The Magazine for ENERGY EFFICIENCY in Compressed Air Systems

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March 2016

Plastic Molding


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SUSTAINABLE MANUFACTURING FEATURES

12

18

COLUMNS

32

FROM THE EDITOR | Plastic Molding

Here are some "plastics fast facts" provided courtesy of SPI, the plastics industry trade association, at www.npe.org. The plastics industry:

- is the 3rd largest manufacturing industry in the U.S.
- employs nearly 900,000 workers
- creates $374 billion in annual shipments
- operates nearly 18,500 plastics facilities in the U.S.

Our lead article is written by former Sidel employees who have formed SKV Services, a company dedicated to servicing PET blow-molding machines and introducing new blow mold base technology able to lower compressed air pressure requirements. These French gentlemen really know how compressed air is used in bottle blowing!

PET Power Containers, a Canadian manufacturer of PET plastic containers, had plans to add more blow-molding equipment. Our second article details the utility-incentive-winning compressed air system assessment, performed by Shannon de Souza of Compressors aiR Us. His assessment was used, and a new compressed air system was installed to efficiently support the plant expansion.

Pete Rhoten, from Hope Air Systems, and Greg Fitzpatrick, from Compressed Air Technologies, describe a plastics plant whose compressed air system suddenly couldn't support the 5th SIPA blow molding machine when it kicked on. The reciprocating compressors appeared to be working fine, so what had changed? This article describes the system assessment leading to the discovery of the "demons" hidden inside the blow-molding machines. This project is the subject of our March 2016 Webinar titled, Purging Demand-Side Demons at a PET Bottle Blowing Plant (Details about the Webinar are on page 31).

Bauer Compressors is a leader in on-site nitrogen generation for gas-assist plastic injection molding. Members of their dedicated Plastics Technology Group explain, in a feature article, how nitrogen is used to pressurize mold cavities – rather than liquid mediums like melted plastic. The benefits include reduced material waste, shortened cycle times and improved product quality.

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

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INDUSTRY NEWS

SPX FLOW Opens New Dehydration R&D Lab and Training Center

Through its Dehydration business, SPX FLOW is a global leader in the supply of compressed air and gas dehydration and filtration solutions. The company recently announced the opening of a new 10,000-square-foot Research & Development Lab and Training Center at its Dehydration headquarters in Ocala, Florida. The center offers advanced testing capabilities to conduct compressed air dryer and filter performance validation to international standards. Other competencies include testing and performance validation of filtration media, condensate drain valves and desiccant material.

“Our testing capabilities validate product performance to better serve our customers in a highly competitive, global market place," stated Jay Francis, National Sales Manager for Dehydration’s Industrial Product Group.

SPX FLOW’s globally recognized Dehydration brands include Hankison, Deltech, Pneumatic Products, Delair and Jemaco. As part of SPX FLOW’s continual work to give better customer experience, the new facility also serves as an expert product sales and field service training center for channel partners, service providers and end users.

“We provide both in-depth classroom and practical 'hands-on' training to enhance the product and applications knowledge of channel partners that promote, maintain and service our products," Francis added.

The new SPX FLOW Dehydration R&D Center provides the ability to test products to international standards and validate product performance to better serve customers.

INDUSTRY NEWS

Compressed Air Dryer Performance Validation

To validate product performance, SPX FLOW constructed an environmentally controlled laboratory in the new center to test refrigerated, desiccant and membrane dryers to the ISO 8573-1 air purity standard. The test lab creates variable ambient conditions and effectively measures product performance. Full instrumentation and PC-based data acquisition accurately records pressure dew point, pressure drop and power consumption.

The laboratory is equipped to simulate a wide range of flow and site conditions. To enable dryer testing under varying load profiles, rotary screw compressors reliably generate air flow to 3000 scfm. To simulate standard and extreme site conditions, ambient and inlet air temperatures are controlled in the range 35˚F (2˚C) to 130˚F (54˚C). Air saturation levels are a critical design condition in air dryer capacity rating, and a moisture saturator is further used to precisely control air saturation levels up to 100 percent. Global power supply requirements may also be replicated to 480 volts, in 50 and 60 Hertz.

ISO 12500 Filter Testing

The Ocala R&D Lab is furnished with three ambient-controlled test booths to validate compressed air filter performance to the ISO 12500 series of standards. ISO 12500 provides internationally recognized test parameters for manufacturers to test and rate compressed air filters. It is a multi-part standard with Part 1 defining the testing of coalescing filters for oil aerosol removal performance, Part 2 quantifying vapor removal capacity of adsorption filters, and Part 3 outlining requirements to test particulate filters for solid contaminant removal.

Critical to the ISO 12500 test standard is the ability to disperse the defined inlet challenge concentration and the technology for downstream detection. Test results provide users with commercial data for comparative purposes and differentiate filtration products through certifiable performance. Performance certificates, in accordance with ISO 12500, are available for oil, solid and vapor removal filters.

For more information, visit www.spxflow.com.

Accudyne Industries Names New CEO

Accudyne Industries, a global provider of flow control systems and industrial compressors and parent company of Sullair, announced that Charles L. "Chuck" Treadway has been named chief executive officer, succeeding Elmer Doty. Mr. Treadway, who most recently served as president and chief executive officer of Thomas & Betts Corporation, a global business unit of ABB, will assume the position on March 1 and be based in Dallas, Texas. Accudyne is a portfolio company of BC Partners and The Carlyle Group.

Raymond Svider, a managing partner at BC Partners said, "We are pleased to welcome Chuck to the Accudyne team. He has a proven track record of growing industrial businesses globally and will build upon Accudyne's strong culture of innovation and product delivery. We believe Chuck's leadership and experience will propel Accudyne's long-term success."

Mr. Treadway said, "Accudyne is a strong company with a strong portfolio of brands and leading positions in attractive end-markets. I look forward to working with customers and partners to deliver technologies and solutions to solve their most challenging problems. I am eager to work with such a talented leadership team and dedicated work force to take Accudyne to the next level of growth and profitability."

Brian Bernasek, Carlyle managing director and head of the global industrial and transportation team, said, "On behalf of the board, we are grateful for Elmer Doty's service these past three years. Elmer has helped Accudyne establish a strong culture, expand product capabilities and enter new markets. He has left us with a strong foundation on which to build. We look forward to a smooth transition and believe Accudyne is in good hands with the proven leadership of Chuck Treadway."

Mr. Treadway has been Chief Executive Officer of Thomas & Betts since 2012 and President and Chief Operating Officer since 2011. Mr. Treadway joined Thomas & Betts in 2009 as Group President of Electrical, its largest segment. Under his leadership, the company delivered industry-leading growth and profitability.

Prior to Thomas & Betts, Mr. Treadway served in several management and executive positions at

INDUSTRY NEWS

Schneider Electric S.A., Prettl International, Inc. and Yale Security, Inc. He earned his Bachelor and Master of Science degrees in electrical engineering from the University of Louisiana-Lafayette and Clemson University, respectively, and his M.B.A. from Harvard Business School.

For more information, visit www.accudyneindustries.com.

C.H. Reed Provides High-Purity Nitrogen to Aluminum Foundry

A local aluminum foundry was experiencing issues with impurities in its aluminum castings and needed a quick, completely packaged solution to improve the quality of their finished product.

When aluminum is cast, impurities known as inclusions can create weak points in the product. One of the most prevalent causes of these impurities is the presence of hydrogen in the molten aluminum due to atmospheric humidity, combustion in gas furnaces, condensation on tools, fluxes, and alloy additives. Hydrogen gas is soluble in liquid aluminum and can pass through it almost as easily as it passes through air. As the liquid metal cools and becomes hard, the hydrogen flows from areas of high pressure to areas of low pressure, which creates pockets of gas. When the metal solidifies, those pockets become inclusions and weak spots in the castings.

Installed by C.H. Reed, the foundry's nitrogen generation system featured a nano NRC Cycling Refrigerated Air Dryer (left) and a nano N_2^{plus} Series Nitrogen Generator (right).

The demand for higher quality aluminum products is progressively on the rise, especially in cutting-edge industries like aerospace. Degassing is a process used to remove the hydrogen from the molten aluminum. The most popular degassing method involves introducing nitrogen gas into the liquid aluminum. The hydrogen causing these inclusions is simply drawn to the nitrogen bubbles, then carried up through to the surface and released, thus eliminating the hydrogen gas pockets causing the impurities.

To effectively supply high-purity nitrogen into this foundry's process and fulfill the needs of their application, C.H. Reed installed a nano N_2^{plus} Series Nitrogen Generator piped together with Transair aluminum compressed air piping. The system also included a nano NRC Cycling Refrigerated Air Dryer, along with two F-Series coalescing pre-filters and an F-Series general purpose buffer vessel filter.

Overall, this foundry will experience a rapid return on investment (typically less than 24 months), increased reliability, a reduced carbon footprint, and increased worker safety—all while eliminating the impurities in their finished product.

For more information, visit www.chreed.com.

Festo Names Two New Distributors in Colorado

Festo has named two new distributors in Colorado: MSI Tec, and ProWest Pneumatics and Supply, Englewood. Festo is one of the world's leading suppliers of pneumatic and electric motion actuation components and subassemblies. The company is recognized for the breadth of its product lines, the number of industries served, trailblazing engineering, and the unsurpassed performance of Festo-based solutions.

For more than 25 years, MSI Tec has played an integral role in the design, building, installation, and support of thousands of automation systems. MSI Tec specializes in precision motion control, intelligent machine control and operator interface systems, device networking for remote monitoring and control, computing and networking systems, both industrial and collaborative robotics, sensing technologies, and machine safety. MSI personnel provide help with product selection, engineering, programming, installation, and product training.

ProWest Pneumatics and Supply offers industrial customers in the Rocky Mountains a one-stop-shop for pneumatic components and power/controlled tools. ProWest customers are involved in building automated machines and systems, plant maintenance and operation, light assembly, material handling, transportation, and oil and gas generation. The company's experienced staff offers technical solutions from complete assembly setup to pre-engineered automation design. ProWest also specializes in replacement or crossover for hard-to-find components.

"The best distributors in automation today have advanced parts stocking and distribution systems in place, as well as the engineering expertise to help customers quickly identify optimum solutions," said Mark Snyder, Head of Festo U.S. Distribution. "These distributors invest in training their personnel and instilling a culture of service. MSI Tec and ProWest Pneumatics and Supply exemplify these qualities."

Festo recently named two new distributors, expanding its distribution network throughout the U.S.

For more information, visit www.festo.us, www.msitec.com, and www.prowestair.com.

Innovative Blow Molds REDUCE COMPRESSED AIR PRESSURE in PET Blow Molding

By Vincent Duvernois, Partner – SKV Services, Stephane Larcade, President – SKV Services, and Jean Pilnard, Export Manager – COMEP

Technological trends in plastics manufacturing are driving the costs of production down. In industrial PET blow molding specifically, two innovative techniques have had major impacts over the last 15 years: "light weighting" the plastic bottles, and recirculating high-pressure compressed air. Both have helped to improve the energy efficiency of PET blow molding by reducing compressed air requirements dramatically.

In the past, the pieces of PET used to manufacture 16-oz water and carbonated soft drink (CSD) bottles weighed anywhere from 12 to 14 grams. The compressed air pressure required to blow those PET bottles was between 365 and 590 psi (25 to 40 bar), depending on the container shape. Light weighting, a method for reducing the amount of PET needed to produce a bottle, has cut the weight of PET to about 8 grams for bottles of the same size. Consequently, the compressed air pressure requirement decreased, enabling tremendous energy savings.

Since the early 2000s, compressed air recovery systems have also added to the energy savings by recycling high-pressure compressed air for other processes. Recirculated compressed air can be used to produce pre-blow air and service air for the blow wheel, or it can be returned to the plant's lower pressure compressed air network. In a traditional machine from Sidel,

> "In industrial PET blow molding specifically, two innovative techniques have had major impacts over the last 15 years: "light weighting" the plastic bottles, and recirculating high-pressure compressed air."
>
> — Vincent Duvernois, Partner – SKV Services

for example, up to 60 percent of the exhausted compressed air can be reused in the blow-molding machine's low-pressure circuit. While there were struggles initially to achieve the advertised savings (there are a lot of controls required for the system), air recirculation technology is now used frequently, and is saving a lot of money for end users.

The molding section of the blow-molding machine presents the most recent opportunity for achieving substantial energy savings. Blow-molding machines can retrofit or incorporate new blow mold technologies requiring lower compressed air pressures.

Correct Compressed Air System Configuration for PET Blow Molding

Industrial PET blow molding requires a stable supply of compressed air, but maintaining the constancy of the supply is challenging. PET bottle-blowing applications are designed to be fast moving, with the capability to blow up to 2400 bottles per cavity per hour. This can cause large pressure drops in the headers and filters delivering compressed air to the blow-molding machine. In order to compensate, air compressors will operate at much higher levels than necessary. In some situations, manufacturers will have to turn a blow-molding machine down to keep enough pressure for the other machines.

Because of the system dynamics of a PET bottle-blowing plant, the design of the compressed air system is paramount. Typically, plastics manufacturers will design two separate compressed air systems, one for low pressure and the other for high pressure, so that the PET blow molders do not impact other processes downstream. This setup is also ideal for compressed air recirculation, as the manufacturer can take the high-pressure compressed air used to blow bottles and recycle it back into the plant's low-pressure system.

INNOVATIVE BLOW MOLDS REDUCE COMPRESSED AIR PRESSURE IN PET BLOW MOLDING

COMEP's Low Pressure Base® can be used to lower the compressed air pressure requirements of blow-molding machines.

In addition to separating the high- and low-pressure compressed air systems, localized air receivers and appropriately sized pneumatic components can help reduce pressure drop. The receiver tank should be positioned as close as possible to the point of use (the PET blow molder), and the piping should be as large as possible to handle instantaneous spikes in demand. Under-sized pneumatic components can be retrofitted for higher flow to optimize flow from the storage receiver all the way to the mold. An expert should be consulted for this process, as identifying and measuring pressure drop within a blow-molding machine can be very challenging.

Compressed Air Treatment and Filtration

Most problems caused by compressed air in PET blow molding are related to cleanliness, be it water vapor, oil or particulate. During production, high-pressure compressed air comes into contact with beverage containers—meaning quality is paramount. Compressed air dryers are standard, and it is common to place two sub-micronic filters where the high-pressure compressed air enters the blow-molding machine.

PET blow-molding machines use pneumatic valves to operate, and those valves need to work to the millisecond. Commonly, there are six valves found in a blow molder, including the pre-blow, high-blow, recovery, exhaust, air sweep (balayage), and a valve on the stretch cylinder. If the compressed air supply is even slightly contaminated with oil, water, or particulate, then any number of those valves will not operate as designed, and you will have trouble. Particulates, for example, can impact the flow of compressed air moving through the valve to the detriment of the final product's shape.

Finding and Fixing Compressed Air Leaks

Whether they are caused by contaminated compressed air moving through the valving, or a more innocent reason, leaks in the compressed air system are inevitable. From our experience—and depending on the plant—many operations do not perform the maintenance required to keep their system running efficiently. As compressed air leaks accumulate, the costs can escalate quickly. And worse still, there might be seven or eight lines of blow molders running all day, making leaks incredibly difficult to detect audibly.

In PET blow molding, leaks regularly occur inside the machine itself—commonly in the tooling, pneumatic circuit and the valves. For instance, an application called "compensation" can be a culprit of leaking high-pressure compressed air. During compensation, a cavity next to the mold is supplied with compressed air through an O-ring, and it presses the two sides of the mold together. Because of a lack of maintenance, these O-rings can leak. Not only does the leak waste high-pressure compressed air, but the bottles produced at the machine are not uniform with the others in size, causing product defects.

Given the potential risk of leaks, a comprehensive leak management program is highly recommended for PET blow-molding facilities. Flow

> "Most problems caused by compressed air in PET blow molding are related to cleanliness, be it water vapor, oil or particulate."
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> — Stephane Larcade, President – SKV Services

meters positioned at each machine can help identify leaks by showing users average flow rates. If the compressed air flow rate jumps, maintenance can be alerted to find and fix a leak. Vigilant maintenance of the pneumatic circuitry and valving on the blow molders themselves can also help prevent compressed air leaks from springing up.

Blow Mold Bases Designed for Better Venting

Once system design and best practices are addressed, PET bottle manufacturers can focus on continuous process improvement. The molding section of the blow-molding machine presents another opportunity for achieving substantial energy savings. COMEP's Low Pressure Base® has been tremendously successful for industrial clients in Europe, Japan, the Middle East, Central America and the U.S., with more than 2500 mold bases sold and installed since 2013. Currently, 0.5-liter CSD and water bottles can be blown at approximately 334 psi (23 bar), and 2-liter CSD bottles can be blown at 295 psi (21 bar), representing a large reduction in standard pressure requirements.

While the Low Pressure Base is approximately two times more expensive than standard mold bases, the savings can be huge, with a typical ROI of six months or less. In addition, the technology completely respects the customer's original mold base shape, and original production speed. In most cases, the Low Pressure Base definitively limits the risks of stress

The patented design of the Low Pressure Base® can provide tremendous ROIs for customers.

INNOVATIVE BLOW MOLDS REDUCE COMPRESSED AIR PRESSURE IN PET BLOW MOLDING

About SKV Services

Founded in 2014 by PET blow molding industry veterans, SKV Services provides service, rebuild, and rigging for blow-molding machines. As a consultancy for plants with blow-molding applications, SKV can help optimize processes by retrofitting machines and training staff on how to properly maintain equipment for efficiency and reliability.

Company President Stephane Larcade has worked in the blow-molding industry for nearly 20 years, primarily in North America. Vincent Duvernois has 30 years of experience in the industry, and worked for Sidel previous to SKV. To date, the company has grown to 12 people, and its base of operations is located in Virginia. SKV partners with COMEP to bring energy-efficient solutions to industrial PET blow-molding applications.

COMEP's Super Vented Mold® is designed with additional vents in the ribs of the mold.

cracking (better PET "naturally" stretch in the base, hence there is less amorphous material on and around the preform crystallized injection point). Finally, the technology can increase the general mechanical performances of the container.

Super Vented Molds® Present Opportunity for More Energy Savings

Developed in 2013, the Super Vented Mold is COMEP's latest innovation. Blow mold machines need to vent the excess compressed air used during the bottle-blowing process. Traditional blow molds mainly vent compressed air through the parting line—or the seam—of the mold itself. In the Super Vented Mold, additional vents have been engineered into the ribs of the mold. The design ensures the PET is in contact with the mold surface much faster, making the process especially efficient when at high production speed, as the contact time is increased.

The quicker venting also reduces the required compressed air pressure it takes to blow the bottle. A 1.5-liter water bottle weighing 20.5 grams, for example, needs only 218 psi (15 bar) of compressed air pressure for full expansion. In addition, the process speed remains the same, as does the bottle's shape. The molds can be added to blow-molding machines, such as those made by KHS, Krones, and Sidel, but they require extra machining for integration. COMEP sells the blow molds to both OEMs making blow-molding equipment, and to end users looking to retrofit their equipment for energy savings.

> "Traditional blow molds mainly vent compressed air through the parting line—or the seam—of the mold itself. In the Super Vented Mold, additional vents have been engineered into the ribs of the mold."
>
> — Jean Pilnard, Export Manager – COMEP

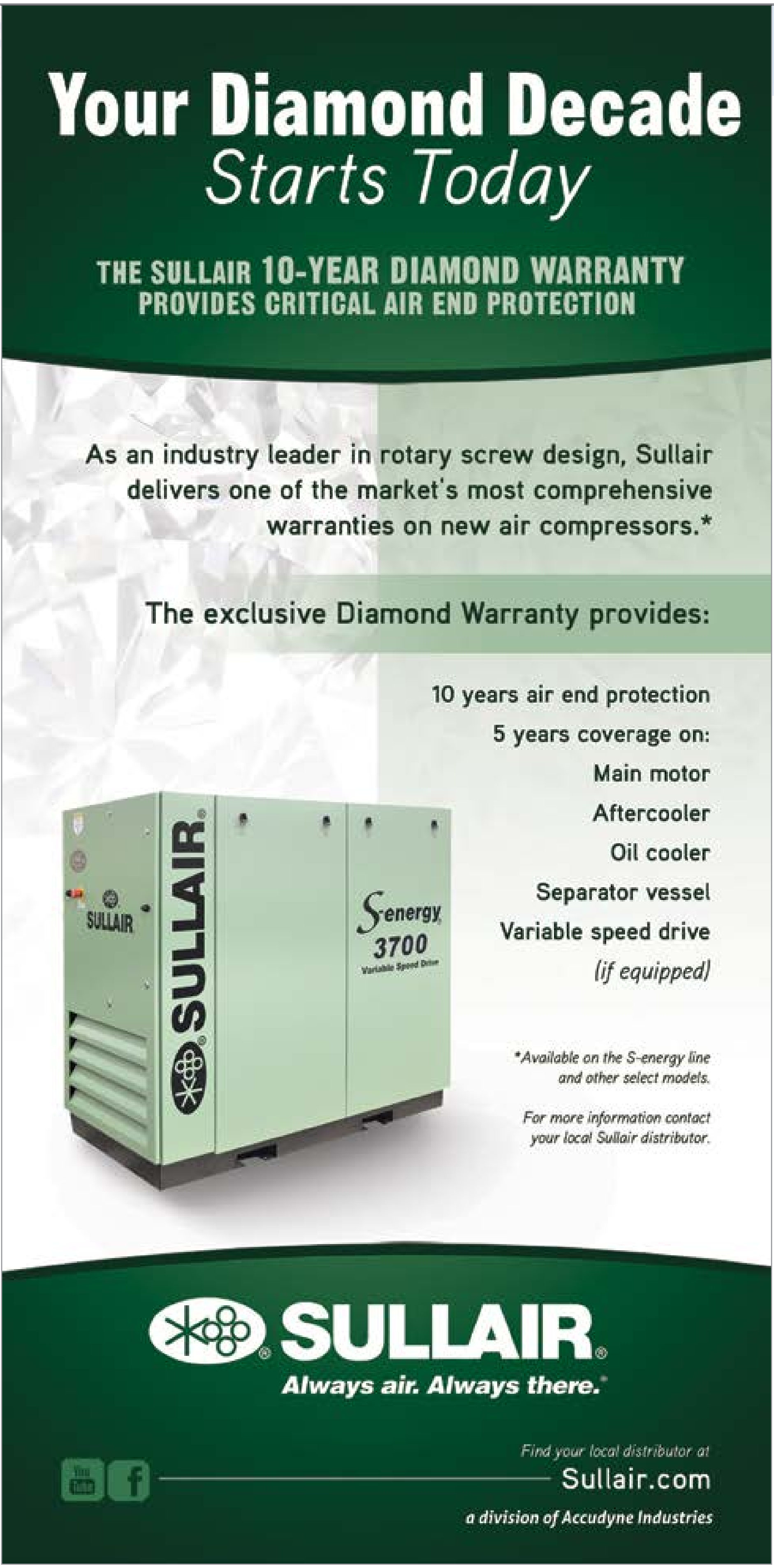
About COMEP SA

Founded in 1998, Comep is an independent company based in Cognac (France), producing PET blow molds for all OEM machines regardless of the technologies and standards, and providing the related services as bottle design, prototyping, worldwide technical assistance and R&D for process improvement. Its own continuous production workshop supplies molds all around the world.

In order to take advantage of newer, more energy-efficient technologies, however, the compressed air system at the plant needs to be configured correctly. This means having the proper compressed air treatment equipment in place, along with an appropriate control strategy for the supply system. It also means implementing a rigorous preventative maintenance program for the PET bottle-blowing machines, because air leaks can cause major problems for system efficiency and process integrity. BP

For more information, contact Vincent Duvernois, tel: (404) 513-3318, email: Vincent@skvservices.com, or visit www.skvservices.com. Additional information about COMEP can be found at www.sa-comep.com.

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



PET Power Containers and Compressors aiR Us Design Plant Expansion

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

PET Power Containers, a Canadian manufacturer of PET plastic containers, had plans for expanding its operations with the addition of more blow-molding equipment. Before the expansion could happen, however, the company needed to assess its compressed air system. Based in Vaughan, Ontario, PET Power provides a dizzying array of differently shaped and sized plastic bottles. Their operations run 24/7, and compressed air plays a key role in their primary manufacturing applications, including PET blow molding, PET preforming, and labeling bottles.

For the compressed air system assessment, PET Power Containers contacted Compressors aiR Us, Inc., an energy auditing company located in Ontario, to evaluate its compressed air system. The goals of the system assessment were to evaluate the current compressed air system, identify any opportunities for improvement, and make sure the plant could accommodate the expansion.

PET Power Containers manufactures all shapes and sizes of plastic bottles using a two-stage PET blow-molding process.

Compressed air auditor Shannon de Souza, CEM and Qualified AIRMaster+ Specialist, helped inspect the compressed air system at PET Power Containers. During his audit, he found the plant's two reciprocating air compressors running inefficiently. Additional issues were found within the piping and drains, resulting in large amounts of moisture and the need for manual draining.

All problems considered, there was no way the existing system would accommodate plant expansion. Several solutions were implemented to optimize the compressed air system, including the installation of a SIAD Vito 1330 reciprocating air compressor, a cycling refrigeration dryer, and multiple zero air-loss condensate drains. On its own, the installation of the SIAD Vito air compressor will save PET Power Containers an estimated 534,239 kWh annually, or about $53,424 per year (at $0.10/kWh). The retrofit also qualified for a rebate of $109,600 through the local utility company.

PET Power Containers is a Salbro Bottle company based in Vaughan, Ontario.

Compressed Air Uses at PET Power Container

There are two types of PET blow-molding operations. The first is single stage, where the preform is manufactured in the blow-molding machine itself. One side of the machine performs the injection molding, and the other side blows the molds to form. The second type is two stage, where the preforms are fed into the machine from a different source. PET Power Container is a two-stage PET manufacturer. The company manufactures its preforms separately, feeding them into the blow molder as a separate process. With prototyping and 3D printing capabilities, the company can also design all of its own molds in house.

PET Power Containers manufactures bottles sized anywhere between 8 and 128 oz. As its operations grew, the company started manufacturing more large bottles, consequently increasing demand for high-pressure compressed air. The plant also planned to expand its blow-molding capabilities with two to four additional blow-molding machines. Since the two existing reciprocating air compressors had been in the plant since 2002, plant management decided to assess the entire compressed air system prior to expanding.

Assessing the Compressed Air Situation

As is often the case with plastics manufacturing facilities, PET Power Containers employs two compressed air systems—one for low-pressure applications, like the company's two injection molding machines, and one for the high-pressure applications, such as the plant's seven PET blow molders. This particular compressed air audit focused on the high-pressure compressed air system. Installed in a dedicated compressor room, the high-pressure system comprised two reciprocating air compressors, each with a dedicated refrigerated air dryer. Compressed air was fed into a 120-gallon receiver tank (dry), before being routed to the plant.

During a comprehensive seven-day audit, de Souza measured the compressed air system's baseline energy efficiency, assessing both the supply and demand sides. During his assessment, specific energy conservation measures (ECMs) were identified, and retrofit projects were proposed to hit target ECMs. All proposals included critical information about energy costs in order to make the opportunities eligible for local utility incentives through the Save ON Energy RETROFIT Funding Program.

Establishing the Baseline for Incentive Opportunities

The compressed air audit included the following steps, carefully undertaken per international standards to properly report energy measurements.

- Measure the plant's baseline compressed air system efficiency, taking both the supply and demand side into consideration.
- Declare the set of conditions to which all energy measurements will be adjusted, so savings can be reported as avoided energy.

PET POWER CONTAINERS AND COMPRESSORS aiR US DESIGN PLANT EXPANSION

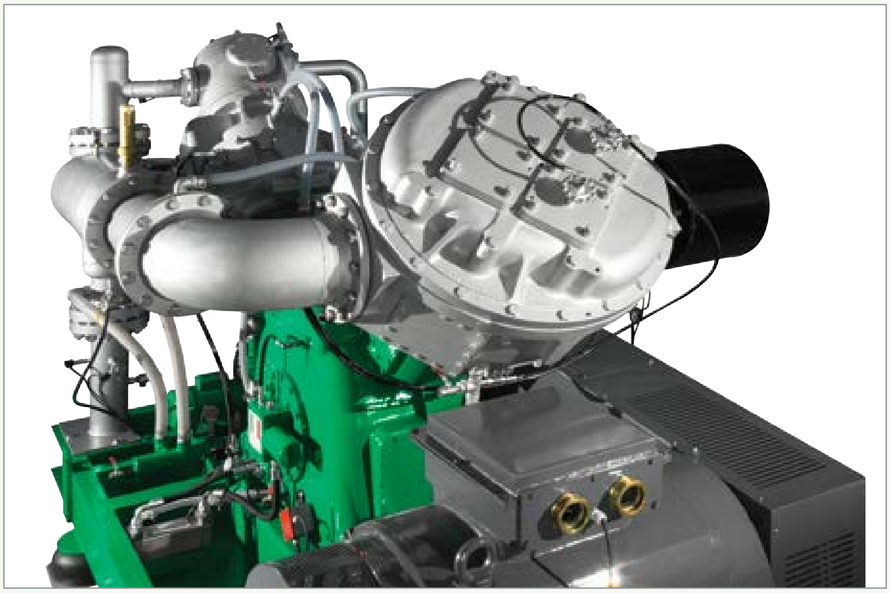
- Define static factors that have been assumed for the purpose of establishing baseline data.
- Specify metering points, and the type of equipment used to measure baseline data.
- Identify Energy Conservation Measures (ECMs) within the facility's compressed air system.
- Propose retrofit projects that will address the targeted ECMs.
- Estimate the potential consumption savings in kW and kWh that could be realized with proposed ECMs.
- Declare the energy prices that will be used to value optimization opportunities and estimate savings for the ECMs.
- Define the measurement and verification (M&V) plan and International Performance Measurement and Verification Protocol® (IPMVP) Option that will be used to determine savings, should the proposed ECM receive approval.
- Provide critical information for deciding whether the proposed system efficiency

SIAD Vito Air Compressor for PET Blow-Molding Applications

SIAD Macchine Impianti is an Italian manufacturer of compressors for all types of gases, mixtures and air separation plants. Involved in the design, production and sales of air compressors worldwide, the company's Compressor Division manufactures lines of air compressors specifically designed for PET bottle-blowing applications.

Launched in February of 2014, the SIAD Vito is an oil-free, three-stage reciprocating air compressor tailored to PET blow-molding applications. From its inception, the Vito air compressor has been developed with the application in mind. The design engineers have reduced power losses concerning both the flow dynamics and the compressor's mechanical operation, in addition to reducing reciprocating masses to eliminate vibration as much as possible.

The SIAD Vito can reduce energy costs by up to 12 percent when compared with the previous series of reciprocating air compressors. This has been achieved through the reduction of both pressure losses across the cylinder valves and friction losses. As an example, the design team reduced the number of piston rings inside the chamber, selecting the smallest number of rings needed for PET bottle-blowing applications. This results in less friction and less kW usage, without reducing the lifetime of the air compressors themselves.



The SIAD Vito oil-free reciprocating air compressor was specifically designed to reduce energy costs in PET blow-molding facilities.

The SIAD design team created the machine's integral moisture separator by focusing on quickly reducing the speed of air and abruptly changing the direction of flow. This has helped to improve the separation of air and water in the process of producing ISO 8573-1 compliant compressed air. SIAD also partnered with several suppliers in the design of main components and other parts, resulting in a robust technical design with a guaranteed 8,000 continuous running hours before any maintenance is required.

For more information, visit www.siadmi.com/en.

upgrades are feasible to proceed with potential from the Save ON Energy RETROFIT Funding Program.

Determining the Details of the Compressed Air System

Based on data gathered during the compressed air audit and extrapolated over the plant's 24/7 operations, de Souza calculated that the plant runs approximately 8,760 hours per year. To determine the running efficiency of the air compressors, voltage meters were used to measure the voltage to the load/unload solenoid valve. When the solenoid was energized, the air compressor went to 100 percent load. When de-energized, the unit unloaded. This technique helped to determine the FAD at 30-minute and 1-hour intervals. The measurements indicated that the two existing air compressors were operating at a worse specific power (kW/100 cfm) than anticipated. According to plant maintenance, modifications had been made to the air compressors, and they were de-rated accordingly. Operating data can be seen in Chart 1.

CHART 1: DETERMINING SPECIFIC POWER

AIR COMPRESSOR CONTROLS	UNIT 1 LOAD/UNLOAD	UNIT 2 LOAD/UNLOAD
Voltage	575/3/60	575/3/60
kW	90	110
MAWP (psi)	580	580
Maximum Flow (cfm)	239 *De-rated to 205	341 *De-rated to 248
Specific Power (kW/100 cfm)	38.5	32.3

A compressed air system pressure profile for the plant was also developed. Used to feed seven PET blow-molding machines, the high-pressure compressed air system provided an average of approximately 453 acfm at peaks of 605 psig. After measurements, it was determined that the average system pressure on weekdays was 558 psig. On weekends, the average system pressure

PET POWER CONTAINERS AND COMPRESSORS aiR US DESIGN PLANT EXPANSION

dropped significantly to 513 psig. Annual energy costs for supplying high-pressure compressed air was about $117,323.

The piping and drainage systems also had issues. Large amounts of moisture were found in the compressed air piping—a damaging condition that could potentially lead to corrosion. Water could also backfill the air compressors when in idle or standby mode. In addition, the minimal drains on the system were problematic, as manual draining was needed on a daily basis. The supply piping system header, which feeds the plant machinery, was 2 inches in diameter. Where the Compressed Air Challenge recommends the supply header to deliver compressed air at 20 fps, the plant's system was calculated at 8.56 fps. Finally, a leak detection sweep identified one major compressed air leak resulting in an estimated leakage of 15 to 20 cfm.

The newly installed SIAD Vito 1330 will help PET Power Containers save approximately $53,424 per year in energy costs.

Accounting for Plant Expansion

As initially discussed, PET Power Containers planned to expand current production with the addition of three to four blow-molding machines. The system assessment determined the current compressed air system would not be able to satisfy the expanded compressed air demand. Using estimates from the initial audit, the plant would add approximately 62 to 124 cfm of demand—for two or four new blow-molding machines respectively. To accommodate the increased demand, PET Power would likely purchase a used reciprocating air compressor to add capacity. If used in conjunction with the existing air compressors, it would result in the following inefficiencies:

- It would increase demand charges for another 110 kW motor that must start.
- Plant kWh consumption would increase, as the new air compressor would have run at partial load. This running condition would increase unloaded energy consumption and require the air compressor to consume kW with no compressed air being produced.
- There would be a negative impact on the plant's power factor due to an induction motor running unloaded for large periods of time.

> "This machine is capable of running more blow molders, so we can grow. At the moment, it's running just over 60 percent on our current machines. We can comfortably put in a few more blow-molding machines and keep running with the same equipment."
>
> — Paul Saltz, VP, PET Power Containers

Recommended Compressed Air System Retrofit Projects

The following recommendations were made to improve the compressed air system at PET Power Containers. If implemented just for the existing system, the projects would save the company approximately $36,929 annually in energy costs (10 percent safety factory included). However, with expanded plant capacity, the recommendations would save PET Power $53,423 annually, and still provide capacity for additional expansion.

1. Install one new SIAD Vito 1330, a three-stage, oil-free, variable speed drive reciprocating air compressor designed specifically for PET blow-molding applications.

2. Install a new 1000 cfm cycling refrigerated air dryer dedicated to the new air compressor. The two other air dryers could then be shut down.

3. Replace drains in system with zero air-loss Bekomat drains to remove all moisture while eliminating compressed air discharge when purging. The new drains will also remove all bulk moisture accumulation in the supply header upstream of the air dryer.

4. Reduce system pressure to the lowest possible target pressure using a target pressure on the Vito 1330, as opposed to the pressure band currently required. This would include reducing pressure on the weekend if no reduction in quality is found, as pressure was significantly lower without reported incidence during the compressed air audit.

5. Maintenance costs would be minimized with the implementation of these ECMs, as there would only be one air compressor and one air dryer required—even with planned production increases. The new air compressor would also be covered by a 5-year warranty.

6. Repairing the leaks found in the compressed air pipe distribution system would help eliminate 15 to 20 cfm.

The new SIAD Vito 1330 retrofit would handle both the plant's current load and the load from additional blow-molding equipment —all from one air compressor. This would also leave PET Power with a partial backup compressor system in one of the original air compressors. Because the Vito has a VSD, it could be programmed to run at a target pressure on weekdays, and a different target pressure on weekends, maximizing the energy efficiency in both cases.

Compressed Air Retrofit Package Qualifies for Funding

Altogether, the SIAD Vito Retrofit Package included the new air compressor, a new refrigerated air dryer, zero air-loss condensate drains, and a replacement of all piping on the supply side. Energy savings from the zero air-loss drains were calculated into the energy incentive report as part of the 10 percent correction factor. Unfortunately, energy savings from the new refrigerated dryer were not calculated, as the original dryers were not metered. The energy savings calculated to earn incentive funding—as shown in Chart 2 (pg. 25)—resulted in $109,600.

PET POWER CONTAINERS AND COMPRESSORS aiR US DESIGN PLANT EXPANSION

Room for Expansion with the New SIAD Vito Air Compressor

As a result of the compressed air system retrofit, the staff at PET Power Container could not be happier with the services rendered by Compressors aiR Us, Inc. Shannon de Souza and his team worked tirelessly to optimize the system, and get the new air compressor up and running.

"Compressors aiR Us did everything for us. And, honestly, they were outstanding," Paul Saltz, VP, PET Power Containers, commented. "Whatever they did, they went above and beyond. We did the installation between Christmas and New Year. They told us we'd be up and running January 4, and we could literally switch our machines on by the first of January. Not only did they just do the installation, they came afterwards to monitor and check the machine. They were phenomenal."

Saltz was also particularly impressed with the new SIAD Vito 1330 air compressor. With the installation finalized, he and his colleagues at PET Power Containers are now ready to ramp up production.

Paul Saltz, VP, PET Power Containers, could not be happier with the new SIAD Vito 1330 installed by Compressors aiR Us, Inc.

CHART 2: CALCULATING ANNUAL ENERGY SAVINGS

	ELECTRICITY DEMAND (KW)	ANNUAL ENERGY CONSUMPTION (KWH)	ANNUAL OPERATING COSTS ($)
Base Installation	258	1,432,004	$143,200
SIAD Vito Retrofit Package	121	897,765	$89,776
Savings	137	534,239	$53,424

*Based on a rate of $0.10/kWh

"This machine is capable of running more blow molders, so we can grow," Saltz said. "At the moment, it's running just over 60 percent on our current machines. We can comfortably put in a few more blow-molding machines and keep running with the same equipment. It's much more efficient than the other compressors, so we're going to save about $50,000 per year with this machine, versus the old machines." BP

For more information about the project, contact Shannon de Souza, tel: (905) 501-1240, email: shannon@compressorsairus.com, or visit www.compressorsairus.com.

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

Compressed Air Demand-Side Demons AT A PET BOTTLE BLOWING PLANT

By Pete Rhoten, Hope Air Systems LLC, and Greg Fitzpatrick, CPE, CEM, of Compressed Air Technologies

Sometime in mid-2015, I received a call from a project engineer at a major plastics firm. He had a troubling issue with one of his PET bottle plants. The bottom line was this: They could not run all five high production blow-molding machines at one time—even though they were able to do so 18 months previously.

Obviously the first area to evaluate was compressor room to make sure the air compressors were as close to 100 percent as they could be based on their age, and to ensure there were no excessive pressure drops in the cleanup equipment. Even after the factory technicians rebuilt the air compressors and the filters were changed, there was still no improvement

Nothing had changed in the production area—no new equipment was installed, and bottle sizes remained the same. The only positive changes were that the piping had been looped, and leaks in the piping system had been found and addressed.

If nothing had changed in the compressor room or in the production area, what was going on? After much debate, it was determined that an outside resource needed to be brought in to do the detective work and make recommendations. The following article provides an overview of the system, and the steps taken to identify the issues—along with final recommendations. The moral of the story? The culprit of your compressed air system problems is not always in the compressor room…

Air Compressors—Checking Output Versus Specifications

The compressed air system at this PET bottle plant consists of two Bellis & Morcom water-cooled reciprocating air compressors. The WH40 H3N is rated for 400 kW (550 nameplate motor horsepower) with a capacity of 1135 acfm, and it is used as the trim unit.

The base-loaded unit is a VH18 H3N Bellis & Morcom water-cooled reciprocating air compressor with a rating of 205 kW (300 nameplate motor horsepower) with a capacity of 519 cfm.

ANNUAL COST CALCULATION FOR HIGH-PRESSURE COMPRESSED AIR SYSTEM

AIR COMPRESSOR	AIRFLOW CAPACITY	MEASURED KW	CFM/KW
WH40	1135 acfm	296.7 kW	3.83 cfm/kW
VH18	519 cfm	168.5 kW	3.08 cfm/kW
Total	1654 acfm	465.2 kW	NA
Annual Hours of Operation		8,520	
kWh per Year		3,963,504	
Annual Electrical Cost ($)		$206,102	

*Based on a blended electric rate of $0.052 per kWh

With the VH18 acting as the primary air compressor, the WH40 air compressor loaded when the pressure fell below 570 psig, loading until the pressure reached 595 psi when the unit again unloaded.

Blow-Molding Equipment—Is the Calculated Air Usage Real?

There are five SIPA blow-molding machines, an HS, an FX, and three SFLs. Any four blow-molding machines could be in full operation, but starting the fifth unit resulted in the air pressure falling to a level of 551 psig, whereupon the FX blow molder would electronically sense the low pressure and shut off.

The projected consumption of 1656 acfm versus the capacity of 1654 acfm from the combined output from both air compressors leaves very little margin for error in the compressed air system. As previously mentioned, a service crew had recently overhauled the air compressors prior to our arrival, and the air compressors appeared to be operating at optimum performance.

PROJECTED AIR CONSUMPTION FOR BLOW-MOLDING EQUIPMENT PER MANUFACTURER	
FX	273 acfm
HS	123 acfm
SLF 1, 2 and 3	1260 acfm
Total	1656 acfm

Audit Methodology—What Did We Do?

The Money Meter—kW Monitoring: We measured kW on the WH 40 and VH18 during the course of investigation to determine power savings, using a recording kW meter for the duration. A sample can be seen in Figure 1 (pg. 28).

The System Detective—Pressure Monitoring: A pressure transducer was installed on the WH40 prior to the compressed air dryer. Pressure for load and unload on the WH40 air compressor varied from 555 to 600 psi, as recorded by our transducer, which was set to record at 1-second increments.

COMPRESSED AIR DEMAND-SIDE DEMONS AT A PET BOTTLE BLOWING PLANT

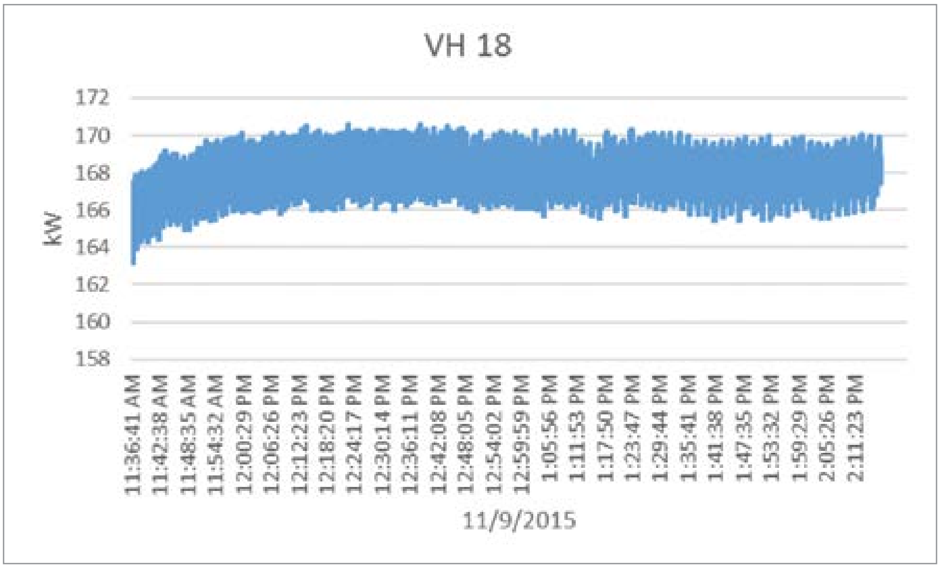


Figure 1: This graph shows the measured kW usage of the VH18 reciprocating air compressor.

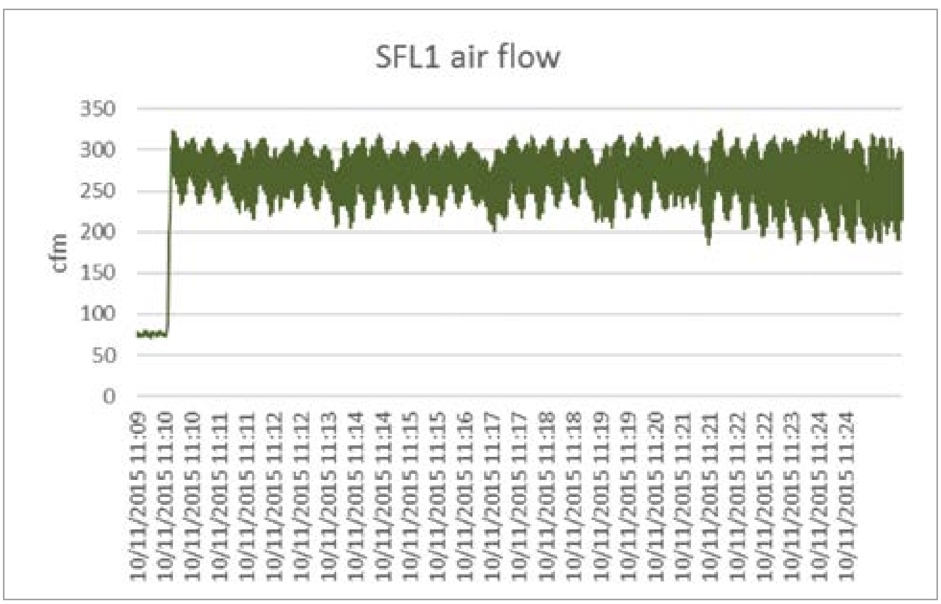


Figure 2: The graph above shows the airflow in cfm of the SFL1 blow-molding machine.

After installation of this pressure transducer, we started to observe the effects the five blow molders had on the compressed air system. The pressure varied by over 120 psi and caused the FX blow molder to go into default due to low pressure.

The Real Information—Flow Metering: We initially installed a 1.5-inch CDI flow meter on SLF2. This machine had a leakage rate of 78 cfm, and had a flow of 270 when operating, including the air leakage.

Next we moved the CDI flow meter to the SFL 1 blow molder to determine leakage on this machine. We recorded a leak rate of 77 cfm before the machine was restarted with a 224 cfm total operating flow, including leakage. It is important to note that this measured flow is below the flow of 420 cfm listed in the technical data from SIPA.

When the SFL 1 blow molder restarted, it was found that there was a 20-psi pressure differential recorded on the downside of the

MEASURED LEAKAGE PER CDI FLOW METERS	
FX	85 cfm
HS	160 cfm
SLF 1	77 cfm
SLF 2	280 cfm
SLF 3	54 cfm
Total	656 cfm

> "The leak measurement indicated that 39 percent of the total compressed air production was lost to leakage. There was no way of knowing this leakage until the flow meters were installed on each blow machine."
>
> — Pete Rhoten, Hope Air Systems LLC, and Greg Fitzpatrick, CPE, CEM, of Compressed Air Technologies

regulator versus the pressure reading at the WH40 air compressor (As shown in Figure 2). This was a major concern.

The meters were essential in identifying the volume of leaks on all the molders when the unit was pressurized but not operating.

Revelations: Leaks = Big Deal

The leak measurement indicated that 39 percent of the total compressed air production was lost to leakage. There was no way of knowing this leakage until the flow meters were installed on each blow machine. The leakage proved to be a major impediment to proper pressure from the air compressors in order to maintain production. At an electrical rate of $0.052 per kWh, this leakage would cost $81,700 per year.

Air Receivers—A Missing Piece of the Puzzle

The length of the main overhead 3-inch pipe is equal to about 633 linear feet. With the existing 20-psi pressure differential on the WH40, the main header provides a capacity of only 44.8 cubic feet. Storage only occurs when there is a pressure differential. Based on how this system was operating, there was no storage in the overhead lines when the system reached the low-pressure level and the compressor prepared to load.

Gauges installed on the SFL blow molder's filter identified that a pressure differential was the result of the compressed air not being able to pass through the filter and regulator at a rate to satisfy the immediate flow requirements of the blow molder. It was calculated that the flow was at a rate of 20.65 feet per second (Multiplied by 60 seconds = 1239 cfm). This calculation was performed by taking the cfm flow meter readings combined with the pipe size to determine the feet per second in the section of piping. The Department of Energy's Compressed Air Challenge recommends that any velocity in excess of 20 feet per second will result in a pressure loss.

The existing 1.5-inch pipe delivering air to the molding machines would have a velocity of 44.32 feet per second at pressure of 470 psi with a flow of 1239 cfm. At the high end of the pressure range, the Bellis & Morcom unloaded at 570 psi, and the velocity would still be too high at 36.7 feet per second.

Immediate Actions Required

1. Repair the air leaks on the blow-molding equipment as soon as possible.

2. Bypass regulators on blow machines and change inlet filter elements to eliminate 20-psi pressure drop.

3. Reduce system air pressure from 580 psi to the minimum level required to make product acceptable to quality control for all five blow-molding machines. Done through trial and error, we determined that a 464-psi set point would produce good bottle even on the FX blow molder. Reset the low-pressure molder.

Any pressure regulation must be done slowly and methodically. The air compressors originally loaded at 570 and unloaded at 595 psi respectively. The five blow molders ended up operating at 464 psi for an extended period of time and still produced quality bottles. Figure 3 shows the WH40 load rate prior to lowering the pressure, and Figure 4 shows the

COMPRESSED AIR DEMAND-SIDE DEMONS AT A PET BOTTLE BLOWING PLANT

load rate after the pressure was lowered and the blow machine's regulators and filters were bypassed.

By repairing some of the blow machines' internal leaks, bypassing the filters, and lowering the pressure, all five blow machines could be run for normal production and achieve the proper quality. However, **this was not a long-term solution.**

Changes Required for Long-Term Stability

Implement Leak Reduction Program: The total leakage measured by a flow meter was 656 cfm. At an electrical rate of $0.052 per kWh, this leakage costs $81,743 per year. The plant needs to implement a blow molder leak reduction program with an appropriate budget to monitor and repair leakage on all of the blow-molding machines and the compressed air piping system. Flow meters, which cost $3100, should also be installed on each of the five blow molders. Those devices should tie into the building information system or standalone data loggers. The ROI of these actions is approximately 0.5 months.

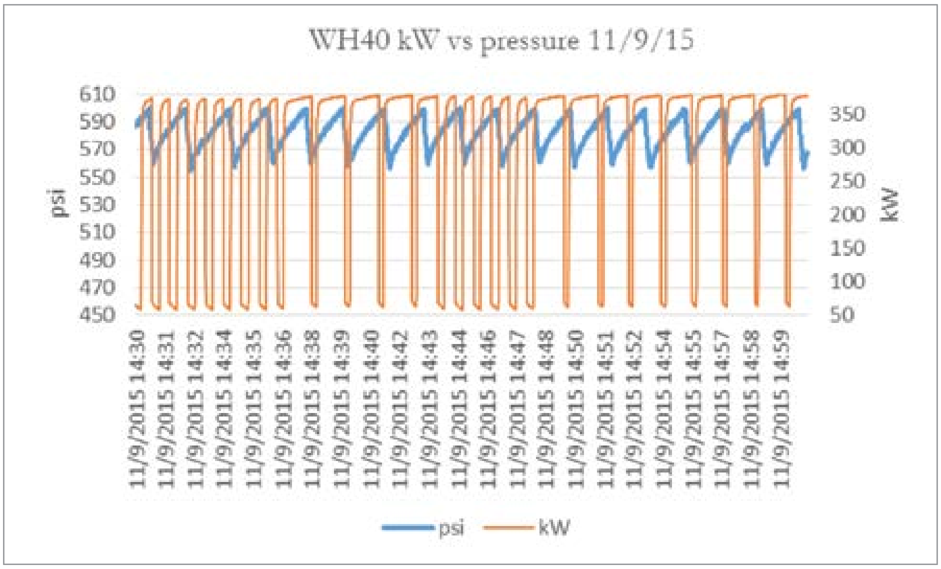


Figure 3: This graph displays the kW and pressure readings of air compressor WH40 prior to pressure-reduction measures.

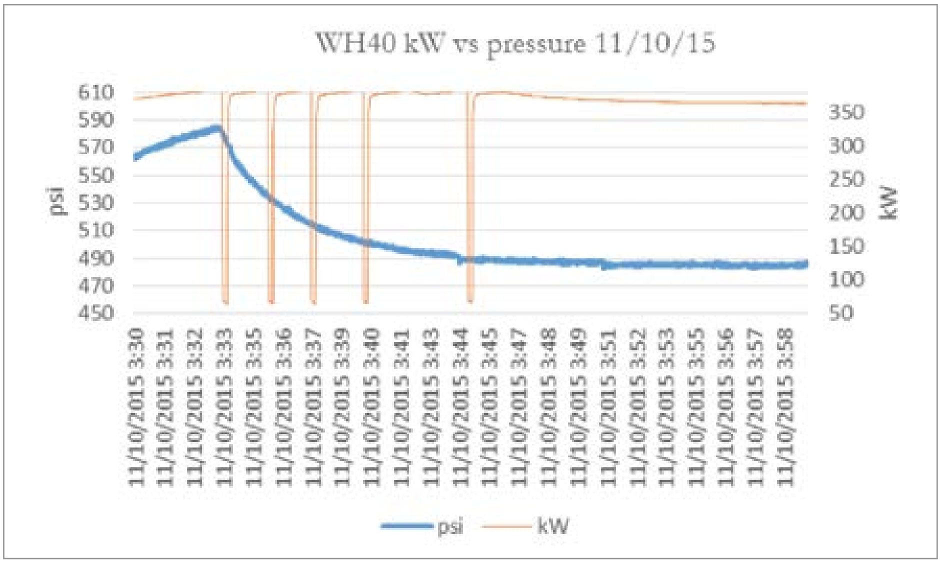


Figure 4: After the blow machine's regulators and filters were bypassed, pressure requirements dropped significantly.

Install Air Receivers at Points of Use: Installing a 200-gallon air receiver at each blow machine will allow for pressure reduction and adequate flow. It will also maintain pressure at each machine for product quality stabilization. With an estimated investment of $30,000, the direct ROI is approximately 14 months—not including product quality improvements and an increase in production.

System pressure was 580 psi, and it is now operating between 465 and 500 psi—while maintaining production quality. This pressure reduction eliminated 213 cfm of compressed air consumption, equaling $27,331 per year (at $0.052 per kWh, based on present compressor efficiency).

Service Air Compressor Intercoolers: The air compressors' intercoolers are overheating and require fans to maintain temperature. Intercoolers should be serviced, and the cooling system should be checked for water flow and temperature.

Use Flow Meters for Preventative Maintenance: Compressor output may be questionable—even though it was recently serviced. Flow meters should be installed on the 3-inch line after each compressed air dryer to monitor compressor output and determine when service is required. The flow meter investment would require a total of $2000, resulting in a potential ROI of 1 year to be verified by reduced maintenance over the next year.

Install Air Receivers Before Main Piping: With the air compressors cycling rapidly, they are sustaining excessive wear, and operating at a higher kW. To solve the issue, the facility should install a 1060 gallon high-pressure air receiver after the air dryers, along with a demand controller. With an investment of $30,000 for the air receiver and controller, the potential ROI would be under 2 years due to reduced maintenance on the air compressors and a lower system pressure.

Implement Leak Detection Program for Low-Pressure System: As previously noted, the operational air leaks are substantial on blow machines and the ancillary equipment fed by the high-pressure compressed air system. Flow meters should be installed on the 4-inch, low-pressure line from the low-pressure air compressors. Requiring an investment of $1300, the ROI would be under one year with the implementation of a leak remediation program.

Purging Demand-Side Demons

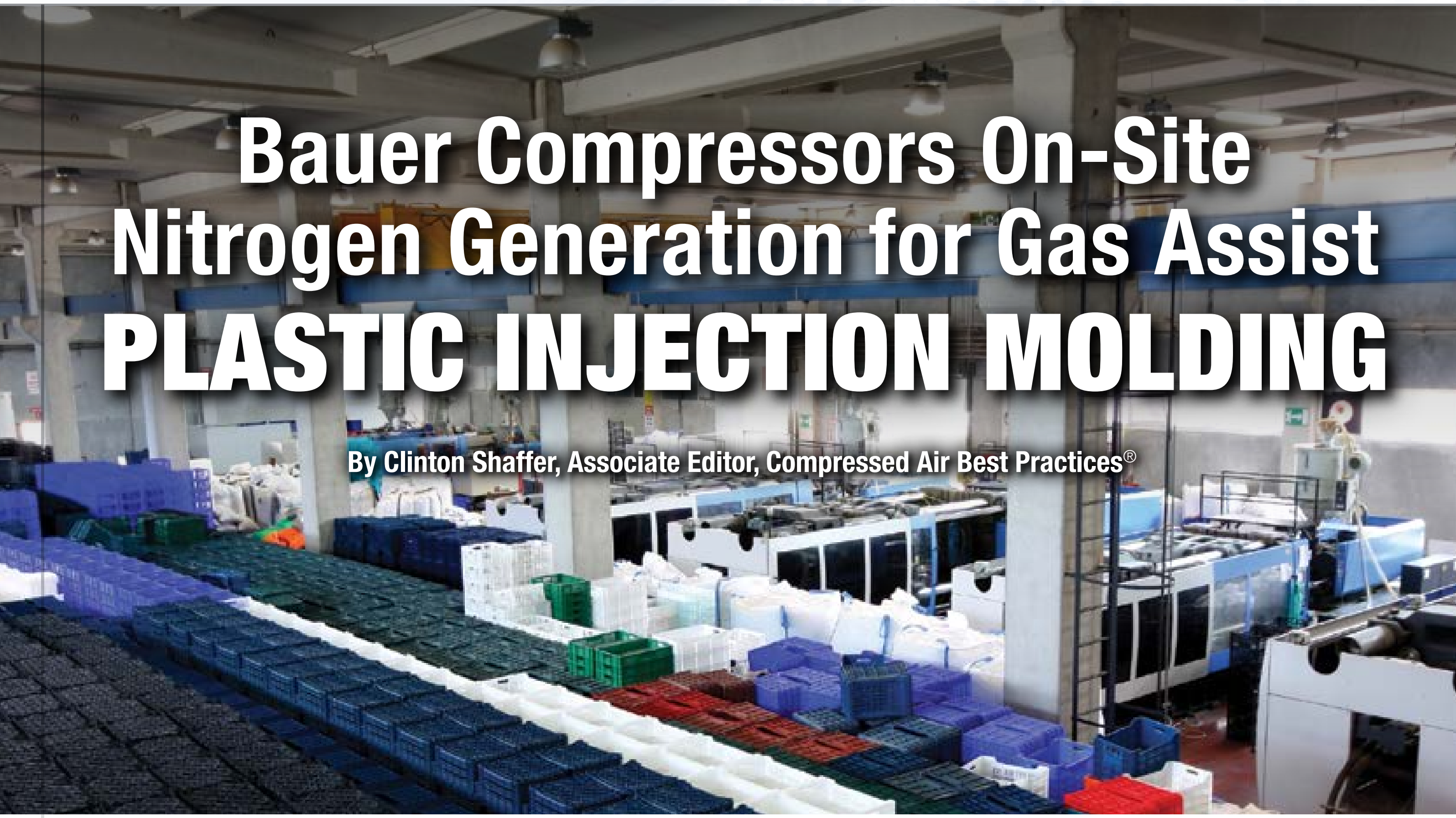
During our audit, the demand-side demons were found, and some of them purged within 72 hours. Lowering system pressure and opening the bypass on the regulator/filters helped. However, the immediate actions that allowed the five blow molders to be put back into production actions ***were not the permanent fix.***

The key is to implement changes required for long-term stability of the system with the existing air compressors. Any system that has borderline capacity as compared to requirement absolutely has to be monitored, because demand-side issues create operational problems. If the changes are not implemented, the system will slide back into the same situation as before—leaving it without a sufficient supply of compressed air.

If you have an issue involving PET bottle blowing or system capacity, you may have a hidden problem on the demand side. First look for obvious issues outlined in this article, If you need additional help, contact an auditor that you trust. BP

For more information, contact Pete Rhoten, tel: (508) 351-1834, email: prhoten@hopeair.com, or visit www.thehopegroup.com. Greg Fitzpatrick can be reached via email at greg.fitzpatrick@verizon.net.

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



Bauer Compressors On-Site Nitrogen Generation for Gas Assist PLASTIC INJECTION MOLDING

By Clinton Shaffer, Associate Editor, Compressed Air Best Practices®

Plastic injection molding is a common process in manufacturing, and it can be used to produce just about anything. To create a part, molten plastic is injected into a hollow mold, where it is formed and cooled before being ejected from the cavity. Plastic injection molders make a seemingly limitless range of products, from fishing tackle boxes and kayak paddles to tooth brushes and miniscule medical devices.

In plastic injection molding, maintaining even pressure within the mold cavity is vital for creating a high-quality part. Conventional injection molding uses the liquid medium (melted plastic, resin, etc.) to pressurize the material within the mold cavity, forcing the liquid material to the edges of the mold to achieve the desired shape.

Using the material to pressurize the mold, however, has drawbacks, and it can lead to inconsistent pressure, resulting in product abnormalities. Gas Assist Injection Molding, an alternative version of plastic injection molding, leverages nitrogen to pressurize the mold instead. The manufacturing technique has been around for more than 20 years, although it has not been adopted uniformly.

"[Gas assist injection molding] has been refined somewhat over the years, but it's no longer a mystery," Rick Goralski, Bauer Compressors, told Compressed Air Best Practices® Magazine. "It's something that should be more commonplace, but there still seems to be a little lack of understanding—a lack of education out there in the industry."

Goralski and his colleagues within the Plastics Technology Group at Bauer Compressors

Gas assist injection molding gives engineers the freedom of design to mold intricate parts with less material.

literally wrote the book on gas assist injection molding. Involved with plastic injection molding for more than 20 years, Goralski has helped many manufacturers implement gas assist to reduce material waste, shorten cycle times, and improve product quality. To learn about how Bauer Compressors helps plastics manufacturers, we spoke with Goralski and his peer Dennis Paul of Bauer Compressors. During our discussion, we talked about the advantages of gas assist injection molding, and learned about Bauer's on-site nitrogen generation systems.

Gas Assist Injection Molding: A Primer

During the traditional plastic injection molding process, a cavity is filled with molten resin. Once injected, the cavity is pressurized as the plastic cools, typically with hydraulic force generated by packing more resin into the mold through a material feed gate. Maintaining the pressure through a feed gate can be exceedingly difficult, depending on the geometry of the piece. Injection molded parts can experience freeze off—or the solidification of the resin within the mold—before the piece is fully formed.

"The problem with conventional injection molding is the freeze off occurring during cooling," Goralski explained. "As soon as that part cavity is filled, freeze off begins. It starts from the walls of the mold cavity and works its way back to the center, to the thickest areas of the part. You can only maintain pressure on that part by forcing more material into it until the actual gates freeze off. Then you won't be able to apply pressure to the part any longer."

Uneven pressure and freeze off can cause defects, especially in parts with thin-wall designs, heavy bosses (a configuration of the part that intersects with a wall) and ribs. These added complexities inside the mold make it difficult to achieve the proper form before the resin freezes off, leading to sink marks, or depressions in the surface of the part.

"As freeze off occurs at different areas of the part, you'll get different densities, or different amounts of resin in certain areas of a part," Goralski said. "As that resin cools, it shrinks, and if you are getting different shrink rates throughout the part, it creates warpage."

Gas assist injection molding helps eliminate the quality issues inherent to conventional injection molding, because nitrogen is used to push the resin to the ends of the mold. A pre-selected amount of resin is injected into the mold, followed by nitrogen, which fills the cavity from inside the resin, leaving a designed void in the middle of the part (Figure 1, pg. 34). The void eliminates a significant amount of resin waste, and the evenly applied gas pressure helps to reduce shrinkage and warpage during cooling. With less mass to cool at the end of the process, gas assist can shorten cycle times as well.

"Plastic starts solidifying as soon as it hits that back wall of the mold, so you're fighting that freezing off all the way through the process," Dennis Paul of Bauer Compressors explained. "Gas assist can extend the flow inside the mold by pushing the hot molten plastic from the inside of that part and continuing to roll it forward towards the last to fill, or the zero pressure area of the mold itself."

Gas Assist Injection Molding Reduces Cycle Times

Initially, plastic injection molders adopted gas assist for economic reasons—namely reduced cycle times and less material waste. To make the most of the technique, manufacturers targeted thicker parts that required longer cycle times. During the 90s, one of the biggest growth periods for plastic injection molding, manufacturers yielded substantive savings by switching to gas assist

BAUER COMPRESSORS ON-SITE NITROGEN GENERATION FOR GAS ASSIST PLASTIC

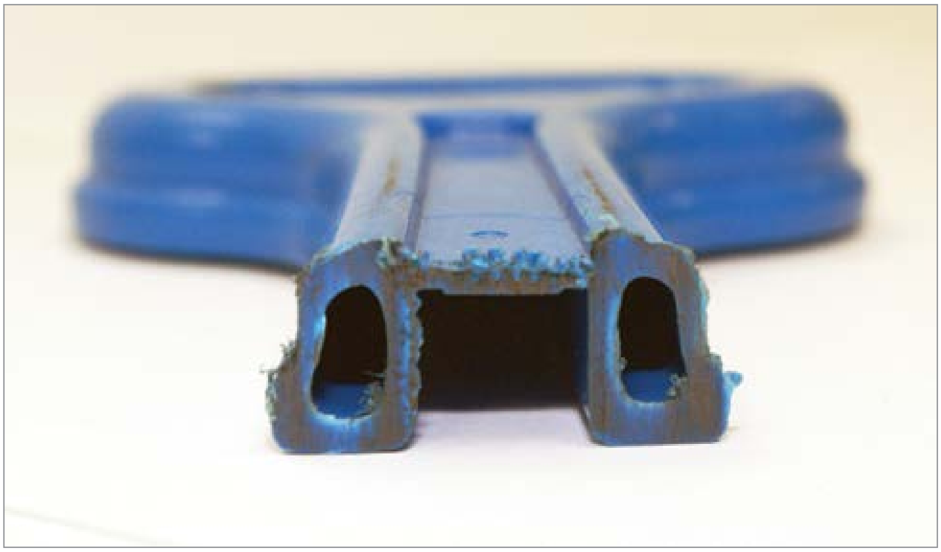


Figure 1: Gas assist injection molding creates a designed void within the plastic part, eliminating wasted resin and improving part quality.

injection molding for products like large plastic bins, thick handles, TV enclosures, and cumbersome automotive parts.

"In some thin-wall parts that don't have very thick sections, we may be able to reduce the cycle time by 10 percent," Goralski commented. "With thick parts where we are able to take a lot of the mass out, it's not unheard of to get a 50 percent cycle reduction or more. In some instances, we would replace the structural foam process, which can have 3- to 4-minute cycles. We have gotten them down to under 2 minutes."

Structural foaming is a time-intensive method of plastic injection molding that blends a chemical foaming agent with the heated material before it enters the injection chamber of the machine. It is used for thicker parts, and the foaming agent effectively reduces the amount of resin used for a part. According to Goralski, "a 4- or 5-mm wall will generally need done with structural foam. Thin walls would be maybe 1 to 2.5 mm thick, and, in that instance, you would be able to mold it conventionally." Regardless of thickness, gas assist injection molding can eliminate chunks of resin within the part, and reduce the cooling times required.

"Gas assist pressurizes the part with nitrogen rather than using hydraulic force on the screw to pack more resin into the cavity," Goralski added. "We replace that resin with high-pressure gas, which actually flows through the part and maintains pressure during cooling. By doing this, we take the place of some of the resin, so we are saving on the resin costs. There is also less mass there to be cooled, so we have the advantage of shorter cycle times as well."

Greater Freedom of Design for Plastic Parts

Manufacturing products faster with less material is a commonsense benefit, but there is another a major reason manufacturers use gas assist injection molding. With burgeoning markets for handheld devices and the constant drive for miniaturization, plastic parts today need to be smaller and more intricate than ever. As noted previously, however, conventional injection molding struggles with more complex designs.

"In the early 2000s, manufacturers transitioned to smaller, thinner wall parts where less mass savings were realized," Paul explained. "When Rick and I started in the industry, designers were making some pretty bad parts that weren't even manufacturable. There was no way you could make a quality part without the plastic falling away from the outside of the mold, so we started implementing gas assist injection molding to solve those particular design problems."

The ability to design more intricate parts has become a major driver behind gas assist injection molding. As Goralski explained, "Before gas assist came along, you either had to strategically locate your gates, or you had some general rules of wall-thickness-to-

> "With gas assist, you get a little more design freedom, and you can get a much better, more efficient pack on the part."
>
> — Rick Goralski, Bauer Compressors

INJECTION MOLDING

rib ratio that you had to maintain to make a quality part. With gas assist, you get a little more design freedom, and you can get a much better, more efficient pack on the part."

Gas assist injection molding can also eliminate added steps in the manufacturing chain, like welding or gluing, since it enables a molder to create a small, intricate piece in its entirety. One example Goralski shared involved a catheter for an R&D project. Catheters are small medical devices designed for insertion in the human body. Instead of making the tube and the catheter separately, which would require a separate process for adhesion, the manufacturer was able to mold the device all in one piece. While the piece was small (1.5 grams), the benefit of reducing cycle times and consolidating the process was huge.

Figure 2: Bauer Compressors developed the SNGII Stationary Nitrogen Generation System specifically for the gas assist injection molding market.

BAUER COMPRESSORS ON-SITE NITROGEN GENERATION FOR GAS ASSIST PLASTIC

Generating Nitrogen for Gas Assist Injection Molding

Nitrogen is used in gas assist injection molding because it is an inert gas. For the lion's share of products manufactured today (and the resins used), a nitrogen purity level of 98 percent will suffice. As with any process, however, there are caveats.

"There are certain engineered resins, colorants and additives that may react poorly with even that 2 percent [oxygen content]," Goralski stated. "In that case, we recommend 99.5 percent. Then there is always that one out of a thousand where 99.5 percent becomes a problem. We make our equipment up to 99.5, but even that is not good for everything."

Every cycle of the plastic injection molding machine will use a specific quantity of nitrogen fed at a pressure ranging between 100 and 6000 psi (depending on the part). Traditionally, compressed air bottles used in conjunction with pneumatic boosters were used to feed the process. Unfortunately, that setup has a number of disadvantages: The pneumatic boosters, or piston pumps, require about 500 psi of inlet air; they cycle constantly; they generate a lot of heat; and they are maintenance intensive.

One alternative to the pneumatic booster configuration was to purchase nitrogen from a supplier. The supplier delivers nitrogen in high-pressure storage bottles, typically stored on modular racks. This path, while easier to maintain, is not cost effective.

"Whether it's an outside installation with a massive cryogenic system that is replenished, or if you take the dewars inside, there's still a pretty high cost associated," Goralski explained. "And you can't use all of it. If you are using nitrogen bottles, you're probably only going to use about 75 or 80 percent of what you purchased before it gets below a pressure that can actually feed a pneumatic booster."

On-Site Nitrogen Generation Solutions from Bauer Compressors

According to Goralski, Bauer was one of the first companies to develop a nitrogen generator for the gas assist market. During his time at Bauer, he has replaced many pneumatic booster systems—and all the maintenance that goes along with them—with the SNGII™ Stationary Nitrogen Generation System (Figure 2, pg. 35). The SNGII is a standalone, turnkey solution capable of supplying 5000 to 6000 psi at purities up to 99.5 percent.

Since compressed air contaminants like water vapor can seriously disrupt the operations of a plastics manufacturer, the SNGII comes equipped with its own rotary screw compressor. Complete with inlet air filtration, the air compressor feeds directly into permeable membranes at about 145 psi, thereby avoiding any contaminants that might lurk in a plant's compressed air distribution piping. Once the proper nitrogen purity is achieved, nitrogen is sent to an integral Bauer high-pressure booster, which pumps nitrogen into storage cylinders.

Figure 3: With an integral controller, the Bauer N2IT can help smaller operations generate nitrogen for gas assist injection molding.

Integrated with a separate Bauer NCU (Nitrogen Control Unit), the SNGII generates and compresses the nitrogen to storage, while the NCU uses this stored gas to precisely control the plastic injection molding process. In addition, the SNII has an adjustable nitrogen purity levels, enabling flow optimization for different manufacturing processes. The unit's PLC controls can modulate down to a 98 percent purity level to generate greater gas flow from the unit, lowering its run time.

"Somebody who doesn't know much about gas assist, or doesn't understand it historically, would look at a part and say 'Why isn't this being used in everything?' And we say the same thing."

— Dennis Paul, Bauer Compressors

INJECTION MOLDING

Enabling Gas Assist Injection Molding in Smaller Operations

The SNGII is ideal for large operations running three or more gas assist injection molding jobs at their plant. Bauer Compressors recently introduced another nitrogen generation solution, the N2IT™ Gas Assist Molding System, for smaller operations, where the company may not want to invest in the SNGII and separate controllers.

Bauer Compressors presented the N2IT system at NPE 2015. Shown in Figure 3, the unit takes all of the nitrogen generation capabilities needed for the gas assist process, and puts it into one package, including a small compressor and a process controller. Requiring 100 psi of clean shop air at about 12 cfm, the N2IT is designed to work on one single gas assist injection molding process.

"The N2IT is the first of its kind: an all-in-one, turnkey gas assist system. It doesn't take a number of different components, so it's really quite revolutionary," Goralski said. "It's being quite well received in the industry, mainly in small facilities that are not going to run multiple machines with gas assist. It's very portable, so they can move it from one machine to the next."

The N2IT's control system, featuring True Track Ramping™, is also unique. For the highest quality part, gas assist injection molding requires precise control of the nitrogen pressure. In the past, end users had no control over the nitrogen's rate of pressure increase within the mold, which could be detrimental. True Track Ramping gradually increases or decreases the pressure into the mold at specific pressure set points. It can be particularly beneficial for parts with varying thicknesses—like a kayak paddle, as seen in Figure 4.

Figure 4: Plastic kayak paddles have varying thicknesses, so precisely controlling nitrogen pressure into the mold can strengthen the part and improve it cosmetically.

"A kayak paddle has a thick area in the center because you need some strength for support as it goes through the water. That area is very thick, and then it thins out to the blade," Goralski explained. "If you hit it with 1500 psi of pressure, some of that gas will migrate into the thin area of the paddle. That's not something desired for cosmetics or strength. With True Track Ramping, we can slowly ramp up that pressure, allowing the freeze off, or the solidification to occur, on that thin-wall area. We slowly ramp the pressure up so we get to the pack pressure we need to achieve the result without permeation within the wall."

Adopting Gas Assist Injection Molding for Better Parts

The experts at Bauer, who have been implementing gas assist injection molding for more than 20 years, are major proponents of the technology. With its many benefits, gas assist injection molding can improve part quality, reduce cycle times, and eliminate material waste.

"Somebody who doesn't know much about gas assist, or doesn't understand it historically, would look at a part and say 'Why isn't this being used in everything?' And we say the same thing," Paul said. "As industry changes over every 8 to 10 years, we're having to educate more and more people about what the technology can do, what it can't do, and how to implement it."

If integrating nitrogen generation into the conventional process is intimidating, Bauer's expertise with gas assist injection molding, and nitrogen generation, can help overcome initial challenges. The SNGII and N2IT nitrogen generation systems are specifically designed for gas assist injection molding to help streamline the process. BP

If you have any questions about gas assist injection molding, contact Rick Goralski, Bauer Plastics Technology Group, tel: (586) 247-1900, rick.goralski@bauerptg.com, or visit www.bauerptg.com

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FIBERGLASS PARTS PLANT FINDS SAVINGS BEYOND THE AIR COMPRESSOR ROOM

By Ron Marshall for the Compressed Air Challenge®

A Canadian fiberglass plant has completed a lengthy compressed air improvement journey and achieved significant efficiency gains by applying "the systems approach." Along the way, the company ran across many frustrating problems, the solutions to which were only determined after the entire system was monitored holistically using data loggers. The overall compressed air audit led to a reduction in energy usage of 48 percent, yielding savings worth $17,500 per year. The project also qualified for a large utility incentive of $32,000 with a calculated payback of 4.4 years.

The company makes fiberglass components for the type of highway buses we see on most interstate roads. Using lighter materials like fiberglass reduces the weight of the vehicles and makes them more fuel-efficient. Due to the size of the buses, some of the parts are very large. The site uses compressed air to supply hand tools and various compressed air-powered production machines and processes. When the parts are made, compressed air is used to hold the parts in the molds using pressurized bladders. At the same time, vacuum is used to suck the parts into the molds to make a perfect fit. After the parts are set, they must be cut out of the mold with air-powered cutters, and then finished using various air-powered grinders, sanders, polishers and painting systems.

A Long History of Compressed Air System Changes

Starting in 2004, the compressed air system has been constantly changing as production levels have increased. The site originally had three 30-hp, two-stage, air-cooled reciprocating compressors running to feed plant demand. But these compressors started

FIBERGLASS PARTS PLANT FINDS SAVINGS BEYOND THE AIR COMPRESSOR ROOM

to experience problems as compressed air flows increased. Air-cooled reciprocating compressors are often adequate for lightly loaded systems in well-ventilated environments, but as duty cycles increase, the units typically overheat, causing failures of the internal parts and valves. The compressed air flow produced by these very noisy machines is often extremely hot and filled with lubricant carryover, which requires special, high-temperature dryers and filtering. To solve these problems, a special after-cooler was installed to reduce the air temperature before it entered the air dryer, allowing a standard dryer to be used.

After a few years of maintenance headaches, the company decided to switch to a rotary screw air compressor. Rather than installing a standard fixed-speed air compressor, a more efficient variable speed drive (VSD) air compressor was purchased with a cycling air dryer, a pressure/flow control valve, and mist eliminator filtering. No changes were implemented on the demand side of the system. Measurements determined the new air compressor, dryer and filters lowered plant pressure, saving about 31 percent compared to a fixed-speed compressor. The lower pressure resulted in electrical savings worth $7,700 at today's prices. For backup, the existing reciprocating compressors and after-cooler were left in place.

Load Increase Causes Pressure Problems

This system worked well on one air compressor for a number of years, but as the compressed air load increased and the installed equipment aged, pressure problems started occurring. Data loggers were installed on the system to see if the problem could be determined. Even though the VSD air compressor was set to the highest pressure possible, 140 psi, the system had trouble keeping up with demand—with main header pressure often falling as low as 80 psi. This was causing major problems on the demand side. Compressed air hand tools were operating with reduced power and often stalling, which increased the time it took to process each part.

To attempt to increase the plant pressure, the old reciprocating air compressors were placed into service. Unfortunately, the pressure coordination strategy caused the reciprocating units to run at 100 percent duty cycle, which is fatal for air-cooled units of this type. One after another, the units failed. Even worse, the hot lubricant they expelled coated the internal surfaces of the after-cooler and clogged the pneumatic actuator on the pressure/flow controller, causing other problems. Detailed pressure measurements showed that during peak plant flows there

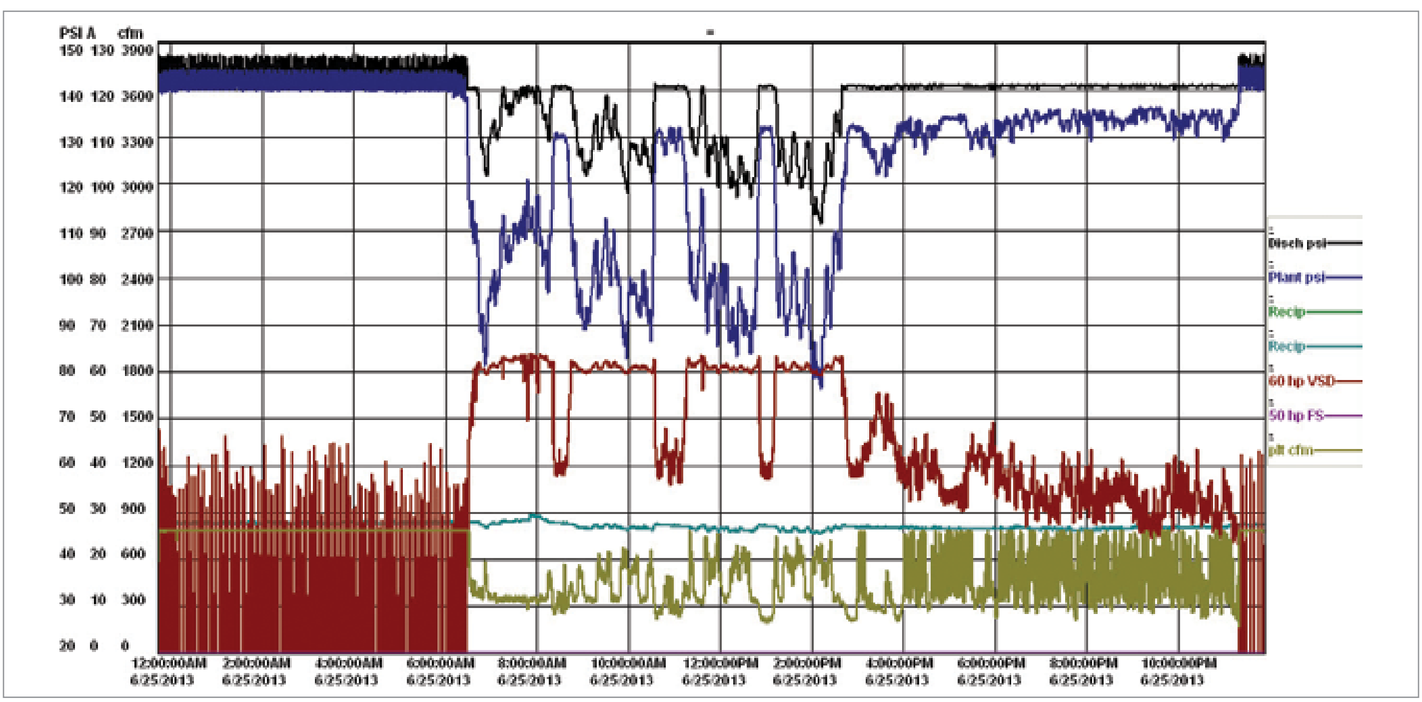

Figure 1: Even with very high air compressor pressure, the plant pressure was inadequate due to component failure.

was a 20-psi pressure differential across the contaminated after-cooler and flow controller. The data also showed that the regulator was no longer accurately controlling the pressure due to internal problems. In addition to this, the peak plant demand was exceeding the capacity of the available air compressors, allowing the system pressure to drop below the lowest levels required for critical production machinery. An increase in capacity was required.

Salvaged Air Compressor Added

The company had obtained an older screw compressor in a plant closure, which was installed in an attempt to increase capacity. However, this air compressor was only rated for a full-load pressure of 115 psi—much lower than the main compressor set point of 140 psi. This made efficient coordination of the compressors impossible. The unit had to be placed in modulation mode to produce a high enough pressure. During times it was not required, it ran constantly, because it lacked any shutdown timer. The unit ran many hours while lightly loaded, greatly reducing the efficiency of the compressed air system.

Despite the addition of more capacity, the plant continued to experience poor tool performance, especially at a critical mold where very large pieces were cut with a special air-powered tool. Production was suffering, so a compressed air auditor was called in to have a look.

Compressed Air Audit Finds Excessive Pressure Differential

From the initial data logging, the problem with the clogged cooler and malfunctioning flow controller was very obvious. The cooler was removed and regulator bypassed. Surprisingly, however, this did not completely solve the problem with poor tool performance. Further investigation was done at the end use, and found a poorly designed supply system feeding this most critical cutting tool. A special test was performed to measure the pressure gradient in the supply lines using a T connection with a test gauge. The test gauge was inserted into the line directly before the final tool connection. With no tool operation, the line pressure was at 118 psi, but once the tool trigger was pulled and the unit started operating, the input pressure fell to 44 psi. Since the rating of the tool is 90 psi, poor performance was a result.

In looking back towards the system to the main header, the hose system feeding the tool consisted of a total of four standard

Figure 2: Hose selection and poor connection practices cause poor compressed air tool performance.

FIBERGLASS PARTS PLANT FINDS SAVINGS BEYOND THE AIR COMPRESSOR ROOM

Figure 3: Questionable connection practices caused huge pressure differentials in some areas.

Figure 4: Poorly adjusted pulse filter cleaning system wasted compressed air

1/4-inch quick connect couplings at various points and a 50-foot section of 1/4-inch hose mounted on a hose reel. A hose of significant length is required to provide sufficient mobility to reach all locations along the length of the large molds. Calculations confirmed the expected pressure differential of this configuration. The hose system was undersized.

Examining End Uses for Potential Reductions

The auditor also thoroughly examined other end uses in other areas of the plant for possible reduction opportunities. Leakage levels were high, consuming 45 percent of average compressed air flows during weekend non-production times. Air-powered agitators were allowed to run to mix solvents during non-production hours when no mixing was required. A significant waste of compressed air was found in the grinding area where pulse-type cartridge filter cleaners had been adjusted incorrectly. Instead of sending a cleaning pulse of compressed air every few minutes, the sequencing timer had been adjusted to pulse every 2 seconds. Even with this increase in frequency, the filter cleaning performance was not as expected.

"A significant waste of compressed air was found in the grinding area where pulse-type cartridge filter cleaners had been adjusted incorrectly. Instead of sending a cleaning pulse of compressed air every few minutes, the sequencing timer had been adjusted to pulse every 2 seconds."

— Ron Marshall for the Compressed Air Challenge®

Extra Savings in the Vacuum and Ventilation Systems

While assessing the system, the auditor noticed that a vacuum system located in the compressor room was running excessively. Further study using data loggers revealed that the vacuum pump control system had failed, causing two 15-hp pumps to run all the time— when only one was required for typical loads. The other vacuum pump was only required for short duration peaks.

In addition to this, it was noticed that the compressor room ventilation system was using 100 percent outside air draw for compressor cooling due to the dusty plant environment. A 20-kW electric heater ran full time in winter to temper the compressed air to prevent freezing up the air compressor's after-cooler. Calculations showed that the air compressor was producing enough heat to temper the room with the heat of compression.

Comprehensive Compressed Air System Improvements

Various system improvements were implemented to correct the situation. They included:

- Critical tool hosing was upgraded to 3/8 inch, and the number of quick-connect couplers was reduced to one full-flow connector. The cutting tool now sees 90-psi operating pressure.
- Leakage was repaired and mixers turned off on the weekend. Pulse cleaners were outfitted with receivers to boost pulse force, allowing a reduction in operation frequency and saving compressed air.

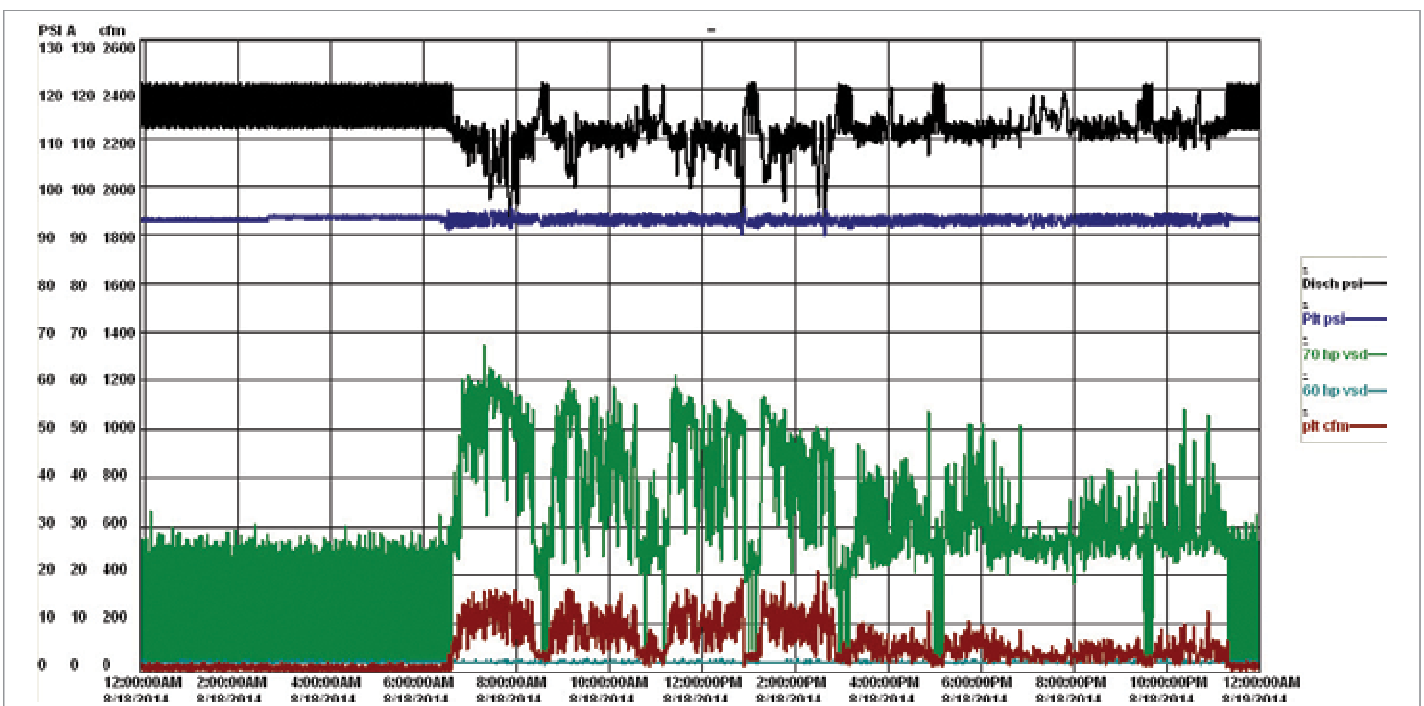

Figure 5: Plant pressure and compressed air flow during the off hours were greatly improved after the projects.

FIBERGLASS PARTS PLANT FINDS SAVINGS BEYOND THE AIR COMPRESSOR ROOM

- A pressure/flow controller was replaced with a unit sized for full compressor flow.
- Additional storage receiver capacity was installed to help with peak demands.
- Compressor room piping was upgraded to a larger size to reduce pressure differential.
- The air dryer was upgraded to cycling style with heat directed to the compressor room.
- A new VSD air compressor was installed, with an old VSD compressor used as backup. Compressor discharge pressure was lowered to 110, and plant pressure reduced to 92 psi.
- Heat of compression is now directed into the compressor room with thermostatically controlled dampers. The 20-kW heater is now turned off.
- Vacuum system control was upgraded to reduce operating time. The vacuum system is turned off during weekend hours.

As a result of the improvements, the compressed air system, the room heater, and the vacuum system energy consumption has been reduced by 48 percent for savings worth $17,500 per year. This project qualified for a substantial utility incentive of $32,000 with a calculated payback of 4.4 years, not including the increased plant productivity.

This project illustrates the benefit of improving the whole system, including the end uses and distribution system, rather than looking at just the air compressors. BP

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

To read more ***System Assessments on End Uses*** in plants, please visit www.airbestpractices.com/system-assessments/end-uses.

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TECHNOLOGY PICKS

TESEO Aluminum Piping Receives Non-Flammable Classification

According to a report released by the RINA Service institute concerning the fire reaction classification of products, the AP aluminum modular piping by TESEO has been classified as A2, s2, d0, i.e. "non-flammable product that causes no spread of flame and fire propagation," in compliance with standard EN 13501-1:2007+A1 2009.

TESEO aluminum piping has been classified as a non-flammable product.

TESEO distribution systems for compressed air, vacuum, nitrogen and other fluids under pressure are manufactured in compliance with the safety requirements of applicable standards and have obtained several product certifications. The excellent rating assigned by RINA Service to the fire-resistant properties of the AP family is based on the fact that TESEO pipes and the related joints are entirely made of aluminum, and they are therefore not flammable, unlike other pipes on the market that use plastic joints not resistant to fire.

Several factors contribute to the high quality of TESEO modular piping: aluminum is a tough material that withstands oxidation and corrosion; the tightness of O-rings in the joints that connect the profiles prevent any leak; modularity reduces plant modification costs; and finally, product warranty can be extended to 20 years. For all of these reasons, purchasing a modular aluminum system by TESEO implies higher initial investment but offers excellent cost effectiveness in the long run.

For more information, visit www.teseoair.com.

Spectronics Ultrasonic Leak Detector Diagnoses Maintenance Issues

The Spectroline® MDE-2000NC Marksman™ II is an ultrasonic diagnostic tool that converts and amplifies inaudible ultrasonic sound into audible "natural" sound. It allows the technician to "hear" even the smallest compressed air, natural gas, vacuum, steam, or other pressurized leaks—before they lead to major breakdowns.

This cutting-edge tool uses a two-tiered approach to ensure accurate diagnosis. The receiver converts inaudible ultrasonic sound into audible sound using heterodyne circuitry. Then, its unique Sound Signature Technology "fine tunes" the audible sound into the natural sound emitted by the leak itself. A 5-LED signal intensity indicator and audible alarm pinpoint the exact source of the problem. An Internal Noise Control (INC) feature safeguards against ambient noise.

The Spectroline® MDE-2000NC Marksman™ II helps maintenance personnel identify leaks in various industrial applications.

TECHNOLOGY PICKS

The Marksman II comes complete with an ultrasonic receiver; full-sized, heavy-duty, noise-canceling headphones; a hollow air probe to isolate leak sources in cramped places; a solid contact probe to find gear and bearing wear in internal parts and electric motors; and an ultrasonic emitter that helps locate faulty seals, gaskets and weatherstripping in doors, windows, ductwork and other non-pressurized enclosures. All components are packed in a sturdy carrying case.

For more information, visit www.spectroline.com.

New CEJN eSafe Coupling Range Now Standard

CEJN's new eSafe coupling range will come standard on all CEJN couplings, and will supersede the previous versions beginning in January, 2016 (at no additional cost).

CEJN's new eSafe couplings offer the highest flow rate on the market combined with a low pressure drop, a low connecting

CEJN has paralleled safety with performance by introducing new eSafe coupling range.

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The Ashcroft® type 1198 finned siphon can support media temperatures of up to 700˚F (371˚C).

force, a built-in venting function to control hose whip, and a compact, easy-grip design. Its extreme durability, together with the high flow and low pressure drop, offer maximum operation productivity and a reliable product for years to come.

The product range includes Series 300 (ARO 210), Series 310 (1/4" Industrial Interchange), Series 315 (Asian Standard), Series 320 (High Flow Euro Standard 7.4), Series 410 (High Flow Euro Standard 10.4), Series 430 (3/8" Industrial interchange), and Series 550 (1/2" Industrial interchange).

For more information, visit www.cejn.com.

Ashcroft Introduces New Finned Siphon

Ashcroft Inc. recently introduced the Ashcroft® type 1198 finned siphon for protecting pressure instruments from high-temperature processes.

The new Ashcroft® type 1198 finned siphon protects pressure instruments from high-temperature processes. Capable of containing pressure up to 3000 psi, the type 1198 finned siphon can also support media temperatures up to 700˚F (371˚C). 316L stainless steel construction ensures compatibility with a wide variety of media, while a built-in dampening mechanism controls the effects of pulsation.

For more information, visit www.ashcroft.com.

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PROBLEM:

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SOLUTION:

Kaeser performed a complete Air Demand Analysis (ADA) to identify the plant's current compressed air needs and to develop a plan for implementing the most energy efficient solution possible. Additionally, Kaeser recommended a Sigma Air Manager (SAM) master controller to properly control the system and ensure the most energy efficient combination of units would be selected to meet current plant demand.

RESULT:

Thanks to better controls and adding an energy efficient variable frequency drive compressor, the customer was able to reduce their annual maximum power consumption by 865,440 kWh—the equivalent of removing 100 homes from the power grid for one year—all without compromising stable system pressure. With the older compressors relegated to back-up, annual maintenance costs have been reduced from $37,000 to $18,000. Less maintenance also means less downtime, for increased productivity.

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