diffusers? Craig Correa, the Head of Process Automation at Festo Corporation, told our own Clinton Shaffer how pneumatic control works in a wastewater treatment plant. "30 percent of facilities use pneumatic control technology. In those projects, firms like Evoqua, Pall and GE Water build skids that use compressed air as the working medium to control and automate the influent and effluent of the WWTP. Low-pressure compressed air (at least 60 psi or 4 bar) is used throughout the instrumentation, valving, sensors, and even the filter membranes."

We turn back to compressed air with an article from Don van Ormer titled, "What to Expect from an Effective Compressed Air Audit." Saying auditors have "sprung up like dandelions," this article provides an excellent checklist of questions an effective audit should answer.

Variable inlet guide vanes (IGV) can have a significant impact on the energy efficiency of centrifugal air compressors. We were able to catch up with Rick Stasyshan, the Compressed Air and Gas Institute's (CAGI) Technical Consultant, and John Kassin of Cameron to discuss this topic. They said many manufacturers now offer retrofit options: "Replacing a standard inlet butterfly valve with a new inlet guide vane assembly can generate energy savings up to 9 percent whenever the compressor operates at less than full load or when ambient air temperature is less than design temperature (usually 95°F, 35°C)."

Thank you for investing your time and efforts into ***Compressed Air Best Practices®***.

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INDUSTRY NEWS

HTE Technologies Hosts Manufacturing Event at Busch Stadium

More than 600 industrial engineers and technical personnel from over 275 regional manufacturing companies were the guests of HTE Technologies for an all-day seminar and product exhibition billed as the "2015 WORLD SERIES of Manufacturing — *Productivity Powered by Innovation"* at Busch Stadium. The 28 seminars and 55+ exhibits highlighted advanced manufacturing solutions, each focused on helping local manufacturers compete globally by becoming faster, leaner, smarter, and safer.

Atlas Copco's 4,200 ft² exhibit included over 70,000 lbs. (35 tons) of "iron," in an array of 28 machines representing 9 different Atlas Copco product and service technologies. The three Professional Development Hour (PDH) seminars taught by Atlas Copco instructors highlighted advances in blowers, vacuums, and quality air systems.

Atlas Copco President John Brookshire led a team of technical and sales specialists highlighting some of their latest product developments, including the:

- High-efficiency redesigned 175-hp GA132 flooded rotary screw compressor with integral dryer
- Revolutionary VSD+ vacuum
- Ultra-quiet VSD+ compressor, operating in the exhibit area
- SmartLink remote monitoring system that is standard with current controller models

Atlas Copco's exhibit at the 2015 WORLD SERIES of Manufacturing

INDUSTRY NEWS

Also in attendance and sharing space with HTE Audit Services, Ameren Illinois, and Ameren Missouri ActOnEnergy incentive program exhibits was VPInstruments, presenting its VPFlowScope® in-line for point-of-use flow measurement. It measures mass flow, temperature and pressure, all of which are key data points for compressed air energy management. The bright blue display provides real-time information, and with the built-in data logger, recording is as easy as taking a picture.

The day culminated with an executive address by renowned roboticist Rodney Brooks, the inventor of Baxter the Robot (of recent Bud Light TV commercial fame), the Rumba domestic vacuuming robot, and the bomb-defusing robots seen in the 2010 Academy Award-winning blockbuster "The Hurt Locker."

Attendees also enjoyed:

- A visit by St. Louis Cardinal 2006 World Series pitcher and current co-host of the top-rated sports talk show "The Fast Lane" on 101ESPN radio, Brad Thompson
- Pitching in the major league bullpen to bullpen catchers
- The Cannonball Home Run Derby competition
- Grand Slam Trivia
- Individual pictures with Baxter and the stadium
- Open concession stands serving the ballpark food everyone loves

Industrial technologies featured in the Professional Development Hour (PDH) seminars and exhibits included: blowers, vacuums, quality air solutions, and compressors; energy incentive programs; pneumatic & hydraulic best practices; industrial computers and PLCs; assembly tools; industrial and collaborative robots; vision systems; and precision sensors.

For more information, visit www.htetechnologies.com.

Sullair Expands Partnership with Pumps & Service

Sullair, an industry-leading compressed air solutions provider since 1965, announced it is expanding its relationship with distributor Pumps & Service, who will now extend its service to customers in northwest Texas. The expanded territory, encompassing 57 counties, will be focused around the cities of Amarillo, Lubbock and Abilene.

New Mexico-based Pumps & Service — who fabricates, rents, sells and services pumps, air compressors, vacuum systems, engines, generators, clean water and wastewater systems, and more accessories — serves Sullair customers in Arizona, Colorado, and Utah in the energy, commercial/industrial, agricultural, municipal, manufacturing, national laboratory and construction

"Pumps & Service has demonstrated superior performance results in New Mexico, and we anticipate that their new territory will not be any different."

— Michael O'Hanlon, Sullair's Sales Manager for North America.

Sullair recently expanded its relationship with New Mexico-based Pumps & Service

industries. The company prides itself on fulfilling customers' complete compressed air and vacuum system needs for new equipment, service and spare parts.

"Pumps & Service has a proven track record as a Sullair distributor and is committed to supporting Sullair in our current market, and we are very capable of doing the same with our newly awarded northwest Texas territory. Pumps & Service is dedicated to the Sullair product line and is ecstatic over the expansion opportunity," said San Henry, president of Pumps & Service, and Bill Eads, regional sales manager, in a statement.

Pumps & Service began as a Sullair portable air compressor distributor in the early 1990s before acquiring the rights to sell and service the stationary compressor line. The company's facilities are staffed with Sullair sales, service and parts support and offer a full suite of services. Pump & Service's seasoned sales and service technicians provide fabrication, planned maintenance agreements, compressed air system audits, rental equipment, and 24/7/365 emergency service.

"Pumps & Service has demonstrated superior performance results in New Mexico, and we anticipate that their new territory will not be any different. We look forward to expanding our efforts together in northwest Texas," said Michael O'Hanlon, Sullair's Sales Manager for North America.

Pumps & Service will soon open a new facility in Amarillo, Texas, and has existing facilities in Farmington, Albuquerque and Carlsbad, New Mexico.

For more information, visit www.sullair.com.

INDUSTRY NEWS

The FS-Elliott Polaris+ oil-free centrifugal air compressor

FS-Elliott Introduces New Warranty Program

FS-Elliott Co., LLC, a leading manufacturer of oil-free centrifugal air and gas compressors, is pleased to introduce their SteadiAIR™ 5 Warranty available on all new Polaris+ compressors.

In addition to FS-Elliott's standard warranty, SteadiAIR 5 provides customers with added coverage, guaranteeing efficient and reliable operation from their compressor airend assembly for a period of at least five years starting from the time of shipment.

"The SteadiAIR 5 Warranty reflects the level of reliability and durability we demand of our compressors and signifies our long-term commitment to product excellence and customer satisfaction," stated Tom Taylor, Aftermarket Marketing Manager. "We have always been extremely proud of our products, and this warranty helps us to pass along that certainty. SteadiAIR 5 allows customers to purchase an FS-Elliott compressor with confidence, knowing their investment in the latest technology is not only secure, but it will drastically reduce if not eliminate production interruptions."

About FS-Elliott Co., LLC

FS-Elliott Co., LLC, is a leading manufacturer of centrifugal air and gas compressors with sales, service, and manufacturing locations around the world. First introduced to the market over 50 years ago their energy-efficient machines incorporate the latest aerodynamic and control system technologies to ensure optimum performance.

For more information, visit www.fs-elliott.com.

Centralized Piping System From TESEO Helps Save Energy

TESEO has supplied its HBS modular piping to build a new compressed air distribution system in the factory of Persico Spa, a Bergamo-based company primarily engaged in the automotive, industrial and marine industries.

Founded in 1976, Persico Spa provides co-design, engineering, prototyping and modeling services, combined with automation systems. Based in Nembro, near Bergamo, the company also has production and sales units in Germany, China and the United States.

Within the project for the refurbishment of the ex-Comital industrial site, covering 18,000 square meters, the existing manufacturing structures have been expanded with new business divisions. Until recently, the different units were fully independent, each with a 30- to 50-kW compressor. Today, a compressor room with 3 inverter compressors (including a backup machine) with 75-, 55- and 37-kW ratings supports a central distribution backbone. This approach has lowered consumption significantly and has resulted into an estimated 30 percent cost saving.

Due to demand peaks and discontinuous operations in the different units, the design and optimization of compressed air systems

was very challenging. For this reason, Persico Spa relied on the qualified consulting of C.G.C., a company in the Bergamo area with long-standing experience in compressed air generation and distribution. The consultant recommended using TESEO piping for the high technological content of the solution. Leveraging the cooperation with C.G.C. and TESEO, the compressed air system, comprising five kilometers of piping, was designed to meet the strictest energy efficiency standards.

"Meeting the customer's requirements for 8 bar pressure, with minimum pressure drop and irregular consumption, we adopted HBS80 in the compressor room and for the main circuits, while for most cross lines we used HBS50," said Piercarlo Guerini, owner of C.G.C. "The drop columns, made with HBS32 and HBS25 piping, were defined on-the-fly, in order to meet the specific requirements of each department; this approach was enabled by the great flexibility of TESEO's system. The possibility to modify the system after the installation is essential in a building and an industrial area still under development. We have also added connections for the future monitoring of each unit, so that the company can monitor costs and assign them to each production order, pursuing the constant improvement of energy efficiency."

"The quality and flexibility of TESEO's system, which we had the opportunity to appreciate in previous projects, were key factors in selecting the supplier," said Giuseppe Cividini, who supervised the refurbishment of the ex-Comital area. "Persico Spa's mission is not production, but rather prototyping, as the latter pushes the limits of creativity always beyond what you think was possible. For this challenging project, we selected reliable, competent partners with a high-tech profile, who could effectively analyze our requirements and raise the bar."

TESEO HBS modular piping for the new compressed air distribution system in the factory of Persico Spa.

INDUSTRY NEWS

"We are not just happy with what we have done so far, we are already considering a new project for a 3,300 square meter area where we would like to use TESEO systems for compressed air distribution and for vacuum as well," Cividini added.

For more information, visit www.teseoair.com.

Ingersoll Rand Acquires Assets of Air Center of Mississippi

Ingersoll-Rand plc, a leader in creating comfortable, sustainable and efficient environments, completed the acquisition of the assets of Air Center of Mississippi.

The Air Center of Mississippi is a distributor that provides compressed air equipment, parts and services for industrial and manufacturing applications. The company generated sales of approximately $2 million in 2014. Based in Jackson, Mississippi, the Air Center of Mississippi has four employees and sells compressed air equipment, parts and services in 37 counties in the state.

"The Air Center of Mississippi acquisition provides Ingersoll Rand with a more direct presence in a core industrial market," said Manlio Valdes, president of Compressed Air Systems & Services business at Ingersoll Rand. "We're pleased to expand our offerings in rental, financing and service contract solutions to our customers."

The acquisition strengthens Ingersoll Rand Compressed Air Systems and Services business, which provides a comprehensive range of centrifugal, reciprocating and rotary air compressor products, systems and services for a wide variety of industrial and manufacturing applications.

For more information, visit www.ingersollrand.com.

Atlas Copco Begins Production of GAR Series in U.S.

Atlas Copco is now manufacturing its GAR series of railway compressors at its Bay Minette, Alabama production facility. Currently, two GAR-30 models and SDR membrane dryer systems for U.S.-based locomotive builders are under production.

"By offering production of the GAR series in the U.S., it now meets the Department of Transportation's Buy America provisions that ensure transportation infrastructure projects are built with American-made products," said Robert Eshelman, vice president, Industrial Air Division, Atlas Copco Compressors. "Our customers in the railway market told us it was important for us to meet Buy America standards, and we responded. This move shows Atlas Copco's continued commitment to and investment in the U.S. rail market."

GAR series compressors are specifically designed at Atlas Copco's Railway Competence Center in Chambly, France, where a specialized group of electrical and mechanical engineers design and build compressors exclusively for the railway market.

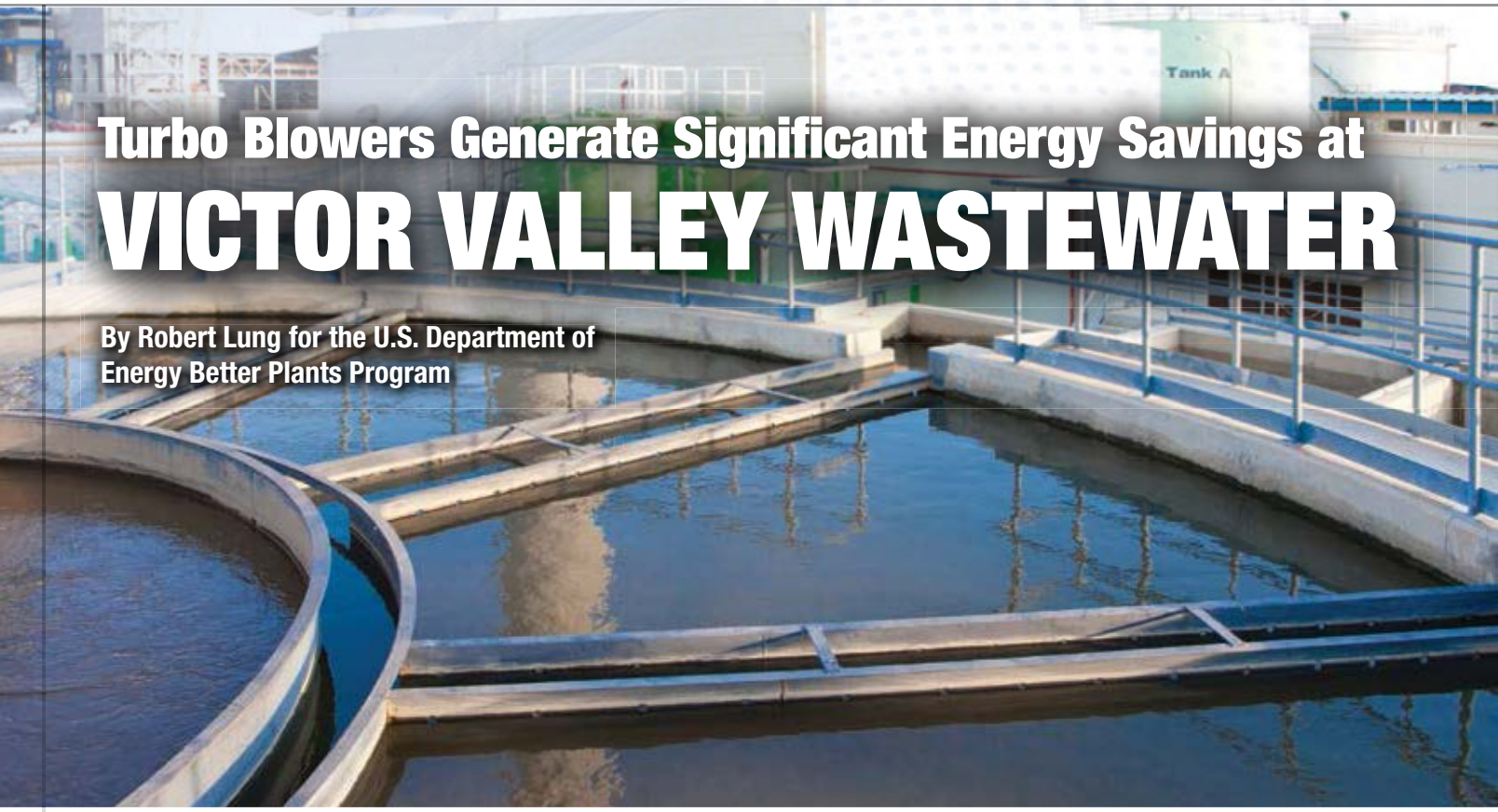
"At the Railway Competence Center, we adapt our core technologies — rotary screws, reciprocating pistons and oil-free orbital scroll elements — to meet the harsh demands of the rail industry," said Jim Donohue, business development manager for railway and marine air systems at Atlas Copco. "Atlas Copco is committed to sustainable productivity

for its railway customers, and the Railway Competence Center is where we develop the latest technical innovations to increase energy efficiency and reliability."

The GAR compressor uses Atlas Copco's rotary screw element design to deliver up to 180 cfm (rated as free air delivery as opposed to displacement) with emerging designs up to 240 cfm. Designs can be adjusted based on electrical requirements, physical space and ambient operating conditions, and can accommodate most custom requests including connector types, air treatment requirements and cooling air flow.

For more information, visit www.atlascopco.com/us.

Atlas Copco GAR Localization Team, left to right, Dempsey Parker, Peter Verrett, Carla Vasquez, Jaron Drake, Jim Donohue and Andries de Bock



Turbo Blowers Generate Significant Energy Savings at VICTOR VALLEY WASTEWATER

By Robert Lung for the U.S. Department of Energy Better Plants Program

A replacement strategy for air compressors and blowers integrated into a system-level approach towards energy efficiency can deliver significant energy savings and optimize equipment performance. At the Victor Valley Wastewater Reclamation Authority, a blower replacement project yielded annual energy savings of more than 928,000 kWh and $98,000 in energy costs, while improving the reliability of its secondary treatment process. In addition, the agency qualified for important incentives from its electric utility — significantly improving the project economics and resulting in a 2.94-year payback. The project also enables VVWRA to more easily meet its energy intensity goal within the context of the agency's participation in the U.S. DOE's Better Plants program.

Staff at the Victor Valley Wastewater Reclamation Authority decided to implement new 400-hp blowers to address their aeration needs.

Victor Valley Wastewater Reclamation Authority

The City of Victorville, California, is located in the Mojave Desert. The local wastewater treatment agency, the Victor Valley Wastewater Reclamation Authority (VVWRA), has an aggressive approach to energy efficiency and water reuse focusing on continuous improvement and optimal performance of plant energy-using applications. In 2015, VVWRA joined the DOE's Better Plants program at the Challenge level. VVWRA treats wastewater from four nearby member agencies, including: San Bernardino County service Areas 42 (Oro Grande) and 64 (Spring Valley Lake), the City of Hesperia, the Town of Apple Valley, and the City of Victorville.

> "At the Victor Valley Wastewater Reclamation Authority, a blower replacement project yielded annual energy savings of more than 928,000 kWh and $98,000 in energy costs, while improving the reliability of its secondary treatment process."
>
> — Robert Lung for the U.S. Department of Energy Better Plants Program

VVWRA operates one wastewater treatment plant in Victorville and uses an activated sludge process to treat approximately 13 million gallons of sewage per day (MGD). The Victorville plant operates 24 hours a day and was equipped with two 500-hp centrifugal blowers that served the secondary phase of the activated sludge treatment process in which air is supplied to the bacteria that break down organic waste. Most of the blowers were base-loaded to satisfy the normal system demand. Depending on the load, the fans must deliver between 3000 and 8700 standard cubic feet per minute (scfm) at a system pressure of 8 psig, according to VVWRA's nutrient loading and season.

Existing Blower Issues

When the plant was first built, VVWRA began operating with natural gas-fired aeration blowers. Over time, the agency began using some of the biogas it generated to fuel the blowers, but natural gas still accounted for approximately 60 percent of the blowers' energy consumption. In 2011 VVWRA began experiencing reliability problems and excess venting from their engine-powered aeration blowers. In addition, the agency needed to prepare for an eventual expansion of its wastewater treatment capacity to 18 MGD. After seeing how much air the existing blowers were venting, the cost of natural gas to operate them, and the difficulty of adjusting them to support variable nutrient loads, the VVWRA operations team decided to investigate different blower options. In addition, VVWRA wanted to use all of its biogas to generate electricity for its internal needs.

Staff at VVWRA obtained an energy audit from the University of California San Diego through a grant from the U.S. EPA. The audit found that the existing units would not be able to support the plant's expansion. Additionally, it found that newer blower technologies could support current and future loads more efficiently. Specifically, high-speed turbo blowers with variable speed control were found to be a good fit for VVWRA's process. Not only could this type blower offer a high degree of energy efficiency over a wide range of flows, but it also could accomplish the work with a smaller footprint and lower maintenance requirements.

TURBO BLOWERS GENERATE SIGNIFICANT ENERGY SAVINGS AT VICTOR VALLEY

Department of Energy's Better Plants Program:
Energy Efficiency Resources that Yield Value to Industry

The U.S. Department of Energy (DOE) launched the Better Plants program in December 2011. This initiative, part of the President's Better Buildings Initiative, is a corporate energy efficiency leadership initiative through which manufacturers partner with DOE to set energy saving goals and receive technical assistance and national recognition from DOE. In addition, these partner organizations receive priority access to an array of DOE-developed resources, such as training, tools, and live technical assistance — along with significant recognition opportunities. Today, more than 160 manufacturing companies and industrial organizations have joined the program and have achieved cumulative energy and energy cost savings of approximately 320 trillion Btus and $1.7 billion.

Better Plants
U.S. DEPARTMENT OF ENERGY

In the past year, the program has developed new initiatives and resources to facilitate greater energy efficiency gains, thereby increasing its value to industry. These include:

- **Supply Chain Pilot —** A select group of partners are engaging their suppliers to improve energy performance.
- **Water Savings —** Several partners volunteered to improve water efficiency and will share lessons learned on successful technologies and techniques with the program.
- **New In-Plant Training —** The In-Plant training sessions are addressing topics beyond the traditional industrial systems, such as energy management and specific processes (papermaking).
- **Water/Wastewater Agencies —** The program has expanded to serve the water/wastewater treatment sector.

In addition, the Department of Energy's Advanced Manufacturing Office continues to provide resources that can help manufacturers save energy, cut costs, improve competitiveness and reduce carbon emissions. These resources include:

- **Industrial Assessment Center (IAC) Energy Audits —** The IACs are a network of 24 University-based centers that offer free, one-day energy audits to small and medium-sized manufacturers (www.energy.gov/eere/amo/industrial-assessment-centers-iacs).
- **Combined Heat and Power (CHP) Technical Assistance Partnerships —** A group of seven centers across the U.S. help manufacturers evaluate and implement CHP projects (www.energy.gov/eere/amo/chp-technical-assistance-partnerships-chp-taps).
- **Superior Energy Performance —** An ANSI/ANAB-accredited plant-level certification program that recognizes facilities that adopt the ISO 50001 energy management system and demonstrate a third-party verified energy performance improvement (www.energy.gov/eere/amo/superior-energy-performance).

WASTEWATER

Project Implementation

The evaluation's main recommendation was to replace the existing engine-driven blowers with new, smaller, high-speed turbo blowers controlled by variable frequency drives. The assessment report also included a financial analysis that showed that the high-speed turbo blowers would save VVWRA more money and energy over their estimated 10-year life spans than newer versions of the existing units. This portion of the assessment report was important for justifying the project to senior management.

VVWRA engineering staff carefully assessed multiple types of high-speed turbo blowers. This assessment included blower capital cost, ease of installation, turndown capacity, maintenance requirements, rated lifespan, bearing configurations, blower controls and blower energy efficiency (based on a wire-to-air efficiency rating). In addition, VVWRA was planning an upgrade to new membrane diffusers. The new membrane diffusers would require 30 percent less airflow than the existing sock-style diffusers, making it possible for VVWRA to select smaller blowers.

After calculating the aeration needs associated with the expected expansion and new diffuser technology, VVWRA staff determined that the most cost-effective and energy-efficient approach was to install two new, 400-hp blowers. VVWRA decided on two blowers from Piller TSC. The first unit, a PillAerator MP12000 was installed in 2011, and the second one, a PillAerator LP14000, was installed in 2013. The new blowers included sophisticated controls that are able to orchestrate blower operation much more effectively.

The newest blower was installed in 2013, and provides sophisticated controls.

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TURBO BLOWERS GENERATE SIGNIFICANT ENERGY SAVINGS AT VICTOR VALLEY WASTEWATER

> "We have been extremely pleased with the new Piller Blowers. They have delivered the performance we need and our energy savings have been greater than expected."
>
> — Gilbert Perez, Chief Engineer, VVWRA

Better Blower Efficiency Than Anticipated

The replacement of three aging aeration blowers with two smaller, more efficient high-speed turbo units has yielded substantial energy savings and better system performance for VVWRA. The first blower was installed in 2011, and it reduced annual energy consumption and energy costs for the plant's aeration process by 928,500 kWh and approximately $98,000. Based on the success of the first blower, VVWRA installed the second one, and the newly configured aeration blower system is expected to consume 1,105,000 million kWh less per year than the previous engine-driven system. These energy savings represent a 40 percent reduction in energy consumption by the treatment process and should result in annual cost savings of $125,000[1]. With incentives through SCE's Customized Solutions program of $45,220, and total project costs of $660,000, the expected simple payback is 2.11 years.

Proper optimization and sizing of aeration blowers can improve system performance and save energy. In the case of VVWRA's Victorville plant, aging blowers that vented air were wasting energy and did not adjust well to changing loads. This meant that they were not capable of denitrifying the effluent to the required level. In addition, the blowers were not able to serve anticipated plant nutrient limits. In this situation, an electric blower was found to be better able to adjust to variable nutrient loads, which provided better control of the aeration system and better denitrification. In addition, VVWRA wanted all of its biogas to go towards electric power production. Once the plant installed the two smaller, high-efficiency blowers, it achieved significant energy savings and improved aeration performance. According to Gilbert Perez, Chief Engineer at VVWRA: "We have been extremely pleased with the new Piller Blowers. They have delivered the performance we need, and our energy savings have been greater than expected." BP

For more information, contact Robert Lung, U.S. DOE, tel: (202) 586-4411, email: Robert.Lung@ee.doe.gov, or visit www.energy.gov/eere/amo/better-plants.

References

1 The fuel consumption by the existing blowers has been converted to kWh using a conversion factor of 3412 BTU/kWh.

To read more about ***Blower Systems,*** please visit www.blowervacuumbestpractices.com/system-assessments/blower-systems.

PTFE Membrane Bubble Diffusers REDUCE DEMAND ON AERATION BLOWERS

By Doreen Tresca, Stamford Scientific International, Inc.

In a wastewater treatment plant, aeration tanks are the most energy-intensive portion of the plant, and can account for 45 to 75 percent of the energy footprint. Because of the high consumption of energy in the aeration tanks, this area is a prime place to turn to when looking to conserve energy in your plant.

Aeration tanks use bubble diffusers to distribute oxygen within the wastewater. Fine bubble diffusers, or those that produce a large amount of very small air bubbles, first began to become popular in the 1980s, as they had a much higher efficiency than coarse bubble diffusers. Fine bubble diffusers generally feature a membrane that allows airflow to pass from the piping system on the floor of the tank through the body of the diffuser and the membrane, providing oxygen into the wastewater for treatment.

Stamford Scientific International, Inc., headquartered in Poughkeepsie, New York, has developed and patented multiple advanced membrane technologies, including our PTFE (Polytetrafluoroetyhylene) coated membranes. PTFE membranes from Stamford Scientific International (SSI) have been installed worldwide in various applications — both municipal and industrial. These membranes have become increasingly popular, as the focus on energy conservation and life-cycle costs has grown worldwide.

How Do PTFE Membranes Impact Blower Efficiency?

SSI's patented PTFE membranes were first introduced in 2004, and feature a coating which prolongs efficiency and reduces whole-life costs. The PTFE coating not only reduces plasticizer extraction, shrinking, and membrane hardening, but also limits dynamic changes that can result from swell, such as creep. Both swell and creep dramatically change the initial shape of the membrane and can cause the membrane to stretch or even tear. As a membrane stretches out the airflow pattern is no longer even along the surface of the membrane, and this will affect the overall performance of the system. In addition, PTFE slows the rate of fouling on the surface of the membrane when compared to uncoated products. Uncoated products are more susceptible to increases in dynamic wet pressure (DWP, or head loss), due to more aggressive fouling and changes in physical properties and weight. The PTFE-coated membrane improves consistency of DWP values over the product life.

> "Our plant is very large. Anything we do costs a lot of money just because of the scale. We were facing the possibility of having to build side stream treatment facilities to keep up with the demand — and this would have been extremely expensive."
>
> — Gary Lagassey, Operations Superintendent

These direct benefits of the PTFE coating impact long-term power costs and the ability of a system to distribute air uniformly across the tank floor. As a membrane fouls and loses its initial shape, many plant operators find they need to increase the airflow rate of their blowers to overcome the fouling on the membrane and achieve the same oxygen transfer rates. Since PTFE membranes maintain their initial efficiency and slow the rate of fouling overtime in service, plants will not see the same increase in energy needs and consumption as they would when compared to an uncoated or untreated product.

Bubble Diffuser Upgrade Yields Energy Savings

With the increased focus on conserving energy, energy savings contracts have become increasingly popular and provide a way for plants to finance improvements. Wastewater treatment plants can finance capital improvements overtime using the projected savings in energy costs to help pay for the project.

PTFE membranes have been recognized by energy savings contractors, and have been supplied on a number of energy savings contracts to date. In 2010, SSI was chosen as a vendor for an energy savings contract with the City of Fort Worth, Texas, where 70,000 pieces of our 9-inch disc diffuser with PTFE membrane were supplied to upgrade their wastewater treatment plant.

Jerry Pressley, the Operations and Maintenance supervisor at the plant, could not be more pleased with SSI's products. He said:

"Aeration diffusers are a major part of the wastewater activated sludge process. Ours were old, and we needed to replace them. We have 13 aeration basins and over 75,000 diffusers, so we spent a lot of time looking for the right supplier for the project. We had to keep costs in mind and needed to implement the change without any interruptions to our service. We, along with our "energy savings performance contractor," chose SSI and their PTFE diffusers because they have an excellent track record, and they focus on improving energy efficiency. Although it's a major undertaking to replace all these diffusers,

PTFE MEMBRANE BUBBLE DIFFUSERS REDUCE DEMAND ON AERATION BLOWERS

The WWTP of the City of Fort Worth, Texas, installed 70,000 pieces of 9-inch disc diffusers with PTFE membrane coatings.

Installing PTFE-coated membranes helped avoid the costly construction of additional facilities.

> "Before, we could manage about 2,000 to 2,500 MLSS. With the new diffusers, we've upped that to 3,500 to 4,000 mg/L."
>
> — Gary Lagassey, Operations Superintendent

it's an investment in the future and is much more efficient in the long run. We earn the investment back in savings in energy costs."

PTFE Membrane Technology Boosts Plant Productivity

In addition to the energy savings experienced by upgrading the plant, the staff at the Fort Worth Village Creek Wastewater Treatment Plant also noticed an increase in the productivity of their system.

"With the old system, we were really limited in the loading, particularly ammonia, from return streams that we could run through the plant," noted Gary Lagassey, Operations Superintendent. "Our plant is very large. Anything we do costs a lot of money just because of the scale. We were facing the possibility of having to build side stream treatment facilities to keep up with the demand — and this would have been extremely expensive. But because the SSI PTFE diffusers are so effective, we didn't need to do that project, and we're handling more water than ever before. With the old diffusers, we were limited with the amount of MLSS (the industry term for mixed liquor suspended solids), which we could use in our process. Before, we could manage about 2,000 to 2,500 MLSS. With the new diffusers, we've upped that to 3,500 to 4,000 mg/L."

These diffusers are unique because of a patent on the membranes that resists the accumulation of matter, which avoids the blocking of the oxygen transfer and extends the time between cleaning cycles. This is a patented process unique to SSI.

"SSI really made it a straightforward implementation for us," Pressley continued. "We had several different projects going on at once, and they just made something that we thought could be a huge headache into a smooth, seamless process." BP

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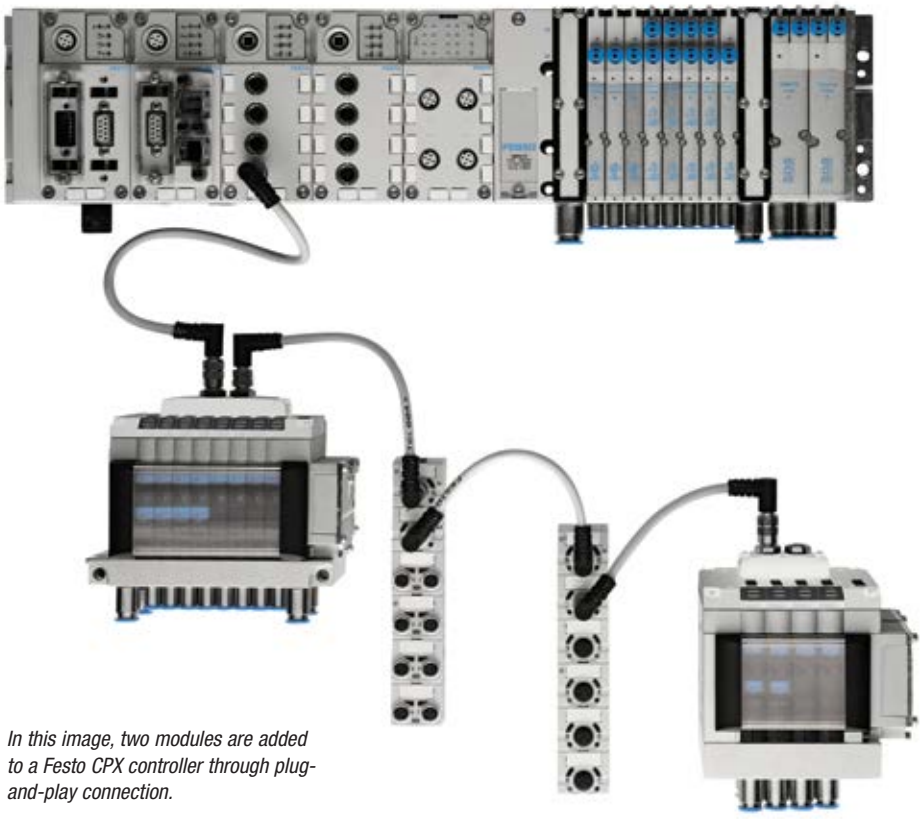
To read more about the ***Wastewater Industry,*** please visit www.airbestpractices.com/industries/wastewater.

Pneumatic Control in MODULAR WASTEWATER TREATMENT PLANTS

By Clinton Shaffer, Editorial Associate, Compressed Air Best Practices® Magazine

The design of wastewater treatment plants is changing, and it has something to do with LEGO® bricks. More specifically, it has to do with how large and complex LEGO structures are built. If you follow the instructions carefully, you build module after module, eventually piecing them together to create a fully functional and cohesive unit.

According to Craig Correia, Head of Process Automation at Festo Corporation, a similar approach is being adopted for the design of wastewater treatment facilities, and it has several advantages for both the manufacturer and the end user.



In this image, two modules are added to a Festo CPX controller through plug-and-play connection.

"OEMs are already modularizing. That's where the trend is being pushed from," Correia explained in a recent interview. "They'd rather build fifteen of the same skid each year than fifteen different skids. The advantage for the OEM is that it is repeatable, efficient and more profitable."

For the plant personnel, the advantage is scalability. Instead of constructing a new plant, a facility designed with small, independent units can increase its production capacity by adding more modules. This approach can be used for wastewater facilities, along with production facilities in the pharmaceutical, food processing, fine chemical and beverage industries.

During our conversation, Correia discussed the advantages of modularization in detail, outlining how the approach can help better monitor compressed air use. He also provided several recommendations for designing wastewater treatment plants to ensure they use compressed air as efficiently as possible.

Pneumatic Controls in Wastewater Treatment Plants

When a municipality decides to design and build a wastewater treatment plant (WWTP), there is typically a standard process. The city puts the project up for bid, evaluates the proposals, and selects a civil engineering firm to perform the work. The firm then designs the plant from the ground up. According to Correia, about 70 percent of these projects incorporate electrical systems to control the valving.

The remaining 30 percent of facilities use pneumatic technology. In those projects, firms like Evoqua, Pall and GE Water build skids that use compressed air as the working medium to control and automate the influent and effluent of the WWTP. Low-pressure compressed air (at least 60 psi or 4 bar) is used throughout the instrumentation, valving, sensors, and even the filter membranes. Correia mentioned there are more than 70 of these OEMs across the U.S. making filtration skids for the wastewater industry, and they are the companies currently pushing modularization.

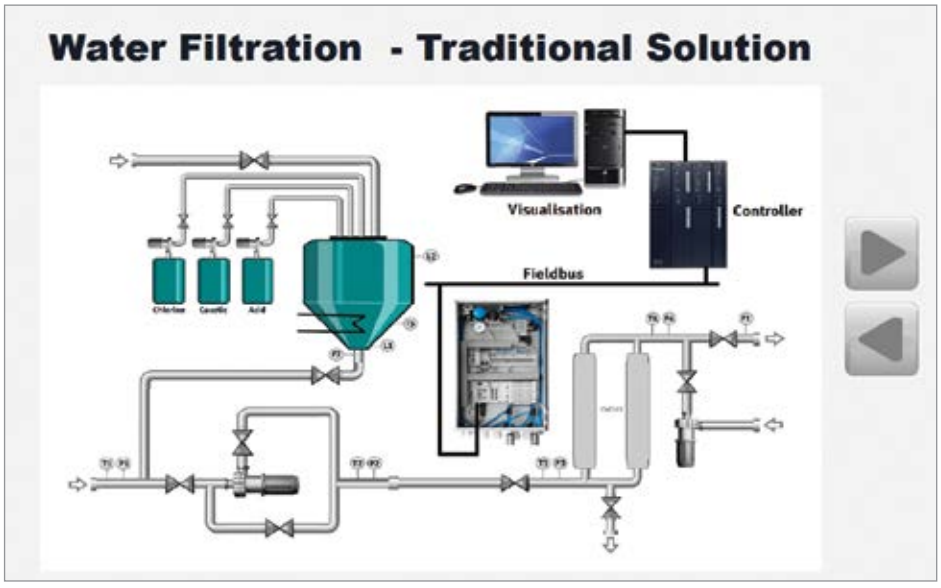
Advantages of Modular Design

For these OEMs, modular skid design is a no-brainer, because it enables them to make serial products, or the same product in high volumes. Making the same product is more efficient and, consequently, more lucrative than customizing every skid.

"If [the OEMs] are making a system for Cranberry Township one week, and the next week they're working with someone in Mexico, all the requirements change," Correia said. "If they have to re-design it every time, they are losing some of their efficiencies as a skid-builder. They want to standardize instead of re-designing every time."

When a company can make smaller, standard skids, its drawings become more repeatable. The company's labor also becomes more comfortable with the equipment, helping them to piece the skids together more efficiently.

Modular design helps the end users in a number of ways as well. Aside from potentially driving down costs and enabling quicker turnaround, a modular approach enables greater flexibility for the facility.



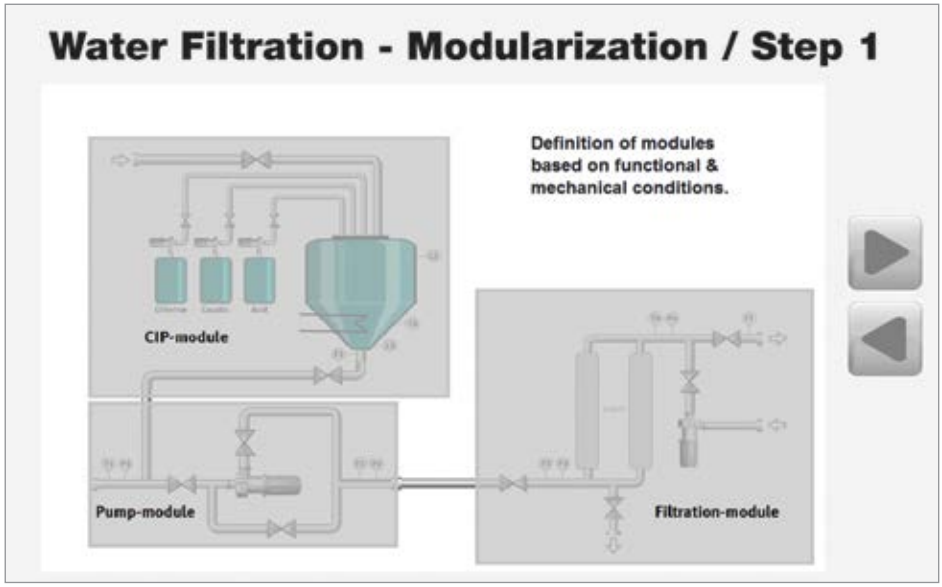
Traditional water filtration plant design

PNEUMATIC CONTROL IN MODULAR WASTEWATER TREATMENT PLANTS

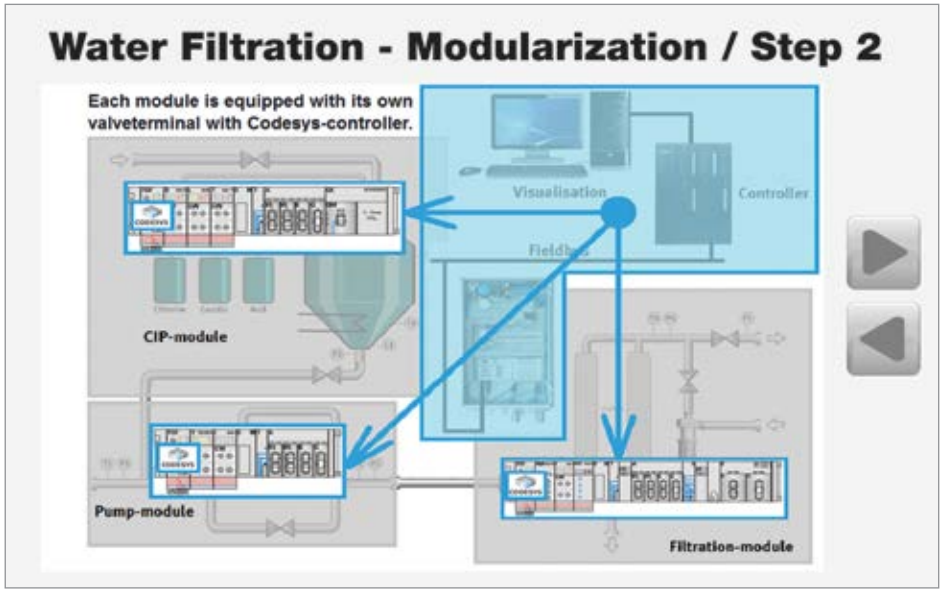
In the context of a WWTP, OEMs manufacture skids for ultraviolet (UV) light treatment, membrane filtration, reverse osmosis (RO), and chemical dosing. With a modular design, the skids can be clustered together, or sequenced in a series, to achieve the desired effects. Additional units can be added, or existing ones shut down, as determined by the facility's needs.

How Can Modularization Help Monitor Compressed Air?

If the facility has the programming expertise on-site, it can also leverage the smaller modules to better monitor skid performance — including compressed air usage. According to Correia, one of the reasons that companies don't run diagnostics across their entire system is due to bandwidth issues. The more information you collect across the system, the more there is slowing the top-level controller down.



Modularization of the mechanical and functional tasks of a water filtration plant



Modularization of the automation tasks of a water filtration plant

"If each of these [skids] is locally controlled — which is feasible — meaning that each skid has its own controller, its own valve terminal, its own electrical terminal, they can cross-communicate and push the communication to a higher level controller, or SCADA system," Correia commented. "You can perform diagnostics at each module with a decentralized intelligent valve and electrical terminal and only push up alerts when something falls out of the predefined range. You should have a flow meter locally just monitoring compressed air. If the volume of air spikes up at that module, you can go evaluate it."

Not only would this setup help reduce network congestion, but the decentralized concept of monitoring air consumption would also help diagnose issues better than using one flow meter at the front end of the whole wastewater treatment process.

"We might see an increase in air consumption — but where?" Correia asked. "The system has a series of modules for RO, UV, membrane filtration and chemical dosing, but where is the air lost? By using a decentralized diagnostic approach at each module, you can quickly pinpoint your compressed air use."

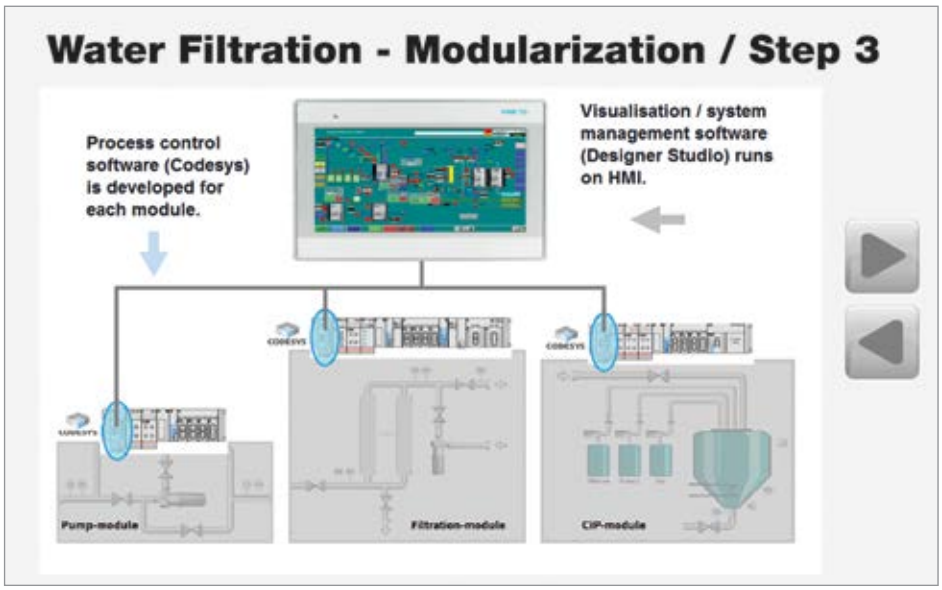
During our discussion, Correia mentioned automation components would not be more expensive for this approach. The cost — and the challenge — would come with the programming. A controls engineer would have to write more programs. If there were eight modules, you might need eight different programs feeding up to a ninth supervisory

one, as opposed to one main program controlling eight skids with no intelligence.

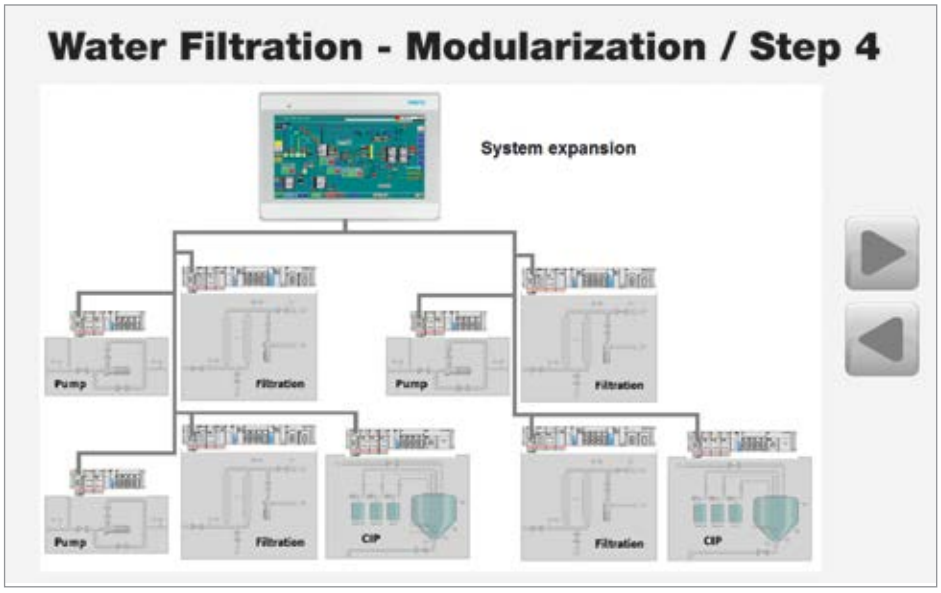
Pneumatic Valving Provides Remote Diagnostics

Even facilities without in-house programming capabilities can monitor their compressed air usage through modular skids. Festo provides valving and process control terminals for these skids, along with the automation software. The software offers the biggest benefit for end users and OEMs.

According to Correia, Festo technology enables filtration skid manufacturers to run remote diagnostics on any skid they manufacture in real time.



Modularized water filtration plant



By adding more modules, the system can be expanded.

PNEUMATIC CONTROL IN MODULAR WASTEWATER TREATMENT PLANTS

"[OEMs] can install this in a municipality or a food production plant or a winery in California — doesn't matter where — and in real time they can see what is happening in that skid," Correia said. "If a customer calls and reports the effluent is not meeting a particular standard, they can go into the Festo system remotely and see the last forty diagnostic events, allowing them to troubleshoot immediately and remotely."

In a traditional system, technicians may receive sensory feedback, but it would not specify where the problem occurred. This scenario leaves a lot to be desired, as the plant technician would have to troubleshoot every subsystem of the skid. According to Correia, the Festo valves provide this information — and pinpoint the problem.

"The valves can perform diagnostics in addition to getting sensory feedback from the skids," Correia explained. "It can tell you if there is a broken valve, a short circuit, a blown fuse, a broken wire, a voltage overload, and, in real time, display this information first on a touch screen, but also on a higher level SCADA system."

The information provided from the remote diagnostics is invaluable for both the end user and the OEM responsible for servicing the skid. The capability to remotely diagnose issues enables the OEM to service a customer across the country without having to bring in a third-party technician or fly someone to the site.

"We don't see companies using this information enough," Correia said. "It gives everybody a little more peace of mind."

Designing with Compressed Air in Mind

When it comes to using compressed air efficiently, Correia provided several recommendations for WWTP skid design. He mentioned that the safety factor for reliability is too high across the industry, especially for municipal applications. Large WWTPs may have controls engineers who understand programming and automation, but the smaller towns typically lack those resources.

"Too many systems are designed from copy and paste to save time or because bigger feels safer, but the long-term costs are not being considered," Correia explained. "Both engineers and designers often oversize pilots valves, actuators, and tubing diameters to save design time or for comfort level. It might only add $3,000 in component costs at the initial build, but I have piece of mind that it will work. But guess what? Every cycle of that valve consumes and exhausts excess compressed air. There needs to be more consideration about life-cycle costs for the decades the plant will be in operation."

Every time the pneumatic controls turn a valve on or off, compressed air is sent through the tubing and expended. The closer your pneumatic control cabinet is to your pneumatic valves, the less air you'll waste. According to Correia, you should keep your pneumatic control cabinet close to the process valves they control to improve efficiency.

"We always push our customers to spend a little more time designing [skids] more efficiently," Correia said. "Don't oversize your pneumatic valves. Don't oversize your compressed air tubing. Shorten your tubing runs. Put your pneumatic valves closer to the process control cabinet."

Use a Flow Meter — No Matter What

Perhaps the most important thing to do when designing or installing pneumatically controlled WWTP skids is to incorporate a flow meter. The old motto of "You can't monitor what you don't measure" applies particularly well to pneumatic controls.

"When we talk about the efficiencies of compressed air, one thing we tell these OEMs to do — and we tell everyone to do this — is they should be putting a flow meter on the front end of their system," Correia said. "Everybody typically measures pressure, but they aren't measuring flow. Flow is equally as important because you need to have volume. You need to fill these actuators at that pressure."

According to Correia, compressed air flow meters have really come down in cost over the last five years. Festo highly encourages its customers to put them in place on every skid for two reasons: (1) They provide traceable energy metrics, and (2) Flow monitoring provides great preventative diagnostics.

"If a customer calls and reports the effluent is not meeting a particular standard, they can go into the Festo system remotely and see the last forty diagnostic events, allowing them to troubleshoot immediately and remotely."

— Craig Correia, Head of Process Automation, Festo Corporation

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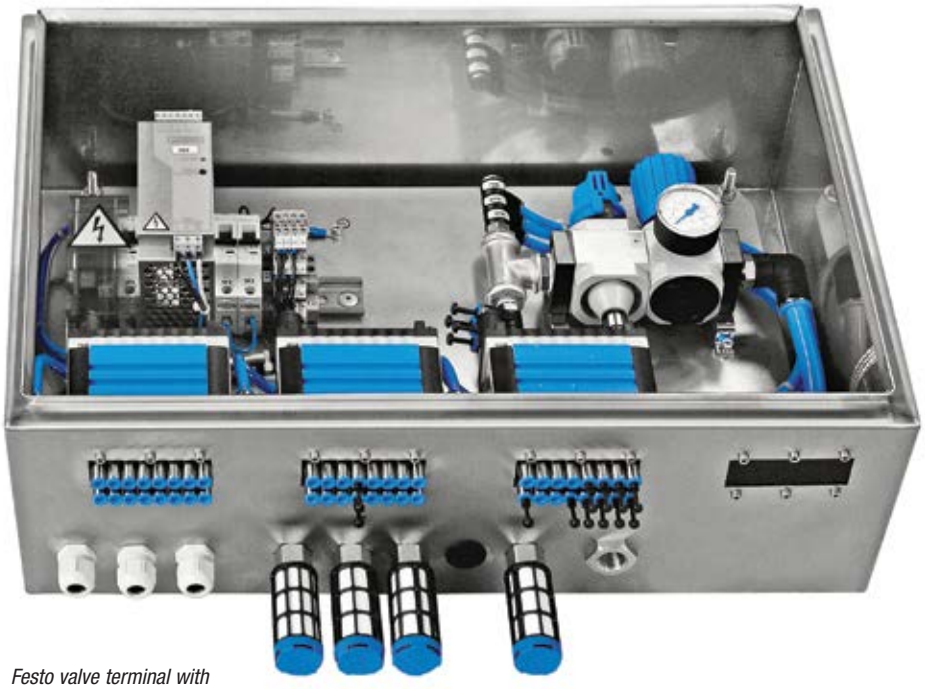
By installing a flow meter on a filtration skid, you can track exactly how much compressed air it consumes. That is huge because it provides a baseline for comparison. OEMs can take that number and push their engineering teams to improve it. WWTP personnel can take those same metrics and use it to compare different skids, enabling them to select the most energy-efficient one.

"If you want to operate in the industrial space, big companies all have energy conservation projects," Correia explained. "If you are bidding and you can say a skid is 20 percent more efficient than the one we built last year, that procurement person or that engineer is going to feel better about buying that skid."

Flow meters also help provide preventative diagnostics. For a hypothetical example, let's say one of these OEMs installs a skid in a small municipality. After some consistent monitoring, they determine it consumes about 16 liters of air every hour in order to run smoothly. If one day, perhaps a month down the road, they noticed it was consuming 80 liters of compressed air every hour, they would know immediately that there was a leak.

"That leak is going to result in two things," Correia said. "Either it is going to result in a failure at some point, bringing the system down, or it's just going to waste compressed air until it does fail. Monitoring compressed air usage with a flow meter is the best preventative diagnostic tool for your skid."



Festo valve terminal with multiple bulkhead mounting

Modular Automation Enables Energy Efficiency

LEGO models are great because they are simple enough for children to enjoy, yet complex enough for an adult to appreciate. Obviously, designing a WWTP is exceedingly more complex than piecing together a set of LEGO bricks, but the same modular concept can help bring scalability and flexibility to an industrial facility. By following best practices, some of which were laid out in this article, you can also make sure those modular skids use compressed air efficiently, and monitor compressed air usage as a preventative diagnostic measure. BP

For more information, contact Craig Correia, tel: (631) 404-3407, email: craig.correia@festo.com, or visit www.festo.us/water.

To read more about ***Pneumatics,*** please visit www.airbestpractices.com/technology/pneumatics.

"Monitoring compressed air usage with a flow meter is the best preventative diagnostic tool for your skid."

— Craig Correia, Head of Process Automation, Festo Corporation

What to Expect from an Effective COMPRESSED AIR AUDIT

By Don van Ormer, Air Power USA

Compressed air has moved to higher visibility in the energy conservation field, and the buzzwords abound: "the fourth utility" — "your most expensive utility" — "eight times more expensive than electricity" — "a quarter-inch leak costs $9,000 in wasted energy." This greater awareness has also produced compressed air auditors that are springing up like summer dandelions. With audits available from many sources, it is important to understand what plant operations, engineers and maintenance managers should expect from a complete audit — or more aptly — a complete air system review.

Begin with the Basics

Compressed air system reviews incur costs in the mid to high four figures or low five figures. However, paybacks are often measured in months — not years. These reviews allow development of longer term follow-up opportunities that continue to reduce the operating cost. Some plants recorded reductions up to 80 percent.

Although many companies look at energy expense as a variable cost, in reality, the production energy costs saved with a well-managed and well-controlled compressed air system represent a reduction in fixed costs. The reason is that as the electrical usage goes down, production stays the same or even increases.

A $100,000 energy reduction will have the same net income effect as $2,000,000 in sales at a net 5 percent margin.

Expect an effective plant air system survey or audit to reduce air demand and power costs from 25 to 50 percent almost immediately. Below are some frequently asked questions and issues about what drives energy costs in compressed air systems found during a survey:

- Is it leaks?
- Running excessive pressure?
- Lack of air-saving devices like venturi nozzles, air curtains, and the like?
- Producing high-pressure air only to use it at low pressure?
- Poor selection of primary air supply?
- Poor selection or application of compressor controls?
- Poor selection or application of filters, dryers, connectors, and regulators?
- Poor air receiver placement?

WHAT TO EXPECT FROM AN EFFECTIVE COMPRESSED AIR AUDIT

- Incorrect piping?
- Poor selection of compressed air to do the job compared to an alternate energy source?
- How can you compare relative costs if you don't know the cost of compressed air?
- Or, all of the above?

The truth is that it is always "all of the above," plus others.

The survey must provide a quality overview of the compressed air system at a cost commensurate with the system size, complexity, and potential recovery. The survey should generate both short- and long-term plans to establish basic control and management of the air system.

Focus on what is needed to pull together the interrelated parts of the system, and allow the user to understand the "basics" of these parts and their relationship. Create a general guide you can follow to continue to increase the efficiency of the system. Identify specific programs and actions to be implemented with estimated costs and payback. Develop a full sustainability program to include basic plans for expansion if required.

Certainly, this minimum effort should not be expected to produce the ultimate payback associated with more complete and detailed system analysis and training. The initial audit should lead to additional follow-up programs, or even to completely controlled and fully managed compressed air systems. The well-thought-out, simple audit has its place. It can generate significant savings, a success that should lead the user to more in-depth programs in the future press for efficiency and returns. Audits that do not contain this should be deemed unacceptable.

Assessing the System from the Supply Side

Evaluate the suitability of the existing air compressors as to the application and the general apparent performance and condition (without disassembly or mechanical work). The report should address the efficiency ratings, suitability of unloading controls,

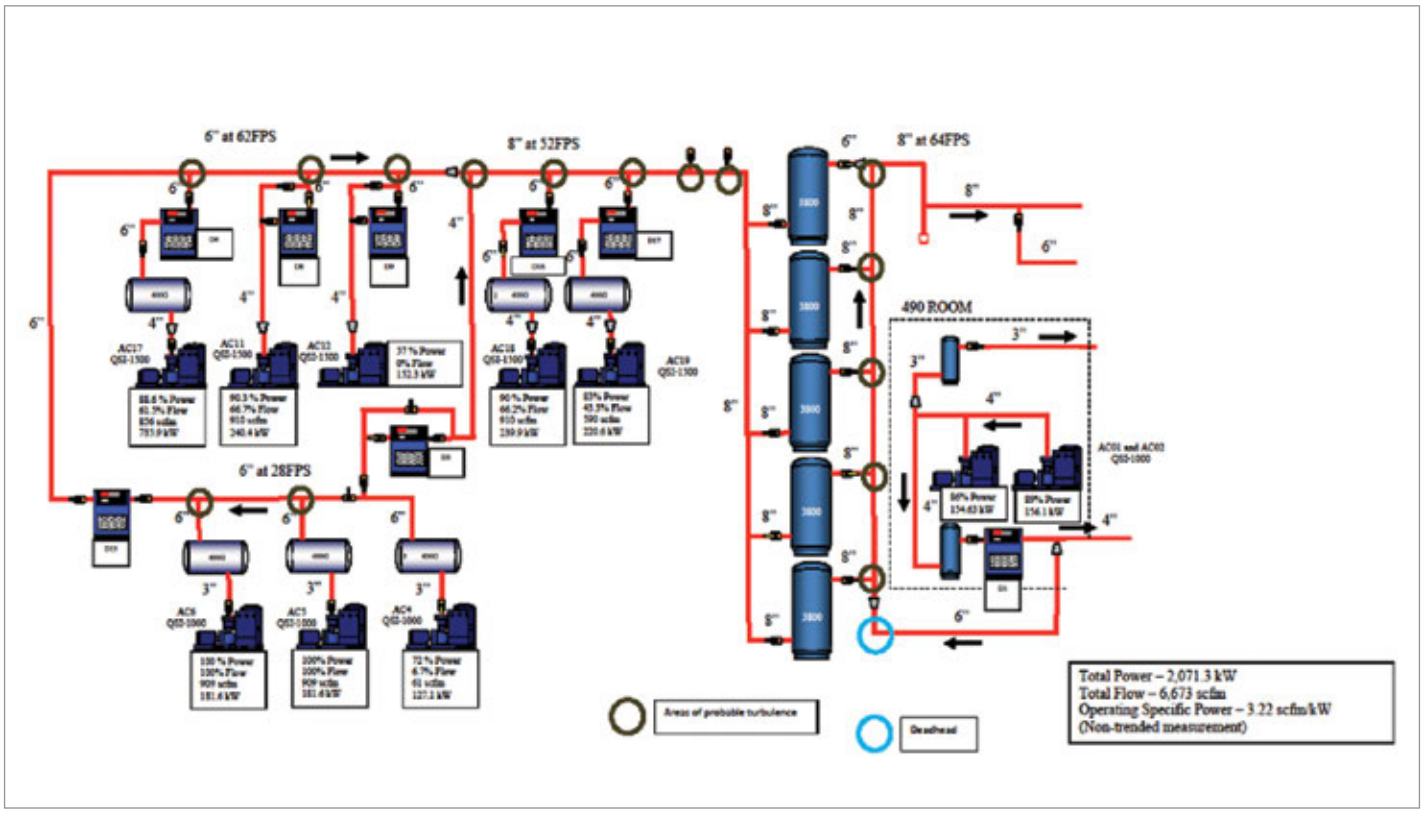


Figure 1: Current System

and capacity for translating lower air demand into lower power cost. If required, get the facts about the potential for modification, including: the capability for system sequencing; the installation and support systems, like cooling water and ventilation; and general advice on alternate types of equipment and controls that may be more preferable or more power efficient.

Also, expect an evaluation of the compressed air treatment equipment. This includes: installation, general apparent conditions, and performance; the suitability for application; and the general effect on efficiency and energy costs, along with effect on production and quality issues. Specifically, look for data on the following:

- For the aftercooler, you want to know about the effectiveness it has for delivering 100°F in the hottest ambient temperature. If not, then determine the possibility of using auxiliary coolers at the dryer inlet. You'll also want a critique of the installation geometry to the dryer.
- Be sure the dryers and filters are suitable for the application with respect to sizing, efficiency, pressure drop, and the controls. Learn about possible modifications that would improve performance and efficiency. Are the auto drains applied correctly, as well as sized properly? Is the sizing and installation correct to meet the most extreme ambient temperature?
- The supply-side piping between the compressor and the system storage vessel should be evaluated for suitability, efficiency, and pressure drop. Finally, the placement of the air receiver should be consistent with good practices for control, storing dry air, and its ability to function with appropriate storage to offset capacity control response lag.
- It is vital that the operating control band for the compressor capacity controls includes the primary dry air storage for the production area to ensure the control is operating in relation to actual production and not in relation to false signals from internal piping and other pressure spikes.

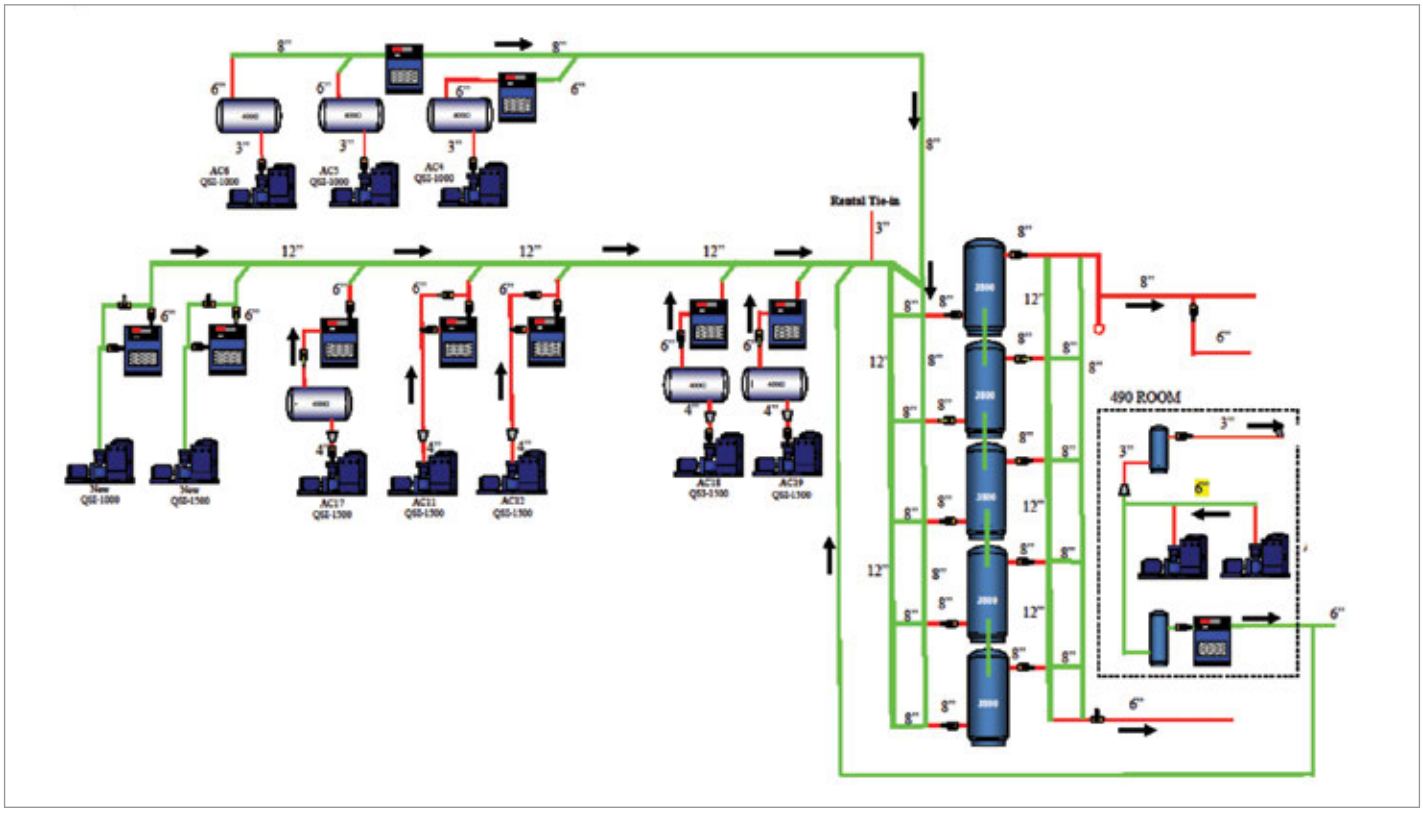


Figure 2: Proposed and Modified System

WHAT TO EXPECT FROM AN EFFECTIVE COMPRESSED AIR AUDIT

An effective review or audit will evaluate all the compressed air generation, treatment and air distribution to the production area. It does not have to recommend new equipment but should identify any operating energy cost benefits currently available, and/or generic alternates for future considerations.

Any recommendations should reference the impact on productivity and quality. Are the unloading controls capable of translating lower demand for airflow into lower electrical usage? This is a most critical issue, and the capabilities depend on things like the type of compressor, type of control, condition of the equipment, the piping, and storage capacity.

Proper Auditing Reveals Significant Savings

Once the supply side is reviewed and modified as required to achieve controlled and monitored operation for continued sustainability, performance should remain optimum unless improper changes are made.

As an example, a Midwestern plant had twenty-two 300-hp, lubricant-cooled, rotary screw compressors all running simultaneously (Figure 1, pg. 32). A previous audit had them all at full load and recommended three additional units. Plant personnel also felt all the units were at or near full load, and additional units would be required.

A second professional system analysis revealed that several units were actually at no load, and all the other units at part load (Figure 2, pg. 33). Reconfiguration of the piping allowed the plant to deliver the same airflow at the same pressure with only 11 units. This resulted in annualized energy savings of $800,000/year with 6 months simple payback.

The additional maintenance savings were also significant. Imagine the difference in fixed maintenance costs between 11 operating 300-hp rotary screw compressors and 22!

Supply-Side Summary

What are the key points we look for and their potential magnitude of savings? For supply management, the issues are these:

- Different types of compressors and basic performance can vary from 5 to 10 percent at full load. This can affect the power bill by 5 to 10 percent with conventional motors and controllers. General acceptable installation configuration includes intake and discharge piping.
- Types of unloading controls and their ability to translate reduced demand into a lower power draw can vary the savings from 10 to 70 percent in the unloaded condition and affect the power cost by up to 50 percent with conventional motors and controllers.
- Motor efficiency and basic performance characteristics of the main driver are important. Is it possible to install an effective variable speed drive (VSD)? If so, the potential part-load savings could run between 5 and 25 percent, but more than one VSD is rarely required. VSD drives may not deliver a significant energy reduction with oil-free rotary screws.
- Dryers, filters and each 1 psig of lost pressure may represent 1/2 percent of wasted power if the compressor has to run at a higher discharge pressure. Each auto drain has the potential to waste from $300 to $1,000 per year. Too much pressure drop will also impact the available effective storage and capacity control performance.

Analyzing the Demand-Side of a Compressed Air System

The demand side is another case altogether. Identifying and implementing energy-saving projects are always very significant. Continuous and diligent monitoring and review is essential to retain sustainability.

The actual projects will ultimately dwarf the supply-side savings over time. Many of the

"Most leak surveys identify leak rates as high as 20 to 35 percent of the total airflow. This produces a minimum impact of 10 to 20 percent on the power bill."

— Don van Ormer, Air Power USA

generic areas for energy savings continue to create new significant opportunities in the future as technology (particularly electronic) continues to improve. Many processes, such as blow-off efficiency, air-driven vacuum generators, cabinet cooling, and diaphragm pump controls, continue to evolve with new energy-saving designs and controls. All processes should be reviewed every two to three years.

Demand-Side Management / Waste Management

We often classify waste management and demand-side management as separate sectors, but they are, in reality, two parts of the same entity. Together they generate the air usage for which the compressors supply air. You should look at waste management separately, because it is obvious yet often ignored.

Everyone always jumps immediately to leaks, and they should and must be addressed. It takes proper equipment in the hands of trained personnel accurately evaluating leak size and measured system performance to identify the true recovery value in electric energy dollars for their repair and elimination. For example, a 1/4-inch air leak could be equal to the cost equivalent of operating about 286 light bulbs at 60 watts each.

Implementing a Leak Inspection Program

A continuing, economical program must be in place to effectively conserve air and manage leaks in the plant. Generally speaking, the most effective programs are those involving the production supervisors and operators working with the maintenance personnel in a positive manner. Most leak surveys identify leak rates as high as 20 to 35 percent of the total airflow. This produces a minimum impact of 10 to 20 percent on the power bill.

Consider these suggestions:

- Set up a continuing leak inspection program by maintenance personnel so that each sector of the plant is inspected once every four to six weeks. Identify and repair leaks. Keep a record of these findings and the results. The leak can be quantified and measured to estimate flow and assign a measurable cost value to it.
- Install a program that positively motivates production personnel (particularly the operators and supervisors) to identify and repair leaks. Establish and monitor continuing air conservation programs.
- Monitor airflow to each responsible sector (perhaps use of a recording or non-recording flow meters), and identify the air usage as a measurable part of the operating expense of that area. Too often the production supervisors closest to the problems are not held accountable for compressed air energy costs.
- This usually works best when combined with effective in-house training and awareness program for those involved. Leak detection and repair programs provide greater energy savings at substantially lower costs than any other procedure.
- Walk through and evaluate the compressed air distribution system. Review and identify air using tools and processes. Most importantly, talk to the operating and maintenance personnel to identify the opportunities for waste management and demand-side management.

Operate at the Lowest Effective Pressure

This is one of the most overlooked areas of opportunity in managing the cost of a compressed air system. Identify areas in the plant and the lowest possible pressure at which they can operate with optimum production.

Identify areas in the systems that are running off unregulated air with resultant "pressure spikes." Realize that the actual volumetric airflow is directly proportional to inlet pressure on any fixed demand. Extra pressure means extra airflow with no commensurate increase in production. Excess pressure of too many processes (air tools, air-driven vacuum generators, etc.) can have a negative impact on production and quality.

Identify areas of wasted, but controllable, compressed air power in the air distribution system — particularly areas of excessive pressure loss in the system or the final user.

- Develop methods to measure the airflow delivered to various departments and areas of usage for follow-up programs.
- Identify the minimum optimum flow and pressure required to perform each job. Find ways to use flow control regulators, storage air receivers, intermediate controllers, and so forth.
- Look for unregulated air usage. Holding a regulated, steady, minimum effective pressure uses the least

WHAT TO EXPECT FROM AN EFFECTIVE COMPRESSED AIR AUDIT

possible air, and the steady, predictable pressure enhances productivity and quality of almost any process.

- Review blow-off procedures and consider the use of air-saving devices, such as Venturi air amplifier nozzles, Venturi air curtains, and Vortex cooling tubes in place of open tube compressed air cooling.
- Look for areas of usage or event demands that may need their own storage area, and then use intermediate flow controllers to convert short-term high rate of flow to the low average flow.
- Review all piping configurations for possible use of directional connections in lieu of tees if there are converging airflows, completion of the loop system, possible flow chokes, and the like.
- Review location and effectiveness of all isolation valves. Check plant operating procedures to be sure these valves are closed except during production periods of their area or machine. This can be done automatically and/or controlled remotely.
- Review areas of higher pressure demand than most of the system that can be satisfied by such things as a satellite smaller unit, a small hydraulic booster system, a pneumatic booster, and so forth, and will allow overall production air pressure reduction.

What to Expect from an Effective Compressed Air Audit

Air systems have a supply side and a demand side. For optimum performance, we want the supply-side compressors to produce and store air at the highest necessary pressure. On the demand side, we want to run at the lowest effective pressure at each process. A good compressed air management program looks at the entire system. It recognizes interconnectivity to optimize compressed air energy cost to the corresponding productivity. Any program that does not deal with these areas on a continuing basis will not be effective nor have any permanent positive effects.

One of the most important components of any compressed air program is employee education and awareness. Every employee, from management to machine operators, should be made aware of the costs of air usage and waste. Company newsletters should include a column on air use. Employees should be encouraged to report air leaks. Machine operators must remember to turn off the air supply to idled equipment and to report any air-related problems.

Employee recognition is essential. Appreciation of those employees who have contributed to air loss prevention will go a long way to encourage others to participate. This can come from mention in a newsletter, a public announcement, or even by a plaque or notice on the company bulletin board.

Compressed air is not free, but it can be less expensive and more reliable with a proper systems analysis review and management program. Learning to manage and maintain your compressed air system now will save you time and money in the future. BP

For more information, contact Don van Ormer, Air Power USA, email: don@airpowerusainc.com, or visit www.airpowerusainc.com.

To read more about ***System Assessments,*** please visit www.airbestpractices.com/system-assessments.

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— Don van Ormer, Air Power USA

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Variable Inlet Guide Vanes Boost CENTRIFUGAL AIR COMPRESSOR EFFICIENCY

By Rick Stasyshan and John Kassin, Compressed Air and Gas Institute

Compressed Air Best Practices® (CABP) Magazine recently caught up with Rick Stasyshan, the Compressed Air and Gas Institute's (CAGI) Technical Consultant, and John Kassin of Cameron to discuss variable inlet guide vanes (IGV). The following interview describes how centrifugal compressor efficiency can be improved thanks to recent developments in IGV technology.

Figure 1: Inlet guide vane assembly mounted to first stage inlet of a centrifugal compressor.

CABP: Many of our readers own and operate centrifugal compressors, and they frequently ask about how to reduce their energy consumption. Is there anything new from CAGI's Centrifugal Compressor Section that you can share?

CAGI: Absolutely, and energy conservation should be first on their minds. Frequently, equipment cost is the major decision factor, but energy consumption represents approximately 82 percent of the product life-cycle cost. CAGI and our members emphasize the opportunities to conserve energy while maximizing compressor system performance every chance we can. We would like to share some of the developments in centrifugal compressors utilizing variable inlet guide vanes.

Lowering Your Centrifugal Compressor Operating Costs

CABP: In simple terms, how can you reduce centrifugal compressor operating costs, and what are the potential results?

CAGI: For starters, you can save energy when running at less than full capacity, and you can also save energy on cooler days.

Variable inlet guide vanes are an ingenious yet simple option that, when installed on your centrifugal compressor, can deliver energy savings of up to 9 percent. By replacing a standard inlet butterfly valve with a new inlet guide vane assembly, substantial energy savings can be realized whenever the compressor operates at less than full

load or when ambient air temperature is less than design temperature (usually 95°F, 35°C). Many manufacturers offer this option as a retrofit for existing compressors.

Inlet guide vanes impart a whirling motion to the inlet airflow in the same rotational direction as the impeller. This decreases the power required to deliver the rated airflow and pressure. There are opportunities for energy savings when the compressor inlet is throttled. Throttling takes place under most operational circumstances, except when plant air demand requires full 100 percent flow and when ambient air temperature is the highest expected at that location. This means your compressor inlet is likely throttled during the majority of its operation.

Inlet guide vanes in their application consist of wedge-shaped steel blades mounted around the inside circumference of a short length of inlet pipe (see Figure 1). They are turned in synchronization by a ring or yoke assembly on the outside of the pipe. Each vane is designed with an airfoil cross-section (similar to an airplane wing) to minimize air resistance when in its full open position (vanes positioned parallel to the air stream). The inlet guide vanes modulate from this fully opened position to a fully closed position, providing an infinitely variable degree of throttling and pre-rotation. When fully closed, the blades overlap to block all airflow — except that through a small center hole that is required for stable compressor operation (see Figure 2).

A standard actuator positions the yoke assembly. These are similar to the actuators used on a butterfly valve (See Figure 3). The existing control system required to operate the butterfly valve can also be used to operate the inlet guide vane (microprocessor and PLC systems provide the best results). Thus, it is typically easy to retrofit existing centrifugal compressor installations with inlet guide vanes. Only minor piping modification is required.

Low Ambient Temperature Means Throttling Down

CABP: How does temperature come into the equation?

CAGI: Temperature indeed does play a role in centrifugal compressor performance. Centrifugal compressors are designed to produce the rated flow and pressure on the hottest day expected (hot design day) at their installation location. At lower ambient temperatures, the compressor can deliver more air at the same pressure. Since this additional air is not normally required, the compressor intake must be throttled to match the plant demand. By throttling with inlet guide vanes, a substantial power savings can be realized in comparison to a butterfly throttle valve. Compressor operators will see these savings almost every

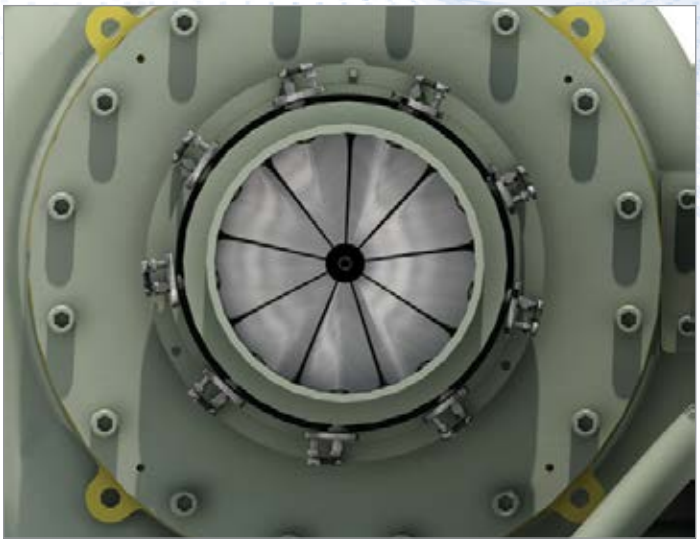

Figure 2: Front view of an IGV in fully closed position.

Figure 3: Side view of a mounted IGV showing the yoke assembly and actuator.

VARIABLE INLET GUIDE VANES BOOST CENTRIFUGAL AIR COMPRESSOR EFFICIENCY

day — every day, that is, when the temperature is below the design point, and/or when the plant air system demands less air than the maximum designed volumetric flow.

CABP: Can you provide additional input?

CAGI: There are opportunities to save during "off-design" conditions. Compressors are designed to deliver pressure and flow for plant or process requirements under the most extreme anticipated atmospheric and air system demand conditions. These are often referred to as "design day" conditions. Design day conditions are highly dependent upon the ambient atmospheric temperature and the demand for compressed air from the plant. For most applications in the northeastern United States, design day conditions are considered a "worst-case scenario" of 95°F (35°C).

However, design day conditions are rarely experienced at the compressor jobsite. If we consider the case of the winter season where temperatures mainly persist below the design day maximum, significant energy savings can be realized through the unique throttling effect provided by inlet guide vanes.

Additionally, for plant air applications, it is common that the design flow rate (maximum anticipated design volumetric flow rate for peak production requirements) is not required by the plant's compressed air system continuously.

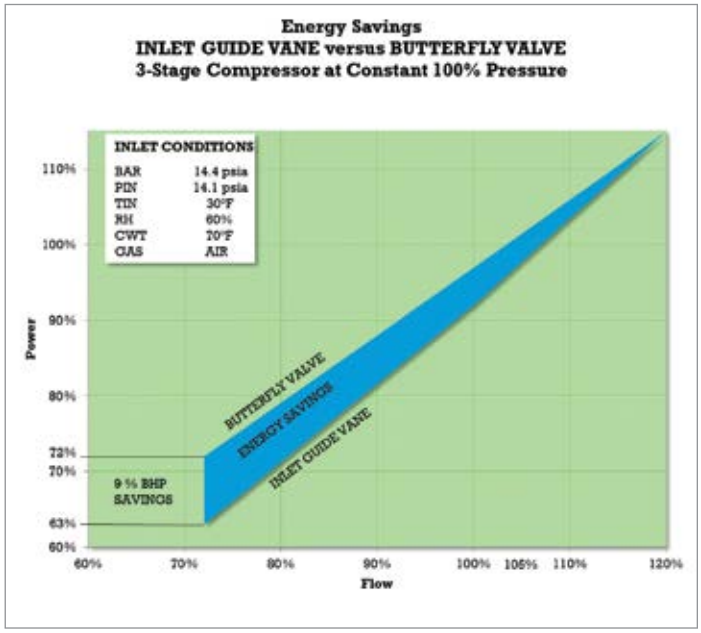

Chart 1 considers the case where the atmospheric temperature is 30°F (-1°C) and where the demand of the compressed air system is 72 percent of the design-rated flow. At this temperature and volumetric flow demand, the inlet guide vanes throttle and impart a pre-rotation to the incoming airstream. Due to this pre-rotation, less power is required to compress the incoming airstream.

In this case, the IGV can reduce power consumption to 63 percent of the design day load. Under the same conditions, a compressor utilizing a butterfly valve (which does not impart the same favorable aerodynamic flow characteristics to the incoming airstream) would require 72 percent of design power to achieve similar performance. The difference represents a total net savings of 9 percent in power.

Conversely, by properly sizing the compressor drive motor (over-sizing) for a cold day and running it in un-throttled operation mode, the integrally geared centrifugal air compressor can deliver up to 20 percent more airflow above its design. The additional flow will require more power.

Learn More About Centrifugal Compressors

CABP: How can our readers learn more about CAGI's Centrifugal Compressor Section and other means of operating their centrifugal compressor systems more efficiently?

CAGI: CAGI's Centrifugal Compressor Section members are Atlas Copco, Cameron, FS Elliot, and Ingersoll Rand. Our members all have highly trained technical engineers to assist users with application questions, assist in specifying the correct products, and assist with conducting system assessments to make educated and responsible decisions.

For more detailed information about CAGI, its members, compressed air applications, or answers to any of your compressed air questions, please contact the Compressed Air and Gas Institute. CAGI educational resources include e-learning coursework on the SmartSite, selection guides, videos and the Compressed Air & Gas Handbook. BP

For more information, contact the Compressed Air & Gas Institute, tel: (216) 241-7333, email: cagi@cagi.org, or visit www.cagi.org.

To read more about ***Air Compressor Technology,*** please visit www.airbestpractices.com/technology/air-compressors

SHOW REPORT:

COMPRESSED AIR AT THE NPE 2015 PLASTICS SHOWCASE

By Rod Smith, Compressed Air Best Practices® Magazine

The NPE 2015 International Plastics Showcase was held at the Orange County Convention Center in Orlando, Florida, March 23-27. The Show attracted 2,029 exhibitors — including Compressed Air Best Practices® Magazine! Over 1,128,000 square feet of exhibition space was used — both figures breaking the all-time NPE records set in 2000. Held once every three years, NPE registered attendance was 65,810 – 19% greater than the 2012 event.

The plastics industry is the 4th largest in the U.S. It's a major user of all the technologies we cover including blowers, vacuum, chillers and compressed air system components. Compressed air pressure requirements vary significantly for the plastics industry.

- PET bottle blow molding: 510-590 psi, (35-40 bar)
- PET bottle blow molding with lightweight plastics: 290-365 psi (20-25 bar)
- PET bottle blow molding with custom intricate design: 650 psi (45 bar)

Dave Hubbard from Mid-America Machining standing next to their milk jug mold display. Mid-America designs and manufactures rotary molds, for products like milk jugs typically requiring 100 psig inlet compressed air.

- Rotational molds for plastic car parts or milk jugs: 100 psi (7 bar)
- Bottle labeling (100 psi-7 bar) and drying with blow-off (1.3 to 3 psi)

The plastics industry is exploring how to use less material and be more sustainable. This is driving air pressure requirements lower. SIDE is a Barcelona based blow molding machine manufacturer for PET bottles. They told me their specialty bottles are using less plastic and require lower pressure compressed air. For example, the Lipton 1 ½ liter ice tea bottle requires 190-235 psi (13-16 bar) compressed air.

Often overlooked are the rotational molders. These plants use standard 100 psi compressed air and represent a large segment of the plastics industry. Our trade show booth neighbor was Dave Hubbard, the Sales Manager for Mid-America Machining, a manufacturer of rotational molds specializing in milk jugs. His clients conduct extrusion blow molding processes requiring 100 psi blow air in seven (7) second cycle times.

A recurring recommendation, in the editorial of Compressed Air Best Practices® Magazine, is for plants to review and see if different pressure sub-zones can be created. When air is compressed at the highest pressure and then regulated down, this is where large energy-savings can be found. Creating pressure sub-zones can entail significant piping re-works, and — as usual — every situation has to be reviewed on it's own merits.

Compressed Air Technology Focused on Plastics

Negri Bossi is a leading Italian manufacturer of injection molding machines. Their booth featured a Frigel chiller and a N_2IT^{TM} gas assist molding system from Bauer Compressors side-by-side. Off I went to meet with Jason Pruss (also known as "the plastics guy"!) at the Bauer booth to learn more about this N_2IT^{TM} system. Jason patiently explained the growing demand for plastic parts with thin walls and hollow centers

SHOW REPORT: COMPRESSED AIR AT THE NPE 2015 PLASTICS SHOWCASE

Supporting their injection molding machines, the Negri Bossi booth had a Bauer N_2IT^{TM} Gas Injection Technology unit alongside a Frigel chiller.

Jason Pruss, Dennis Paul and Rick Goralski, from Bauer Compressors, next to the Bauer N_2IT^{TM} Gas Injection Technology unit (left to right).

Michael Camber, Shane Smith, Tracy Carter, Keily Grubaugh, Bob Glenn and Joe D'Orazio from Kaeser Compressors (left to right).

— demand driven again by the interest in using less plastic material. Showing me a coat hanger as an example, Jason explained that thin plastic walls are now possible (versus thick walls using more material) thanks to the injection of nitrogen inside the product. The pressure reinforces the wall strength and eliminates plastic sinks due to the equal pressure spread throughout the product.

Marketing Manager Matt Henry explained that Bauer Compressors has formed a Plastics Technology Group to help companies deploy their Gas Injection technology. Jason elaborated detailing that nitrogen applications can range from 600 to 3000 psi depending upon the product being created. The Bauer N_2IT^{TM} system consists of an integrated nitrogen generator (using membranes), a high-pressure booster compressor, storage and a process control unit in one package. The unit requires 100 psi inlet air and can deliver up to 5000 psig (345 bar) nitrogen at 98% to 99.5% nitrogen purity. This is a 5 horsepower, 37 kW unit. I found this very interesting and it appears to be a growing market. Must be just another reason why Bauer is expanding their operations so significantly in the U.S.

I was able to meet Gardner Denver's high-pressure solutions team at the show. The booth featured the Belliss & Morcom WH40 Oil-free PET Bottle Blowing Air Compressor. This technology has been a market leader since it was launched in 1852! It is a water-cooled, capacity control or variable speed drive, 3-stage, oil-free reciprocating air compressor able to deliver very efficient performance when matched up with the right demand profile. The unit also offers a series of "Enhanced Products" designed to reduce energy consumption. These include an AirPET Control System monitoring, logging and managing the system to optimize efficiency. Also featured is an Air Recovery System designed to recapture air from the blow molding machines as well as a Heat Recovery System allowing customers to use hot water coming off the air compressor to pre-heat their own feed water to their heating systems. Savings are typically in the 22-30% range.

Gardner Denver High Pressure Solutions Product Director Trevor Perry also said they were bringing new products to North America, including more options on high-pressure air compressors and Reavell brand gas compressors for CNG, marine and oil/gas drilling applications. Long-time High-Pressure Sales Manager for the Americas, Mike Bakalyar, said high-pressure nitrogen packages for coffee producers are also doing very well.

Kaeser Compressors displayed their full array of solutions for the plastics industry. The biggest number of plastics plants blow mold plastics at 100 psi. Think of all the plastic parts and containers we

use. Some may also do some high-pressure work, but with a single production line. Kaeser focuses on providing pressure sub-zone solutions for these clients. They displayed the AS 25T rotary screw compressor — a 25 hp 100 psi unit with enhanced flow capabilities to 120 cfm. Also on display were high-pressure boosters for PET applications. An interesting analysis each bottler must make is how much high-pressure air is required? Should they have a 100 psi system complemented by a booster for 300 to 600 psi blow molding? All too often we hear about plants who regulate-down 500 psi air for their 100 psi plant air requirements.

Atlas Copco had their full range of air compressors — for all pressures — on display. I have to admit I spent more time, at their booth, reviewing their newly launched GHS+ rotary screw vacuum product lines featuring standard variable speed drives. Sorry, I digress. Atlas Copco offers a broad range of high-pressure air compressors for 25-40 bar, CNG stations and industrial gas compressors. Having said that, lately I've been particularly impressed by their SmartLink data monitoring technology helping them provide clients with factory comparisons on energy intensity performance. Vice President for Communications and Branding Erik Arfalk told me they now meet with key accounts and provide them with the specific energy used (kW per cfm) in each plant. This provides Energy Managers with an invaluable metric, one based upon on-going running hours — as opposed to data received during a one-week data-logging snapshot.

AF Compressors has quietly built itself into one of the leading global suppliers of high-pressure oil-free air compressors to the PET bottling industry. Sales Manager Joe Mashburn said clients are interested in their CE Range Compressors new Air Back 5 Re-Injection air recycling systems where they recover 74 psi (5 bar) blow air from the blow molding machines and inject it into the 2nd stage of their compressors. This can improve flow capabilities by 14% on some models. Their 250 kW compressor has a normal flow rating of 777 cfm, with air recycling it can deliver up to 883 cfm.

Another leader in oil-free technologies, Hitachi's Air Technology Group had a nice booth where they exhibited their oil-free scroll air compressors. Designed for 100 psi applications, these air compressors range from 2 to 300 horsepower and deliver ISO 8573-1:2001 Class Zero air quality. BP

For more information on NPE 2018 visit www.npe.org.

To read similar ***Plastics Industries*** articles, visit www.airbestpractices.com/industries/plastics.

Trevor Perry, Mike Bakalyar, Tony Marlow, Tyson Mulvaney and Dave Shanahan from Gardner Denver Bellis & Morcom (left to right).

Joe Mashburn, from AF Compressors, next to the CE 24B air compressor able to deliver 353 cfm at 40 bar (590 psi).

Sam Mirza, Sayaka Eiki and Warren Story, from the Hitachi Air Technology Group, next to the SRL 16.5 Oil-free Scroll air compressor.

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– Patrick Jackson, Director of Global Energy Management, Corning Inc. (feature article in June 2014 Issue)

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– Doug Barndt, Manager Demand-Side Energy & Sustainability, Ball Corporation

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– Michael Jones, Corporate Energy Team Leader, Intertape Polymer Group (feature article in July 2014 Issue)

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SPX Releases New Range of Competitive, High Value Compressed Air Dryers

SPX has announced the release of a new value range of non-cycling, refrigerated compressed air dryers. Expertly engineered, the dryers offer the perfect balance between technology and simplicity to dry compressed air systems to ISO 8573-1 Air Quality Class 4 to 5 pressure dew points.

The newly introduced HPRN Series of refrigerated air dryers

The HPR & HPRN Series of refrigerated air dryers are based on a proven design to ensure reliable, consistent performance. The range includes an impressive 19 models offering flow capacities between 10 and 500 scfm to meet a broad variety of operating requirements. The dryers include many options and innovative features that ensure the entry-level design gives exceptional performance, reliability and value for money.

The use of smooth bore, copper tube heat exchangers ensures consistent low-pressure dew point performance across the range. Models are also designed with a static condenser for efficient, quiet, trouble-free operation. All units offer easy monitoring with clear, illuminated indicators. At lower flows, the range uses pneumatically operated internal float drains or electronic drain valves to ensure condensate is reliably managed in the units. Higher flow models, between 75 and 500 scfm, use integral demisters/separators that efficiently remove condensate across their full flow range without moisture carry-over. These models also employ innovative stainless steel heat exchangers for optimum heat transfer, efficiency and reliability.

All of the HPR & HPRN Value Series have high energy efficiency and environmentally friendly performance with the use of a CFC-free refrigerant. They offer excellent performance, as well as the availability of optional additional filtration to achieve ISO 8573-1 Class 1 for particulates, pressure, dew point and oil.

For more information, visit www.spx.com.

Ingersoll Rand Introduces UP6S Series Fixed Speed Rotary Screw Compressor

Ingersoll Rand, a global leader in compressed air and gas systems and services, power tools, material handling, and fluid management equipment, recently debuted the new UP6S Series 15-30 hp fixed speed rotary screw compressor. The UP6S Series builds on Ingersoll Rand's commitment to reliability by adding several standard features to the unit, such as Progressive Adaptive Control™ (PAC) protection, O-ring face seals to reduce leak points, and a Totally Enclosed Fan Cooled (TEFC) motor.

The unit's TEFC design reduces the risk of particulates entering the motor, while also keeping it cool, so the compressor can be used in harsh environments. Meanwhile, its NEMA® Type 4 rating allows it to be used indoors or outdoors, and the new Tri-Voltage motor enables it to adapt to a variety of applications. These features make the UP6S ideal for powering pneumatic tools and equipment of many types, from saws and spray painting guns, to hoists and other tools, for use in industries from woodworking, to metalworking and brewing, to automotive repair.

"We at Ingersoll Rand understand the expectation of quality our customers have when purchasing a compressor," said Jason Grizzi, channel marketing leader, Ingersoll Rand Compressed Air Systems and Services in North America. "The new UP6S Series builds on our legacy of dependability with its robust design that offers reliable operation across a number of applications."

The new UP6S Series 15-30 hp fixed speed rotary screw compressor from Ingersoll Rand

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The airend, interconnecting piping and integral separation system are features of the UP6S Series 15-30 hp that increase performance, reliability and ease of service. A high-efficiency compression module and O-ring face seals eliminate leaks and pressure loss. The UP6S Series also features spin-on filtration and separator cartridges to allow for easy maintenance.

The compressor features a new Xe-70M controller that comes standard and makes operating the UP6S easier with simple diagnostics and remote start and stop access capabilities. The intuitive user interface and PAC software adapts and continuously monitors key operations, such as element conditions and system parameters to maintain uptime and increase bearing life.

For more information, visit www.ingersollrand.com.

FilterSense Launches New Particulate Monitoring System

FilterSense recently introduced the PM100 PRO particulate monitoring system, featuring new DynaCHARGE technology that allows for measurement sensitivity as low as 0.1 mg/m^3.

With its advanced digital signal processor and full color display, the PM100 PRO provides a wide range of value-added features, making process control and EPA, MACT and NESHAP compliance seamless.

The new PM 100 PRO particulate monitoring system from FilterSense

In terms of performance, the PM100 PRO comes standard with on-screen trending, a comprehensive alarm management system, and options for an integrated historian and EPA quality assurance checks. With single- and multi-channel configurations, this solution is ideal for detection, monitoring and concentration measurement in the power, bulk solids, cement, metals and chemical industries.

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VPInstruments Updates Energy Monitoring Platform

The newly released VPVision monitoring platform by VPInstruments — also known as the 3.10 release — can help control factory efficiency and energy management by providing an overview of all energy usage patterns through any installation.

VPVision provides advanced, web-based energy monitoring, and can be accessed from any PC, tablet or phone. It is the cornerstone of any energy management environment under ISO 50001 certification.

As with any VPInstruments product, the VPVision platform is continuously being enhanced by the VPInstruments Development department — always building on previous innovations to reach an even higher level. The new release is very easy-to-install. It offers standard support for Modbus RTU, Modbus/TCP, and 4-20 mA based analog sensors; real-time critical performance indicators for efficiency and costs; easy-to-configure alarms for monitoring threshold values; and an automated PDF report generator with built-in email function. New features include:

The VPVision monitoring platform as seen on an iPad

- Virtual channels to calculate difference values, rather than having to invest in additional measurement instruments (as used, for instance, in ring networks)
- An optional SQL connector module, which can be used to interface with operational intelligence software (for example, a collective database for multiple production sites)
- Advanced, pre-configurable data export for large CSV files

Contrary to many other energy management software solutions, VPVision is an "out-of-the-box" solution, and designed for quick implementation. VPVision can be tailored for optimum return on investment, even for smaller facilities. To ensure proper operation through the years, VPVision users are offered to take part in a service program for maintenance and upgrades.

For more information, visit www.vpinstruments.com.

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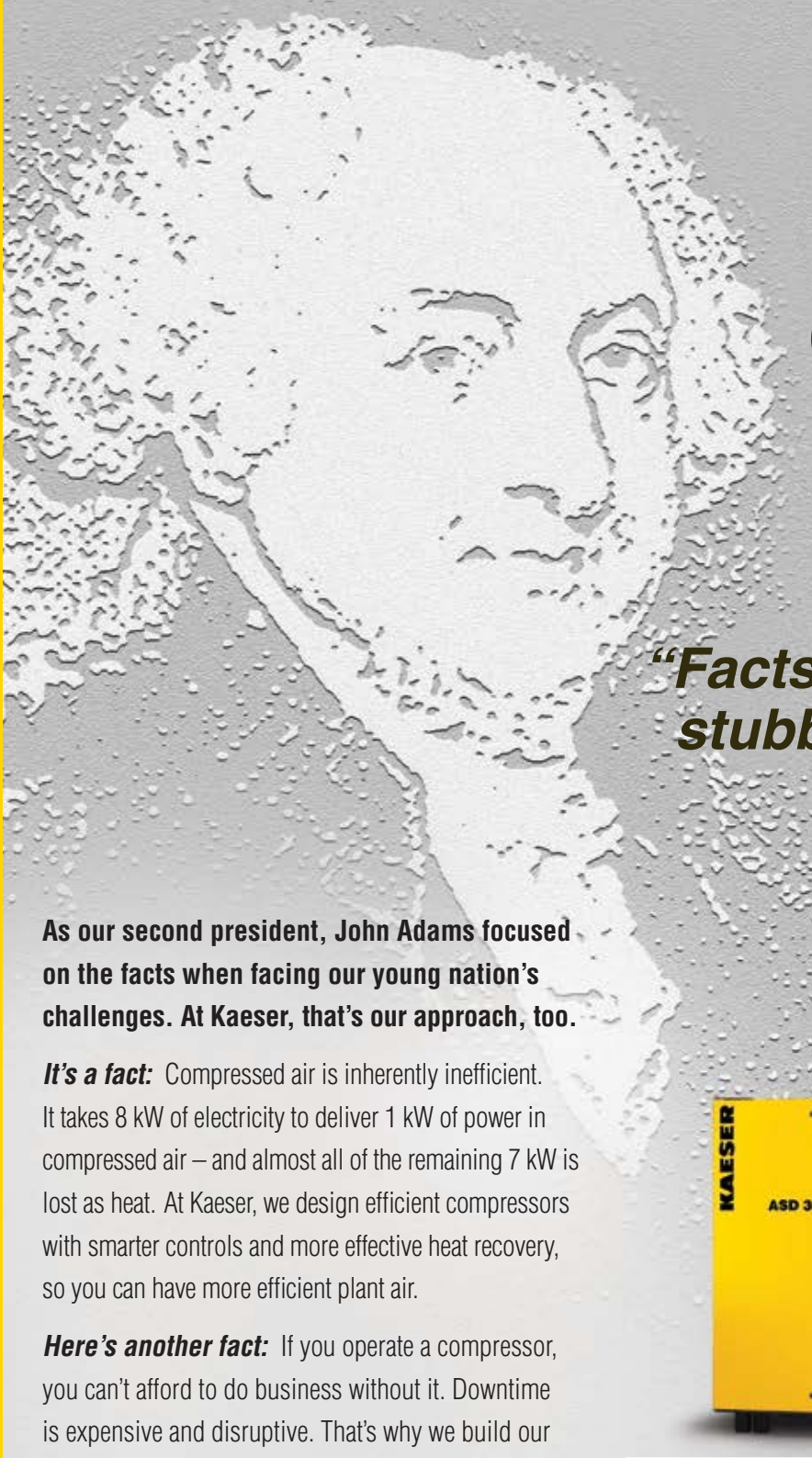

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— John Adams

As our second president, John Adams focused on the facts when facing our young nation's challenges. At Kaeser, that's our approach, too.

It's a fact: Compressed air is inherently inefficient. It takes 8 kW of electricity to deliver 1 kW of power in compressed air – and almost all of the remaining 7 kW is lost as heat. At Kaeser, we design efficient compressors with smarter controls and more effective heat recovery, so you can have more efficient plant air.

Here's another fact: If you operate a compressor, you can't afford to do business without it. Downtime is expensive and disruptive. That's why we build our products for maximum reliability and easy serviceability. So when service is needed, it takes less time.

Learn the facts. They point to Kaeser.

Our 25-125 hp compressors feature **true direct drive** design, a **thermal management** system plus built-in **heat recovery** options for the ultimate in operational efficiency.

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