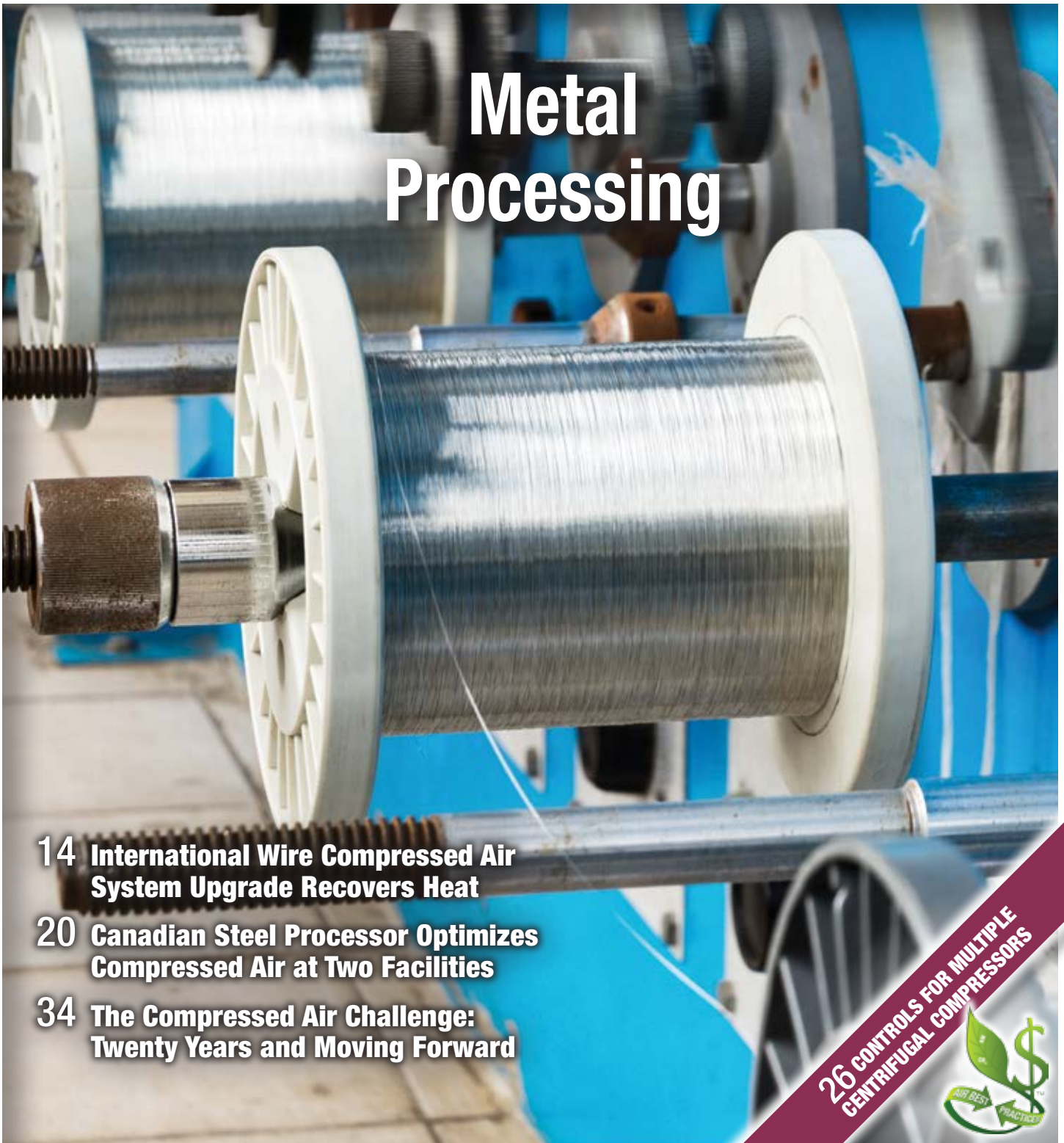
The Magazine for ENERGY EFFICIENCY in Compressed Air Systems

COMPRESSED AIR BEST PRACTICES

airbestpractices.com

October 2017



Metal Processing

SUSTAINABLE MANUFACTURING FEATURES

COLUMNS

FROM THE EDITOR | Metal Processing

International Wire Group, Bare Wire Division is a leading U.S. manufacturer of bare copper and tin-plated copper wire products used to transmit digital, video and audio signals or conduct electricity. Brian Sorbello, from Rogers Machinery, provides us with a heat recovery success story about how this factory used custom designed Kobelco KNW series oil-free screw air compressors, to provide compressed air year-round, and space heating for six months of the year.

A Canadian steel distribution and processing company has upgraded and consolidated the compressed air systems in two of their distribution and processing facilities for big energy savings. Ron Marshall reports the previous compressed air systems were running in modes of operation with very low efficiency. A complete replacement of the two systems with new air compressors and dryers has reduced energy consumption significantly.

Most "sequencers" on the market have been designed to work with positive displacement rotary screw air compressors. Tim Dugan, provides us with an excellent article continuing his series on control strategies for dynamic displacement centrifugal air compressors. In this piece the focus is on strategies for controlling multiple centrifugal air compressors.

The Compressed Air Challenge™ (CAC) is celebrating their 20th Anniversary. Congratulations to all those in our industry who have been part of the CAC's journey training thousands of industry and factory personnel on how to optimize compressed air systems. CAC President Steve Briscoe has provided us with a great article detailing the current strategy moving forward.

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

ROD SMITH, *Editor*
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INDUSTRY NEWS

Sauer Compressors USA Launches Lifetime Warranty Program

Sauer Compressors USA offers the first for its industry, a lifetime warranty on all medium and high-pressure air and gas compressors.

The introduction of the lifetime warranty is another way for Sauer Compressors USA to standby one of their long-held slogans, "High Quality, High Performance, High Pressure." Don Eaton, CEO of Sauer Compressors USA stated, "putting a lifetime warranty behind our compressors will give our customers the ultimate confidence when investing in our products, knowing our solutions will last them a lifetime."

Customers can take advantage of this groundbreaking warranty upon the purchase of a new compressor. The Lifetime Warranty will provide peace of mind to the customer, knowing the compressor purchased will be protected, as long as the proper scheduled maintenance is completed with Genuine Sauer Spare Parts. An option for a Set Budget Maintenance Agreement will be available at the time of purchase, giving customers the benefit of long term budget planning and worry-free maintenance, if desired.

Sauer Compressors USA hopes the new warranty program will enhance the total customer experience by giving a guarantee of reliable operation from their compressor for a lifetime.

About Sauer Compressors USA

Sauer Compressors USA Inc. specializes in the manufacturing of medium and high-pressure air and gas compressors for naval, commercial maritime, offshore, research & development, and demanding industrial applications. In addition to air, Sauer is extremely strong in the CNG, N2, He, and inert gas markets. Sauer USA, located in Stevensville, MD is a subsidiary of J.P. Sauer & Sohn, headquartered in Kiel, Germany. With a reputation for reliability and life cycle product support, Sauer Compressors is the global leader in the medium and high-pressure

compressor markets. For more information please go to www.sauerusa.com/lifetimewarranty or reach out to sales@sauerusa.com.

Motion Industries Acquires Numatic Engineering

Motion Industries, Inc., a wholly owned subsidiary of Genuine Parts Company, officially acquired Numatic Engineering August 1, 2017.

Founded in 1955, Numatic Engineering has over 60 years of experience selling and supporting automation components. Their vast product offering ranges from pneumatic automation to electrical motion controls, PLCs, VFDs, machine vision, sensors and industrial communication. For more than a decade, Numatic Engineering has been selling multiple lines of robotics, including end-of-arm tooling. Numatic Engineering is one of the leading companies in California selling and implementing revolutionary "collaborative robot technology." Their sales and application support teams have the in-depth knowledge to help engineers, from both OEMs and end users, apply the right products to solve customers' challenges. Their value-added solutions team, with UL 508 listing, provides Numatic Engineering the ability to assemble the products they sell into engineered solutions to meet specific customer needs.

Numatic Engineering's reputation is built on superior product knowledge and representing world-class suppliers. Headquartered in Los Angeles, California, Numatic Engineering has a proven and powerful reputation in the California and Nevada markets. The company's success is a testament to their quality people and outstanding culture.

Motion Industries has over 530 locations, including 13 distribution centers throughout North America and serves more than 300,000 customers.

INDUSTRY NEWS

Steve Leach, Numatic Engineering's President, commented about the acquisition, "After meeting with several potential buyers, we found a cultural fit with Motion Industries and are very pleased to become part of their team. Becoming part of Motion assures that our employees will be well-cared for in the future and that we will have the ability to continue to service our customers and represent our supplier partners in the way which they are accustomed. At the same time, we'll now have access to even greater capabilities and resources, enabling us to accelerate the growth of our already successful business."

Tim Breen, President and CEO of Motion Industries, said, "We are very pleased with the addition of this well-established company. The acquisition of Numatic Engineering continues to build upon and complement our growth strategy in the area of industrial plant floor automation. Numatic Engineering will be operated as part of Motion's Automation Solutions group, including Braas Company, acquired in October 2016. We are happy to welcome all Numatic Engineering employees to the Motion family, and we look forward to the contributions they will make to our Company in upcoming years."

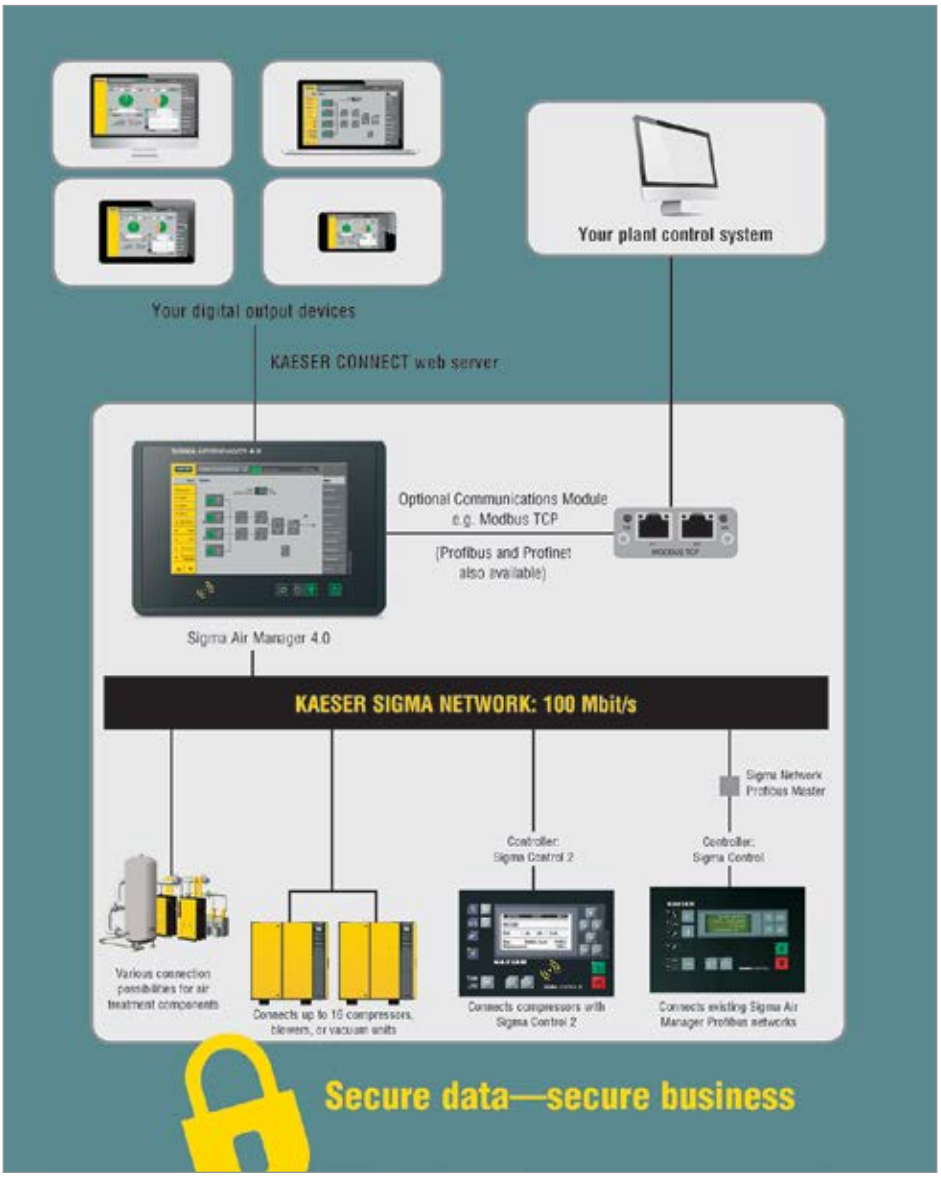
About Motion Industries

With annual sales of $4.6 billion, Motion Industries is a leading industrial parts distributor of bearings, mechanical power transmission, electrical and industrial automation, hydraulic and industrial hose, hydraulic and pneumatic components, industrial products, safety products and material handling. Motion Industries has over 530 locations, including 13 distribution centers throughout North America and serves more than 300,000 customers from the food and beverage, pulp and paper, iron and steel, chemical, mining and aggregate, petrochemical, automotive, wood and lumber and pharmaceutical industries. Motion Industries is a wholly owned subsidiary of Genuine Parts Company (NYSE: GPC). Visit our website at www.MotionIndustries.com. Contact us toll-free at (800) 526-9328.

Join the Kaeser Network

The Ethernet-based Sigma Network developed by Kaeser provides optimized compressed air system monitoring and control. Moreover, it is able to take advantage of the future-oriented benefits Industry 4.0 and the Industrial Internet of Things (IIoT) have to offer.

Industrial applications place special demands on machine-to-machine communications – and this is the basis of Industry 4.0 and the IIoT. The technology must not only be durable and easily manageable onsite, but should also be globally compatible, fast, secure and able to transfer large volumes of data with maximum integrity. In addition, it should ensure the real-time capabilities required



The Sigma Network is a local network within the compressed air system enabling integration of a system's components.

by the process. Kaeser Sigma Network meets all of these needs and more.

Secure Data

Based on secure Ethernet technology, the future-ready Sigma Network is a local network within the compressed air system enabling optimized integration of a system's components. Unlike current field-bus solutions, such as Profibus, CAN, or similar technologies operating at relatively slow speeds (max. 12 Mbit/s), Sigma Network has a transfer speed of 100 Mbit/s. The widely accepted TCP/IP protocol standard – also recognized as the Lingua Franca of the internet – forms the basis for data traffic in the Sigma Network.

The Network uses Kaeser's own MAC addresses and creates a closed and secure network segment in accordance with the recommendations for industrial control systems. A defined transfer node enables secure data exchange with external partners.

Basis for Predictive Maintenance

Sigma Network, working in perfect harmony with the Sigma Air Manager 4.0 master controller, forms an infrastructure making data available for future services, such as predictive maintenance or energy management. This not only reduces costs, but also increases operational reliability and availability. If desired, operational data from the compressed air system can be securely transferred to the Kaeser Data Center via a broadband connection. This allows Kaeser experts to perform remote diagnostics and enables predictive and demand-oriented maintenance. Users therefore benefit from maximum supply dependability, as well as lowest possible life cycle costs. This is because Kaeser's compressed air specialists are able to adjust the energy characteristics of the compressed air station as required so the station performs at its maximum efficiency at all times.

INDUSTRY NEWS

About Kaeser

Kaeser is a leader in reliable, energy efficient compressed air equipment and system design. We offer a complete line of superior quality industrial air compressors as well as dryers, filters, SmartPipe™, master controls, and other system accessories. Kaeser also offers blowers, vacuum pumps, and portable gasoline and diesel screw compressors. Our national service network provides installation, rentals, maintenance, repair, and system audits. Kaeser is an ENERGY STAR Partner.

For more information, visit www.kaesernews.com/network. To be connected with your local authorized Kaeser representative, please call (877) 596-7138

Ohio Transmission Corporation Acquires Tri-Power MPT

The Ohio Transmission Corporation, an industrial equipment distributor and service provider headquartered in Columbus, OH, announced the acquisition of Tri-Power MPT, Inc., a single location headquartered in Akron, OH.

Tri-Power MPT, Inc., distributes automation, electrical, power transmission, motion control and safety products, primarily in the northern Ohio industrial markets. Founded in 1954, the company has received recognition by Industrial Distribution as one of the top 50 small distributors in North America. Tri-Power MPT is one of the principal independent distributors for many of the core product lines it represents.

Tri-Power MPT maintains a diverse customer base in a variety of industries, including food processing, automotive, Amish manufacturing, glass, medical, packaging, plastics, stamping, steel, tire and rubber.

"Like OTC, a key differentiator for Tri-Power is to be considered experts in the products they represent, a responsibility their 14 associates take to heart," said Phil Derrow, president and CEO of the Ohio Transmission Corporation. "Most importantly with all of our acquisitions, we welcome the addition of new associates to our team. OTC is a people-focused business with product and service experts who know how to help customers find the right solutions. Our 14 new associates in Akron are excited to join our fast-growing company and we're excited to work with them."

With this acquisition, Ohio Transmission Corporation now has 29 locations throughout the South, Midwest and Northeast regions, along with 12 service shops. The addition of Tri-Power MPT's 14 associates brings Ohio Transmission Corp.'s total employment to 800 employees.

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— Phil Derrow, president and CEO of the Ohio Transmission Corporation

"Tri-Power is an excellent strategic fit that further enhances our ability to provide value and technical expertise to our customers in northern Ohio," said Matt Piatt, COO and CFO of Ohio Transmission Corporation. "We are pleased to welcome the Tri-Power associates to the OTC family."

"While OTP has offices in northeastern Ohio and Pittsburgh, the addition of Tri-Power MPT provides us with a dedicated team in the Akron market and strengthens our presence in that area," said Rob Webb, president of OTP Industrial Solutions. "Our customers value the expertise of our associates and the professionalism we bring to every relationship. The associates of Tri-Power MPT will be an excellent addition to help us deliver outstanding service and products to northern Ohio."

The acquisition of the assets of Tri-Power MPT will expand OTP's product line offerings. In turn, Tri-Power MPT, as a branch of OTP Industrial Solutions, will have access to OTC's vast product and service offerings and support resources. The acquisition provides significant growth opportunities for Tri-Power MPT's associates and will provide its customers with a more comprehensive set of technical solutions.

"I've known OTC for as long as I've been in this business, and they share our values of commitment to product expertise and integrity in all they do," said Ric Wiley, president of Tri-Power MPT, Inc. "They represent the very best opportunity for growth for the associates of Tri-Power MPT to continue to do what they do best every day."

About Ohio Transmission Corporation

Established in 1963, Ohio Transmission Corporation is one of the largest industrial distributors and service providers in the United States. Its divisions include OTP Industrial Solutions, a provider of expert

INDUSTRY NEWS

solutions for industrial spray finishing, motion control, fluid power, power transmission and pumping systems, and Air Technologies®, a compressed air system equipment and service provider and the largest distributor of Atlas Copco compressed air equipment in North America. Ohio Transmission Corporation maintains locations throughout the Midwest and South. Ohio Transmission Corporation's 800 associates share its founding vision of delivering excellent value through work with integrity. For more information, please visit https://www.otpnet.com.

About Tri-Power MPT, Inc.

Tri-Power MPT, Inc., founded in 1954 and headquartered in Akron, is a leading industrial distributor of sensors, power transmission, motion control, and safety products throughout northern Ohio. Recognized as a Top 50 small distributor by *Industrial Distribution,* Tri-Power MPT, Inc., has committed itself to its role in the supply chain, offering excellent customer service and high quality products from the world's premier manufacturers. For more information, go to www.tri-power.com.

Honeywell UOP Introduces ARMGuard to Optimize Adsorption Cycles

Honeywell introduced its new Connected Plant ARMGuard™ system, a remote monitoring service helping natural gas processors manage the adsorbents used to remove water from natural gas.

Honeywell UOP's ARMGuard system uses existing instrumentation to help customers optimize their adsorption cycles, reduce energy consumption, operate under variable feed conditions and reduce costs due to unscheduled shutdowns.

Natural gas at the wellhead naturally contains water and water vapor. If water is left in the natural gas stream, it will freeze as the gas is being cooled into a liquid, clogging the lines with ice. This water can be removed with adsorbents, trapping the water molecules before the gas is cooled.

Most adsorbent systems are not actively monitored and analyzed for optimal performance, causing these systems to run well below their capability, wasting energy and underutilizing the adsorbent.

"The ARMGuard system monitors the performance of our adsorbents to advise how the dehydration process can be kept running efficiently and reliably," said Ken Stacherski, vice president and general manager of Catalysts, Adsorbents and Specialties at Honeywell UOP. "The more effectively you can manage your adsorption system, the more effectively you can keep the unit on-stream and operating profitability."

Honeywell UOP's ARMGuard system entered service in May with Enterprise Products in Opal, Wyoming, and continuously collects operating data from the adsorbent unit and analyzes it using UOP adsorbent models to determine the effectiveness of the process. The system can detect issues, and with the assistance of UOP's technical team, can be used to improve unit performance and prolong adsorbent life.

"Nothing like this has ever existed before because it's a software-based service dedicated specifically to dehydration, and it compares plant operation to proprietary UOP process models," Stacherski said. "As a result, these models reference the true capability of the adsorbent, not just the past operation of a plant."

In addition, the ARMGuard system can detect process upsets and recommend ideal adsorbent regeneration cycles to increase adsorbent performance and reduce operational costs. It also can forecast optimal adsorbent changeout times to better plan maintenance downtime.

The ARMGuard system can be connected to a customer's corporate data historian, aggregating the operation of several gas plants at once. Once established, the system can help to reduce energy consumption by as much as 20% and increase the useful life of an adsorbent, also by 20%.

About Honeywell UOP

Honeywell UOP (www.uop.com) is a leading international supplier and licensor of process technology, catalysts, adsorbents, equipment and consulting services to the petroleum refining, petrochemical and gas processing industries. Honeywell UOP is part of Honeywell's Performance Materials and Technologies strategic business group, also including Honeywell Process Solutions (www.honeywellprocess.com), a pioneer in automation control, instrumentation and services for the oil and gas, refining, petrochemical, chemical and other industries.

About Honeywell

Honeywell (www.honeywell.com) is a Fortune 100 software-industrial company delivering industry specific solutions including aerospace and automotive products and services; control technologies for buildings, homes, and industry; and performance materials globally. Our technologies help everything from aircraft, cars, homes and buildings, manufacturing plants, supply chains and workers become more connected to make our world smarter, safer and more sustainable. For more news and information on Honeywell, please visit https://www.honeywell.com.

International Wire Compressed Air SYSTEM UPGRADE RECOVERS HEAT

By Brian Sorbello, Kobelco KNW Series Northeast Regional Manager, Rogers Machinery Company

The International Wire Group Bare Wire Division plating facility in Camden, New York.

While late summer may not be the time of year many of us think about heat recovery, the potential for energy savings in compressed air systems should be on our minds year-round. For those involved with the compressed air systems within International Wire Group's facilities, energy savings is on their minds each day. This culture of continuous improvement has everyone on the lookout for savings wherever possible.

International Wire Group, Bare Wire Division is a leading U.S. manufacturer of bare copper and tin-plated copper wire products used to transmit digital, video and audio signals or conduct electricity. They are sold to a diverse customer base of insulated wire manufacturers and various industrial OEM's.

Back in 2011 International Wire Group (IWG) completed a full compressed air piping system

> "By completing the heat recovery portion of their overall compressed air system project, IWG has set a good example for other compressed air users who may have the potential for savings."
>
> — Brian Sorbello, Kobelco KNW Series Northeast Regional Manager, Rogers Machinery Company

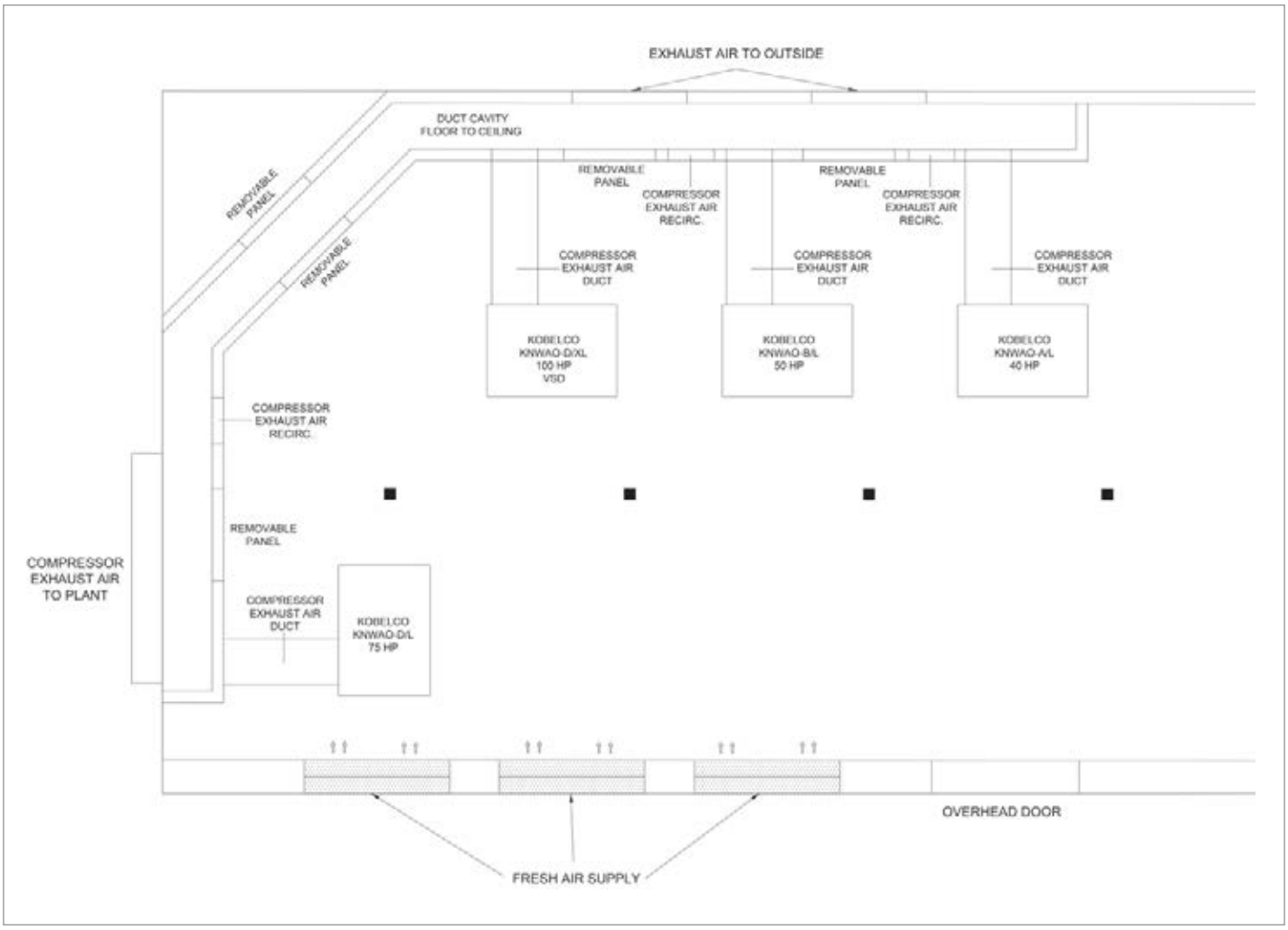
upgrade at its wire plating facility in Camden, New York, optimizing the piping for two different processes at two different pressures. This has allowed them to reduce delivery pressure to the lowest possible levels for the majority of the plant's demand, this being air wipes in between the stages of their plating process. The upgrade has saved them over 400,000 kWh/year yielding cost savings of over $40,000/year. On its own, this piping upgrade and its results are a definite success. Phase 2 of the project later in the year was to replace the aging compressors with new, more energy efficient oil-free compressors. Doing so has provided an additional estimated savings of over 200,000 kWh and $20,000/year. Since the completion of Phase 2, not only have these combined system upgrades saved operating costs, they have provided years of continual uptime for plant operations.

We spoke with John Hoyt, who was a member of IWG's project team for both phases as a mechanical engineer: "To produce electro-plated wire that meets IWG's strict quality standards, it is critical that the compressed air supplied to the platers is free of any contaminants and oil. As a result, the project team chose to use Kobelco's KNW Series of oil-free compressors because of their reputation for reliability and efficiency."

Both phases of the project have produced a more reliable and energy efficient compressed air system for IWG continuing to save them operating costs each year. However, facilitating a piping system optimization/upgrade and replacing equipment, while still keeping a plant operating is no small task. This project was no exception. The project took months and was very involved, but with expert assistance IWG's team worked through it, and the results speak for themselves. Sonny Angell, the plating operation's lead maintenance mechanic, had this to say regarding the system since it was installed: "In my nearly 40 years working as

The custom designed Kobelco KNW series oil-free screw compressors provide compressed air year-round, and space heating for 6 months of the year, at International Wire's plating facility.

INTERNATIONAL WIRE COMPRESSED AIR SYSTEM UPGRADE RECOVERS HEAT



The compressor room layout at IWG's plating facility.

The custom designed rear discharge on each Kobelco KNW series compressors (left) and custom insulated wall plenum (right) directing air into the plant during winter months and to the outdoors during summer months.

a maintenance mechanic, I have had experience with many brands of air compressors. The Kobelco KNW Series compressors are the best I've ever worked with. They are virtually trouble free."

Yet, there's more. IWG has been able to further increase their cost savings each year, while simultaneously reducing their carbon footprint. They made sure not to overlook something relatively simple yielding even more savings with Phase 2 of the project. Historically, the main source of heat at this facility was from a #2 fuel oil-fired boiler. Instead, IWG now utilizes an insulated wall plenum of their own design recovering the waste heat from their air-cooled compressors, saving them an estimated $27,000+/year. This is accomplished by offsetting their space heating costs during the winter months. This estimate is based on the average cost of #2 fuel of $1.94/gallon back when the project first started! The savings each season changes with the fluctuations in fuel costs, and last season IWG's cost was around $2.12/gallon. If fuel prices are close to what they were last year, the offset stands to be nearly $30,000 for this upcoming heating season.

All of the compressors are two-stage, oil-free rotary screw design. The average system demand calls for two fixed speed base load units, a 40 hp (178 cfm) and a 50 hp (228 cfm), to run constantly and the trim compressor, 100 hp (330 cfm) variable speed, adjusts its capacity as needed to meet the demand. Other than scheduled shutdowns, the plant runs three shifts so all three main units essentially run 24/7. A fourth unit serves as standby. Even with the base-load compressors running at reduced pressures, the three main compressors reject a combined total of over 300,000,000 BTU per month via 6,500 cfm cooling fans in each unit. IWG has been able to consistently recover enough heat in the winter months, so

INTERNATIONAL WIRE COMPRESSED AIR SYSTEM UPGRADE RECOVERS HEAT

the compressors are now the primary source of heat for the majority of the facility. While there is still supplemental heat in certain parts of the plant and they also continue to recover heat from their wire drawing emulsion fluid, the aging boiler was able to be removed from service entirely. This freed up floor space for storage and production.

Coming up with the wall plenum was necessary for IWG's project team, given the room's height constraints. It has worked out well since being installed. Built out from the corner of the room, the compressors all feed their discharge air into the plenum. Motorized dampers are used to allow warm air to be delivered to the plant during the winter months and vented to the outdoors during warmer months.

Anticipating the high likelihood of rising costs if they continued to use the oil-fired boiler, they recognized this heat recovery project would have a short payback. Hoyt estimates the total cost for labor and materials to construct the plenum, as well as the cost of the compressor customizations to be approximately $36,000. Translating to a simple payback of around 16 months. "Knowing their compressors would reject a lot of heat, IWG recognized the opportunity to save a significant amount in space heating costs, while also making a positive impact on the environment," says Brian Sorbello, Northeast Regional Sales Manager Kobelco KNW Series Oil-Free Air Compressors for Rogers Machinery Company, Inc., of Portland, Oregon, who was involved with both the upgrade and heat recovery portions of the project. "The plenum installation is unique and the IWG project team did a great job implementing it."

Like many compressed air equipment upgrades, bringing Phase 2 of the project to a successful completion had its challenges. With a height as low as 7 ft. in places, the room was not conducive to standard air-cooled compressors, discharging vertically. The exterior doorway was also too short to easily rig the equipment into the space. In working with its local supplier, D&W Industrial (Auburn, New York) and Rogers Machinery Company, the manufacturer of the compressors, a solution was devised. Hoyt recalls the room dilemma and solution: "The low ceiling height in the compressor room presented a challenge to the installation.

Since the compressors are designed to discharge exhaust air from the top, it would have been impossible to install them in this location without making modifications. After speaking with the engineers at D&W and Rogers Machinery, the most feasible option was to redesign the compressor's exhaust to discharge from the rear. This would enable them to be installed in the desired area, and allow us to effectively recover the (warm) exhaust air to offset our heating costs during the winter months. The staff at D&W and Rogers Machinery were able to provide a design that was suitable for our application." The compressor package design was also customized to allow for partial disassembly/ reassembly for rigging into the room. The cooling fan in each unit is also sized to handle the additional external static pressure from the ductwork and plenum.

By completing the heat recovery portion of their overall compressed air system project, IWG has set a good example for other compressed air users who may have the potential for savings. Even though there were challenges, they adapted to the conditions, worked to overcome those challenges and continue to reap the rewards. Their example is a good reminder if heat can be recovered without causing operational or reliability issues with a compressed air system, it should be investigated further. With summer coming to a close and the heating season nearly upon us, now is the time to do investigative work to find what heat could be recovered, and what savings could be added to your company's bottom line. BP

For more information contact Brian Sorbello, Rogers Machinery Company, email: brian.sorbello@rogers-machinery.com or visit www.knw-series.com

To read more about ***System Assesments,*** please visit https://airbestpractices.com/system-assessments

Canadian Steel Processor Optimizes COMPRESSED AIR AT TWO FACILITIES

By Ron Marshall, Marshall Compressed Air Consulting

➤ A Canadian steel distribution and processing company has upgraded and consolidated the compressed air systems in two of their distribution and processing facilities for big energy savings. The previous compressed air systems were running in modes of operation with very low efficiency. A complete replacement of the two systems with new air compressors and dryers has reduced the energy consumption significantly.

Facility 1 Initial Findings

The company first started out by agreeing to a compressed air audit in one of their facilities, conducted by their local power utility's energy

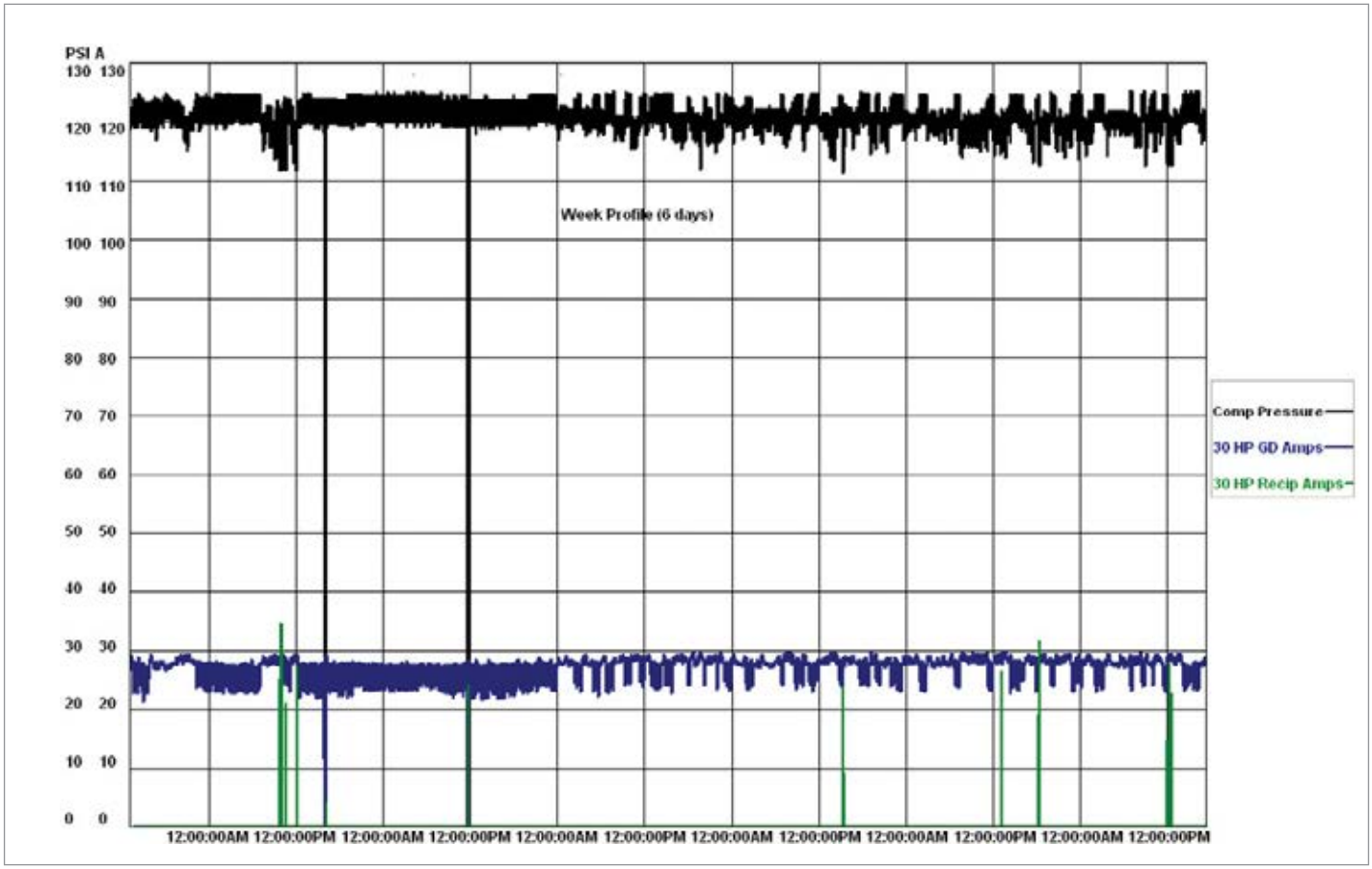


Figure 1: Even though the flow was at low levels the modulating compressor consumed higher than desired power.

efficiency experts. The auditors placed data loggers on the system to monitor pressure and amps, from the readings an annual baseline was calculated. The first plant was serviced by a single 30 hp lubricated screw air compressor and a non-cycling refrigerated compressed air dryer. The data collected showed the air compressor was an older unit operating in modulation mode. This compressor would choke off the inlet air to the screw to control the output flow during part load conditions. The compressor was rated for about 120 cfm output, but the plant production machinery consumed just 30 cfm average flow, about 25% of the full load capability. Because a modulating air compressor of this type only turns down about 1% for every 10% of partial flow, the compressor consumed about

Figure 2: A VSD air compressor, cycling dryer, pressure/flow control valve and storage receivers optimize energy usage.

CANADIAN STEEL PROCESSOR OPTIMIZES COMPRESSED AIR AT TWO FACILITIES

77% of its full load power while producing the very low average flows (Figure 1). In addition to this, the non-cycling refrigerated air dryer consumed about 95% of its full load power, even though it was processing only 15% of its full drying capability. As a result, the compressed air system was found to be consuming power at the rate of 117 kW per 100 cfm. About 22 kW per 100 cfm is optimum for a system this size. A change to the compressor control mode was recommended.

The auditors were able to identify some additional items for improvement. The plant pressure was running higher than required, causing process machines to consume extra compressed air (artificial demand). The system had no storage receivers, and had undersized filters and piping. The compressed air condensate drains were timer style and were blasting at excessive rates. Leakage in the plant was higher than normal because there was no leak detection system and repair at the site.

Facility 1 Improvements

Rather than running an air compressor in modulation, the plant selected an efficient new VSD controlled compressor and installed it with some well-sized storage receivers (Figure 2). Discharge pressure was maintained at a slightly lower average pressure and the plant pressure was reduced to 110 psi using a pressure/flow control valve. The plant selected a thermal mass cycling refrigerated air dryer, reducing its energy in proportion to the moisture loading. Condensate drains were replaced with airless style and piping was upgraded to reduce pressure drop. Leakage was found using an ultrasonic detector and repaired.

Data loggers were again placed on the system after commissioning and showed a substantial power reduction (Figure 3). The previous system was consuming about 278,800 kWh of electricity per annum, the new air compressor and dryer were now only consuming about 63,300 kWh a reduction of 71%. About 42% percent of the purchase and installation cost of the new compressed air system was covered by a power utility incentive. This, and the annual energy savings of over $11,000 per year, made

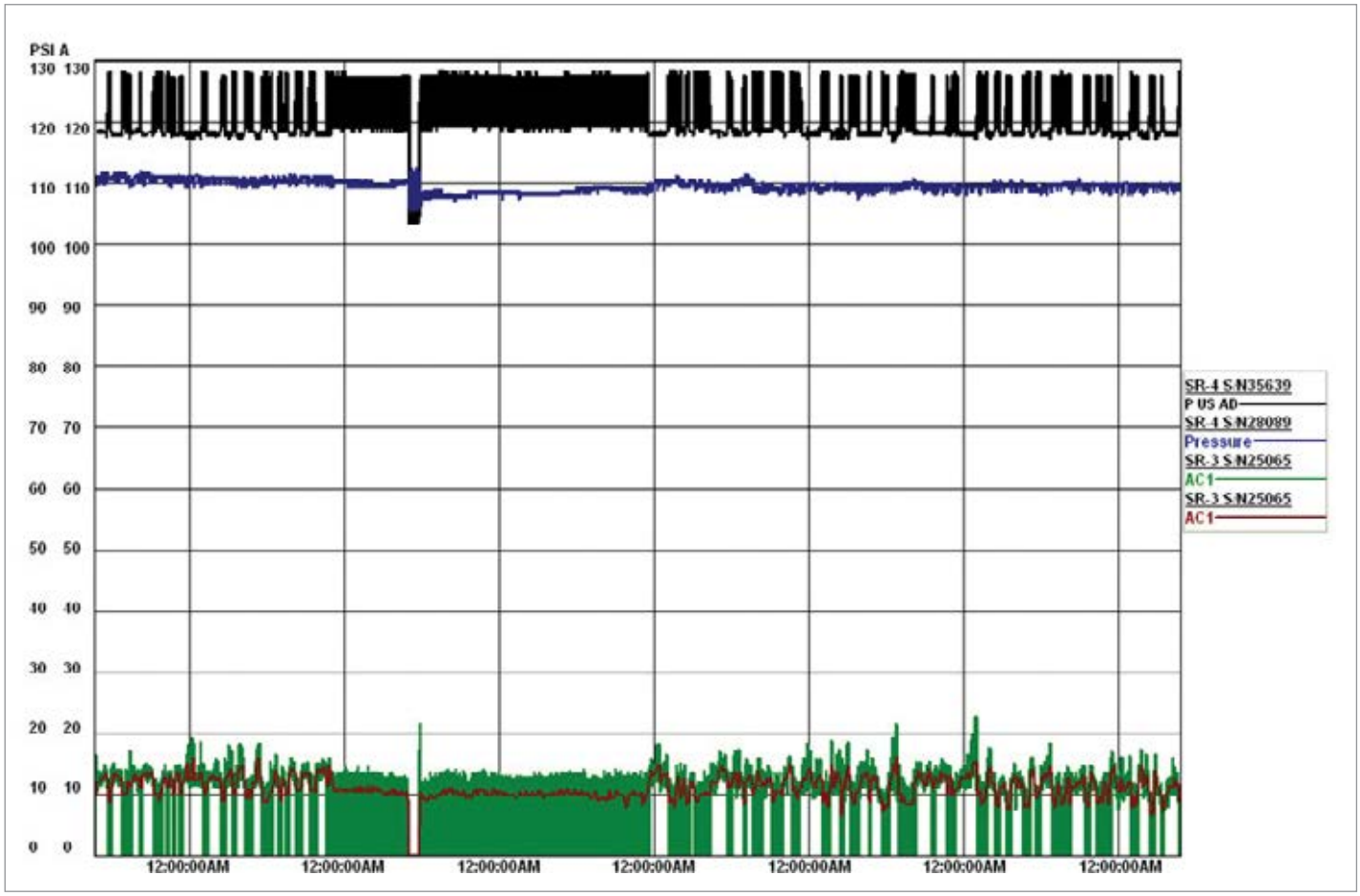


Figure 3: Facility 1 power consumption reduced 71 percent.

the simple project payback slightly more than one year. Since the time of installation, the electrical power prices have increased dramatically, saving even more annual costs over the years.

The plant personnel were pleased with the cost reduction and renewal of the system, but one of the biggest benefits of purchasing the new equipment was the reduction of compressor noise. The plant workers were really impressed with how quiet the new compressor is, something quite bothersome with the old-style unit.

Management at this company were so impressed with the results of the project, they asked for another of their facilities across town be studied in the same way.

Figure 4: Six smaller air compressors totaling 165 hp were replaced with one 75 hp compressor (and a 75 hp backup).

Facility 2 Initial Findings

The second facility had quite different characteristics from the first site. This facility started small with a few production machines, but over time more and more machines were added. Lasers and CNC cutters are used to produce steel products at this site, and the plant management had settled on a strategy of using dedicated compressors for every major piece of cutting equipment. After the various expansions were complete, there were six compressors installed in six separate compressed air systems totaling 165 hp (Figure 4). Some of these systems had multiple desiccant dryers. The compressors in these systems operated in a different mode of operation than the first site, with the compressors running in load/unload mode, a much more efficient way to run screw compressors while partly loaded. Load/unload mode has better power turndown at part loads, with about 7% power reduction for every 10% reduction in flow. However, to get this reduction the compressors must have large storage receiver capacity installed, and

CANADIAN STEEL PROCESSOR OPTIMIZES COMPRESSED AIR AT TWO FACILITIES

to a system specific power of about 64 kW per 100 cfm, much higher than an optimized system. The number of compressors, therefore, was obviously excessive, and as a result the system power consumption was much higher than needed. A significant part of the energy consumption was unloaded power on compressors producing very little air. Each system was running constantly and the compressors were rapid cycling due to inadequate storage receiver capacity and high filter differential. This means the air dryers were consuming large amounts of wasted purge flow.

Facility 2 Improvements

The system data was carefully analyzed, and it was found the six air compressors totaling 165 hp could be replaced by one 75 hp compressor with one of the old 75 hp units used as backup in a single compressed air system. A 75 hp VSD controlled compressor was selected and installed with a large storage receiver, two-inch piping, oversized filters for lower pressure drop, with an externally heated desiccant dryer. The heated dryer consumes only 7% of its rating in purge flow, controlled with a dew point dependent switching algorithm. This reduces purge flow to lower levels if the air dryer moisture load is lower than its rated capability, saving energy (Figure 5). A pressure flow control valve was used to reduce the plant pressure to 100 psi from the previous average pressure of 110 psi to reduce artificial demand. A 10 psi reserve is used in the storage tank to guard against peak demand events.

Verification logging showed the new system consumed only 154,000 kWh of energy per year for a 60% saving in energy cost. About half of the $65,000 purchase and installation cost of the new compressed air system was covered by an energy incentive from the local

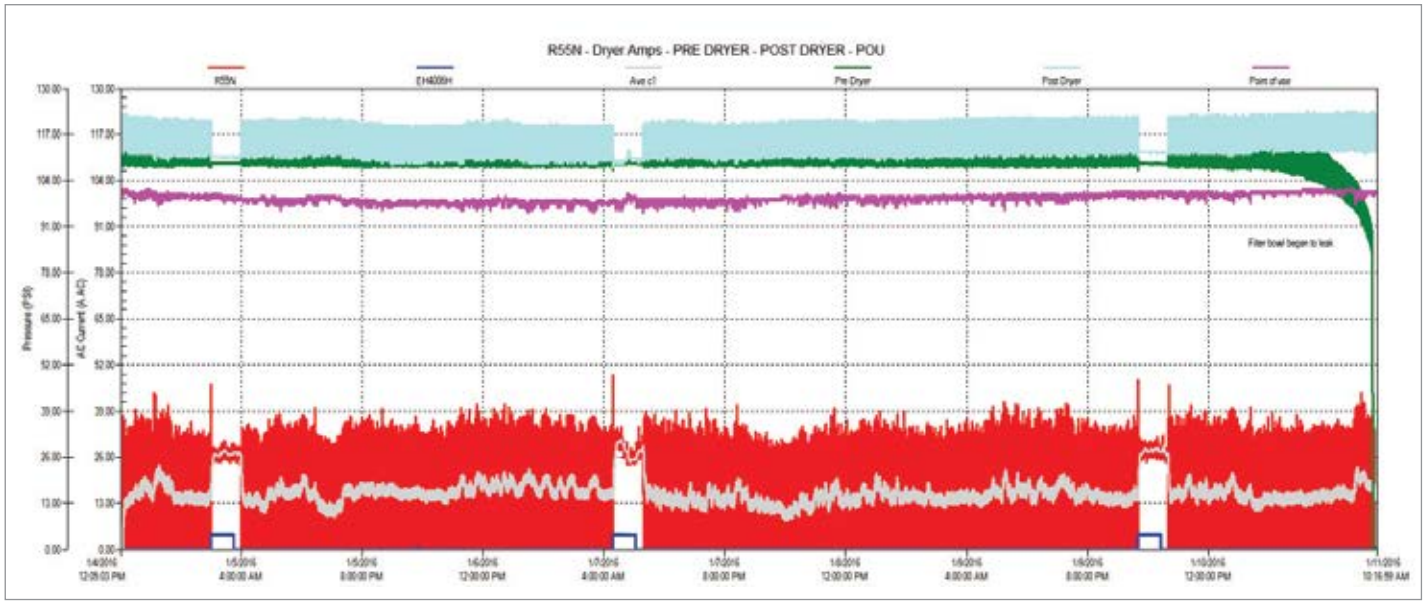


Figure 5: The single VSD compressor consumes much less than the previous compressors. Note how the dryer purges only every 24 hours due to light loading.

"The plant personnel were quite impressed by the significant energy savings, but noted there was also a large reduction in maintenance costs."

— Ron Marshall, Marshall Compressed Air Consulting

power utility. This, and the $18,700 operating costs savings, resulted in a simple project payback of 1.6 years.

The plant personnel were quite impressed by the significant energy savings, but noted there was also a large reduction in maintenance costs. The annual maintenance on the six previous compressors and air dryers was quite high due to the age of the old compressors, and the high number of annual operating hours on so many machines.

Conclusions

The following are some conclusions based on these projects:

1. Data logging compressed air systems can identify significant energy savings.
2. Use of more efficient compressor control modes can save significant energy over both modulation and load/unload control.
3. Significant savings can be gained by choosing more efficient air dryers for both refrigerated and desiccant styles.
4. Pressure reduction, reduction of compressed air condensate drainage and leakage repair can save extra energy over and above simply replacing the compressors.
5. Newer compressors can help to reduce noise pollution.
6. Consolidating multiple systems can help to reduce electrical and maintenance costs. BP

For more information contact Ron Marshall, Marshall Compressed Air Consulting, tel: 204-806-2085, email: ronm@mts.net

To read more about ***Metals Industry System Assessments,*** please visit www.airbestpractices.com/industries/metals

UNDERSTANDING CONTROLS
for Multiple Centrifugal Air Compressor Systems

By Tim Dugan, P.E. President, Compression Engineering Corporation

➤ Introduction

Most "sequencers" on the market have been designed to work with screw (or reciprocating) compressors, "positive-displacement" type. When these controllers are adapted to centrifugal compressors, the net result is not always optimal. The result can be higher energy usage and lower reliability than manual, separate operation.

As described in my last article on centrifugal compressor control, centrifugal compressors are "dynamic," generating flow from rotational momentum and pressure from slowing down the velocity. Their flow depends on inlet density and discharge pressure. In contrast, positive displacement screw compressors intake essentially a constant flow at a given speed or displacement. Inlet flow is not dependent on inlet density and pressure. Delivered flow from a screw compressor can vary with inlet condition and with inlet modulation control. However, this form of control is inefficient and discouraged.

Secondly, centrifugal compressors can't reduce inlet flow below their "surge" point, somewhere between 60% and 80% of full load capacity, depending on the specific aero. Screw compressors can efficiently run from 0% to 100% in a variety of ways (variable speed, variable displacement, load-unload, start-stop or a combination).

Third, centrifugal compressors are generally designed for "proportional," not "discrete" control. Typically, they are not run as load-unload. Their bearings are also not typically designed for frequent on-line/off-line operation. I am aware there are some centrifugals being introduced on the market claiming to be able to operate like a screw compressor, and have reverse thrust bearings. However, for this article will assume conventional centrifugal compressor design with high speed axial bearings.

Finally, part-load performance of some centrifugal compressors is not good sometimes, even without blow-off. The compressor is 10% to 20% off its "best efficiency point" when running inlet modulated. Not bad, but not ideal.

These differences make the control of multiple centrifugal compressors very different than multiple screw compressors.

Actual Project

Fifteen years ago, I performed a Level 1 audit on a compressed air system with four 800 hp Joy TA centrifugal compressors. See Figure 1 for the system, as found in 2002. Three

were running in parallel, with local controls, and one running in a segmented part of the system. Two compressors would be blowing off, one in each subsystem, about 10%, still a high number for a system this large, about $50,000/yr of waste. They were all running through regenerative dryers, some of these were purging type, adding random load to the compressors whenever they started to purge.

In the Level 1 report, I recommended a master control system to optimally run the compressors, as well as dryer upgrades. At that time, I had not yet had experience implementing this type of master control, and might have oversimplified the process for the site.

The next time I was at the site, in 2010, I observed the system after a less than perfect project was implemented. They decided to install individual new control panel upgrades for all four compressors and stage them, (in a "cascade" manner), without a master controller. The new controls faithfully started and loaded/unloaded the last of four compressors. This was mainly due to a false load from dryer purge, and cycled the third one when the dryer stopped purging. The combined compressed air system had more blow-off than in 2002, about $80k/yr of waste. Energy had gone up, not down. See Figure 2 for the flow ranges where blow-off will occur when you cascade-control multiple centrifugal compressors, about 70% of the time. See Figure 3 for the actual power versus time for this specific system.

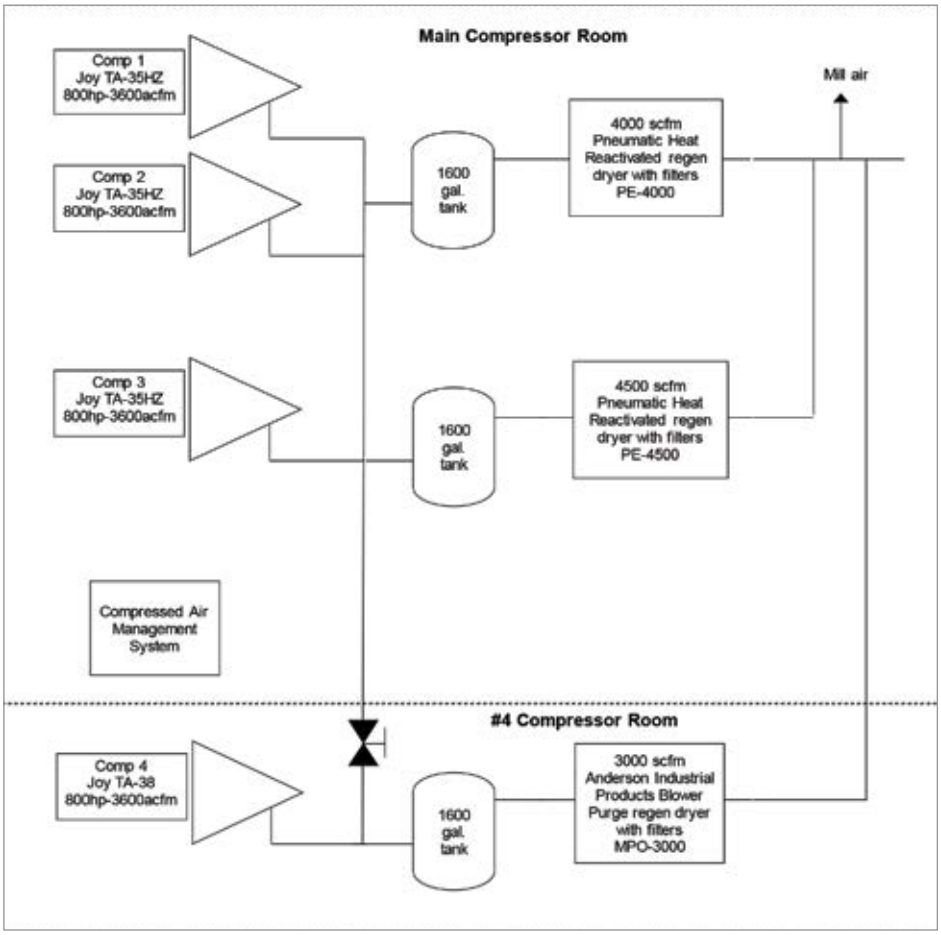


Figure 1. System Layout, Before Improvements

UNDERSTANDING CONTROLS FOR MULTIPLE CENTRIFUGAL AIR COMPRESSOR SYSTEMS

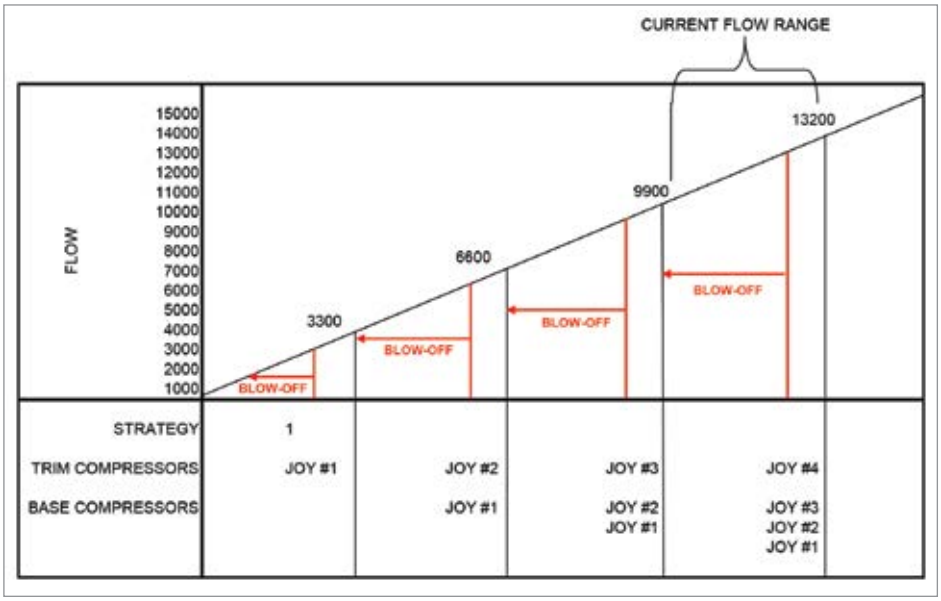


Figure 2. Blow-off in Cascaded Multiple Centrifugal Compressor System

In order to eliminate, or at least minimize blow-off, a different type of master control than cascade control needed to be implemented. Several alternatives were assessed. This article will discuss two, "load-sharing" and "hybrid".

Load Sharing

Picture two draft-horses, both pulling evenly on the same plow, in parallel. To make this happen, they need to be harnessed correctly, pulling evenly and straight. The plow itself tends to adjust to keep the pulling force even between them. It wouldn't stay straight otherwise. Draft horses are more amenable to being "partly loaded" than a centrifugal compressor. If they had a low capacity "surging" problem, it would be as if they could only pull hard or not at all,

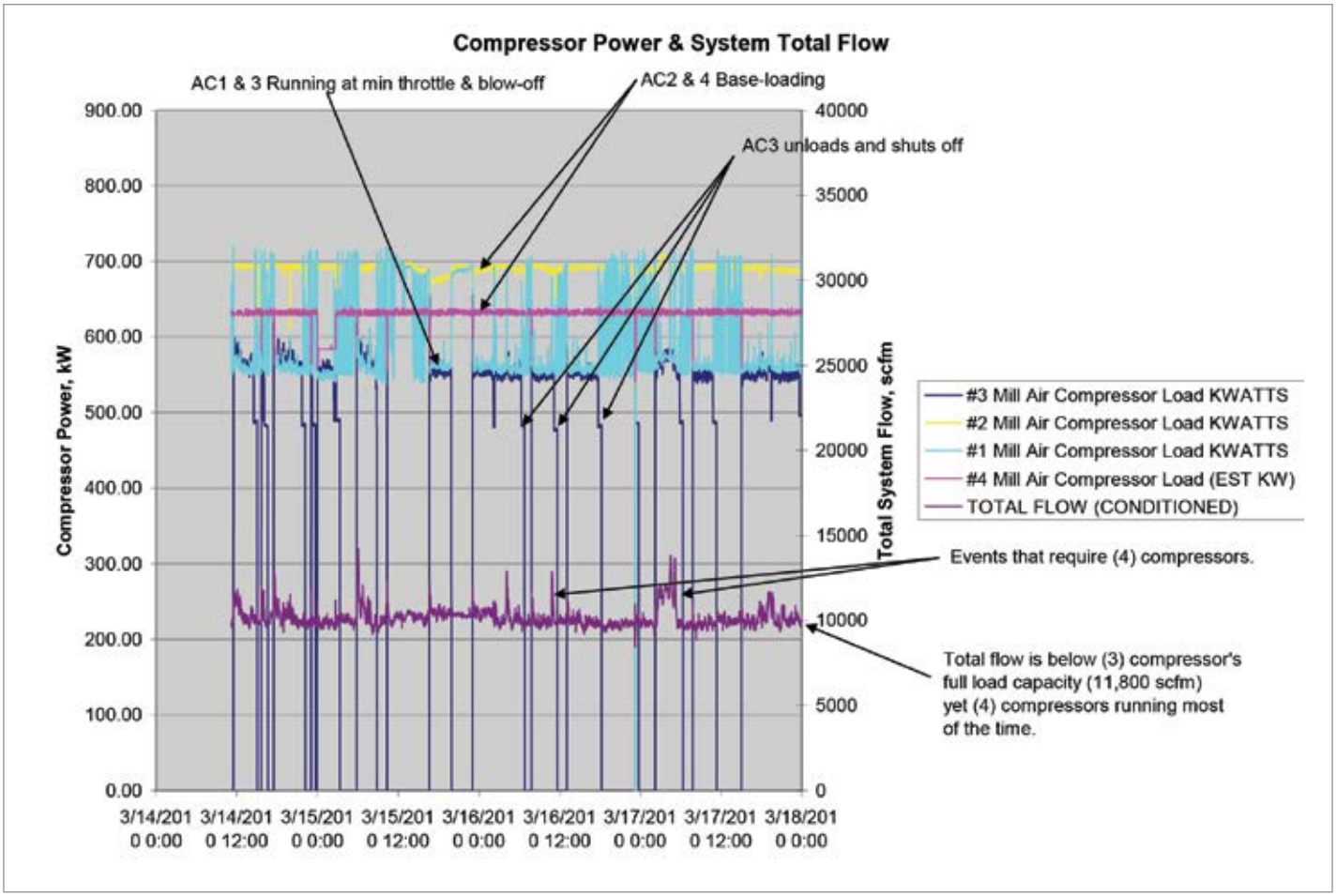


Figure 3. Compressor Operation in Cascade Control

or risk yanking on the collar, then slacking, going back and forth.

The driver has multiple levels of control, including harness adjustment and reins. The harnesses of each horse can be adjusted so the force in the "trace" is likely to be balanced, assuming the horses are pulling equally. The driver then uses the reins to control each horse to pull as evenly as possible, or to intentionally pull asymmetrically to turn the load.

Similarly, two centrifugal compressors running in one system need enough load to be able to share it evenly, and when loaded need a compensating mechanism to share the load evenly. This is made more difficult if the compressors are not side-by-side, like the draft horses. But, it is still practical to do load-sharing.

Load-sharing is essentially done by "bumping" compressor set points, within a pressure range, to get both compressors (or a set of more than 2) to be all operating in the upper range, with none blowing off, if possible. The more compressors there are in the system being load-shared, the more combined "turn-down," and the less likely blow-off is. For instance, for the compressors in the example project, we measured the following performance points:

- Full load, inlet valve 100% open:
  - 3,300 icfm
  - 650 kW
  - Specific performance = 5.08 icfm/kW
- Min load, inlet valve 45% open, BOV starting to open:
  - 2,300 icfm (71% capacity, 29% turn-down)
  - 542 kW
  - Specific performance = 4.24 icfm/kW

With one compressor running, turn-down is only 1,000 icfm. With two, the two compressors combined have a turn-down of 2,000 and so on. So, the more compressors running, the more potential combined turn-down without blow-off. This is, if one could bump set points of all the units so they shared the load evenly.

For instance, if the demand is 11,000 acfm, we would have to run four compressors. The capacity percentage of the set would be 11,000 / (4 x 3,300) = 83%. This is more than 71%, so the set of compressors can theoretically load-share to meet the demand. Total power would be 2,355 kW and 589 kW each, in a perfectly balanced system.

If all were set at the same pressure, say 100 psig, and the piping between them was sufficiently large, they would almost be able to load-share on their own. In real systems, however there are different pressure differentials between each compressor discharge and the common header. This results in uneven sharing. For instance, if one of the compressors in this system had a restrictive piping, requiring 2 psi more to hit the same discharge pressure as the other three, it could swing the compressor more than 30% in capacity. Three of the compressors may be at 90%, while the fourth one is at 60%. The unit at 60% would be in blow-off. If it stayed there too long, local controls might unload the unit, pressure would drop quickly, and it would need to instantly reload, causing instability.

A load-sharing master controller would sense the real-time condition of all compressors' inlet and blow-off valves, and would "bump"

UNDERSTANDING CONTROLS FOR MULTIPLE CENTRIFUGAL AIR COMPRESSOR SYSTEMS

the set point of the compressor in blow-off in small increments to get it out. In this case, it would bump the unit at 60% to 100.25 psig, then 100.5 psig, until the blow-off valve closed and the inlet opened up. As pressure rose slightly, the other units would throttle back at the same time, without a change in set point. The set of four would about settle out with three at 85%, and the fourth at 75% with no blow-off. Performance wouldn't be "perfect," but much better than before. The specific performance is still lower at partly throttled than at full capacity, but better than if blowing off. And the system would be more stable. At lower flows, however, blow-off would be unavoidable. There is not enough turn-down to avoid it at two and three compressors running. See Figure 4.

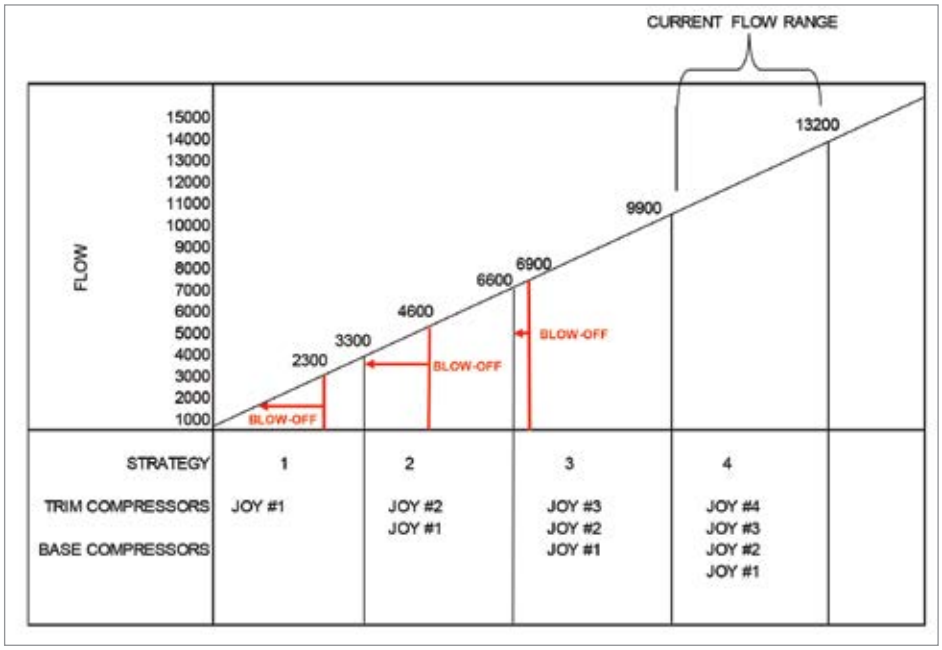


Figure 4. Pure Load-sharing Control Strategies

Load-Sharing With Remote Start-Stop

Some load-sharing algorithms only balance the compressors. They don't turn off a compressor at the point there is sufficient turn-down. This is okay for systems with flat loads. But if demand floats, a master control system able to start and stop, along with load-share, saves more energy.

For instance, at 9,900 acfm, or less, and four compressors running, a load-sharing master controller could direct one of the centrifugal compressors to unload, then stop if the other units were able to fully load and carry the 9900 scfm. There are some controls risk for this transition, but a qualified master control engineer could tune the compressors and master controller to shift smoothly without a pressure dip.

Implementation requires more than just adding a black box. Older compressors might need new inlet and blow-off valve actuators and better surge controls added to enhance the compressors' speed and accuracy for following the load, without surge. We are

UNDERSTANDING CONTROLS FOR MULTIPLE CENTRIFUGAL AIR COMPRESSOR SYSTEMS

aware of several compressor OEMs with load-sharing available, but require the customer's DCS system to direct a compressor to start or stop. Some might be available with start-stop included. Consult your dealer. In any case, it is a team effort. What we strongly recommend is flow metering on each compressor, a qualified centrifugal compressor technician to thoroughly review the compressors, test the surge and integrate the master control system.

Hybrid System

Since performance degrades as the inlet valve closes back, 15% in this example project, one might suggest a hybrid system using a screw compressor for trim with the centrifugal compressors base-loading. This can work if the screw compressor is big enough. In most larger systems, it is not practical to install a screw compressor large enough to do this. It would need to be over 3,300 ifcm, and over 800 hp. A hybrid system using a simpler base plus trim control first, then load-sharing only in the upper range, would be more efficient than pure load-sharing. Depending on load, the system can be at its best efficiency point (full capacity for the centrifugal compressors).

For instance, at 11,000 acfm, you can base-load three centrifugals and trim one 500 hp screw compressor, and result in 10% less

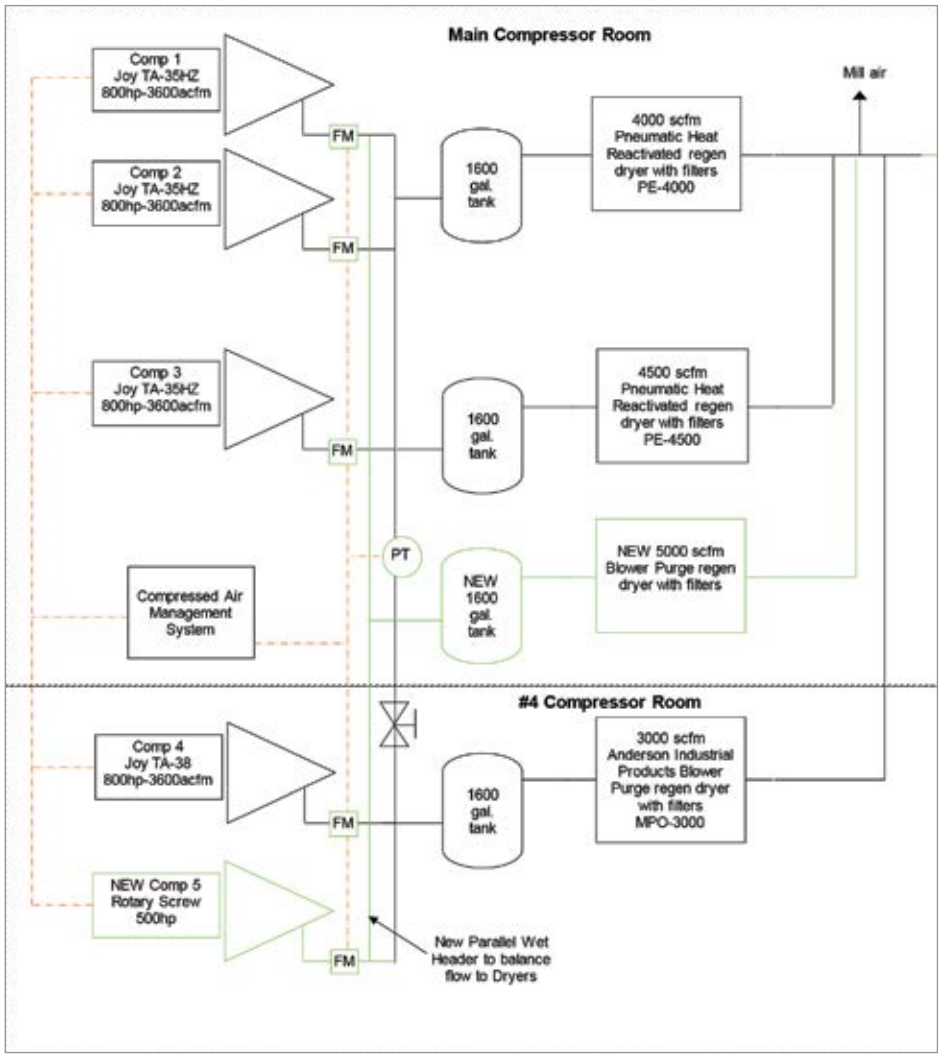


Figure 6. Proposed System Design

energy than the pure load-sharing system. Total power would be only 2,161 kW, this is 194 kW less than pure load-sharing. See Figure 5 for the strategies, assuming a 500 hp, 2,200 icfm load-unload trim compressor.

The Real Project

My customer decided to implement the "hybrid" system. Figure 6 shows the system design. In addition to adding the trim compressor, they improved the compressor discharge header piping and replaced a dryer.

This project cost about $900k. They also got a $392k incentive and saved $92k/yr in energy, so for them, it was worth it. For your system, you might not have the budget to do all the improvements my customer did. Just load-sharing and DCS controls would have saved about half as much, over $45k/yr. The controls part of the project cost less than $100k, including all engineering and installation. After their utility incentives, it would have been less than a one-year payback project.

Conclusions

Load-sharing is an important part of a multiple centrifugal-compressor master control system. It minimizes blow-off based on the available turn-down. In addition, remote start-stop saves more energy if load floats between different ranges. Finally, adding a screw compressor and implementing a hybrid control system might save the most energy and provide the best back-up. In any case, a well-instrumented system allows engineers and operators to assess, optimize and tune the system. BP

For more information, contact Tim Dugan, tel: (503) 520-0700, email: Tim.Dugan@cmop-eng.com, or visit http://compression-engineering.com.

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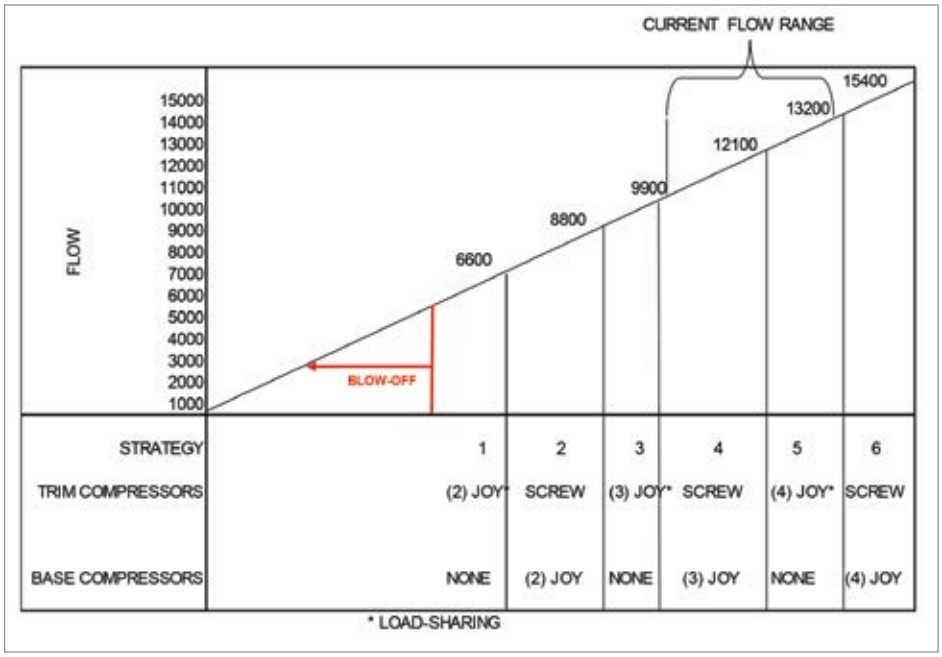

Figure 5. Hybrid Load-sharing / Base-trim Control Strategies

THE COMPRESSED AIR CHALLENGE: TWENTY YEARS AND MOVING FORWARD

By Steve Briscoe, President, Compressed Air Challenge®

TRAINING • EDUCATION • EFFICIENCY
COMPRESSED AIR CHALLENGE

As the current president for the Compressed Air Challenge™ (CAC), it is an honor to write about this organization and how it has progressed, now since we have hit our 20-year milestone. What it means to be involved in the CAC means something different to each person who has contributed. What I will share in this article is from my own experiences and observations over the past 21 years in the compressed air industry, with some help from my fellow board members.

My CAC Beginning

I entered the compressed air industry on Valentine's Day in 1996. At the time, there was not much talk about energy efficiency, at least not from much of the industry. Even today, it is still one of the least focused on areas in manufacturing process systems, considering how inefficient compressor systems are and how much they cost to operate. I had no idea what I was getting into, a compressor is a compressor is a compressor, right? It was not until the year 2000 I attended my first CAC trainings in Chicago, Illinois. Back to back Fundamentals and Advanced classes (more on this later). These classes opened my eyes to the opportunities available for improvement, and a core desire within me grew to help companies improve their systems through being an auditor. These trainings were the first stepping stone to help me work towards becoming a DOE AIRMaster+ Qualified Specialist in 2003.

My direct involvement with the CAC began in summer of 2006. In my new sales manager role at a larger distributor, I was asked if I wanted to participate on the Project Development Committee (PDC) to replace the current Compressor Distributor Association (CDA) representative who was stepping out. I was very intrigued with the opportunity, and jumped at the chance to be a part of the organization. At my first PDC meeting, I was introduced to the people making things happen behind the scenes. It was not what I expected, considering the pre-conception I created for myself of the group. Stuffy government people? I'd say not! These were people just like me. (No offense intended to the stuffy-type government people out there who may read this article). Each had a passion for the industry and drive for the CAC's continuous improvement of what it could offer. I was right at home. I was honored to meet Kevin Keena, representing National Grid

"Compressed Air represents 15-30% of our electric costs, depending on the plant."

— Joe Ghislain, Ford Motor Company, 1998

and president of the CAC at the time. I later found he was on the original board of directors in 1997. At his side was Bill Haman, CAC secretary, as well as PDC members Joe Ghislain, Aimee McKane and Bill Scales also involved in the CAC since the beginning. Almost as good as meeting Jay Leno at the Indy 500 in 1999!

I was active on the PDC, assisting with inspiring new ideas and development of new products for four years until 2010. This is when I was asked to join the Board of Directors as treasurer, because the Board CDA member was stepping out. I happily accepted. In 2012, the role of Kevin Keena's job had changed, and had to step down as the president. Joining me on the Executive Committee was CAGI representative, and prior vice president, Tim Fox as president, Bill Haman as vice president and Ram Kondapi as secretary. Wow what a change! Overnight, the board really became a newly enthusiastic group driving the organization to do more.

In early 2015 Tim Fox, president of the CAC, left the industry, as well as the CAC, and Bill Haman was named our interim president. At the May meeting, I was nominated for President and elected under Joe Ghislain's request to, "Keep the new president under control." It is always great to hear that, it makes me feel I am doing my job, and a very common statement throughout my career, I might add.

CAC: The Beginning

What exactly is the CAC? How did the CAC get started? Let's jump back 20 years. The CAC was founded as a non-profit corporation. It was incorporated in Wisconsin in 1996 by a group of forward-thinking individuals with the desire to educate end users about their compressed air systems in a product neutral fashion. They recognized the opportunity, and decided to create training classes and resources available to the end user directly, with no influence one way or the other to promote a specific manufacturer's product. The goal was to help companies improve their systems themselves, or through their local service providers, by knowing what questions to ask or what to look for. The founding group of sponsors consisted of industrial users, distributors and their associations, utilities, government, energy centers and manufacturer groups. The CAC was officially formed in October of 1997 and kicked off in January, 1998 with the following founding goals:

- Increase the reliability and quality of industrial production processes
- Reduce plant operating costs
- Expand the market for high quality compressed air services
- Save energy – 10% over current, about 2.7 billion kWh nationwide (1998)

Sound familiar? I thought so as well.

There were ten founding sponsors paying a founding sponsor fee of $45,000, and committed to a yearly sponsor fee of $30,000. The money was needed to develop the training packages eventually used to educate end users, compressed air industry workers and auditors on the costs of compressed air and how they are reduced. Three of the founding sponsors are still part of the CAC today.

The Board Was Formed

A Board of Directors was formed, consisting of one representative from each sponsor, ensuring there was not a majority of one specific group. The original board was: Dan Reicher – US DOE, Ken Rollins – CAGI, Chris Beals – Compressor Distributors Association, Marc Hoffman – CEE, Floyd Barwig – Iowa Energy Center, Barbara Caropolo – NYSERDA, Denise Swink – US DOE, Gary Shafer – Honeywell, Mark Hanson – Energy Center of Wisconsin and Kevin Keena – NEES Companies.

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THE COMPRESSED AIR CHALLENGE: TWENTY YEARS AND MOVING FORWARD

Members of the board took on roles in order to coordinate projects with a group of volunteers from within the Projects Development Committee (PDC). This also had one representative from each sponsor. The function of the PDC was to complete the work set by the board within a certain timeframe. The PDC was split into working groups, allowing for focus to complete projects. The PDC also contracted industry professionals to help facilitate more time intensive aspects of projects. Most of the labor was volunteered. We are not talking about individuals with limited experience, I am talking about decades of direct work in the industry.

Government Regulations? No.

There are often misconceptions as to what the CAC does versus some of the more regulating entities out there. Other groups, such as the US Department of Energy (US DOE), and the Compressed Air and Gas Institute (CAGI), are involved in the energy efficiency side of the compressed air industry, but how does the CAC differ, and what is the core function of our organization?

CAC is not playing a part in the energy efficiency standards or regulations being implemented setting a minimum efficiency on compressed air equipment sold. The CAC encourages end user company representatives to become compressed air "champions," by seriously looking at their existing systems to make them more efficient, or when looking at new systems, to design them according to the best practices in the industry. Coming from a distributor myself, the CAC training classes have opened many doors to companies wanting to improve their systems, but never realizing the extent they could impact their bottom line.

CAC Training Workshops

The first training developed by the CAC was Fundamentals of Compressed Air Systems. This is a one day, 8-hour, system overview and awareness class taught by a level 1 CAC trainer. The class covers all the major components associated with compressed air systems including compressors, dryers, filtration, storage, piping and flow controllers. The course explains the different type of compressor controls, and how each can affect the efficiency of the system. The various technologies of drying and filtration equipment are explained, as well as the energy costs associated to the method of drying selected. End users create block diagrams of their systems as well as a list of poor practices to avoid when reviewing their systems back at their facilities. Attendees are also provided with an action plan to improve their current system, including finding a solutions provider who has their best interests. The overall goal of this course is to bring awareness to how much energy is consumed in compressed air systems.

Advanced Management of Compressed Air Systems was the second training course developed by the CAC. It is a two day, 16-hour course taught by one or two instructors, depending on number of attendees. This is a much more detailed training, getting into designing, troubleshooting and calculations used by system specialists in designing large systems, including oil free and centrifugal compressors. The course also looks at what is required for auditing systems and what measurements should be taken, as well as where to take them. The training also includes developing system profiles, and even calculation for storage, to handle intermittent demands, high pressure applications and proper maintenance of the complete system. Air quality requirements, aligning supply with demand and heat recovery options are also reviewed. This is a far more advanced course typically geared to efficiency improvement managers, engineers, industry professionals or those who find compressed air absolutely invigorating to the soul.

AIRMaster+ Specialist is a three-day joint training developed by the CAC and the USDOE to train auditors on proper auditing procedures, best practices and also how to utilize the AIRMaster+ auditing software. The two CAC Classes, Fundamentals and Advanced Management were used by industry people as stepping stones to taking the AIRMaster+ qualification course and exam. It was not a pre-requisite, but was some of the only training capable of preparing you for the course. Today, AIRMaster+ training is still offered once per year through the CAC, as well as through organizations hosting the training.

In 2013, the CAC developed the Fundamentals class to be delivered in a series of Webinars.

"The Challenge (CAC) gives me the ability to help develop a process to reduce compressed air usage and optimize compressed air systems… These savings can be accomplished with little or no major capital investment."

— Henry Kemp, Strategic Air Concepts, 1998

THE COMPRESSED AIR CHALLENGE: TWENTY YEARS AND MOVING FORWARD

This allowed the CAC to reach groups of end users who otherwise may not have had the time or expenses to travel to a location where the course was being offered. This webinar version is held once per year, based on demand and interest.

Instructors for the CAC classes go through a rigorous process with co-teaching, evaluation and approval by a team of evaluators. The material presented is proprietary and must be taught based on the course curriculum, ensuring the same message is delivered uniformly across the globe. Instructors must provide continuous training and contribution to the CAC to keep their credentials.

The Compressed Air Challenge™ also worked with authors Bill Scales and David McCullough, in the creation of the most comprehensive, easily understandable compressed air system reference book the market had seen. Best Practices for Compressed Air Systems was released in 2003, and soon was showing up in every compressed air distributor office. It has also been a part of the take home information from the Fundamentals' classroom.

In 2016, the CAC completed an update to the Fundamentals class to make the training materials current with today's technologies. We are also in the process of updating Advanced Management for the same reason. These modifications are completed by a team of industry professionals who teach and work with compressed air systems on an ongoing basis. The modifications are then reviewed by the training materials advisory board, and approved by the board of directors.

Going Global!

2017 has been an exciting year with some large leaps forward for our group. We have taken on a global stance, working towards providing our training classes outside of the United States and Canada. Last month we released our new website, changed our logo to be more representative of what we are. Thank you to Jeromy Cotten and his group from Tennessee Valley Authority (TVA) for the new marketing designs and new logo!

We have brought on more new sponsors who want to be a part of the development of new training workshops, as well as the building of our social media presence, strategic outreach and more. We also have manufacturers who have joined to support our mission directly, these include Sullair and Airleader.

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The Compressed Air Challenge™ is Training, Education, Efficiency.

Fundamentals of Compressed Air Systems now has SI units for all those outside of North America who do not think in psig and cfm! We know this was long overdue, but it's here!

Our New Mission and Vision Statements

The Project Development Committee was restructured into Advisory Committees keeping focus on a smaller set of goals or projects. This has led to projects moving forward in weeks rather than months. We have a lot to do and not a lot of time to complete it.

Mission:

Promote energy and operational efficiency in compressed air systems for industry through information and training, leading end users to adopt efficient practices and technologies, while leveraging collaborative cooperation among key stakeholders.

Vision:

Be the global leader in developing and disseminating innovative product-neutral information and educational materials to help industries generate and use compressed air at maximum sustainable efficiency.

The Advisory Committees meet every month on conference calls. The Executive Committee also meets monthly via phone. Twice a year, the Board, and Chairs of the Advisory Committees meet in person in Chicago for a day and a half to bring our efforts for the past six months together. They review the work being performed, as well as new ideas, prioritize and eventually vote on final products.

This year, the CAC participated in our first outreach conference. Three CAC Board Members attended the AICD Conference in Reno, Nevada in May. Dan Ryan, Jan Hoetzel and I attended to both present the CAC to the distributor network members, as well as run a trade show booth. It was a great experience. Thank you, Phil Kruger, and the board of directors for having us!

The Future of the CAC: Looking Forward

What is in store for the future of the CAC, you ask? What else is there for us to accomplish? The world is very small when it comes to technology and business. Our goal is to make our knowledge global, in order to give all people the opportunity to learn from our efforts. With more sponsors, we gain more experience and talent. Ideas start to flourish and we will reach more corners of the globe. With the ISO 50001

THE COMPRESSED AIR CHALLENGE: TWENTY YEARS AND MOVING FORWARD

Energy Efficiency Standard well on its way, reducing energy consumption from compressed air systems will reduce our global carbon footprint dramatically. This will be key to ensure a future for us and our children on this planet.

The CAC's training Fundamentals and Advanced Management of Compressed Air Systems training classes, as well as the *Best Practices for Compressed Air Systems Manual* were used as part of the body of knowledge for the compressed Air System Specialist ANSI Accredited Certification coming soon! Soon afterwards, the ANSI Accredited Compressed Air Auditor Certification will be available, and the CAC's goal is to provide a focused training program to match this certification.

There is also a new one-day training workshop being developed for release in 2018 to train end users on how to prepare energy efficiency projects and sell them to management. More details to come!

We are all looking forward to 2017 being a great year for the CAC. With the new focused Advisory Committees, we are aiming to have a new course for end users complete for the first quarter of 2018. Going global means being able to provide training materials in SI units, and building a new instructor base in all areas of the globe continuing to teach to our standards.

I would also like to take this time to encourage additional large end users of compressed air, manufacturers, consulting groups and utilities to join our growing group of sponsors. The more sponsors we have, the more projects we can take on and really make a difference. Please contact me if you have interest or have any questions.

Special Thanks

In conclusion, I want to thank the Compressed Air Challenge™ for the privilege to serve as your president, and for the opportunity to write this article highlighting the successes of our group. I want to put in a thank you to the Executive Committee, Ram Kondapi (vice president), Dan Ryan (treasurer), Joe Ghislain (former chair of the PDC, chair for multiple Advisory Committees) and especially our executive director, Tracey Kohler, who brings it all together.

Steve Briscoe, Dan Ryan and Jan Hoetzel presenting at the 2017 AICD Conference.

"We are all joined by the convergence of our interests around the Challenge's Core objective – To help industry use compressed air more efficiently."

— Marc Hoffman, Consortium for Energy Efficiency, 1998

Thank you to our current Board of Directors and sponsors who make us what we are today:

- Independent Compressor Partners, Inc., Steve Briscoe (president)
- National Grid, Ram Kondapi (vice president)
- Compressed Air & Gas Institute, Dan Ryan (treasurer)
- Airleader, Jan Hoetzel
- Efficiency Vermont, Matt Dooley
- End-user Representative, Joe Ghislain
- Sullair, LLC, Brian Tylisz
- Tennessee Valley Authority, Jeromy Cotten
- Manitoba Hydro, Myles Boonstra
- U.S. Department of Energy, John Smegal
- Northwest Energy Efficiency Alliance, Geoff Wickes
- Pacific Gas & Electric, Carolyn Weiner
- U.S. Department of Energy, Sandy Glatt
- NYSERDA, Wendy MacPherson
- CLEAResult, Sean Williams
- Tracey Kohler (CAC executive director)

Also in closing I would like to reach out and thank Bill Haman on behalf of our entire group, as well as from all the end users finding benefit in the training we have provided, for your 20 years of dedication in making the CAC what it is today. You will be missed and we all wish you the best of luck in the future. I would also like to thank Aimee McKane and Bill Scales, who have been key players in everything the PDC and CAC has accomplished in the 20 years of their involvement. Best of luck to you both as well from all of us, and we will keep your seat warm for when you can return. BP

About the Author

Steve Briscoe has been in the compressed air field for 21 years and is the Vice-President of Business Development for IAC Air Compression and Power Systems based in Indiana, Ohio and Kentucky. He currently serves as President of Compressed Air Challenge™. Steve has been in the design and improvement of compressed air systems for facilities across the U.S. for the past 17 years, and is a Qualified US Department of Energy AIRMaster+ Specialist. Steve also leads a team in IAC's Energy Management Group providing complete system product neutral evaluations of compressed air and vacuum systems in facilities nationwide to help develop more energy efficient solutions.

For more information contact Steve at 317-402-1261, sbriscoe@iacserv.com or visit www.compressedairchallenge.org

To read more about ***Incentive Program Profiles,*** please visit https://airbestpractices.com/energy-incentives/incentive-program-profiles.

RESOURCES FOR ENERGY ENGINEERS

TECHNOLOGY PICKS

Atlas Copco Introduces CD Heatless Desiccant Dryers

Atlas Copco is introducing the CD+ 25-260 and the CD 25-260, two new dryer ranges designed for flexible compressed air solutions. The heatless desiccant dryers increase efficiency and reliable operation, even in harsh conditions.

The CD+ 25-260 and CD 25-260 are available in inlet capacities from 50 cfm to 550 cfm.

The CD+ delivers the highest efficiency for applications requiring a constant supply of dry compressed air. It offers minimal purge loss and pressure drop at a constant pressure dew point of -40˚F or as low as -100˚F with standard configurations. The CD 25-260 provides a constant pressure dew point of -40˚F.

The new CD+ and CD are available in inlet capacities from 50 cfm to 550 cfm so customers can select an option meeting their specific needs. While most dryers only work at 70% to 80% of their capacity, the CD+ and CD are designed to reliably perform at 100% airflow.

The CD+ and CD come with a revolutionary type of manifold. Its electronically operated 3/2 valve ensures dependable tower switching, even during changing flow conditions. With large flow paths, the units offer a very low-pressure drop – below 2.9 psi for most models. Its novel strainer with "swirl" technology distributes optimal airflow from the manifold and decreases uneven wear of the desiccant.

A state-of-the-art digital control system is included with optional Pressure Dew Point Control (PDP Control), able to synchronize the dryer and air compressor. With PDP Control, a dew point sensor can delay switching towers until necessary, generating energy savings up to 90%.

Built for ease of use and flexibility, the CD+ and CD are suited for applications with a high inlet air temperature and outdoor weather-protected installations. They come with desiccant bags allowing for quick replacement and outside service panels for easy maintenance. The CD+ and CD also include optional nozzles for optimizing the regeneration pressure to a customer's process.

The CD+ 25-260 and the CD 25-260 are available worldwide and will replace the CD+ 25-145, CD 32-190.

For more information, visit https://www.atlascopco.com/en-us/compressors/products/air-dryers/desiccant-air-dryers/BD-plus-CD-plus-XD-plus

Gardner Denver Introduces T02 Hydrovane Rotary Vane Compressor

Gardner Denver Transport is concentrating on innovative solutions for equipping local transport and commercial vehicles with auxiliary units. Overall, electric drives must be designed to be as effective as possible for use in (partially) electrified drive systems. Here, the compressed air supply for door openers on city buses is just as much a focal point as the use of electrically-driven power steering pumps, for example. The efficiency of the entire system thereby depends on the interaction between the on-board technology and on-board electronics. Undesired effects during later use, caused by inadequate interface of the subsystems, must be prevented.

This is where Gardner Denver excels, with its core product, the new Hydrovane T02 transit module for compressed air generation. This rotary vane compressor module was specially developed to provide maximum space savings and weight reduction, along with the lowest noise possible while ensuring maximum energy efficiency.

The technical data is groundbreaking, the Hydrovane T02 has a direct drive by means of a 400V AC IEC E-motor in a speed range of 800 to 3000 rpm. With a maximum pressure

The Hydrovane T02 rotary compressor, an extremely compact, water-cooled version with integrated, frequency-controlled controller.

TECHNOLOGY PICKS

rating of 13Bar, an air volume flow of 6.7l/min is possible, and the power consumption is 1.1. to 4.0 kW. In comparison to the previous compressor stages, this new development achieves double the volume flow and a 30% higher pressure level.

For use in the demanding environment where local buses operate, rotary vane compression has proved to be an ideal principle for compressed air generation. Rotary vane compressors surpass piston compressors with their quiet vibration and pulsation free operation, compact design and low maintenance requirements.

Not only are many of the compressors on the market today still too loud and/or heavy, they also require extensive cooling equipment. This means additional costs during installation and during vehicle operation. But there is another way, as demonstrated by the extremely lightweight, around 50% lighter than conventional DC units, compact Hydrovane T02 unit with integrated air dryer, AC electric motor and inverter technology. Thanks to water cooling, the unit can also be mounted in poorly ventilated, confined installation spaces in the vehicle. The inverter works with the Hydrovane Compressor Smart Protocol, and precisely adjusts the rotary speed of the compressor to suit the compressed air requirement of the vehicle.

The T02 unit can be configured to suit customer requirements. For example, an air-cooled unit can also be configured with the same core components. This flexible, modular construction can be used in a huge range of vehicle types with different drive concepts, and the easy integration of e-motors with even greater energy efficiency makes this compressor unit "future-proof."

The Hydrovane T02 unit has a proven track record in the diesel-electric hybrid bus market. Three years of series production manufacturing has seen the product running in London, Paris and Berlin with a number of other OEMs interested in using the product on their vehicles. Gardner Denver also plays an active role in the EU Commission sponsored "Ecochamps" Project, aimed at creating an efficient, compact, low weight, robust and cost-effective hybrid powertrain for both commercial vehicles and passenger cars. The T02 unit is an integral part of the new hybrid vehicle configuration.

About Gardner Denver

Gardner Denver (NYSE: GDI) is a leading global provider of mission-critical flow control and compression equipment and associated aftermarket parts, consumables and services, selling across multiple attractive end-markets within the industrial, energy and medical industries. Its broad and complete range of compressor, pump, vacuum and blower products and services, along with its application expertise and over 155 years of engineering heritage, allows Gardner Denver to provide differentiated product and service offerings for its customers' specific uses. Gardner Denver supports its customers through its global geographic footprint of 37 key manufacturing facilities, more than 30 complementary service and repair centers across six continents, and approximately 6,100 employees world-wide. For more news and information on Gardner Denver, please visit www.gardnerdenver.com/industrials.

Kaeser Launches VFD Oil-Free Screw Air Compressors

Kaeser Compressors now offers oil-free rotary screw air compressors with Sigma Frequency Control (SFC). These new VFD models meet varying flow demands while delivering oil-free air.

The CSG-2 SFC, DSG-2 SFC and FSG-2 SFC models feature the latest in Siemens drive technology to deliver superior part load efficiency and steady pressure in applications with varying air demands.

Kaeser's variable speed, oil-free air compressors are available from 75 to 450 hp and cover flows from 125 to 1,788 cfm at 125 psig. They offer large flow control ranges and are up to 9% more efficient than the competition.

Kaeser's variable speed, oil-free air compressors are available from 75 to 450 hp and cover flows from 125 to 1,788 cfm at 125 psig.

RESOURCES FOR ENERGY ENGINEERS

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The core of these SFC model's top performance is their premium, two-stage air compressor airend. The rotors' special coating can handle temperatures up to 575˚F. This highly abrasion-proof coating will not wear, providing reliable sealing and protection. This means compressed air delivery and energy consumption remain consistent, even after years of operation. Stainless steel rotors in the second compression stage help guarantee compressed air quality and significantly increase service life.

Units come standard with Sigma Control 2™. This intelligent controller offers unsurpassed air compressor control and monitoring with enhanced communications capabilities for seamless integration into plant control/monitoring systems and the Industrial Internet of Things (IIoT).

Additional features include IE3 premium efficiency motors with PT 100 sensors to measure and monitor winding temperatures for maximized motor switching frequency and minimized idling. The hydraulic inlet valve eliminates replacing pneumatic diaphragms, resulting in reduced service costs and downtime. Fiber-free pulsation dampeners keep pressure losses to an absolute minimum, maintain consistent air quality, and prevent compressed air contamination. Built-in heat recovery options give sustainable energy savings and contribute to lowering a plant's carbon footprint.

About Kaeser

Kaeser is a leader in reliable, energy efficient compressed air equipment and system design. We offer a complete line of superior quality industrial air compressors as well as dryers, filters, SmartPipe™, master controls and other system accessories. Kaeser also offers blowers, vacuum pumps and portable gasoline and diesel screw air compressors. Our national service network provides installation, rentals, maintenance, repair and system audits. Kaeser is an ENERGY STAR Partner.

For more information, visit www.kaesernews.com/oil-free_SFC. For more information or to be connected with your local authorized Kaeser representative, please call (877) 586-2691.

New Pressure and Vacuum Gauges from Festo

The vibrant and adjustable red/green zone dial face on the new pressure and vacuum gauges from Festo provide an exceptional visual cue when a pressure or vacuum system is out of green-zone operation. Red/green zone dial-face adjustability allows a unified visual warning system to be applied across a broad range of processes for more uniform and quicker recognition of issues. Festo designed these new gauges to be the most visible and easily understood on the market today.

How the Gauges Work

Red indicator bands on the high and low end of the green zone are easily adjusted to delineate the upper and lower boundaries of safe operation for each pressure or vacuum system the gauge is applied to. The visually impactful red band, covering the entire out-of-specification zone on the dial face, makes

The pressure gauges are available in a variety of pressure ranges, with a maximum pressure of 150 psi (10 bar).

TECHNOLOGY PICKS

deviations from acceptable conditions easy to see. This type of simple to understand monitoring/warning system is ideal for all personnel, including those new to the plant.

Gauges feature dual displays: Psi/bar for pressure, bar/InHg for vacuum. Various pressure range gauges are available with the maximum pressure of 150 psi (10 bar). The maximum for vacuum is -1 bar (30 InHg). Apply these red/green-zone pressure and vacuum gauges to inert gases. Operating temperatures range between -40°F (-40°C) to 140°F (60°C). Gauges can be ordered with either NPT or BSPT pneumatic connections and with back or bottom mounting position.

For more information on these new Festo pressure and vacuum gauges, call 800-993-3786 or visit www.festo.us for the full scope of Festo automation solutions.

Extech Launches SDL700 Datalogging Pressure Meter

Extech Instruments announced the launch of the SDL700 Pressure Meter and Datalogger. The versatile new handheld meter is designed to measure and monitor pressure conditions in HVAC systems as well as in process control and air compressor control systems in industrial settings. The new meter offers users a rugged design with flexible programming configurations and the convenience of datalogging readings in Excel format directly onto an SD card.

Whether diagnosing and repairing pressure-related problems or performing periodic predictive maintenance to ensure safety, accuracy and reliability, the new Extech pressure meter delivers with unrivaled flexibility to tackle every job. The SDL700 operates in three ranges: 30, 150, and 300 psi using corresponding transducers (available separately), making it easy to use across a range of systems. Plus, the pressure meter expands its measuring capabilities with a wide range of then measurement units including bar, psi, kg/cm², mmHg, inHg, mH_2O, inH_2O, atm, hPA, and kPA.

As part of Extech's SDL datalogging instruments family, the SDL700 records directly to a Microsoft Excel® file, eliminating error-prone file conversions or imports, and making it easy to perform data analysis or prepare reports at a later time or at another location. The large backlit display indicates real-time measurements while data can also be saved to a 4 GB SD card (included) for easy transfer to a computer. Sampling rates can be set from once every second to nearly once every nine hours. Up to 20 million readings can be stored on one SD card. Up to 99 readings can also be recorded manually in onboard memory. A built-in tilt stand and tripod mounting point make it easy to set up the meter exactly where you need it. The TR100 mini tripod is available separately.

Data functions include Min/Max, Zero (for offsetting the meter for relative measurements), and Data Hold. The configurable Auto-Power-Off can be set to save batteries or disabled for extended monitoring.

The meter offers added peace of mind with a three-year warranty from Extech and comes with six AA batteries, 4 GB SD card and a hard carrying case. Learn more by visiting http://www.extech.com/sdl700.

Accessories include: 30 psi Pressure Transducer (PT30); 150 psi Pressure Transducer (PT150); 300 psi Pressure Transducer (PT300); TR100 Mini Tripod and a Universal Power Adaptor (UA100-240) for extended datalogging.

How to Order: Extech's SDL700 is available now from Extech distributors around the world. To find a distributor in your area, please visit our website. US: http://www.extech.com/display/?id=15032386024 International: http://www.extech.com/display/?id=17571

About Extech Instruments

Extech Instruments, a division of FLIR Systems, Inc.'s Instruments segment, is recognized as a leader in handheld test and measurement tools worldwide. Founded in 1971, Extech is known for its depth and breadth of innovative testers and meters suited for electrical, HVAC, building/restoration, as well as a host of environmental testers for measurement of sound, light, humidity and other factors. All Extech meters are distributed worldwide through leading representatives, distributors and OEMs. The company is headquartered in Nashua, NH USA and is ISO 9001 2008 certified.

CS-Instruments Announces Flow Sensors with Modbus TCP Ethernet

CS-Instruments GmbH, with a North American Office in Grand Rapids, Michigan, is a leading German manufacturer of high precision compressed air sensors and monitoring solutions. The company has announced the arrival of Flow Meters with Ethernet (Modbus TCP) connectivity.

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The Ethernet connection is linked via the M12 connector and can be connected as Ethernet with a power source of 18-36 VDC as well as PoE.

The Ethernet connection is linked via the M12 connector and can be connected as Ethernet with a power source of 18-36 VDC as well as PoE (Power over Ethernet). PoE is based on IEEE 802.3af, PD Class 2 (6.5 Watt), Voltage 36-57 DC.

The new option allows easy and cost-effective installation of flow meters throughout your entire facility without the need to install additional cables.

The VA 500 Series flow sensors are applicable to measure compressed air or any other gases like N_2, O_2, H_2, CH_4, He and Ar. The VA 550/570 flow sensors are usable for heavy-duty applications, outdoor installation and ATEX areas.

Besides Ethernet (Modbus TCP), CS-Instruments also provides RS485 (Modbus RTU) and the Standard 4-20mA signal.

For more information contact CS Instruments via email at: sales@cs-instruments.us, tel: 616-828-1024 or visit www.cs-instruments.us.

Spartan Scientific Announces CRDV/S Wi-Fi Drain Valve Technology

Spartan Scientific is introducing its new condensate removal drain valve technology with Wi-Fi capabilities, saving time and money with preventative maintenance. The CRDV/S and CRDV/S Wi-Fi Series keeps pneumatic systems, air compressor tanks and air lines free of moisture. They accomplish this by using a closed-loop drain system, smart sensors, a roomy half-inch orifice and

The CRDV/S Wi-Fi Series keeps pneumatic systems, air compressor tanks and air lines free of moisture.

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

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

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

Compressed Air Best Practices® (USPS# 17130) is published monthly except January-February combined by Smith Onandia Communications LLC, 37 McMurray Rd., Suite 106, Pittsburgh, PA 15241. Periodicals postage paid at Pittsburgh, PA and additional mailing offices. POSTMASTER: Send address changes to: Compressed Air Best Practices®, 37 McMurray Rd, Suite 106, Pittsburgh, PA 15241.

TECHNOLOGY PICKS

Wi-Fi capabilities to make sure systems stay dry, even in the most challenging environments.

"We are excited about our new 'Green and Dry' product that uses state-of-the-art technology to reduce costs and provide reliability and peace of mind. And it's made in the U.S.A.," said Todd Harmon, Canfield Industries' (parent company of Spartan Scientific) vice president.

The CRDV/S and CRDV/S Wi-Fi Series includes:

- Exclusive closed-loop compressor drain system with secure Wi-Fi connection, along with a free app for iOS and Android.
- Reliable water sensing. Removes water when it's there, not when it isn't.
- Efficient monitoring, saving on expensive utility compressed air.
- Timely notification of drain hits through text and email alerts.
- A bonus feature, monitoring ambient temperature and sends freezing alerts.
- Special ball valve/strainer combination in the Wi-Fi version.

The CRDV/S Wi-Fi connects to Spartan's databases where the unit can be monitored 24 hours a day and sends alerts for low and high effluent levels, as well as clogged and leaking drains. On-board voltage as well as low and high ambient temperatures are tracked in real time, shown graphically on the website. For a demo, visit iot.spartanscientific.com.

About Spartan Scientific

Spartan Scientific is a leading manufacturer of industrial solenoid valves, headquartered in Youngstown, Ohio. The company is committed to meeting customer goals one valve at a time by designing and making reliable and innovative media control products coupled with service excellence. For more information, please contact: (855) 629-4648, or www.spartanscientific.com.

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Positions are available in Alabama, California, Colorado, Georgia, Illinois, Kentucky, Massachusetts, and Texas.

Discover more about Kaeser and our open positions at www.us.kaeser.com/careers.

KAESER COMPRESSORS

DISTRIBUTOR AREA MANAGERS

Mikropor America Inc. is seeking exciting, self-driven & performance oriented compressed air professionals to join our team. The focus of the job is to assist distributors in growing their business through the application and sale of Mikropor products. We are considering candidates located in the Northeast, West Coast and Texas.

Mikropor America Inc., headquartered in Michigan City, Indiana, offers a broad range of energy efficient solutions for the compressed air industry such as: Refrigerated and Desiccant Air Dryers, Nitrogen Generators, Air/Oil Separators, Compressed Air Filtration, Air Intake Filters, Oil Filtration and aftermarket replacement filtration elements for compressed air.

To learn more about us visit http://mikroporamerica.com. Send resume with cover letter to nitin@mikroporamerica.com.

WEST COAST SALES MANAGER

AIRCOM, a leading manufacturer of compressed air piping systems, is looking for a Sales Manager experienced in compressed air equipment sales. The West Coast territory includes Washington, Oregon, Idaho, Nevada, California and Arizona. The candidate should be located within the territory. This is a Mid Senior Level position.

Qualifications

- High level presentation and selling skills with exceptional attention to detail
- 10+ years of experience in B2B Business preferred
- Proven success within a structured sales environment including strategic sales planning, sales analysis, forecasting and reporting
- Ability to work independently, following company strategies
- Ability to travel (50-80%)

To learn more about AIRCOM USA visit www.aircom.us.com. Send resume with cover letter to careers@aircom.us.com.

TECHNOLOGY

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Contact Rod Smith at rod@airbestpractices.com to schedule your Marketplace Ads.

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TECHNOLOGY

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DV Systems Ltd. Mooresville, North Carolina

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Sweet Savings!

A compressed air audit opens a world of savings opportunities

PROBLEM: One of the world's leading candy and gum manufacturers had no idea how much their compressed air system was costing them. Four compressors (totaling 290 hp) supplied the air needed for pneumatic controls, packaging, and wax line extrusion applications. Excessive water in the compressed air lines, steep maintenance costs, and high noise levels had them looking for a new solution.

SOLUTION: A comprehensive Air Demand Analysis (ADA) established a demand profile for the plant and showed how they were using compressed air throughout the week. It also identified areas of waste and inefficiency. By installing a 100 hp variable frequency drive compressor and two 75 hp fixed speed compressors, they would have all the air needed—with one of the fixed speeds acting as a back-up. This split system solution would bring energy—and noise levels—well under control. A Sigma Air Manager 4.0 master controller could provide on demand energy reports so they would always know how their system was performing and what it was costing.

RESULT: In just over 9.5 months, the project has paid for itself. Annual energy costs have been cut by more than 800,000 kWh. Part of these savings came from reducing the plant pressure from 125 psi to 100 psi. Additionally, the new energy efficient dryers installed have taken care of the moisture concerns. Needless to say, these savings couldn't get any sweeter.

Specific Power of Previous System:	47.16 kW/100 cfm
Specific Power of New System:	17.77 kW/100 cfm
Annual Energy Cost of Previous System:	$128,756
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Utility Incentive:	**$80,200**

Let us help you measure and manage your compressed air costs!

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