The Magazine for ENERGY EFFICIENCY in Compressed Air Systems

COMPRESSED AIR BEST PRACTICES

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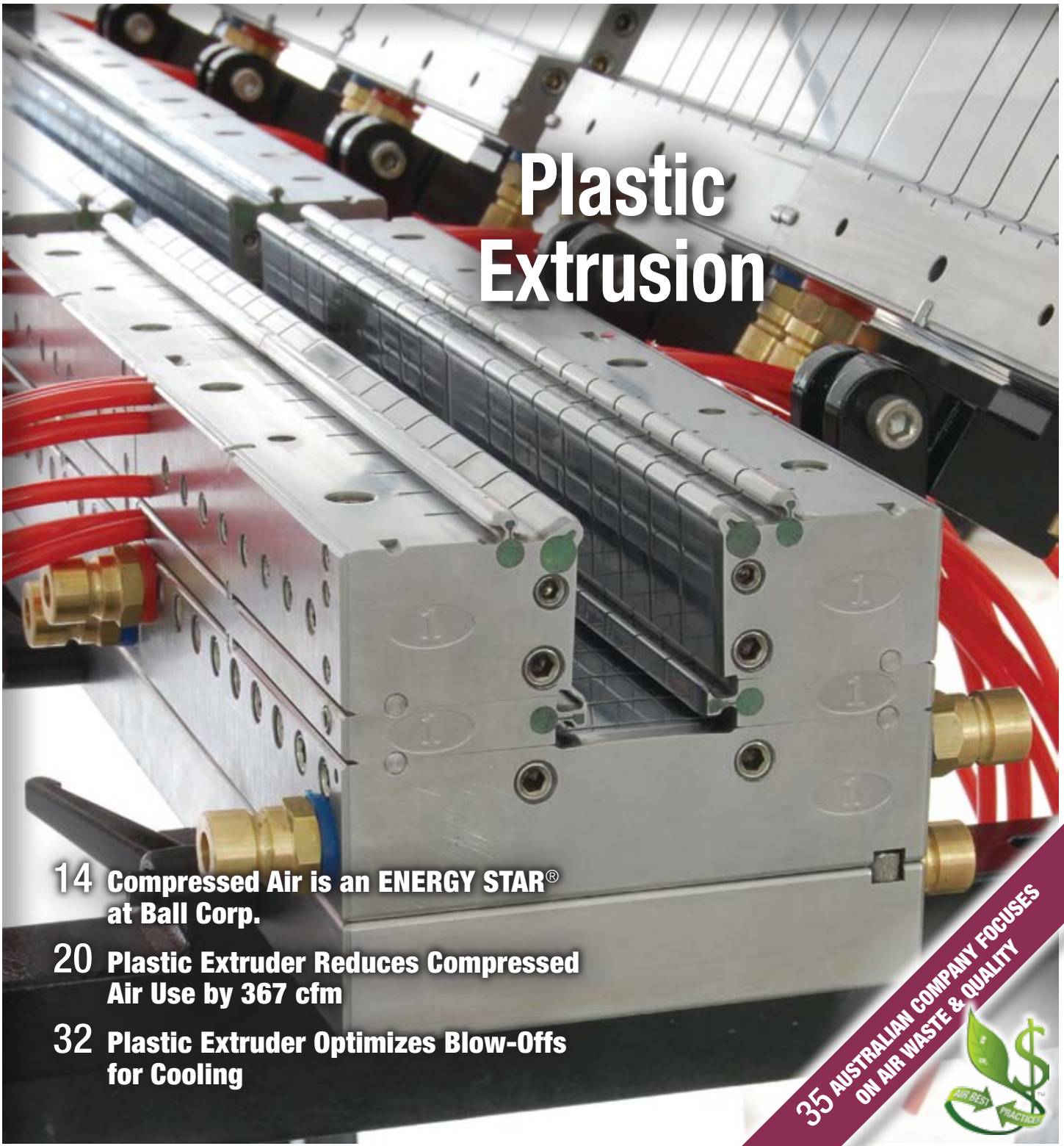
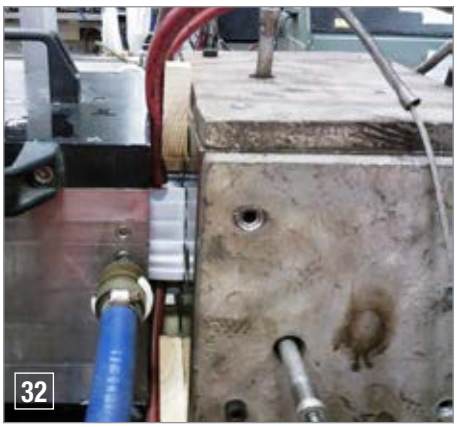
March 2017



Plastic Extrusion

SUSTAINABLE MANUFACTURING FEATURES



COLUMNS

FROM THE EDITOR | Plastic Extrusion

Ball Corporation runs two compressed air systems at their Saratoga Springs (NY) facility where they produce millions of aluminum cans per day. The "high-pressure" system runs at 90 psig, the "low-pressure" system at 50 psig. Editorial Board Members, Doug Barndt (Ball Corp.) and Chris Gordon (Blackhawk Equipment), played important roles in helping Bob Nelson, the Saratoga Springs Facility Engineering Manager, make this happen. I hope you enjoy the write-up and hope many readers will ask the question, "Do we really need 90-100 psi pressure for the whole plant?"

A plastic extrusion company has six Quincy rotary screw air compressors running reliably. The extrusion/main plant and the assembly plant have plenty of compressed air-everything is great, right? Not so fast, the air compressors were all running partially loaded and they were spending $245,000 annually just in electricity to run them. Air Power USA provides us with an audit story of how they were able to turn OFF a QSI 1000 air compressor as a byproduct of many actions – including reducing compressed air demand by 367 cfm – primarily in the extrusion production area.

An Australian company I've known a long-time (from back when I had a real job!), named Basil V.R. Greatrex and run by Richard Mort, hosted a Compressed Air Challenge workshop "Down Under". Ron Marshall's write-up details how they've grown their business by exclusively focusing on reducing waste and improving compressed air quality. How would your strategy change if your firm didn't sell or service air compressors?

Plastic extruders often use compressed air for cooling. Hank van Ormer writes about how one can optimize these "blow-off" applications significantly. Tim Dugan P.E., also provides Part 2 of his series on compressed air system commissioning. These two gentlemen have a lot of experience to share!

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

ROD SMITH, *Editor*
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INDUSTRY NEWS

Atlas Copco Names Mats Rahmström President and CEO

The Board of Directors of Atlas Copco AB has appointed Mats Rahmström as the new President and CEO of Atlas Copco AB, effective April 27, 2017. He will replace Ronnie Leten, who has requested to leave his position after having managed Atlas Copco successfully during eight years.

Atlas Copco AB Names Mats Rahmström President and CEO

"Mats has a strong business focus and is an appreciated leader who is living and breathing the Atlas Copco values," said Hans Stråberg, Chair of Atlas Copco's Board of Directors. "During his time as head of Industrial Technique he has transformed the business which has led to a strong profitable growth. I am convinced that we have found a new solid leader inside the company, who can further develop Atlas Copco."

Mats Rahmström, currently Senior Executive Vice President and President of the Industrial Technique business area, began his Atlas Copco career in 1988. He held positions in sales, service, marketing and general management within Industrial Technique during the first 10 years. Between 1998 and 2006 he held positions as General Manager for customer centers in Sweden, Canada, and then in the United Kingdom. Before he took on his current position in 2008 he was President of the Tools and Assembly Systems General Industry division within Atlas Copco's Industrial Technique.

He is a board member of Permobil Holding AB and of CIBE Lifts AB. Mats Rahmström is a Swedish citizen, born in 1965. He has an MBA from the Henley Management College, the United Kingdom. Mats Rahmström will be the 12th President and CEO since the company was established in 1873.

"I would like to thank Ronnie for the fantastic development of Atlas Copco during his years as the CEO," said Hans Stråberg. "The Group is now stronger than ever with an enhanced customer focus and a solid service business in each business area. Further, Atlas Copco has expanded into the completely new field of vacuum."

Ronnie Leten will resign from the Board of Directors of Atlas Copco AB at the Annual General Meeting on April 26, 2017. The same date he leaves the position as President and CEO of the Atlas Copco Group.

Atlas Copco is a world-leading provider of sustainable productivity solutions. The Group serves customers with innovative compressors, vacuum solutions and air treatment systems, construction and mining equipment, power tools and assembly systems. Atlas Copco develops products and services focused on productivity, energy efficiency, safety and ergonomics. The company was founded in 1873, is based in Stockholm, Sweden, and has a global reach spanning more than 180 countries. In 2015, Atlas Copco had revenues of BSEK 102 (BEUR 11) and more than 43,000 employees.

Visit www.atlascopcogroup.com

HTE Compressed Air Solutions Expands with Opening of Compressor Service and Sales Center in Kansas

HTE Compressed Air Solutions, a subsidiary of HTE Technologies, has opened a compressor service center located at 8004 Reeder St., Lenexa, KS 66214. This new space features a service center, dispatching office, and inventory warehouse for serving the compressed air needs of industrial companies throughout Western Missouri and the 20 counties surrounding Kansas City in Kansas. The focus of this service center will be on Atlas Copco air compressors and dryers, but the seasoned HTE TECHTEAM has extensive experience with other brands including Quincy, Gardner Denver, Ingersoll-Rand, Kaeser, and Sullair.

Also at the Reeder Street location is HTE's Kansas City "TECHTEAM Industrial Productivity Training Center", where local manufacturing personnel will be educated and updated on rapidly changing compressor technologies.

Jon Myers, Vice President at Atlas Copco-Midwest stated, "We are excited with the expansion of HTE to the Western Missouri and Kansas City markets, and continuing the growth of the partnership between HTE Technologies and Atlas Copco."

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INDUSTRY NEWS

HTE has served the Missouri and Illinois manufacturing community for the past 58 years. The company's expansion into Kansas allows HTE's world class equipment vendors and industrial component suppliers to take the message of "faster, leaner, smarter, and safer industry" to the many dynamic industries in Kansas, including animal health, pharmaceutical, packaging, machine equipment, automotive, and aircraft. HTE's talented TECHTEAM has a long track record of increasing local industrial productivity through the innovative application of technology.

About HTE Technologies, LLC

Over the past five + decades, HTE Technologies has evolved into a unique multi-division distributor, operating as a single company but composed of multiple sales and service business units. Today, HTE Technologies serves as the holding company for four wholly owned subsidiary companies: HTE Compressed Air Solutions, LLC; HTE Rental Services, LLC; HTE Automation Technologies, LLC; and HTE Abrasive Blast Solutions, LLC. These four operating units provide customers across Kansas, Missouri, and Illinois with a comprehensive array of quality products, outstanding technical assistance, and the broadest level of supporting design/build/install/remote-monitoring/repair services and inventory available in the Midwest.

For more information, visit www.htetech.com.

Tired of downtime and scrap as a result of poor compressed air quality?

Moisture is found in compressed air lines and exhausting from valves and actuators on equipment thereby reducing component life and machine efficiency. Tired of draining water and oil from your compressed air lines every spring? Tired of cleaning or replacing pneumatic components well before their lifespan?

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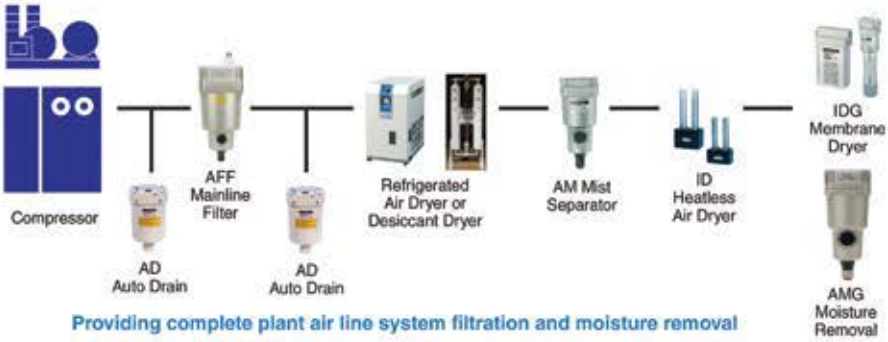

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INDUSTRY NEWS

C.H. Reed, Inc. Appoints Shields as President

C.H. Reed, Inc. announced the appointment of Bob Shields as President of C.H. Reed, Inc. effective December 1, 2016. Shields joined the C.H. Reed team in 2014 as Director of Sales and Service for the Compressed Air Division. During that time, he accomplished a successful realignment of the division to deliver an improved experience to the Compressed Air Division customer base.

Bob Shields was appointed President of C.H. Reed, Inc.

Shields commented, "I am very proud to assume the position of President at C.H. Reed. C.H. Reed's ability to provide customers with a unique solution using a multi-division approach is very exciting. We will continue relentless focus on providing the best solution and develop trusted partnerships with customers."

Bob has over 20 years of compressed air industry experience after serving in the U.S. Navy for 8 years. Prior to joining Reed, Bob spent 13 years with Ingersoll Rand. Most recently, he was the General Manager of the York, PA and Baltimore, MD Ingersoll Rand Customer Care Centers with full sales and service management responsibility for both locations, successfully growing market share. With a B.A. in Organizational Management from Ashford University and relevant industry experience, he brings a wide range of skill, knowledge and expertise to Reed.

"Reed's approach is to provide a value added solution that is cost effective and sustainable. We consider plant processes, productivity, energy reduction, rebate opportunities, environmental concerns, ergonomic matters, reliability, quality and safety. Many projects span more than one division, providing an integrated, efficient result on a turnkey basis," said Shields. "We are somewhat unique in that respect."

About C.H. Reed

Founded in 1948 by Charles and Elizabeth Reed and still family owned, C.H. Reed, Inc. provides a broad based total solution of products, services and engineering through division specific product and service specialists in the three core competency areas of:

- Compressed Air
- Finishing and Fluid Handling
- Assembly Tools, Fixturing and Material Handling

Strategically located in Pennsylvania, Ohio, Maryland and Virginia in six facilities with over 110 employees including remote personnel, Reed covers the entire mid-Atlantic area.

For more information, visit www.chreed.com

Ingersoll Rand Celebrates Two-Year Anniversary of Global Climate Commitment

In the second year of its global Climate Commitment, Ingersoll Rand, a world leader in creating comfortable, sustainable and efficient environments, continues to significantly reduce the greenhouse gas (GHG) emissions of its products and operations, while also convening industry leaders to develop long-term solutions aimed at solving global climate challenges.

Since announcing the commitment in 2014, it has led to the avoidance of approximately 2 million metric tons of CO_2e globally, which is the equivalent of avoiding annual CO_2 emissions from energy used in more than 270,000 homes or more than 2.1 billion pounds of coal burned.

"Announcing our commitment to increase energy efficiency and reduce the GHG emissions related to our operations and products was a major milestone for Ingersoll Rand," said Paul Camuti, Senior Vice President of Innovation and Chief Technology Officer of Ingersoll Rand. "Our progress to date proves we have the expertise to meet our targets while simultaneously providing innovative and sustainable products to our customers and helping them achieve their own sustainability goals."

As part of the Climate Commitment Ingersoll Rand launched EcoWise™, a portfolio of products designed to lower environmental impact with next generation, low-global warming potential refrigerants and high-efficiency operation. The company has introduced six products under the EcoWise label, including the Series R RTWD chiller in, launched in November, used for commercial buildings and industrial applications.

Other successful commitment-led initiatives include the design and implementation of a proprietary tool to measure emissions reductions against GHG-related targets across its product portfolio and employee-led programs to identify facility upgrades and integrate sustainability modules within the product design process.

"We play a critical role in solving some of the world's most serious climate challenges, including the projected 37 percent growth in world energy demand and working to keep the global rise in temperature below 2 degrees Celsius," said Gary Michel, senior vice

INDUSTRY NEWS

president and president of Residential Heating, Ventilation and Air Conditioning and Supply. "Our employees and customers expect us to help meet these challenge and that is exactly what we are doing."

This commitment is another way Ingersoll Rand is helping to solve some of the world's most pressing challenges, including the unsustainable demand for energy resources and its impact on the environment. It benefits customers and the climate by creating more sustainable product choices for customers, improving our operating footprint globally, and continuing to develop lower GHG emissions options.

About Ingersoll Rand

Ingersoll Rand advances the quality of life by creating comfortable, sustainable and efficient environments. Our people and our family of brands, including Club Car®, Ingersoll Rand®, Thermo King® and Trane® , work together to enhance the quality and comfort of air in homes and buildings; transport and protect food and perishables; and increase industrial productivity and efficiency. We are a $13 billion global business committed to a world of sustainable progress and enduring results.

For more information, visit www.ingersollrand.com.

DOE Announces $25 Million for Electric Motor Research

The U.S. Department of Energy today announced nearly $25 million for 13 projects aimed at advancing technologies for energy-efficient electric motors through applied research and development. The Office of Energy Efficiency and Renewable Energy's (EERE) Next Generation Electric Machines projects will address the limitations of traditional materials and designs used in electric motor components by cost-effectively enhancing their efficiency, improving their performance, and reducing weight. This effort will support innovative approaches that will significantly improve the technology in industrial electric motors, which use approximately 70 percent of the electricity consumed by U.S. manufacturers and nearly a quarter of all electricity consumed nationally.

"Advancing these enabling technologies has the potential to boost the competitiveness of American manufacturers and take the development of more efficient electric machines a giant step further," said Mark Johnson, director of the EERE Advanced Manufacturing Office. "These technology R&D projects aim to significantly improve industrial motors for manufacturing, helping companies who use these motors in manufacturing save energy and money over the long run."

Improvements to these systems can be achieved by using key enabling technologies such as wide bandgap semiconductor devices, advanced magnetic materials, aggressive cooling techniques, and improved conductors or superconducting materials. In addition, these projects will leverage recent technical advances made in nanomaterials research, new highly siliconized steel manufacturing processes, and improved performance of high temperature superconductors — all representing potentially economical solutions for next generation electric machines.

Each of the 13 projects have been selected to address one of four topic areas identified by EERE's Advanced Manufacturing Office:

- Manufacturing of high performance thermal and electrical conductors
- Manufacturing of low-loss silicon steel
- High temperature superconducting wire manufacturing
- Manufacturing of other enabling technologies to increase performance.

In addition, these enabling technologies will improve motors used in the growing clean energy sector, helping wind, solar, electric vehicle, and battery manufacturers. The projects also encourage research, development, and deployment of advanced magnets, high frequency insulation materials, and lead-free, low-loss bearing technologies that are critical for high speed electric motors.

The 13 projects selected for awards are led by:

- AK Steel Corporation Research & Innovation
- American Superconductor Corporation
- Carnegie Mellon University
- Florida State University
- General Electric Company, GE Global Research
- NovaTorque, Inc.
- Purdue University
- Rice University
- Rochester Institute of Technology
- Superconductor Technologies Incorporated
- SurfTec, LLC
- University of Central Florida
- University of Houston

Read more about the individual projects.

The Energy Department's Office of Energy Efficiency and Renewable Energy accelerates development and deployment of energy efficiency and renewable energy technologies and market-based solutions that strengthen U.S. energy security, environmental quality, and economic vitality. Learn more about EERE's efforts supported by our Advanced Manufacturing Office to advance technologies in the development of electric machines.

For more information, visit www.energy.gov

Compressed Air is an ENERGY STAR® at Ball Corporation

By Compressed Air Best Practices® Magazine

Paying close attention to compressed air use is paramount for identifying potential energy-saving projects. The engineering team at Ball Corporation has been well aware of this fact for years. An active member in the Environmental Protection Agency's ENERGY STAR® program, Ball Corporation scrutinizes manufacturing processes to maximize the energy efficiency of compressed air systems in each of its plants.

Ball Corporation is an active participant in the Environmental Protection Agency's ENERGY STAR program.

Ball's facility in Saratoga Springs, New York, services beverage companies throughout the northeastern United States. The plant manufactures multiple aluminum can sizes on four production lines, producing millions of aluminum cans per day.

Compressed air accounts for a significant percentage of the total power consumption at the Saratoga Springs facility. They operate both low-pressure and high-pressure compressed air systems.

To learn more about Ball Corporation's Saratoga Springs facility and how their plant engineers optimize for compressed air efficiency, the team at Compressed Air Best Practices® Magazine spoke with Bob Nelson, the facility's Engineering Manager. During our conversation, Nelson told us about demand-side projects they have implemented to reduce compressed air demand. He also described modifications performed on the supply side to better accommodate the lower demand.

Compressed Air System Setup at the Saratoga Springs Facility

It takes a long-winding chain of manufacturing processes to turn raw aluminum coils into small aluminum cans. Consequently, there is a large range of applications at the Saratoga Springs facility, each requiring different compressed air pressure. To prevent regulating high-pressure compressed air down for low-pressure applications — like conveying cans — the Saratoga Springs facility has two compressed air systems in place. The high-pressure system runs at about 90 psi, servicing equipment in need of compressed air at greater than 80 psi. The low-pressure system provides compressed air at 50 psi — some of which is regulated down.

Partnering with a knowledgeable compressed air system supplier has been beneficial for Ball Corporation. The company's national partner, Blackhawk Equipment, has provided both compressed air and process expertise.

"Blackhawk Equipment has been in many Ball plants around the world providing equipment and expertise, and they are very familiar with the applications," Nelson said. "Chris Gordon at Blackhawk is a great resource. He's done a ton for us."

Production Team Guides Equipment Vendors to Use Less Compressed Air

The production equipment at Ball Corporation has a "superintendent team" with knowledge specific to each process. According to Nelson, they really understand the equipment and all of the manufacturing processes throughout the plant. However, when it comes to support equipment (i.e. air compressors, vacuum pumps, etc.), there were times when they did not realize how a change would impact the system. Nelson has been at the plant in Saratoga Springs for 16 years, and has been

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a major driver in educating the production team about their resources.

"I try to teach everyone a little bit about the support equipment and compressed air demand," Nelson explained. "When I first came on board, they were having some problems in production. And so they would just say 'we need more compressed air' — and then somebody would start up another air compressor. I'd go back there and find all three compressors blowing off."

Once the production team understood pressure and flow, they starting taking ownership of how much compressed air the machines used. To reduce demand, the team talked to OEMs, and some vendors were able to make design adjustments to push the pressure requirements down.

"They [the production team] talked to the OEMs and came up with the latest designs," Nelson told us. "We were able to upgrade all the equipment to this new design that uses less compressed air. We were able to turn our pressures down, and the leaking issues also went away. It's all part of their culture now, to take a look at compressed air use."

Monitoring Compressed Air for Preventative Maintenance

Paying attention to compressed air use has yielded another benefit for the production team. On certain pieces of equipment, compressed air is measured and charted. It is also displayed on several tools available at Ball, providing easy access to information, such as pressure and volume trends. With that information easily accessible, production can use it as a preventative maintenance tool.

Over Nelson's tenure at the plant, the overall demand-reduction effort has resulted in substantive drops in compressed air use.

"When I first got here, we were running about 11,000 cfm total, and a big portion of that was on the high-pressure side," Nelson said. "Over time, we've reduced the number significantly."

"Right Sizing" the High-Pressure Compressed Air System

Demand-reduction projects fed into supply-side opportunities, where Ball could reevaluate required capacities and drive big savings in energy. The effort started on the high-pressure system, where consistent throttling occurred due to oversized capacity.

"A big part of our reduction was getting the right air compressors in place," Nelson told us. "We had three 900-hp air compressors. And if we had three of them running, one of them was blowing off. We've gone through a series of projects to 'right size' the high-pressure air compressors, and that is where all these projects started."

Originally, the high-pressure compressed air system had three centrifugal air compressors in place. As demand decreased, Nelson said they "went from running three machines, to two machines, to one," getting to the point where one would still blow off air. Ball worked with its vendor to redesign the air end and put a 600-hp motor on the machine, reducing its capacity to efficiently provide 2200 scfm at 100 psi. While this worked for several years, demand was eventually reduced too far below the machine's optimal performance curve, and it used 23.3 kWh per 100 cfm.

"After a while, we got down to around the 1550 cfm, and we were blowing off 99 percent of the time," Nelson said. "The valve would be open 20 or 30 percent, so we started putting together a program to replace the compressor.

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We went to a flooded screw 400-hp machine with a variable speed drive — two stage. And that machine uses 262 kilowatt-hours for the same output, so that's 16.9 kWh per 100 cfm."

Ball also worked to change some of the process equipment over to the low-pressure compressed air system, since a lot of the high-pressure air was being regulated down to 45 or 60 psi. While it required plumbing work, the project saved energy by eliminating over-pressurized air. According to Nelson, the team at Ball found as much process air as possible on the high-pressure system and transferred it to the low-pressure system, enabling them to right size the high-pressure compressors and prevent blow off.

Retrofitting the Low-Pressure Compressed Air System

On the low-pressure side, the original air compressor was a rotary screw machine. According to Nelson, it "was more of a constant volume, variable pressure type of compressor." Consequently, a blow-off system was put in place to maintain a consistent pressure, because the varying pressure impacted the quality of the necking process. "In order to hold a constant 40 psi, the discharge of that compressor was connected to a blow-off valve set at 40 psi," Nelson said. "It basically made a false load on the compressor, keeping it running at a constant discharge pressure after that blow off."

To retrofit the system, Ball replaced the older low-pressure machine with a two-stage, 1250 hp centrifugal compressor. The newer compressor enabled Nelson to modulate the intake instead of blowing off excess pressurized air.

"We went with a two stage 1250 horsepower centrifugal air compressor," Nelson said. "That enabled us to modulate the intake and not blow off. That saved us probably, all in all, at least 1000 or more cfm. Our average flow is 4850 cfm at 50 psi. Right now, we're averaging 15.2 kWh per 100 cfm of air."

Energy rebates have made all of these projects more compelling. Nelson said all of the "projects have been funded between 33 and 50 percent by rebates." Ball goes through pre-measurement and post-measurement stages to prove energy savings and receive payback. According to Nelson, that has "really helped getting capital funds approved through the corporate system." Doug Barndt, the Manager of Demand Side Energy – Sustainability at Ball Packaging Americas, has also been a major proponent of compressed air system improvements throughout the organization.

Driving Energy Costs Down

Ball Corporation's dedication to energy management has yielded tangible results. Being an active member in the Environmental Protection Agency's ENERGY STAR® program has helped. To date, the Saratoga Springs facility has seen a significant reduction in electrical energy (kW) use — resulting from compressed air system refinement and other process changes. As Nelson said, "We're always looking to improve efficiency here in New York." BP

To read more about Sustainability at Ball Corporation, visit www.ball.com/sustainability

To learn more about the ENERGY STAR for Industry program, visit www.energystar.gov or contact Rod Smith at email: rod@airbestpractices.com

To read more about ***Industrial Energy Management,*** visit www.airbestpractices.com/energy-manager.

Plastic Extruder Reduces Compressed Air Use by 367 cfm

By Don van Ormer, Air Power USA

➤ A plastic product manufacturer spends an estimated $245,000 annually on electricity to operate the air compressors in a compressed air system at its plant located in a midwestern U.S. state. The main manufacturing process is plastic extruding. The current average electric rate, at this plant, is 7 cents per kWh. The compressed air system operates 8,760 hours per year and the load profile of this system is relatively stable during all shifts.

The Current Compressed Air System

The extrusion/main plant air, at the facility, is supplied by two Quincy lubricated rotary screw air compressors (both are Model QSI1000) located in the back of the plant. There are two older Quincy QSI 490 units located in the maintenance area. These two units are in place strictly for emergency back-up use.

> "Most plants can benefit from an ongoing air leak management program. Generally speaking, the most effective programs are those that involve the production supervisors and operators working in concert with the maintenance personnel."
>
> — Don van Ormer, Air Power USA

TABLE 1: AIR COMPRESSOR USE PROFILE – CURRENT SYSTEM							
UNIT #	COMPRESSOR: MANUFACTURER/MODEL	FULL LOAD		ACTUAL ELEC DEMAND		ACTUAL AIR FLOW	
		DEMAND (KW)	AIR FLOW (ACFM)	% OF FULL KW	ACTUAL KW	% OF FULL FLOW	ACTUAL ACFM
Extruding: Operating at 113 psig discharge pressure for 8,760 hours							
1	Quincy QSI490	88	490	OFF			
2	Quincy QSI490	88	490				
3	Quincy QSI1000	179	1,010	88%	159	60%	606
4	Quincy QSI1000	179	1,010	80%	143	40%	404
			TOTAL (Actual):	**302 kW**		**1,010 acfm**	
Assembly Production: Operating at 111 psig discharge pressure and 2,080 hours							
1	Quincy QSI370	66	370	OFF			
2	Quincy QSI370	66	370	89%	59	63%	234
3	Quincy QSI370	66	370	83%	55	46%	170
			TOTAL (Actual):	**114 kW**		**404 acfm**	
Assembly Non Production: Operating at 111 psig discharge pressure and 2,080 hours							
1	Quincy QSI370	66	370	OFF			
2	Quincy QSI370	66	370	89%	59 x 0.5 = 29	63%	230 x 0.5
3	Quincy QSI370	66	370	83%	55	46%	170
			TOTAL (Actual):	**84 kW**		**285 acfm**	

PLASTIC EXTRUDER REDUCES COMPRESSED AIR USE BY 367 CFM

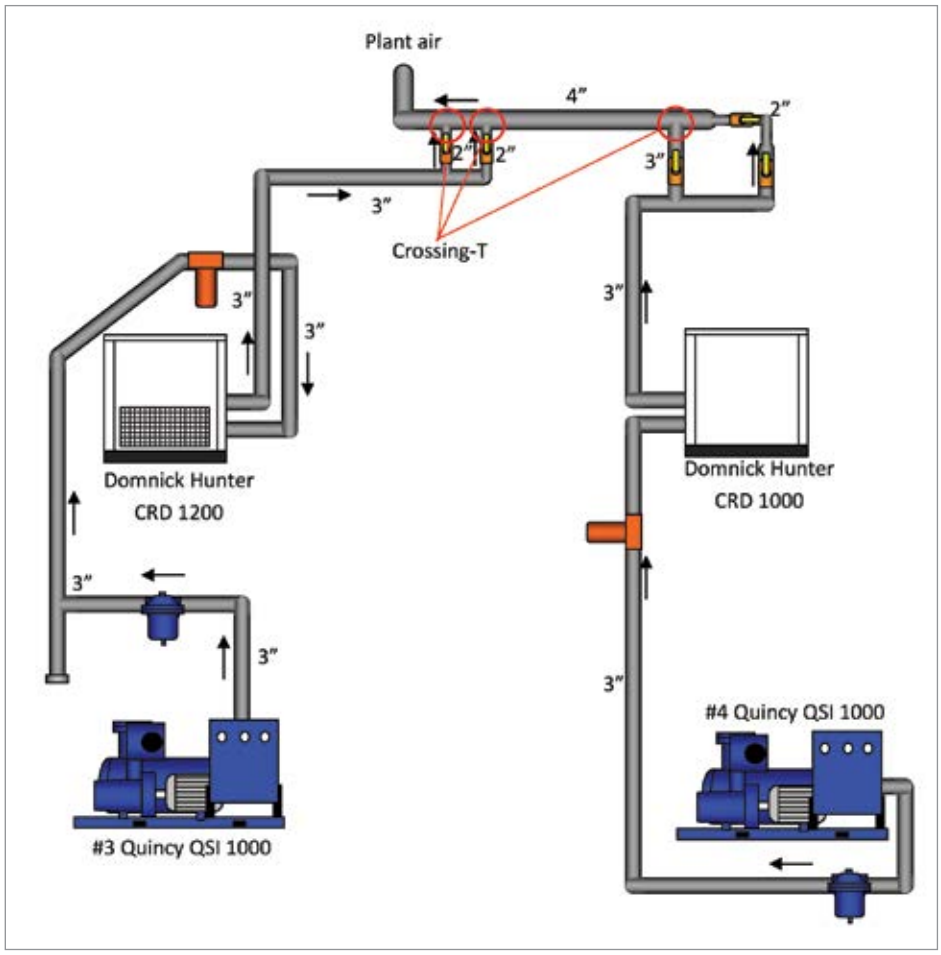


Figure 1. Current Compressed Air System – Extrusion Plant

The assembly plant has three Quincy QSI 370 units – all located in the same room. The Assembly plant system is isolated from all other systems. There is a small Quincy QM B30 unit that is used basically for control air for the conversion plant and is separated from the main plant. These two systems can be valved together for emergency purposes. There is also a QSB30 compressor for the breathing air in the Assembly plant, which is run only when needed.

The two Quincy QSI 1000 units operate reliably. They are both operating, however, at partial load. The first unit is consuming 159 kW (88% of full flow kW) while only at 60% of full load air flow (606 acfm). The second unit is consuming 143 kW (80% of full flow kW) while only producing 40% of full load air flow (404 acfm). One goal of this assessment is to turn OFF one of these air compressors.

The system assessment recommends significant changes to the supply configuration through the use of a master compressed air controller and significant header piping changes – to name a few of the projects. Due to article length constraints, we will only focus on two projects where compressed air consumption was reduced.

Compressed Air Use (Flow) Reduction Projects Deliver 367 cfm in Savings

Compressed air use (flow) reduction projects were identified totaling 205 cfm in the Extrusion/Main Plant area and 162 cfm in the Assembly area. Due to article-length constraints, we will expand a bit on two of the projects – compressed air leak management and blow-off air in the extrusion plant.

Project #1. Repair 50 Identified Compressed Air Leaks – 137 cfm Savings

Most plants can benefit from an ongoing air leak management program. Generally speaking, the most effective programs are those that involve the production supervisors and operators working in concert with the maintenance personnel. Accordingly, it is suggested that all programs consist of the following:

Short Term: Set up a continuing leak inspection by Maintenance Personnel so that for a while, each primary sector of the plant is inspected once each quarter to identify and repair leaks. A record should be kept of all findings, corrective measures, and overall results. The Project Cost Section of this report binder includes current price quotes for ultrasonic leak locator equipment. Table 1 in the Current System Baseline section of this report shows the plant's current annual electrical energy cost to produce one cfm of compressed air.

Long Term: Consider setting up programs to motivate the operators and supervisors to identify and repair leaks. One method that has worked well with many operations is to monitor/measure the air flow to each department and make each department responsible for identifying its air usage as a measurable part of the operating expense for that area. This usually works best when combined with an effective in-house training, awareness, and incentive program. You cannot manage it if you do not measure it!

We recommend an ultrasonic leak locator be used to identify and quantify the compressed air leaks. We use either a VXP AccuTrak manufactured by Superior Signal or a UE Systems Ultraprobe.

Shutting off or valving off the air supply to these leaks when the area is idle would save significant energy use from leaks. Reducing the overall system pressure would also reduce the impact of the leaks, when air to the machine cannot be shut off. Repairing the leaks can save additional energy. The savings estimates associated with a leak management program are based on the unloading controls of the compressors being able to effectively translate less air flow demand into lower cost.

With a few minor exceptions, most of the leaks could not have been found without the use of an ultrasonic leak detector and a trained operator. Leak locating during production time with the proper equipment is very effective and often shows leaks that are not there when idle. However, a regular program of inspecting the systems in "off hours" with "air powered up" is also a good idea. In a system such as this one, some 80 to 90% of the total leaks will be in the use of the machinery, not in the distribution system.

Some of the areas surveyed in the leak study included a great deal of high background ultrasound noise that shields many of the smaller leaks. In continuing the leak management program, plant staff should perform leak detection during non-production hours in order to eliminate some of the high ultrasonic background noise.

PLASTIC EXTRUDER REDUCES COMPRESSED AIR USE BY 367 CFM

TABLE 2. COMPRESSED AIR LEAK LIST IN EXTRUSION PLANT AREA

NO.	LOCATION	DESCRIPTION	EST SIZE	EST CFM	COMMENTS
10	Line 14	Push pull fitting	Small	3	Top of extruder
11	Line 12	Quick disconnect	Small	2	Near extrusion
12	Line 12	Hose connection	Medium	5	Datamatic
13	Line 12	Regulator	Small	2	Datamatic
14	Line 14	Regulator	Medium	5	
15	Line 14	Solenoid	Small	2	
16	Line 10	Quick disconnect	Small	3	Air dryer 5
17	Maintenance Shop	Hose	Small	2	On Hose reel
18	Line 3	Filter drain	Medium	5	
19	P-1	Hose connection	Small	1	
20	Line 5	Lubricator	Small	2	
21	Line 5	Regulator	Small	3	
22	Line 6	Solenoid	Small	2	
23	Line 6	Hose connection	Small	1	
24	Line 6	Regulator	Small	3	
25	Line 6	Under conveyor	Small	2	
26	Line 7	Fitting	Small	2	To regulator
27	Line 7	Regulator	Small	2	
28	Line 7	Hose connection	Medium	5	
29	Dust collector	Inside	Small	2	P-2
30	Line 8	Regulator	Medium	4	
31	Line 9	Push pull fitting	Medium	4	
32	Line 9	Filter drain	Small	3	
33	Line 9	Under conveyor	Medium	4	
34	P-4	Hose connection	Medium	5	On air broom
35	P-4	Fitting	Small	3	
36	Mezzanine	Hose connection	Small	2	On Hose reel
37	Mezzanine	Header	Small	2	Line 8 mixer
38	Mezzanine	Push pull fitting	Small	1	L-5 pump
39	Mezzanine	Above L-5 pump	Small	3	
40	Mezzanine	Fitting	Medium	5	L11-L12 DR selector panel
41	Mezzanine	Filter drain	Small	2	L11 DR supply
42	Mezzanine	Hose connection	Small	2	L11 DR/Grans supply
43	Mezzanine	Quick disconnect	Small	2	L14 Slide Gate panel
44	Mezzanine	Sight glass on filter	Small	2	Hankison air dryer 2
45	Vacuum Room	Hose fitting	Small	2	Wp-4
46	Mezzanine	Up above	Small	2	Grinder 7 return bin
47	Conversion	Regulator	Small	2	
48	Conversion	Valve stem	Small	2	On big air broom
49	Conversion	Solenoid	Small	2	
50	Maint. Shop	Quick disconnect	Small	2	On Hose reel
51	Maint. Shop	Pressure differential gauge	Medium	7	Back up Compressor room
			Total cfm	**117**	

Extrusion/Main Plant Area

Number of leaks	41 leaks
Estimated reduction of air flow with proposed project	117 cfm
Recoverable savings from air flow reduction	$59.66 /cfm yr
Annual electric cost savings with proposed project	$6,983 /year
Cost of leak detection equipment (if required)	$2,800
Cost of leak repairs ($25 materials + $75 labor per leak)	$4,100
Total project cost (materials and installation)	$6,900

Assembly Plant

Number of leaks	9 leaks
Estimated reduction of air flow with proposed project	20 cfm
Recoverable savings from air flow reduction	$34.52 /cfm yr
Annual electric cost savings with proposed project	$690 /year
Cost of leak repairs ($25 materials + $75 labor per leak)	$900
Total project cost (materials and installation)	$900

2. Replace High Pressure Blow-Offs with Low-Pressure Cooling Fans — 70 cfm Savings

Potentially inappropriate uses of compressed air are demand-side applications that may be more efficiently handled by another power source rather than compressed air. Blow-off air is a very common inappropriate use. Two of the extrusion lines were identified as opportunities to replace the use of compressed air with low-pressure cooling fans.

Location: Extruder #12

High pressure compressed air used currently	60 cfm
Compressed air savings with low pressure cooling fan	60 cfm
Value of air reduction	$59.66 /cfm yr
Estimated electrical energy savings	$3,579 /year
Electrical energy cost of new cooling fan	$311 /year
(0.5 kW x 0.071 /kWh x 8,760 hrs)	
Cost of low pressure cooling fan	$2,000
Net electrical energy savings	$3,268

TABLE 3. SUMMARY OF KEY PERFORMANCE INDICATORS AND PROJECTED SAVINGS

SYSTEM COMPARISON	CURRENT SYSTEM			PROPOSED SYSTEM		
	EXTRUDING	ASSEMBLY PRODUCTION	ASSEMBLY NON-PROD	EXTRUDING	ASSEMBLY PRODUCTION	ASSEMBLY NON-PROD
Average Flow (cfm)	1,010	404	285	805	242	
Compressor Discharge Pressure (psig)	113	111	111	100	100	
Average System Pressure (psig)	110	109	109	98	98	0
Electric Cost per cfm	$185.97 /cfm/yr	$41.67 /cfm/yr	$139.78 /cfm/yr	$121.30 /cfm/yr	$34.78 /cfm/yr	
Electric Cost per psig	$939.15 /psig/yr	$84.17 /psig/yr	$199.19 /psig/yr	$488.30 /psig/yr	$42.09 /psig/yr	

Location: Extruder #11

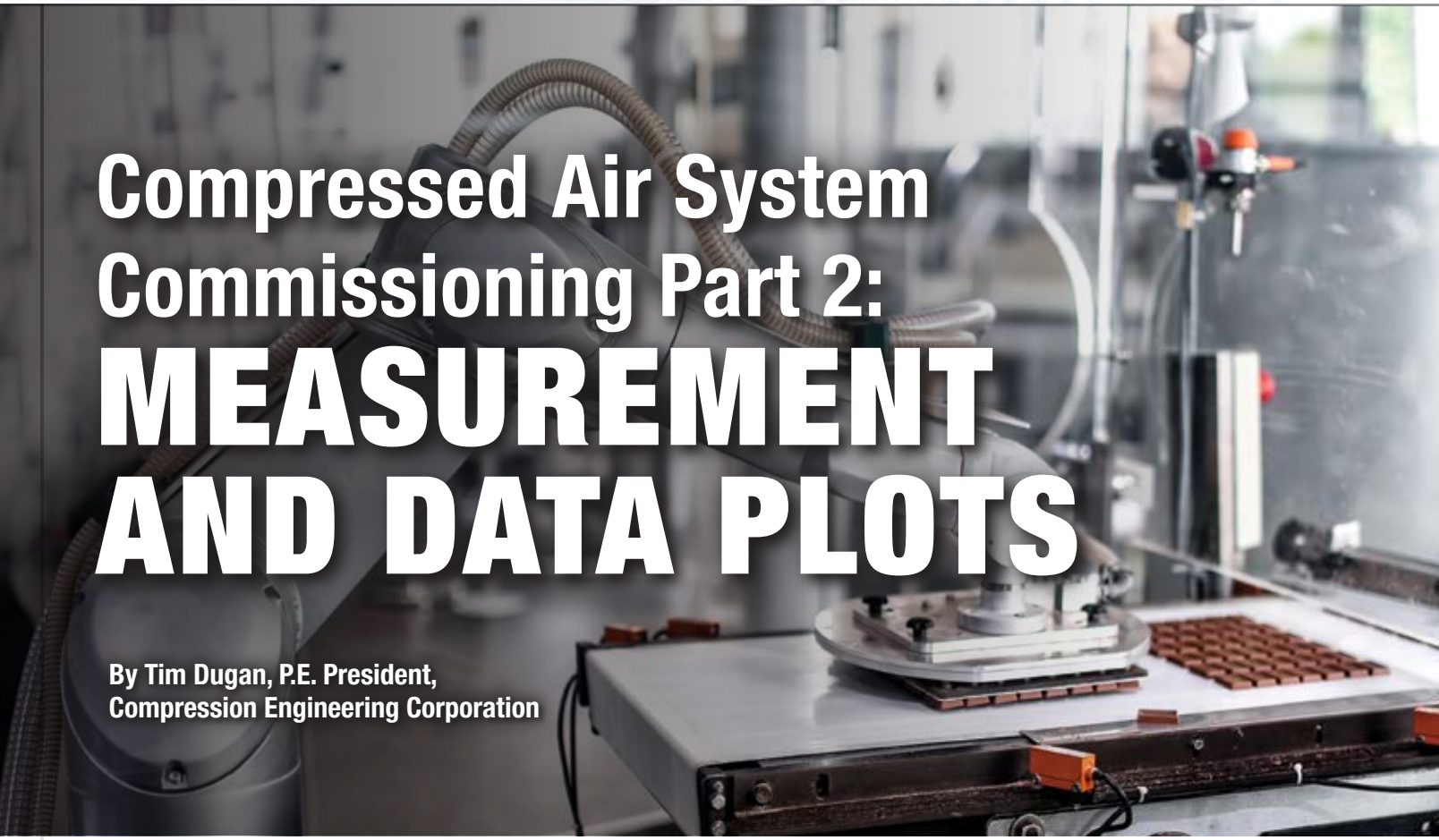
High pressure compressed air used currently	10 cfm
Compressed air savings with low pressure cooling fan	10 cfm
Value of air reduction	$59.66 /cfm yr
Estimated electrical energy savings	$596/year
Cost of project	$0

Conclusion

In this article we have highlighted two simple but important ways to reduce compressed air demand at a plastic extrusion facility. These two projects were part of a larger system assessment involving the installation of supply-side air compressor controls, header piping and air dryer changes able to reduce pressure drop and translate compressed air use reductions into electric cost energy savings at the air compressors. BP

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

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



Compressed Air System Commissioning Part 2: MEASUREMENT AND DATA PLOTS

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

➤ Introduction

Facility managers, how would you like the peace of mind from knowing the system you had installed or modified is thoroughly tested – to the same degree as a new production line? How would you like to be confident that the money you spent is still paying back benefits, year after year?

Air compressor dealer personnel, how would you like to know that your installed compressed air systems are "bullet proof"? That the coordination of parts and pieces function as a whole, and do not "drift" out of optimal condition by random gremlins nibbling away at them?

Auditors and utility DSM energy engineers, how would you like to know that the systems you post-verified or retro-commission are going to stay in that condition? You know that in many of your projects, one little change in adjustment, and efficiencies will evaporate.

All three project stakeholders need to have one agreed-upon robust methodology for commissioning a system, and the teamwork to do it correctly the first time. That is the intent of this series of articles.

Background

In Part 1 of this series on commissioning, I made the case that compressed air systems are typically not commissioned properly at the time a retrofit project is implemented. Further, I made the point that proper commissioning would make most controls "re-commissioning" projects unnecessary. This does assume that some measurement metrics are visible that point out the slippage, if even a well-commissioned project falls into disrepair.

In Part 1, I suggested the following definition:

"Compressed air system commissioning is the process for measuring, testing, adjusting, and documenting that the performance of an entire compressed air system achieves the target system efficiencies (scfm/kW as a whole and for each piece of equipment) in all load regimes and potential failure modes."

This article will attempt to start to describe a general methodology for commissioning that should cover most compressed air systems projects. In a series of articles, I will discuss four aspects of commissioning: measurement and data-plots, testing and adjusting, and documentation. This article will be focused on measurement and data plots.

Measurement

Measurement is seen as costly and time-consuming. If over-designed, that is a justified concern. It is also typically seen as a separate service provided by a separate entity. There are skill specialization issues that

often make that necessary. I will propose a measurement methodology that assumes permanent, low-cost instruments are installed, accented by temporary measurement. Economics will put boundaries on the money spent for measurement. See my June 2015 article in this journal, "Determining the Economic Value of Compressed Air Measurement Systems."

The minimum measurement devices needed for proper commissioning are as follows:

1. Permanently installed:
   - Input AC electrical current, one leg, on each and every compressor and dryer package (except no-energy dryers like HOC or heatless regenerative). These are current transmitters (CTs) and cost about $300/each. This is current before a VFD, not after.
   - Compressor discharge pressure(s), ideally one point. These cost about $300/ea.
   - System discharge pressure(s), ideally one point
   - Data-logging system. There are a variety of systems on the market, from simple data-loggers for under $1,000 to fully-integrated SCADA systems. See below for a discussion.

   Permanent measurement recommendations in this article might or might not be sufficient to meet a utility-required post-verification. Temporary monitoring might be needed to accent it.

2. Temporarily installed (if justified economically, permanently installed):
   - Flow, after dryer(s). I recommend simple, low cost thermal mass type like flow meters, about $3000/each.
   - Indication of dryer purge flow, purge pressure.
   - Power meter(s), spot-measured or permanent (depending on utility requirements). There are many options, and are usually loaned or rented from an utility, auditor, or equipment vendor. These cost about $1000/each.

   If there is sufficient budget, the temporary devices should be permanently installed.

Data-logging Discussion.

Why have permanent logging at all? Most projects don't. The main reason is to provide a basis for real-time indication and maintenance

COMPRESSED AIR SYSTEM COMMISSIONING PART 2: MEASUREMENT AND DATA PLOTS

of performance, called "continuous commissioning" by some. At a minimum, it lowers the cost for having an outside auditor provide performance analysis for the customer. The technology sold in the project and available at the customer's site affect what type of data-logging is practical. I will present an ideal method and a couple alternatives, for when you can't achieve that ideal. Once you make that technology decision, you are "in bed" with it for the life of the system, short of a new retrofit project! Your monitoring technology choices are going to be limited by your prior control system choices. And those were economically-governed as well. Sometimes they were not done ideally, but you need to work with what is there.

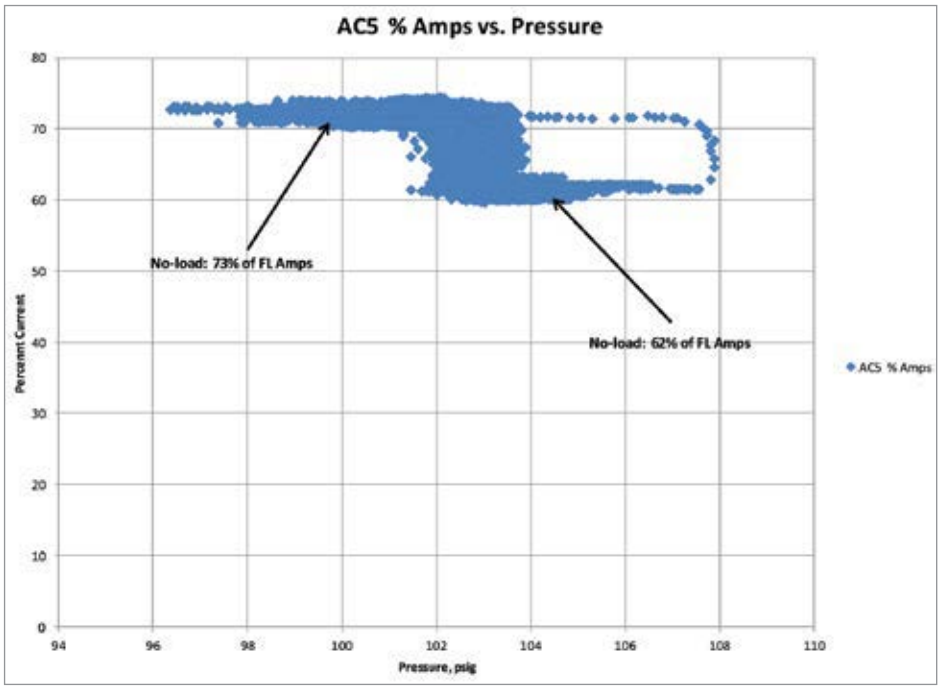


Figure 1. Load-unload Compressor Controls Plot

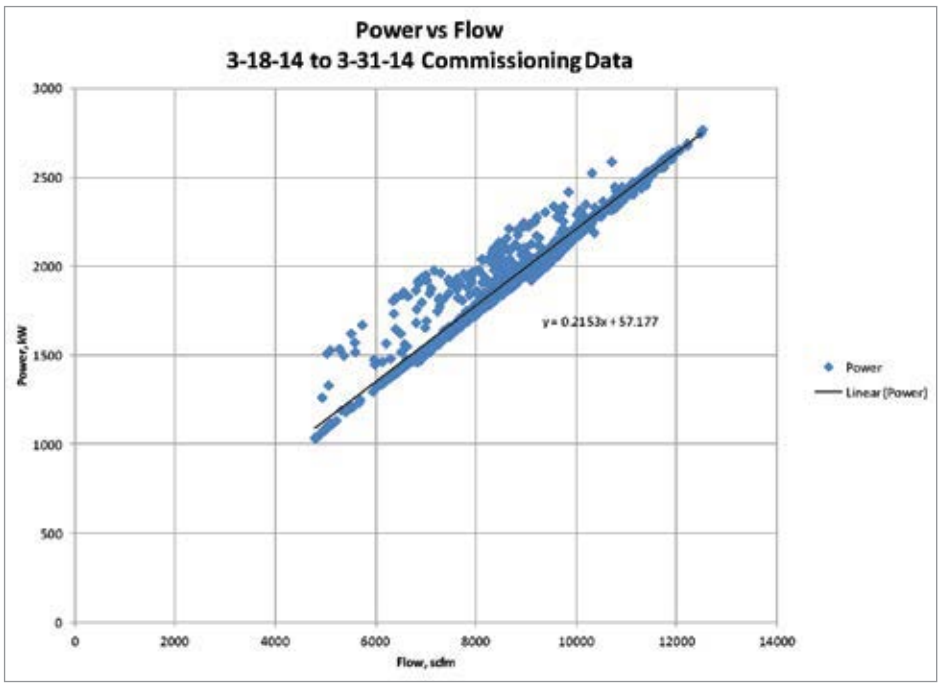


Figure 2. Total Power vs. Flow Scatter Plot

Get the monitoring installed as a part of the project, not after everyone is gone and paid. If the plant network part is not done yet, often the laggard in a project, local PLC downloads of data can suffice for the commissioning phase. As a part of that installation, validate the zero-energy states of your sensors, and either automatically offset them in your system, or in your Excel analysis file. This is particularly important for pressures.

Data-logging System Alternatives:

1. Sequencer (or master control system) with continuous data-logging included. This would include memory, local visualization, and a way to output data for analysis, ideally continuously and automatically. This can be done multiple ways, depending on the type of sequencer:
   - *Stand-alone air compressor OEM sequencer* with data-logging embedded, proprietary hardware. There are several on the market, some with trend data. Prices vary considerably, but are generally from $10k to $40k.
   - *Custom 3rd-party management systems.* There are two families, PLC-based and embedded-controller based. The PLCs don't trend data in general, and require a separate piece of software on a PC and sometimes a server. Prices are dependent on many project-specific issues, but usually start at about $25k and can go to over $100k.

2. Separate "smart" data-loggers. These are configurable monitoring systems that have "widgets", or calculation function blocks, that do some real-time analysis to simplify data, and export data to a separate PC. An auditor is probably needed to supply and program the logger. These systems cost about $2k to $5k.

3. Simple data-loggers. The simplest logging systems that can't do any real-time calculations or connect to a network are cheaper. These systems cost about $1k to $2k. But one audit to upload and analyze the data is multiple times that cost.

Set the sample rate sufficiently fast to catch the system transients. There is no "rule" that is perfect. But it is impossible to troubleshoot a pressure cycling problem that happens in 20 seconds with a 30-second sample rate! I like to have about 3 sample rates or more per pneumatic event I am trying to measure. During the first part of commissioning, the system will not be dialed-in, and some of those events are quick. As a result, you will probably like a 10-second sample rate or better at first.

Data Trends and Plots

These plots are currently not available on any commercially-available compressed air monitoring systems, so they will need to be made in Excel separately. One example of a data scatter plot that I do for every compressor is as follows:

1. Air Compressor Amps vs. Pressure. This shows how the air compressor responds to pressure, basically an air compressor controls plot. See Figure 1 for an example of load-unload control. This came from a project where the air compressor was a centrifugal, and was in full blow-off instead of fully unloaded. No-load power was quite high, over 400 kW, and couldn't be modified at the time. The compressors were centrifugals and would essentially blow-off instead of unload.

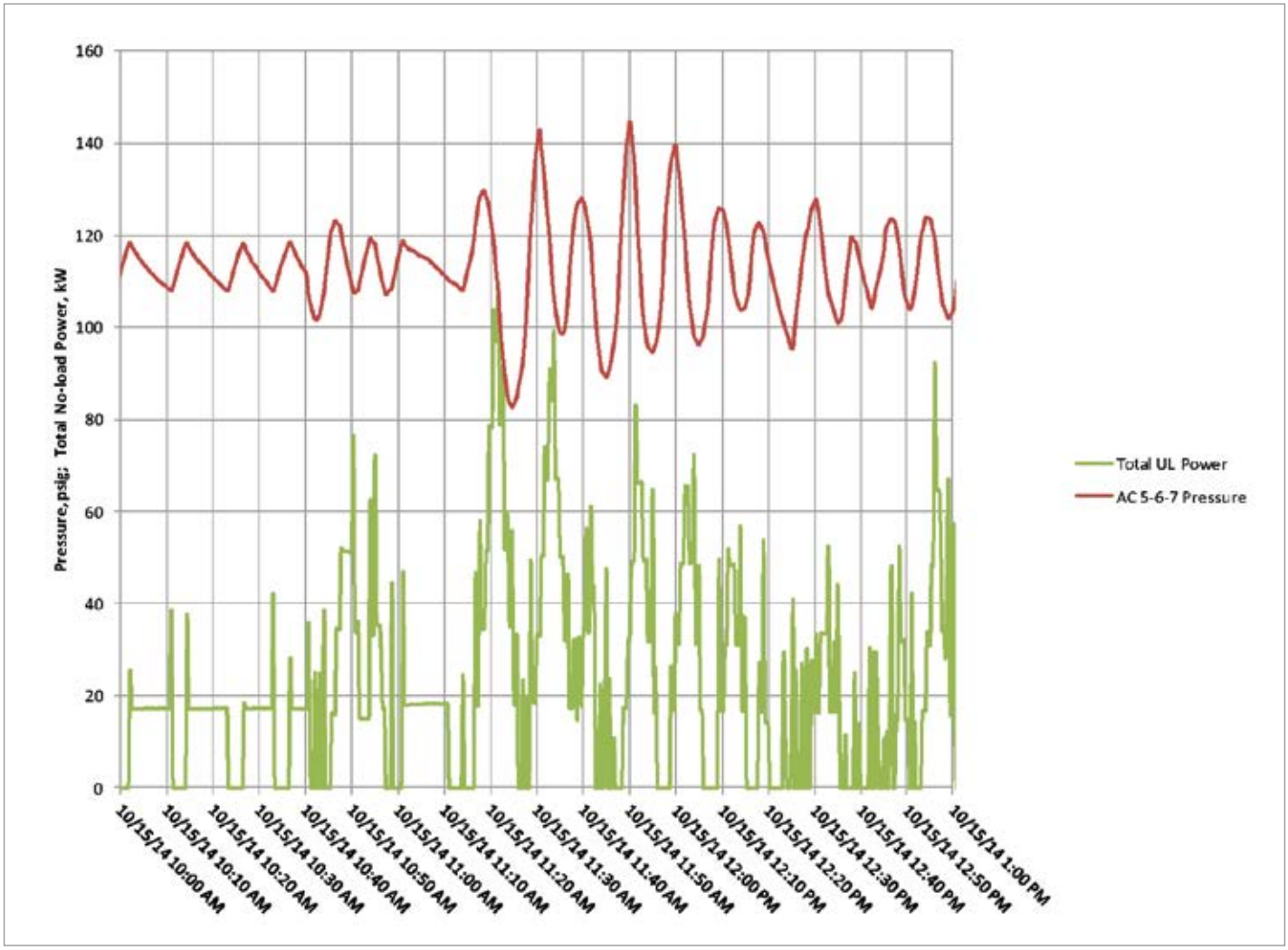


Figure 3. Data Trend Showing Pressure Over-undershoot

COMPRESSED AIR SYSTEM COMMISSIONING PART 2: MEASUREMENT AND DATA PLOTS

Smart Data-logging Functions for Calculating Key Performance Indicators

These can be programmed into some smart logging systems or programmed in Excel, requiring a skilled compressed air auditor. The essential values are as follows:

1. **Power.** If real kW is not monitored, just current, calculate power from current using two power-factor values, full and no-load. Power = Amps x Voltage x 1.732 / 1000 x PF. Add up all power.
2. **Air Compressor Flow**. An estimate can work if flow meters are not in the permanent system. Assign flow based on compressor flow based on performance literature and motor current. A threshold is used (if current is over loaded, and under max) and then a two-point calculation (flow proportional to current, full and min flow). Calculate total compressor flow by summing individual compressors' flow.
3. **System Efficiency.** Individual and aggregate compressor and dryer flow/power ratios.
4. **Unloaded Waste.** Program a reasonably accurate estimate of total no-load power. Create a variable called "no load power" for each compressor. For starters, assume a 60% power factor for no-load condition. Use a threshold to indicate that unloaded condition is occurring, Amps < 50% of full load, for instance. Then, for those periods, calculate no-load power. At no-load, kW is about 0.50 x the current for 480V. So 40 Amps no-load would be about 20 kW. Add up all compressor and dryer no-load power to a "total no-load power" variable.
5. **Blow-off/vent/purge Waste.** Program a reasonably accurate estimate of wasted flow, in scfm. This can be done with a pressure transducer on a vent valve pressure signal (for centrifugal compressor) or on the purge pressure for a dryer. Linear assumptions between two points can be used, with thresholds for zero and max flow. Add up all that waste as one value, total wasted air. In our view, it is not cost-effective to install a permanent flow meter to measure something that you want to be zero.
6. **Total Power vs Total Flow.** See Figure 2 for an example. The total power and flow values need to be averaged over about 5-10 no-load cycles, maybe a 10-min or longer smoothing interval. Then, they are correlated and plotted on an X-Y plot. The slope and intercept can be calculated in Excel. The intercept is

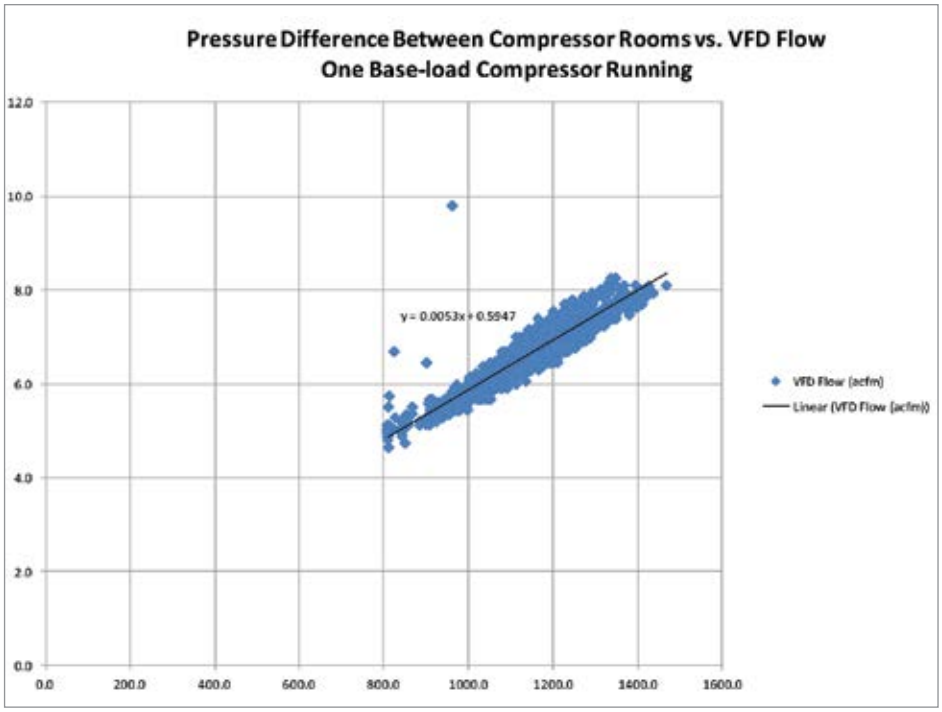


Figure 4. Data Trend Showing Dryer Pressure Differential as VFD Loads Up

> "If you wanted one performance indicator to determine if an air compressor controls project was operating efficiently, it would either be *total no-load power* or *total blow-off*."
>
> — Tim Dugan, P.E. President, Compression Engineering Corporation

the total power of the system at no flow, a very important key performance indicator. Ideally this is zero.

If you wanted one performance indicator to determine if an air compressor controls project was operating efficiently, it would either be **total no-load power** or **total blow-off.** The project that Figure 2 comes from had a total of 4,000 hp of compressors on line. The no-load power could have overwhelmed the system efficiency, so master controls had to minimize it. ***Even though there were four 700 hp compressors, two of which had a "no load" power of > 400kW each, we got the average total system no-load waste to 21 kW.***

Figure 2 comes from the same project that had the potentially high no-load power described in Figure 1. System controls tuning reduced the amount of time that the compressors were in the no-load condition, giving the total system a very efficient performance curve, almost zero power at zero flow. That "Y intercept" is a very important measurement of system efficiency, influenced by largely by the total no-load power.

Other Useful Data Trends

- Number of no-load air compressors running at any one time. This tells you situations where the system is not tuned well. Usually caused by over-shoot and undershoot of pressure. A zoom-in on data can identify timer adjustments that can remedy the problem. See Figure 3 for an example of a target sequencer system that would start too many compressors, then have to stop unload and stop them, creating a large pressure swing. The no-load power peaks as the pressure drops, then goes to zero as all compressors are loaded and pressure shoots back up. The overall no-load power is an indicator of system performance, but this is a diagnostic trend to determine why it was too high (before tuned).
- Pressure differential and dryer flow. Can be used to widen the sequencer pressure differential and avoid system pressure dips at max flow. See Figure 4. This system had the VFD sensing point ahead of the dryer and the sequencer downstream, no ideal. But we were able to avoid nuisance starts of fixed speed compressors by widening the sequencer pressure differential or moving the sensing location to downstream of the dryer.

Conclusions

Measurement of compressed air shouldn't just be a separate "auditor" function that is before and after a project. Measurement needs to be integrated into commissioning of the system as a whole. In addition it should be part of the long-term measurement to show that it stays in tune. For robust commissioning to happen, a reasonably low-cost measurement system needs to be put in place during the project, some key performance indicators calculated from it, and some data plots made to identify what root causes are contributing to less than ideal performance. Then, the system can be adjusted and optimal performance achieved and sustained. BP

For more information, contact Tim Dugan, tel: (503) 520-0700, email: Tim.Dugan@comp-eng.com, or visit www.comp-eng.com.

To read more ***Compressed Air System Assessment*** articles, please visit www.airbestpractices.com/system-assessments

Plastic Extruder Optimizes BLOW-OFFS FOR COOLING

By Hank van Ormer, Technical Director, Air Power USA

➤ Cooling Stations at the Cooling Boxes

At a Midwest window manufacturing plant, the cooling process for the plastic frame pieces, after leaving the extruder, was critical to process productivity and quality. Too much cooling air (or not enough cooling air) would generate scrap and rejected product.

Figure 1. Three cooling lines entering the cooling block blowing on the extruded frame

The plants' 17 extruders and 55 separate blow-offs in these lines had similar cooling stations at the cooling boxes. They consisted of about three hoses at each exit frame angled down to the extruded piece moving past it. The compressed air flow was controlled by a manual control valve set by an operator. The operator used his experience to control the flow delivered and thereby control the product quality.

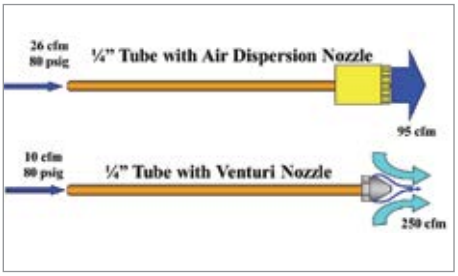


Figure 2. Venturi nozzle uses the Coanda effect to amplify compressed air up to 25 times with compressed air ejected through a thin opening on the outside perimeter. Another type ejects compressed air through the nozzle. The air travels at very high velocities creating low pressure along the inner wall of the nozzle surrounding air and is pulled into the stream at a predetermined amplification.

Measurement of Blow-Off Air

Measurement of compressed air flow, at the inlet to each control valve, showed an average flow of 7 scfm per extruder. The calculation then was the 17 extruders were consuming 119 scfm for 6,176 hours per year of operation at $.08/kWh. The calculated energy to produce this flow with the plants' actual measured operating compressed air system at $90.17/scfm/yr was $10,730/year. Before finishing the description of what was implemented, some background is in order.

Open Blows

Turbulent compressed air blasts straight out of the pipe or tube. It not only wastes large amounts of compressed air, but it may also violate OSHA noise and dead-ended pressure requirements. Engineered nozzles and air flow amplification nozzles used in place of open blows can reduce noise levels, lower compressed air use, and most often improve

blow-off operation in both productivity and quality.

General guidelines in using blow air for cooling:

- Thrust is required to drive the cooling air past the heat barrier to the product. In this case you can see the hose exit is almost on the frame piece so thrust should not be an issue.
- The actual volume (cfm) of flowing air becomes the critical detail in a consistent cooling process.

The choice to be made, to optimize this application, was between the engineered nozzles (or "air jet" flow compressed air) to the process with very little amplification or to use air amplifier nozzles.

An air amplifier requires less compressed air. Air amplifiers use venturi action to pull in significant amounts of ambient air and mixing it directly into the airstream which amplifies the amount of air available at the point of use. Air amplifiers have amplification ratios up to 25:1. This is what was selected for volume and it did not appear to require high thrust.

Amplifier Nozzle Test on the Extruder Line

Recently, several venturi amplifier nozzle manufacturers have developed very small nozzles that can flow .1 cfm to 2.2 cfm of compressed air and still retain most of the 25:1 amplification. This will deliver high flow for cooling with solid thrust at the nozzle exit near the extruded frame piece. Accordingly, a test was set up on one of the extruder lines. In this case, the nozzle used at this low flow had a 20:1 air amplification.

For the test, three hoses were set up at the plant with a flow meter measuring 7 scfm for an average of 2.33 scfm per hose with the individual control valves set to the same spot the operator had them set. Three venturi valves were then installed with the valves in the same place. The flow meter read 3.7 scfm total amplified flow (3.7 x 20 = 74 cfm) which was way too high. Maintenance personnel adjusted the valves to reduce the flow to what appeared to be the preferred flow.

With the valves adjusted to create the desired flow, the flow meter then read 0.4 scfm for the total of three hoses being used. This would reduce the individual hose average to 0.13 scfm which is the average used in the compressed air review savings calculations.

The recoverable electric energy from this test was calculated and is generally less than the total cost to produce. This is calculated by the effect of the air reduction on the actual operating profile of the new system.

Number of applications	55 blows / 17 extruders
High pressure compressed air used currently	119 cfm
Current annual energy cost for blow air	$10,703/yr
Compressed air savings with venturi nozzles (.4 x 17 = 6.8 cfm)	112 cfm
Value of air reduction	$90.17/cfm/yr
Total electrical energy cost recovery by installing venturi nozzles to reduce blow by	$10,099/yr
Cost of nozzles and installation	$2,000
Simple Payback	Approx 2.4 months
Reduction in compressed air use	94%

This audit and test was performed more than two years ago. All the lines were changed to the new blow off systems. The lines are monitored as part of a very significant compressed air management system utilizing key performance indicators and the process continues on saving energy every day.

Productivity and quality improved because maintaining the critical flow in the lines with the current system was somewhat difficult due to compressed air system pressure fluctuations affecting the flow. This haD to be corrected by various plant operators with manual controls. With the selected nozzle the estimated flow is at .13 scfm each which is almost at minimum flow. Since most of the generated air flow (2.4

Figure 3a. Compressed air 7.0 scfm for 3 hoses with current open blows; too much air

Figure 3b. Test flow after installation of venturi nozzles on the three hoses, still too much air

Figure 3c. Test and adjusted by operator. Venturi nozzles with the air flow cut back by the operator to proper level. Three hoses total 0.4 scfm, averaged compressed air per blow = .13 scfm

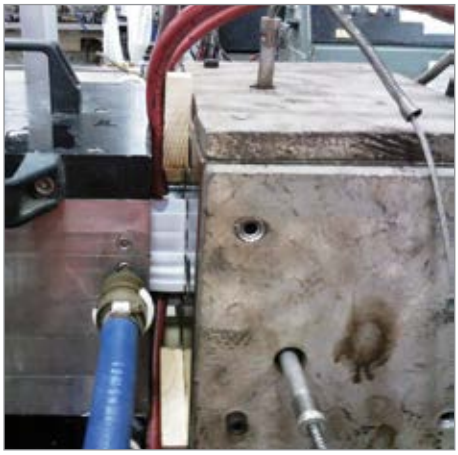


Figure 4. Venturi amplifier mini nozzle at extruded frame (white) on one hose

PLASTIC EXTRUDER OPTIMIZES BLOW-OFFS FOR COOLING

1/8" Post Fixed	Inlet PSI	Tested CFM flow	Inlet PSI	Tested CFM flow	Amplification
	6	.1	60	1.2	25:1
	10	.2	80	1.8	
	20	.4	100	2.2	
	40	.6			

Figure 5. Nozzle used for the test

to 2.5 scfm each) is from amplification, the net flow is affected almost insignificantly by system pressure fluctuation. The end result -- scrap has gone down.

Takeaways

The most common error in using blow air for cooling is to estimate pressure or thrust needed in the air stream without evaluating the actual cooling air flow required.

Thrust is required to drive the cooling air to the point where it can absorb the heat and carry it away. The amount of heat (btu/hr) removed is a function of temperature differential and, most important, volume of working air flow (cfm).

To review the numbers in this scenario the operator-adjusted cooling air flow that worked well was 7 cfm ÷ 3 = 2.33 cfm per hose. When the air amplifier was installed the flow for all three hoses and new nozzles was .4 cfm, or .13 cfm per hose/nozzle — .13 compressed air x 20 = 2.6 cfm per hose — very close to the 2.33 cfm originally set by the operator. The successful production with these nozzles led to a constant, predictable flow at each work station basically unaffected by normal system pressure fluctuation and operator differences. Productivity and quality improved significantly along with a 94% reduction in compressed air use. BP

For more information contact Hank van Ormer, Technical Director, Air Power USA, email: hank@airpowerusainc.com or visit www.airpowerusainc.com

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AUSTRALIAN COMPANY FOCUSES ON COMPRESSED AIR WASTE & QUALITY

By Ron Marshall for the Compressed Air Challenge®

Author's Note: This article was adapted from information and case studies written by Basil V.R. Greatrex

KNOW PRESSURE COMPRESSED AIR CHALLENGE®

A small Australian company, Basil V.R. Greatrex (BVRG), is shaking up the compressed air industry in Australia. While other companies focus on the sale of more and bigger compressed air production equipment, BVRG is helping customers reduce their compressed air system size and lower system flow by attacking waste, inappropriate use, and at the same time improving air quality.

Figure 1: You would not know by looking at it but the famous Sydney Harbor Bridge has a compressed air system installed on it.

Background

The company's unique name is taken from the founder, current owner Richard Mort's grandfather. BVRG was started in 1919 and over the years has provided a wide range of engineering products and services enabling manufacturers to improve their equipment life and reduce maintenance costs. The company's current focus is improving the efficiency of customers' compressed air and oil filtration systems. As such, the products and services they offer target reducing costs, improving productivity and providing significant environmental benefits.

BVRG uses the systems approach, starting off with measuring a baseline with data loggers and system study to identify leakage waste and other optimization opportunities like compressor control improvement. Attention is also paid to the effects of artificial demand – extra flow caused by operating the system at higher pressure. They developed an app and webserver that allows them to record

AUSTRALIAN COMPANY FOCUSES ON COMPRESSED AIR WASTE & QUALITY

leakage, artificial demand and optimization opportunities including photos for their customers, this allows opportunities to quickly be estimated, assessed and ranked so that the biggest savings can be targeted. BVRG also provides analysis in determining the actual quality of the compressed air, with the capability of measuring dew point, hydrocarbon content, and particles that contribute to contamination risk for the customer.

"It is a lot of work digging into the many demand side issues in a large industrial facility." says Warwick Rampley, BVRG's National Sales Manager, "But this effort usually pays off in a big way for our customers and we have many successful projects to prove it."

In helping their customers the company has realized that awareness training is an important aspect to any improvement project. Therefore, BVRG is exploring bringing the Compressed Air Challenge's Fundamentals and Advanced training seminars to Australia. In fact, in November of 2016 BVRG held the first international CAC Fundamentals training session conducted outside of North America for their staff and a select group of industry professionals.

"So many people are struggling to understand compressed air and don't have the time to concentrate on it. As a result, they are forced to rely on poor advice from companies looking to sell more equipment, when the real solutions leading to savings are often easily implemented," says Rampley, "Being able to provide our customers training, advice on project implementation gives them the knowledge to question what they are being told"

BVRG has helped many of their customers achieve substantial savings. To date the company estimates they are saving their

Fundamentals of Compressed Air Systems WE (web-edition)

Join Compressed Air Challenge for the next session of ***Fundamentals of Compressed Air Systems WE*** (web-edition) coming soon. Led by our experienced instructors, this web-based version of the popular *Fundamentals of Compressed Air Systems* training uses an interactive format that enables the instructor to diagram examples, give pop quizzes and answer student questions in real time. Participation is limited to 25 students. Please visit www.compressedairchallenge.org, to access online registration and for more information about the training.

If you have additional questions about the new web-based training or other CAC training opportunities, please contact the CAC at info@compressedairchallenge.org

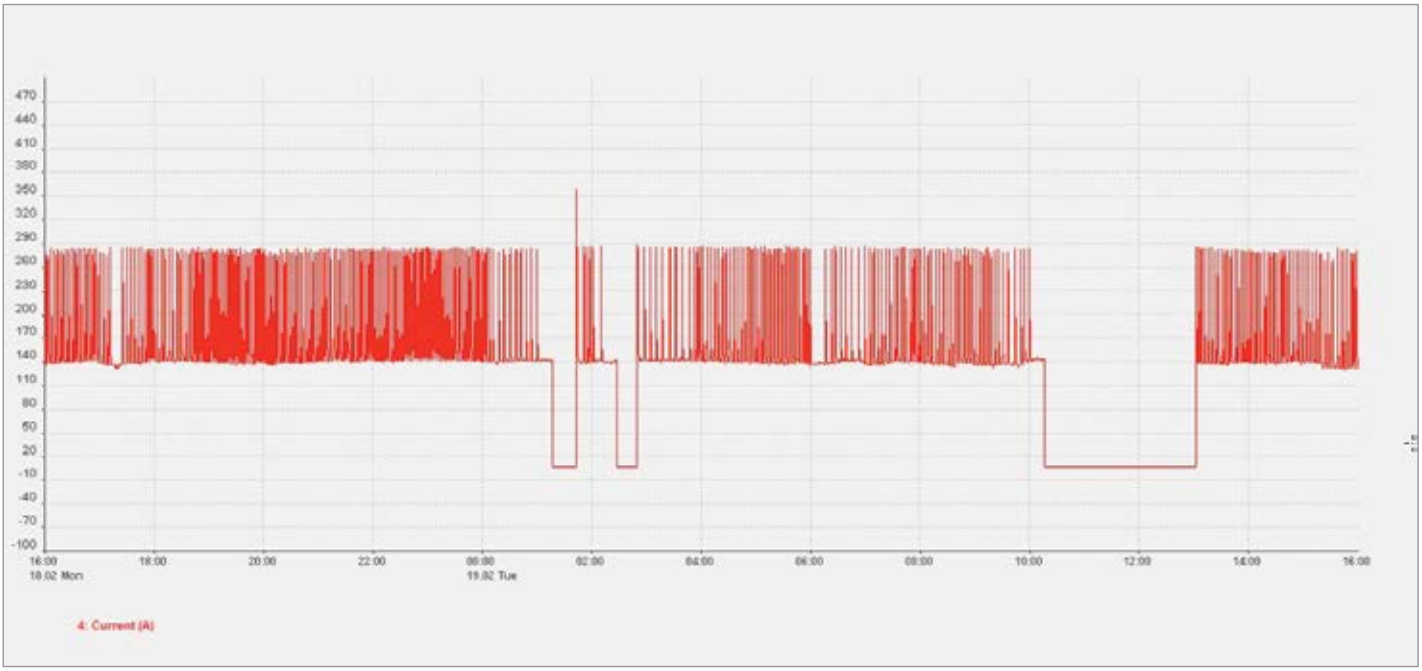

Figure 2: This measured air compressor was wasting substantial power running unloaded.

customers a total of 15,000,000 kWh. Their customers reduce their compressed air energy use on average by approximately 40% and have even gone as high as 75% in several cases. Here are some examples of their work:

Plasterboard Manufacturer Turns Off an Air Compressor

The Engineering Manager from Boral Plasterboard in Camellia, Australia wanted to get a better understanding of the compressed air system in the plant and to somehow quickly reduce his operating costs. Boral was running on two air compressors operating on a typical lead/lag basis. The compressors were located in separate areas of the plant, but fed into one main system and the operating costs were found to be particularly high. BVRG measured and logged the power and flow consumption from both compressors over a 1 week period. It became apparent the second (lag) compressor (a 140 kW unit) was cycling frequently between load and off load. This showed the air compressor was in fact only contributing a small amount of air to the system totaling 1.47 m^3/min (51 scfm). In general, the loading cycle was enough to prevent the compressor from going into complete standby mode. From the power consumption data (Figure 2) BVRG and Boral were able to determine that this compressor ran loaded 7%, unload 89% (but still consuming power) and standby 4%.

With a much clearer picture of their system loading, the company realized that if the system flow could be reduced by only a small amount, the lag air compressor could be turned off. They have since rectified leakage and efficiency issues, which has seen the compressor hours virtually eliminated (see figure 2). The energy savings from this work are estimated at approximately $30,000 per annum plus additional maintenance and capital savings. In the future, once further leakage repairs are completed, it is expected that air demand on the lead compressor will also be reduced, resulting in additional savings.

Through measurement of power and flow, Boral has been able to better understand the inefficiencies of their compressed air system and justify the cost of compressed air energy savings initiatives undertaken.

Food Products Processor Saves

Implementing a compressed air leakage management program has proven to be very worthwhile for a cereal manufacturer, in southern New South Wales, who has managed to save the company a whopping $168,000 per year in estimated power savings (approximately 30% of total compressed air power usage). Previously, the plant ran three large air compressors at full capacity to satisfy the site's air demand requirements. The site's engineering manager contacted BVRG in 2008 and requested help in reducing compressed air leakage in the plant.

BVRG staff were asked to put a special focus on leakage rectification. This initially included two compressed air leakage surveys and repair projects per year, and then reduced down to one per year after 2010. Using advanced diagnostic equipment, the first survey identified 264 leaks. These were

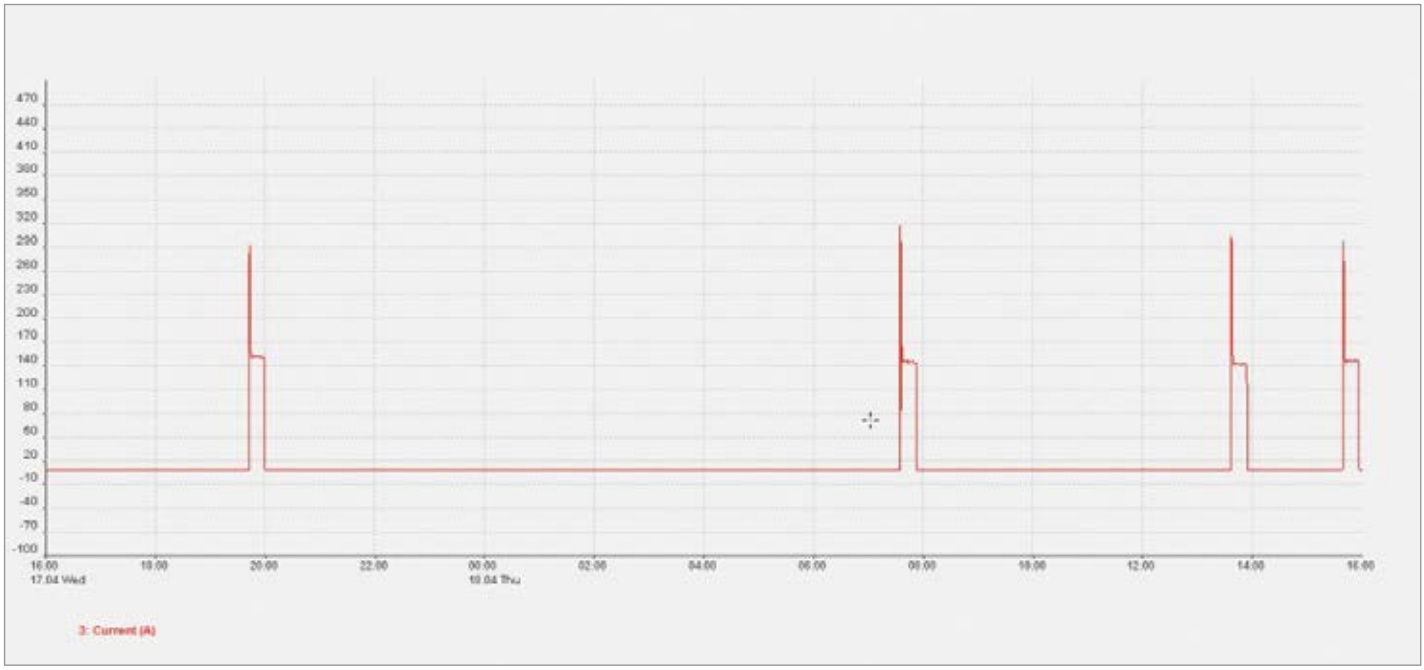

Figure 3: Just a small reduction in leakage has greatly reduced air compressor run-time.

AUSTRALIAN COMPANY FOCUSES ON COMPRESSED AIR WASTE & QUALITY

easily fixed by local contractors. Within a year air demand through leakage had been reduced enough that the site only need to run two air compressors! This provided significant and immediate power savings of 160 kW worth about $168,000 per year at $0.12/kWh. Apart from the energy savings, the site benefited from the security of then having a backup compressor in case of breakdown or maintenance requirements.

To ensure repairs were carried out, a 3rd party local contractor was used to conduct repairs. But in 2011 and 2012, the engineering manager was appointed to an overseas project and unfortunately, without the same dedication to leakage management, there was a resurgence of leakage back into the system. Upon returning in 2013 he found the 3rd compressor was again running (approximately 30% – 40% of capacity) due to an increase of approximately 10 m³/minute (350 scfm) of leakage.

An immediate refocus on leakage has again proven successful and the site is now back to only requiring two air compressors to meet total production air demand. Unlike many Australian manufacturing sites, this engineering manager understands the high costs associated with producing compressed air, and in turn, the savings potential of reducing air demand through implementing a successful ongoing compressed air leakage management program. The site continues to engage BVRG to perform regular leakage surveys, allowing the in-house resources to focus their efforts on production related issues and requirements.

Best Practices for Compressed Air Systems Second Edition

Learn more about optimizing compressed air systems

This 325 page manual begins with the considerations for analyzing existing systems or designing new ones, and continues through the compressor supply to the auxiliary equipment and distribution system to the end uses. Learn more about air quality, air dryers and the maintenance aspects of compressed air systems. Learn how to use measurements to audit your own system, calculate the cost of compressed air and even how to interpret utility electric bills. Best practice recommendations for selection, installation, maintenance and operation of all the equipment and components within the compressed air system are in bold font and are easily selected from each section.

Meat Processor Solves Condensate Problem

Teys Australia's site, located in Wagga Wagga, New South Wales, had been experiencing expensive problems with condensate in their compressed air across the plant. The most severely affected area was a cool room that was temperature controlled to approximately +4°C (+39°F). Extensive condensate was present

Figure 4: When automatic condensate drains were installed the dew point started to improve.

Interview with Warwick Rampley, BVRG National Sales Manager

What is your role at your company and How did you become interested in compressed air efficiency?

I am the National Sales Manager. Besides my sales role, I coordinate our technicians, sub-contractors and manage projects for our customers. I joined BVRG four years ago and once I understood the possibilities and the typical level of waste that most compressed air systems had, I realized something desperately needed to be done about it. This is especially true for Australian Manufacturing that is struggling to be competitive in a global market.

What services does BVRG provide and how do you differentiate yourselves from the marketplace?

We are compressed air efficiency specialists. We conduct comprehensive compressed air measurement, leakage, optimization, artificial demand and air quality testing along with repairs and advice for reducing or eliminating compressed air. We are the Australian distributors for Beko, SPX Hankison, and Suto (formerly CS-iTEC) instruments capable of monitoring all of a customer's utilities.

We are the only company in Australia that reviews entire compressed air systems and offers a complete package for compressed air efficiency which includes air measurement using flow, power, pressure, temperature, dew point, oil and particle contamination, leakage, optimization and artificial demand surveys. Our goal is to eliminate as much compressed air energy use as possible. We have our own in house auditing app that customers use to view results and target specific opportunities within their system.

I believe our most important service is advice that is independent of equipment sales. In many cases, we have solved customer's issues, without the need for significant equipment purchases, simply because we understand the entire system and not just one piece of the puzzle. For example, when there is wet or contaminated compressed air, the issue may not be coming from the dryer. We have seen several occasions where customers have been told they need new, bigger and more expensive equipment when an inexpensive drain is what has failed.

What did you think about the CAC Fundamentals training and what was the most important message taken from the seminar?

I think the program is excellent, it is systematic and provides a good understanding of compressed air systems. I feel that it is very control and air compressor focused and perhaps needs more of a demand side focus to identify significant savings opportunities that are being missed in systems. Using the systems approach fits with our business and helps identify all the opportunities, allowing for the best ones to be acted upon.

I learned to always approach compressed air as a system, use a systems approach and STACOLM (you can learn what this acronym means if you take the course)! This course has given me the background technical knowledge to go with the application knowledge I have gained over the past 4 years.

Do you feel Australia needs compressed air energy efficiency providers?

I think every country needs genuinely trained compressed air efficiency providers that are independent of compressor or component sales. There is too much energy wastage from

compressed air systems globally, and given the energy and environmental challenges of the future, industry as a whole should already be on top of this problem not 30 years behind the times.

Anyone using compressed air should be provided with a level of knowledge and understanding to be able to decide what is a better way to use it. If we can teach everyone to not abuse it, we can save a lot of energy, equipment and the environment. I believe sales people in the compressed air industry should be willing and able to provide the right advice to the customers (not just the company tag lines) and be willing to lose an equipment sale because it is the right thing for the customer (sorry that's my soap box).

Regarding Compressed Air Quality – I believe governments need to set a compressed air quality standard for the food and close related industries, because product contamination is a high risk that no one is willing to do anything about and sooner or later there is going to be an issue that could have easily been avoided.

AUSTRALIAN COMPANY FOCUSES ON COMPRESSED AIR WASTE & QUALITY

because ambient temperature in the room was lower than the dew point temperature of the compressed air in the line. As the compressed air cooled, all the water vapor in the compressed air condensed into large amounts of liquid. The system's refrigerated dryer appeared to be working correctly and was appropriately sized, however, the condensate present in the wet receivers had to be drained manually multiple times daily at a significant cost in man hours.

BVRG initially recommended the site measure the system to size a membrane dryer for the point where the compressed air entered the cool room to ensure the compressed air dew point would be below +4˚C. BVRG performed a logger survey measuring flow, dew point, and pressure for 7 days.

The BVRG analysis of the survey data revealed when condensate was manually drained from the receivers the dew point improved (Figure 4). It was obvious that the root cause of the problem was from build-up of condensate in the receivers, which could have been avoided with significant cost savings through an improved drainage system.

BVRG recommended the installation of zero air loss condensate drains, which were installed on their wet receivers. System condensate drains were installed across the site at available locations. The effects on the system were immediate. At the cool room, dew point was reduced to +1˚C (+34˚F) within a few days, and all condensate issues across the site were eliminated. BVRG issued a further recommendation to increase the dew point out of the dryer to +3˚C (+38˚F) to reduce risks of compressed air condensate freezing and causing damage.

Helping Identify Compressed Air Contamination

With so many contributors to creating or propagating contaminants in compressed air systems, BVRG has recognized it is essential that air quality be tested regularly to prevent potentially hazardous consequences, especially in a plant where the compressed air comes in contact with products. Every day there is the risk of water, oil, microbiological organisms and solid particles (such as corrosion or rust from the inside of pipework) compromising the compressed air and risking contamination of the products and reducing plant equipment reliability.

Humidity, oil, bacteria and particles are present in the ambient air around the compressor room. BVRG has found through testing that the use of oil-free air compressors is no guarantee against contamination. Most air compressors pump out what they draw into the intake, which can include fumes from local traffic or nearby machinery. Filters alone are not capable of removing every contaminant. They are limited by their structure and efficiency drops-off as they fill up with contaminants and become less effective.

Figure 5: This mess came out of a food grade system, what is getting into your food?

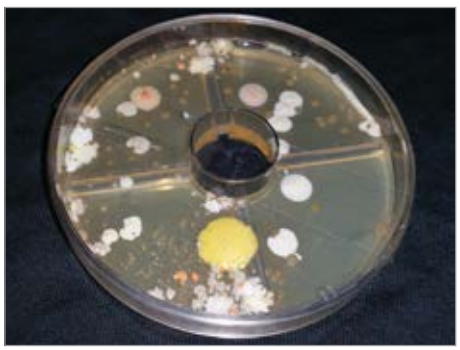

Figure 6: The results of this recent microbial test reveal problems with air quality.

Microscopic organisms can exist beyond the filters and can be blown directly onto products or remain inside the pipes and multiply. Compressed air pipework is an ideal breeding ground for bacteria with a mixture of oxygen, moisture, heat and darkness.

Most facilities do not have a compressed air quality standard, and the limited few that do, set a single standard for the entire site – based around the equipment installed at the air compressor house. Each point of use will have its own contamination issues, due to the equipment installed, ambient conditions, lubrication and condition of pipework.
To treat an entire system to the highest air quality required is not only unnecessary, it's impractical and expensive to maintain and operate. The "one type fits all" approach fails to recognize localized issues for contamination within each zone.

Some companies establish their own in-house air quality standards and self-regulate due to the challenges with organizing samples and testing. Tube testing onsite is a common practice but sampling is inaccurate and allows human error to occur, and fails to reach the levels required by ISO 8573. This leaves the site at risk of unacceptable levels of contamination or worse.

BVRG has found that new electronic technology is making the testing of compressed air quality a lot simpler and significantly more accurate, giving more

meaning to the tests. The company has found there is a degree of ignorance and complacency in Australia with regards to what the correct air quality standards and testing are and how they can be adhered to but, times are changing, and more and more companies regularly test their air quality and reduce their risk of product contamination issues and possible product recalls.

BVRG is using their decades of experience in the field of compressed air quality to assist their customers in reaching an efficient and sustainable compressed air quality suitable for their sites which includes helping them to comply with the standards set out for Safe Quality Food (SQF) and HACCP.

Conclusion

The BVRG story is yet another great example of how providing customers with excellent value can lead to great success. In this case, the company has realized that customer awareness and a focus on addressing the areas of greatest potential can pay off in a big way. Solving their customer's problems is an important aspect to the services they provide. They are able to solve reliability, maintenance, control and air quality problems in an energy efficient way, leading to significant cost reductions for their customers. BP

To learn more about Basil V.R. Greatrex please visit www.bvrg.com.au

For more information about the Compressed Air Challenge, contact Ron Marshall, email: info@compressedairchallenge.org or visit www.compressedairchallenge.org

To read more ***Compressed Air Leak Management*** articles, please visit www.airbestpractices.com/system-assessments/leaks

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Innovative New SPX FLOW FLEX Series Dryer by Hankison

SPX FLOW introduced the new FLEX Series energy saving refrigerated compressed air dryer by Hankison. The FLEX Series refrigerated air dryer utilizes the latest advancements in heat transfer technology, and offers an innovative approach to efficiently remove liquid from compressed air.

What is Phase Change Material (PCM)?

PCM is a material that harnesses latent heat produced as it converts from solid to liquid or liquid to solid. While latent heat is being absorbed or released, the process is isothermal (no temperature change) and the energy from the heat is used to change the form of the material. The PCM has high latent heat properties, meaning it absorbs a lot of heat at constant temperature as it melts or freezes and stays colder for longer periods of time. While the PCM absorbs heat from warm, moisture-laden compressed air there is no significant rise in temperature.

Designed with a 3-in-1 heat exchanger, the PCM encapsulates the refrigeration and compressed air circuits. This allows the phase change material to stay colder for longer periods of time, cycling the refrigerant compressor less often than conventional energy saving designs.

Designed to Match Plant Demands Without Waste

As the FLEX Series dryer automatically matches the compressed air load at any point in time, it can be sized to the maximum plant compressed air load without a material energy consumption penalty.

SPXFLOW

The new SPX FLOW FLEX Series Dryer

Savings Finally Realized

The FLEX Series, named for its flexible design and increased multi-flow bandwidth, allows for deployment into a broader range of flows, without compromising initial costs or energy consumption. The utilization of PCM allows for more regulated temperature and less cycles, thus delivering greater energy savings. The PCM itself is an eco-friendly refrigerant that melts and solidifies above 0°C and does not require the use of glycol, pump, tank or hot gas bypass; further increasing the efficiency of the dryer. FLEX Series dryers minimize the number of components for easy servicing and maximum reliability. Additionally, they have an integrated controller with clear LCD display for easy monitoring and operation.

Summary

The innovative use of PCM in the FLEX Series dryer re-sets energy efficiency expectations for the compressed air industry. The dryers not only offer more economical operation than alternative refrigerated dryers, but also the way they operate means, they inherently adapt to variances in air flow and ambient temperatures to maximize energy savings. Simple in design, efficient in operation, the SPX FLOW FLEX Series refrigerated air dryer sets the new standard in compressed air treatment technology.

About SPX FLOW, Inc.

Based in Charlotte, North Carolina, SPX FLOW (NYSE: FLOW) is a leading global supplier of highly engineered flow components, process equipment and turn-key systems, along with the related aftermarket parts and services, into the food and beverage, power and energy and industrial end markets. SPX FLOW has approximately $2 billion in annual revenues and operations in over 35 countries and sales in over 150 countries. To learn more about SPX FLOW, please visit our website at www.spxflow.com.

Edgetech Introduces X3 Trace Moisture Sensor

Edgetech Instruments, Inc. announces an updated and improved line of portable and fixed location trace moisture analyzer instrumentation. Unlike other techniques, these devices can also measure higher levels of moisture near saturation with no ill effects. The DewMaster and PDM75 moisture analyzers are now available with the recently released X3 high performance chilled mirror moisture sensor. The X3 sensor is a drift free, primary method device with

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TECHNOLOGY PICKS

DewMaster display and probe

PDM75 Portable Hygrometer

certification traceable to NIST. There is no degradation of the life or performance of the X3 sensor when operating near saturation or at very low moisture levels for long periods.

Most other technologies have restrictions when measuring near saturation because of negative effects on their sensors. The chilled mirror sensors used in these analyzers are not affected by long exposure to very high or very low moisture conditions and reliably respond quickly, without ambiguity, when moisture levels change. No special isolation or sampling systems are required.

When pressure and temperature sensors are added, these analyzers display user selectable units of measurement in degrees C or F dew/frost point temperature, relative humidity, parts per million by volume or weight, wet bulb and dry bulb temperatures, grains per pound or grams per kilogram. They also display pressure and temperature, and accurately measure dew/frost point or ppm moisture at any pressure within their operating range. Readings are unaffected by changes in pressure since the analyzers continuously measure it and report the correct moisture value at the measured pressure.

The DewMaster and the PDM75 are perfect choices for accurately measuring moisture content in dynamic processes such as purged laser systems, isolation chambers, glove boxes, semiconductor manufacturing, product and monomer storage, high purity welding and moisture sensitive process environments.

Edgetech Instruments designs and manufacturers accurate and reliable absolute humidity hygrometers, relative humidity transmitters, humidity probes, moisture and dew point analyzers, relative humidity calibrators, dew point generators and oxygen measurement instrumentation. Edgetech Instruments products are manufactured, calibrated and serviced to the highest industry standards in a modern, ISO 9001 certified facility located in Hudson, Massachusetts. All certifications and calibrations are traceable to NIST.

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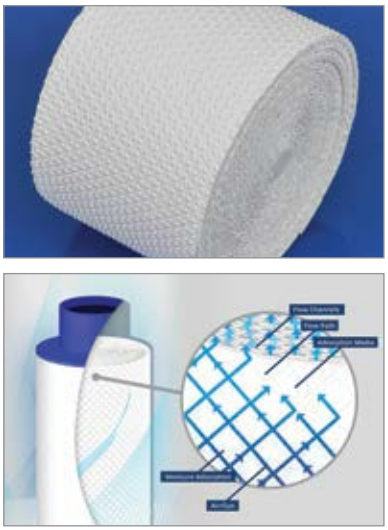
For more information contact tel: 508-263-5900, email: h2o@edgetechinstruments.com or visit www.edgetechinstruments.com

New Air Purification Skroll™ Adsorption Media

Air Purification Skroll™ (APS) is a revolutionary adsorption media (Patents pending). It consists of adsorbent crystals immobilised in a durable polymer support structure, produced in the form of a continuous embossed sheet. The Skroll construction and its integral engineered flow paths are designed to provide optimum performance in the dehydration of air and gases. It is tough, durable, recovers from miss-use and has long service life (typically 10 years).

This Skroll configuration can be used either as an insert directly into a new or existing housing, or in cartridge form. It can be installed in any orientation overcoming the many disadvantages of granular materials, especially in



Air Purification Skroll™ (APS) adsorption media

TECHNOLOGY PICKS

environments susceptible to shock and vibration and where mounting horizontally is necessary or desirable.

APS has been developed for demanding applications in the purification and dehydration of compressed air and gases. It overcomes the disadvantages of granular materials such as channelling, by-pass, bed fluidization, orientation, dust generation, miss-use (flooding), short service life and degradation due to high water loading.

For more information email: enquiries@apskroll.com or visit www.apskroll.com

Parker Hannifin's Pneumatic Division Air Saver Unit

Parker Hannifin's Pneumatic Division has released a new product that addresses several emerging trends such as Energy Saving Sustainability. The product is called an Air Saver Unit and can be applied to new and existing factory floor applications that incorporate uncontrolled blow offs, air nozzles and air guns.

Based on Energy Audits conducted by the U.S. Department of Energy, over 95 percent of compressed air systems have areas perfect for energy saving opportunities. More than 30 percent of air costs in a plant can be associated to inappropriate uses or artificial demand, costing a typical end-user plant a minimum of 1cfm =1/4HP =.207Kw@$.06/kwh = $110/yr.[1]

In air audits conducted by Parker Hannifin, the use of uncontrolled blow offs as one of the top air consumption issues on factory floors was identified. In this application, compressed air is directed through an air nozzle to provide a steady stream of air blow at a part to either dry it, clean it from debris, blow it off a conveyor, etc. It is not uncommon for these applications to continuously discharge air, even when a part was not present.

The Parker Air Saver has been released in Asia and Europe and has numerous documented success stories. The Air Saver generates a rapid pulse of air, not a continuous flow.

This pulsation has two major benefits:

1. Reduces Compressed air costs by as much as 40% – 50% as opposed to typical applications of constant flow.
2. Improves efficiency due to the pulsed air blow off. Compared to continuous air blow, the pulsed air blow hits the work repeatedly, improving the efficiency of the air blow for drying and removing debris.

Other benefits are:

- Reduces Green House Gases (CO_2 emission associated with production of compressed air).
- Easy installation into existing pneumatic systems with no additional PLC programming required (see photos below).
- Quick ROI (Return-On-Investment).
- Aligns well with corporate Sustainability programs & objectives.

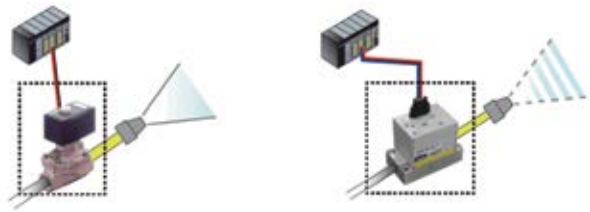
The Air Saver is available in sizes ranging from M5 ports, 5 CFM flow to 1 ¼" ports, 530 CFM. Other features include adjustable pulse frequency & duty cycle, silicon free grease version for paint shop applications, adjustment needle – on time/off time.

About Parker Hannifin

With annual sales of $11 billion in fiscal year 2016, Parker Hannifin is the world's leading diversified manufacturer of motion and control technologies and systems, providing precision-engineered solutions for a wide variety of mobile, industrial and aerospace markets. The company has operations in 50 countries around the world. Parker has increased its annual dividends paid to shareholders for 60 consecutive fiscal years, among the top five longest-running dividend-increase records in the S&P 500 index.

For more information, visit www.parker.com

Before… *…and AFTER with Parker's Air Saver!*



[1] Based on 90% compressor efficiency

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TECHNOLOGY PICKS

Siemens New Sinamics DCP 120kW DC-DC Converter

Siemens introduces a second addition to its popular Sinamics DCP product family of scalable (4X), bi-directional DC-DC drives. The DCP 120kW facilitates the integration of larger energy storage systems such as batteries and supercapacitors into multi-generator applications for a wide variety of industrial, smart grid and e-mobile uses, including photovoltaics, fuel cells, wind power and high dynamic uses such as peak shaving.

This new drive features combined buck/boost capability in a single device for optimized interconnection between DC sources and energy storage devices plus the DC link for both motor inverter and infeed/grid inverter. Available in a wide voltage range from 0-800V DC, this new inverter enables connection of energy storage systems to the DC link of an active line module. Bi-directional energy flow and scalable power are further features, along with a high efficiency up to 98.6% maximum energy yield can be fed back into a power grid, island or industrial grid.

The compact footprint of the DCP 120kW converter results from the built-in reactors and control unit for space-saving design use.

The built-in control unit also permits stand-alone operation of the drive. Profinet or Ethernet/IP are standard for Profibus communications.

Different infeed sources such as solar, fuel cell and wind power can be connected to realize a multi-generator power system, further broadening the application of this unit.

Uses for this new drive include peak shaving using stored energy on centrifuges, presses, elevators, stacker cranes, gantry cranes and industrial lift trucks, as well as battery test systems, and

Siemens SINAMICS DCP 120kW DC-DC converter has myriad uses in industrial, smart grid, marine and e-mobile markets. Unit features buck/boost capability for interconnection of DC sources with energy storage devices.

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test systems for photovoltaic power plants. Smart grid uses including energy storage on wind and solar systems, fuel cells and numerous marine applications such as emissions reduction, offshore platform winch and crane operations and charging technology for e-boats with battery power. In the emerging e-mobility market, the unit is ideal for fast-charge stations for e-cars, e-buses and hybrid systems that incorporate motors in combination with fuel cells or supercapacitors.

About Siemens Corporation

Siemens Corporation is a U.S. subsidiary of Siemens AG, a global technology powerhouse that has stood for engineering excellence, innovation, quality, reliability and internationality for more than 165 years. With 343,000 employees in more than 200 countries, Siemens reported worldwide revenue of approximately $98 billion in fiscal 2014. Siemens in the USA reported revenue of $22.2 billion, including $5.2 billion in exports, and employs approximately 46,000 people throughout all 50 states and Puerto Rico.

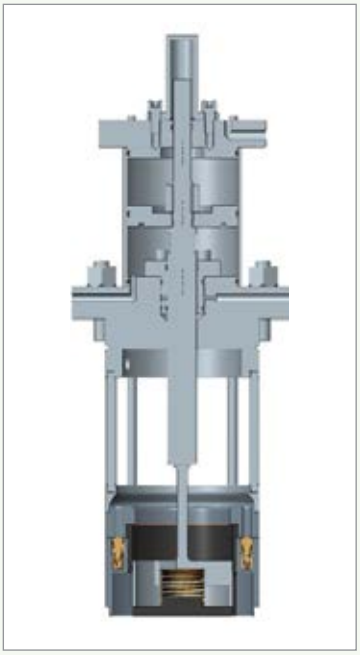
For more information, visit www.usa.siemens.com/drives.

New Zahroof Unloader Valve for Reciprocating Compressors

Zahroof Valves Inc. (ZVI), established with a focus on improving the performance of reciprocating compressors through the introduction of its innovative compressor valve and 10-year warranty, recently announced the launch of its newest product: the ZVI unloader valve.

The ZVI unloader valve is a patent-pending, piston-style unloader, designed to greatly improve reliability over traditional finger-style unloaders. It features a much lower added clearance volume compared to plug-style unloaders.

Setting the ZVI unloader valve apart is the ability to service it in the field without any additional machining. It is a more reliable unloader, as there are no fingers acting against a dynamic valve element. Unlike a plug-type unloader, there is not a large increase in clearance volume in the cylinder that can detrimentally affect the compressor throughout. The flow through the unloader is better than in the case of plate or channel valves, improving unloaded power, as well as eliminating drag forces and the aerodynamic flutter of valve elements. The new unloaders do not have the misalignment / assembly issues of plug-style unloaders. The actuation force required for the ZVI unloader valve is much less than that required for a plate-, channel- or plug-style unloader.



New ZVI unloader valve for reciprocating compressors.

The ZVI unloader valve can be used in all brands of compressors, at any speed, for both lubricated and non-lubricated cylinders. It can be used with virtually any gas where the maximum differential pressure across the unloader is up to 1500 psi.

"The ZVI unloader valve is an important advancement in a compressor industry where breakthroughs are few and far between," said Zahroof Mohamed, President of Zahroof Valves. "The flexibility in the design makes this technology applicable to users who are planning on an upgrade to an existing unloader system, adding a complete unloader system to a unit, or to the OEM compressor manufacturer who is looking for a reliable cylinder unloading system."

"The design of the unloader system for a specific application is backed by analysis and simulation using ZVI's Dynamic Compressor Simulation program. In an economy where it is important to reduce operational costs, the ZVI unloader does so by reducing downtime, reducing maintenance costs and improving efficiency."

For more information, visit www.zahroofvalves.com.

THE MARKETPLACE

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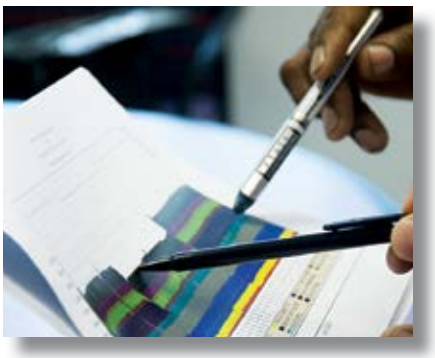
Problem:

A music studio equipment manufacturer had problems maintaining steady pressure with their compressed air system. Additionally, there never seemed to be enough air to meet production demand despite having both a 50 hp and a 75 hp rotary screw compressor. Month after month, energy costs soared with the compressors being the highest consumers. And during the summer months, increased condensate in the lines caused severe air quality issues.

Solution:

An Air Demand Analysis (ADA) revealed that the 50 hp unit (with modulation control) was producing only a fraction of its total capacity yet consuming full load kW. A single 50 hp compressor with adequate storage could easily meet the plant's demand and provide significant energy and maintenance cost savings. The air quality issues were due to undersized storage and air treatment.



Result:

The new, energy-efficient 50 hp dual control compressor provides all the air that's needed and keeps the plant pressure rock steady—with the 75 hp compressor still there for backup. The new refrigerated dryer with energy-saving controls and condensate management system have solved the air quality issues, while the 361,099 kWh reduction in annual energy consumption has this customer singing a happy tune.

Specific Power of Previous System:	59.74 kW/100 cfm
Specific Power of New System:	19.05 kW/100 cfm
Annual Energy Costs of Previous System:	$52,981 per year
Annual Energy Cost Savings:	$36,110 per year
Utility Rebate:	$41,921
TOTAL FIRST YEAR SAVINGS:	**$78,031**

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