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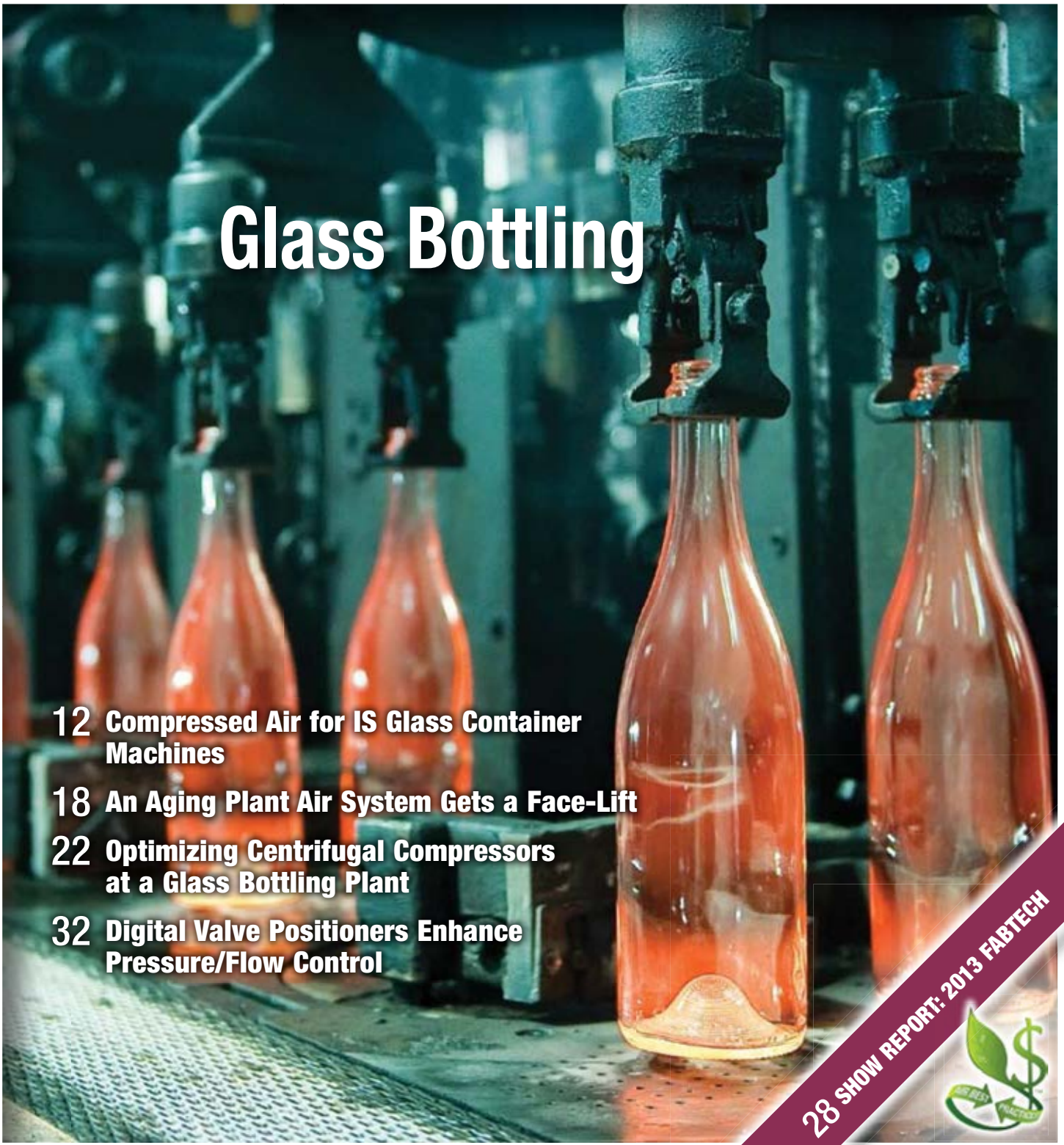
January/February 2014



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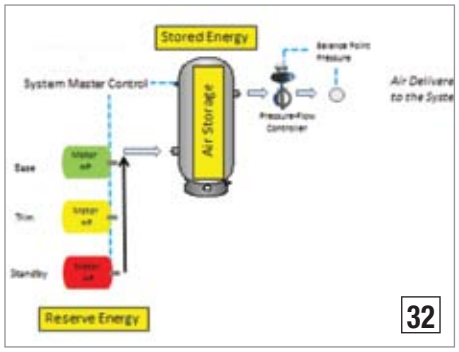

COLUMNS

FROM THE EDITOR | Glass Bottle Production

Glass plants are energy-intensive operations. Our lead article, "Proper Compressed Air for IS Glass Container Machines" by Hank van Ormer, provides an example of a significant energy saving opportunity with low capital costs. Expert knowledge, however, is required to execute this project!

Most factories have been around for a while and also experienced maintenance work-force reduction programs over the years. Veteran utility system auditor, Gary Wamsley, provides us with an excellent "real world" example of his work in the article, "An Aging Plant Air System Gets a Face-Lift." His utility system assessment executed ways to increase air compressor reliability, reduce system pressure, increase air quality and reduce system energy costs.

This glass bottle production plant used 3,148 scfm at 95 psig and 9,400 scfm at 58 psig. A group of centrifugal air compressors and one rotary screw compressor supplied the compressed air. Don van Ormer, from Air Power USA, provides us with an interesting case study of how the supply side was optimized and the associated annual compressed air energy costs were reduced from $3.1 to $2.4 million.

Looking for a good technical article on compressed air pressure/flow control? Bob Wilson, on behalf of the Compressed Air Challenge®, provides an insightful view of the role of digital valve positioners in pressure/flow control strategies. Continuing their series on compressed air dryers, the Compressed Air & Gas Institute (CAGI), has provided us with a solid overview of heat of compression, single-tower deliquescent and membrane type air dryers.

Yours truly was again a roving reporter at the 2013 edition of FABTECH. I hope you enjoy my review of this huge metal fabrication show full of metal laser cutting, material handling and welding machines. Compressed air, chillers and pneumatics are an essential part of every factory in this industry.

Please allow me to take advantage of this first issue to wish all of you a very Happy, Healthy and Productive 2014!

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INDUSTRY NEWS & SUSTAINABILITY REPORTS

Chicago Pneumatic appoints JC Lecocq as Senior Vice President, North America

New role to focus on optimizing distributor network and national accounts

Chicago Pneumatic announced the appointment of Jean-Christophe (JC) as the Senior Vice President for Mexico, Canada and U.S. sales and operations. JC will be based out of Chicago Pneumatic's Rock Hill, S.C., office, and will be responsible for developing new business opportunities and building strategic relationships, while executing procedures and implementing policies to drive efficiency and increase effectiveness.

Additionally, JC is responsible for new business development and further optimizing Chicago Pneumatic's distributor network across the North American compressor markets.

"JC combines all the elements we were looking for in a business line manager and leader — deep experience within the industry, excellent working knowledge of the stationary compressor technology market and a track record of inspiring leadership qualities," said Ellen Steck, President, Chicago Pneumatic. "With his extensive experience, we're very excited to have JC on board to help accelerate our growth and further empower and develop our North American team."

Chicago Pneumatic is among the industry leaders in compressor technology engineered for high-performance. As part of the global Atlas Copco Group, the Chicago Pneumatic brand focuses not only on compressors but also on power tools, construction & mining tools and generators. Chicago Pneumatic features a number of manufacturing locations across the United States.

JC joins the Chicago Pneumatic Compressor executive team with more than fifteen years at Atlas Copco where he held various positions in logistics, engineering, sales and marketing. JC had global responsibility in Atlas Copco's Industrial Air Division as the Quality Air Solution (QAS) product manager and in the USA as the business development manager for QAS. Additionally JC previously served as product marketing manager for the Worthington Creyssensac global portfolio where he also represented several other "group" brands, and the Atlas Copco Houston Product Company.

"I am honored and very excited to be joining such a talented team at Chicago Pneumatic and look forward to elevating business to the next level," said JC Lecocq, Senior Vice President, Chicago Pneumatic.

For more information about Chicago Pneumatic and its products, or to find a distributor near you, please visit www.cp.com

Toyota North American Environmental Report

Looking for a new vehicle? How about one that was assembled at a North American facility that helped save 61 million gallons of water last year? And you can buy that vehicle at one of the most environmentally advanced dealerships in the country. These examples of environmental leadership and more are highlighted in the recently published 2013 Toyota North American environmental report.

Noteworthy efforts for the year include:

1. Toyota and Lexus exceeded sales of **2 million** hybrid vehicles in the U.S. and more than **5 million** hybrids globally. Toyota estimates the use of 5 million hybrid vehicles has avoided 34 million tons of CO_2 emissions.
2. Energy use has been reduced by **22 percent** per vehicle produced (since FY2002).
3. **Ten** Toyota North American plants achieved zero waste to landfill.
4. Since 2002, Toyota's parts and accessories returnable container program has saved over **308 million pounds** of wood and **185 million pounds** of cardboard. Or 2.5 million trees worth.
5. Now in its sixth year, Toyota TogetherGreen has engaged nearly **half a million** participants in conservation action in all 50 states.

2013 also marks the formation of the Toyota North American Environmental (TNAE) organization. TNAE serves as coordinator of environmental efforts across North America by establishing priorities and consolidating environmental action plan targets across all operations, including research and development, manufacturing, logistics and sales.

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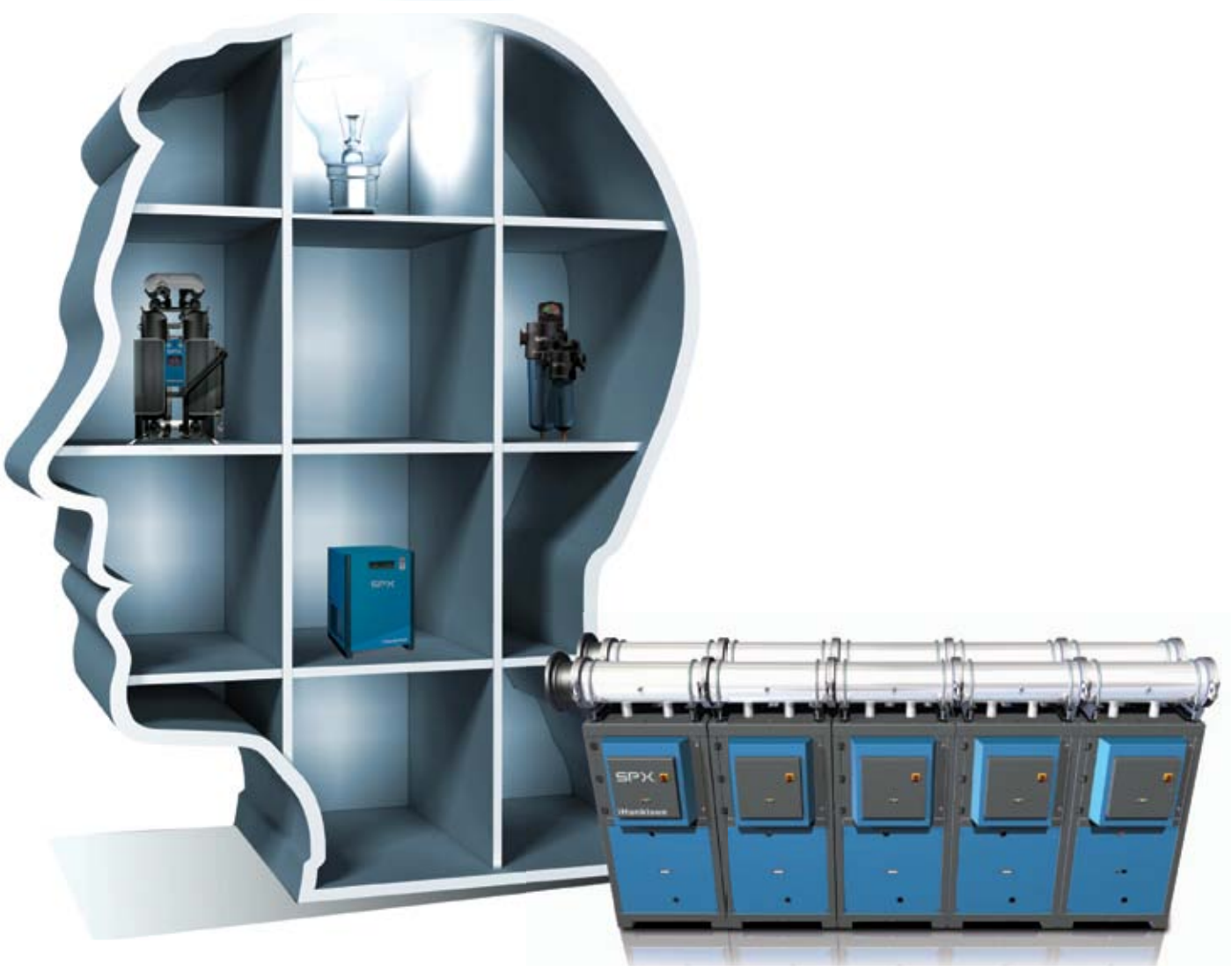

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"At Toyota, we strive to minimize environmental impacts throughout the vehicle life cycle," said Kevin Butt, regional environmental director, Toyota North America. "Our North American companies are working together to continually improve, innovate and serve as environmental leaders in our communities." To view the complete 2013 North American environmental report, please visit http://www.toyota.com/about/environmentreport2013

Additional 2013 environmental highlights:

Operations

Toyota's North American manufacturing division received its ninth ENERGY STAR Sustained Excellence Award for leadership in energy management.

With the implementation of brackish reverse osmosis systems, four Toyota assembly plants are saving 61 million gallons of water per year, or enough to fill 97 Olympic sized swimming pools.

Last year, U.S. parts and vehicle distribution centers diverted **98 percent** of waste from landfill and incineration, and recycled more than 17 million pounds of material.

Toyota manufacturing plants have reduced emissions of volatile organic compounds — compounds that react with sunlight to form smog — by **63 percent** since 2002.

Business Partners

Toyota's truck assembly plant in Texas reduced landfill waste by 71 percent in 2013 through an innovative partnership with Waste Management that turns trash into fuel.

Since 2008, Toyota has participated in energy "treasure hunts" with 41 suppliers, helping them identify annual energy savings of over 43.5 million kilowatt-hours — equivalent to 15,200 metric tons of CO_2 per year.

Visit www.toyota.com

Georgia-Pacific's Brunswick Cellulose Operation Wins 2013 AF&PA Sustainability Award

Brunswick Cellulose, Inc., a wholly owned subsidiary of Georgia-Pacific LLC, has been recognized by the American Forest & Paper Association (AF&PA) as a leader in sustainability by winning an AF&PA 2013 Better Practices, Better Planet 2020 Sustainability Award. The awards were presented at the association's annual meeting on Friday, Nov. 1 in Charleston, S.C.

Designed to recognize exemplary sustainability programs and initiatives, awards are given based on the merit of entries received across multiple categories. Georgia-Pacific is being honored this year with the Leadership in Sustainability Water Award for its "Water Use Reduction" project at its cellulose mill in Brunswick, GA.

"Georgia-Pacific is consistently a leader in innovation," said AF&PA President and CEO Donna Harman. "Through best practices in manufacturing technology, Georgia-Pacific has achieved water use reductions that are particularly impactful in coastal Georgia, where the region's primary drinking-water source is threatened in some areas by saltwater intrusion."

Georgia-Pacific installed a single-line bleach plant to replace three older pulp bleaching processes. The upgrade project resulted in a reduction in overall groundwater use of nearly 10 million gallons per day, or 30 percent of the mill's total daily use, since the new equipment became fully operational in the first quarter of 2012. The project also allows for a smaller energy footprint and lower air emissions from energy production.

"We're honored to be recognized for this sustainability project and as a leader in innovative practices," said Jim Hannan, CEO and president, Georgia-Pacific. "We're always focused on opportunities to apply new process improvements that will help us conserve our natural resources and grow our business at the same time."

AF&PA releases its biennial Sustainability Report every other year, which in 2012 showed that the U.S. pulp, paper, packaging and wood products manufacturing industry has made significant, measurable progress

INDUSTRY NEWS & SUSTAINABILITY REPORTS

toward achieving its Better Practices, Better Planet 2020 sustainability initiative. AF&PA will release its next report in mid-2014.

AF&PA member company applicants are considered annually in two categories — "Innovation in Sustainability" and "Leadership in Sustainability" — with five "Leadership" subcategories: Paper Recovery for Recycling, Energy Efficiency/Greenhouse Gas Reduction, Sustainable Forest Management, Safety, and Water. Projects that support progress toward the Better Practices, Better Planet 2020 sustainability goals qualify for recognition in the "Leadership" category; projects that merit recognition for their contribution to sustainable business practices but that do not specifically address one of these goals may be recognized in the "Innovation" category.

In 2012, Georgia-Pacific was honored with the "Leaders in Sustainability" energy efficiency award for its "Improving Energy Efficiency" project, a comprehensive energy management program for its manufacturing facilities.

Visit AF&PA online at www.afandpa.org or visit Georgia Pacific at www.gp.com

White House Meeting Honors New Superior Energy Performance Members

New Superior Energy Performance (SEP) members 3M Company, Cummins Inc., General Dynamics OTS, Nissan, Schneider Electric, and Volvo Group North America from industry, and the Bonneville Power Administration, Efficiency Vermont, and Northeast Utilities (Connecticut Light & Power Company, Yankee Gas, and NSTAR Electric & Gas) from the utility sector formally joined the Department of Energy's (DOE's) Better Buildings Industrial Superior Energy Performance (SEP) Accelerator Program on December 3, 2013.

The Accelerator Program for industry and utilities will make SEP certification easier and more affordable. By participating in the Accelerator Program company members will demonstrate cost savings enterprise-wide in their own facilities and encourage suppliers and customers up and down their supply chain to do the same.

"These companies have stepped up to help establish a new paradigm for energy efficiency in manufacturing," said Dr. Mark Johnson, Director of the Advanced Manufacturing Office at the Department of Energy. "Each has committed a starting point of at least three manufacturing plants to pursue Superior Energy Performance and to help manufacturers understand the measurable benefits that they can achieve, sustain, and expand over time with an effective energy management system. Achieving the level of Superior Energy Performance will give these companies the greatest ability to manage their energy resources and thereby maximize competitive advantage."

SEP is a DOE administered certification and recognition program that complements and supports the President's larger Better Buildings Better Plants Initiative. The U.S. Council for Energy Efficient Manufacturing (U.S. CEEM), the American National Standards Institute (ANSI), and the ANSI-ASQ National Accreditation Board work alongside DOE to develop SEP as a transparent system for certifying improvements in energy performance and management practices. Learn more about Superior Energy Performance and the SEP Accelerator Program.

Visit www.superiorenergyperformance.energy.gov

Archer Daniels Midland Advances Environmental Goals

A companywide campaign to curb emissions, reduce energy use and decrease water consumption is showing early results at Archer Daniels Midland Company, according to the company's newly released Corporate Responsibility report.

Between 2010 and 2012, implementation of energy-saving projects generated an estimated 4.3 percent reduction in ADM's total energy consumption and a 2.6 percent reduction in global greenhouse gas emissions, both on a per-unit-of-production basis. This progress puts the company on-track to achieve its goal of a 15 percent reduction in both areas by 2020.

The report also notes that from 2008 to 2012, ADM reduced water use 11.8 percent at the six U.S. corn-processing facilities responsible for 70 percent of its global water consumption. The company has committed to a 15 percent reduction per unit of production by 2018.

"ADM's dual focus on Operational Excellence and on serving vital needs in a sustainable way is improving our environmental profile," said Matt Jansen, senior vice president and president, ADM Oilseeds, who chairs the company's sustainability committee. "We're pleased at the results we've been able to deliver so far, and we think prospects are excellent for continued improvement."

In addition to environmental data, the new report provides detailed background on the company's ongoing work to ensure more sustainable supply chains for palm oil, soybeans and cocoa. It offers an overview of company innovations in areas ranging from renewable chemicals to greener tugboats and more fuel-efficient road and rail transportation. And, it details many of the projects and organizations the company's social-investment program, ADM Cares, has supported with $44 million in contributions since 2009.

The report is available at www.adm.com/responsibility

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PROPER COMPRESSED AIR FOR IS GLASS CONTAINER MACHINES

By Hank van Ormer, Air Power USA

Proper compressed air supply to the IS Machine, in glass container manufacturing, is critical. Each process requires carefully controlled pressure, air quality (dryers), and flow as necessary for optimum production with minimum scrap. Most IS machine operations, which Air Power has reviewed over the years, offer significant energy savings opportunities with low capital costs. The final results also enhance quality and productivity.

- Hot molten glass, the *gob,* loads into the mold
- The *baffle* closes the mold and the plunger starts up forcing the *parison* (or partial) container
- Mold shifts with *parison* in blow mold for reheating
- Final blow air is directed through blow head to form the hast parison into the final container shape
- Glass container removed from mold and placed for cooling

What is an IS Machine?

The heart of any glass container manufacturing process is the IS machine; often termed the "press and blow process". Figure 1 is a generic representation of this basic process. The initials "IS" stand for Individual Sections. Each section produces a container independently. Most IS machine are described by the number of sections, i.e. 10-section unit has 10 molds. There are also tandem units, i.e. a 10-section tandem unit will have 20 molds. Another description is how many is a *gob?* A *gob* unit fills one section at a time. A three gob unit fills three at a time. The gob being delivered to the mold comes from the furnace through the forehearth where it conditions and usually gets to the mold entry at about 1800 to 2000 ˚F.

The type and size of the appropriate IS unit is dictated by the type of glass product material, size, and production levels. Regardless of the type of glass container, it is always critical to control the pressure

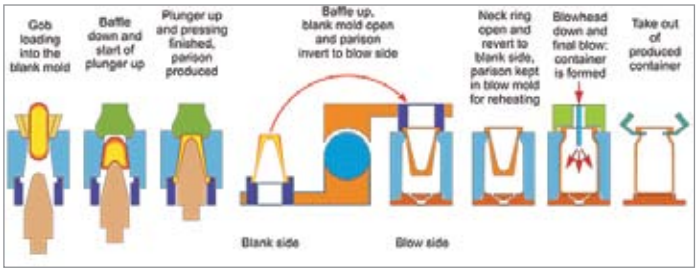

Figure 1. Press and Blow Process basic design

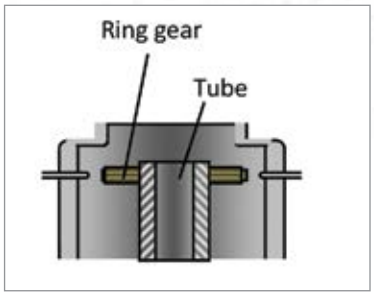

Figure 2a. Spout ring gear

and temperature throughout the process. The compressed air supply has a huge impact on this. In addition to the obvious final blow air (which is usually low pressure at or less than 55 psig) compressed air is used to drive the plunger up and its cooling for various operations in the machine such as mold closing, inverter, pilot air, push out air, blank close, and baffle air. Many times there are often cases of cooling air such as spout ring gear and motor cooling.

Spout ring gear cooling on an IS machine is handled by blowing compressed air through ring feed tubes blowing on the ring gear. The main feed line is often from the high pressure system which has a high entry pressure and later regulated to the lower pressure. Sometimes the line size before the regulator must be increased to create an adequate air supply when switching to low pressure air. Feeds to the regulator should be as short as possible and as large as possible.

Two Separate Compressed Air Systems

Typically press and blow glass container manufacturers use two separate air systems — a low-pressure (50-70 psig) and a high-pressure (90-100 psig) system. These systems are usually set up with two separate compressed air supplies and two separate piping distributions.

The low-pressure air generally goes to the *"hot end"* of the plant to the furnace forehearth and IS units. The high-pressure air also goes to the "hot end" for selected uses and to the "cold end" of the plant for packaging, palletizing, shipping — applications which are almost 100% high-pressure air use. Most plants have some type of controlled (hopefully) crossover valve to allow *occasional* high pressure air to help the low-pressure air supply.

Drying Low-Pressure Air

Until the last decade, most glass container plants had dry high-pressure air but wet low-pressure air. Because of this, many plants are researching and some are implementing the benefits of drying the low-pressure air.

Early decisions not to dry low-pressure air were based on several theories:

- **The IS machine mold receives a typical 2000 ˚F gob of glass.** Once the air (even saturated) enters the IS unit, there will be no further cooling and therefore no condensate generated. Correct piping with appropriate storage tanks, drain legs, and automatic condensate drains will keep the liquid out of the molds and therefore not affect production.

PROPER COMPRESSED AIR FOR IS GLASS CONTAINER MACHINES

TABLE 1. TWO CENTRIFUGAL COMPRESSOR SUPPLY OPERATING DATA *

MEASURE	HIGH PRESSURE	LOW PRESSURE
Average System Flow (scfm)	6864	11,482
Average Compressor Discharge Pressure (psig)	88.5	50.8
Average System Pressure (psig)	88	50
Input Electric Power (kW)	1541	1620
Operating Hours of Air System (hrs/year)	8760	8760
Specific Power (scfm/kw)	4.46 scfm/kW	7.09 scfm/kW
Electric Cost for Air/Unit of Flow ($/scfm/yr)	$196.66 scfm/yr	$123.60 scfm/yr
Annual Electric Cost for Compressed Air ($/year)	$1,349,916/yr	$1,419,120/yr

* based upon a blended electric rate of $0.10 per kWh and 8760 hrs/year

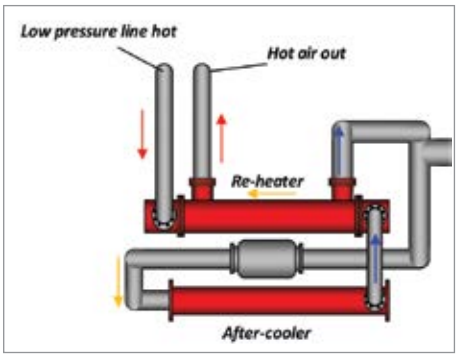

Figure 3. Reheater design

- **Plants used water-cooled aftercoolers without further drying.** In an effort to keep the remaining water vapor in vapor form, some plants employed a "reheater" (Figure 3). This used a second exchanger after the water-cooled aftercooler which used the incoming hot wet air to reheat the outgoing aftercooled air. The results of this action were mixed. The same amount of water vapor was still in the low-pressure compressed air. Where it fell out as liquid condensate totally depended on operating conditions. These reheater units were and are available as a commercial product from several heat exchanger manufacturers.

Today there is a major trend to dry both low-pressure and high-pressure air. Some of the current conditions that have been identified at the "hot end" to stimulate this change are:

- Most control valves, solenoids, and auto drains have their life significantly reduced with liquid condensate present.
- The use of oil-free centrifugal compressors for the larger high and low-pressure air supplies

> "Until the last decade, most glass container plants had dry high-pressure air but wet low-pressure air. Because of this, many plants are researching and some are implementing the benefits of drying the low-pressure air."
>
> — Hank van Ormer, Air Power USA

eliminated oil carryover into the system, but left it with a relatively aggressive acidic condensate which exacerbated the issue.

- These conditions lead to many wasted compressed air dollars due to actions taken by conscientious operators to control the condensate. Common IS Machine system losses:
  - Drain holes drilled in air lines to stop the condensate from entering the area.
  - Drain holes drilled in control valves and solenoids to keep the condensate from going downstream.
  - Drain valves open in receiver filters and risers because the automatic condensate drains are ineffective.

Figure 4. Recommended pressure settings in a press and blow glass container plant on an IS Machine.

Is Your IS Machine Using High-Pressure Instead of Low-Pressure Air?

Many IS machine operations, that could be run on low-pressure air, are put on high-pressure air and regulated down to the needed lower pressure because the high-pressure has had the moisture removed by compressed air dryers.

Table 1 below reflects the current operating data of two centrifugal based compressed air supplies — one low-pressure (50 to 51 psig), and one high-pressure (88 to 89 psig). The dollar per scfm per year cost is the actual operating cost based on the plants' measured data. It only reflects actual electric operating cost to produce the air — no maintenance, water, drying costs, etc.

As shown in Table 1, the average annual electric energy cost to produce the high-pressure air is $196.66 scfm/yr and the cost

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TABLE 2. COMMON APPLICATIONS

SHOP LOCATION:_____

DIGITAL PANEL UNITS MAY HAVE HIGH OR LOW PRESSURE SOURCE	CONTROL AIR WALL UNITS MAY HAVE HIGH PRESSURE SOURCES
Vacuum	_____ psig
Air ride	_____ psig
Plug down	_____ psig
Mold close	_____ psig
Sheer spring	_____ psig
V-blk pilot	_____ psig
P/G cooling	_____ psig
Vertiflow	_____ psig
Finish cooling	_____ psig
Ross pilot	_____ psig
Pocket air	_____ psig
Machine air	_____ psig
Settle blow	_____ psig
Pusher	_____ psig
Final blow	_____ psig
Baffle	_____ psig
Plunger up	_____ psig
DSS	_____ psig
Machine cooling tip	_____ psig

to produce the low-pressure is $123.60 scfm/yr. When high-pressure air is used, instead of low pressure air, the extra cost to this operation is $73.06 scfm/yr. **This is $73,060 per 1000 scfm demand if it is misapplied high pressure air.**

In Figure 4 note the numbers below 55 psig — all of these IS machine pressure settings are on high-pressure air and regulated down. The main feed line from the high-pressure system has a high entry pressure which is later regulated down to the lower pressure.

When using lower pressure air, increase the line size before the regulator to create an adequate air supply. Again, feeds to the regulator should be as short as possible and as large as possible.

Table 2 shows a partial listing of common applications in the press and blow mold IS units where high pressure may be able to be replaced with low-pressure air. This can be an effective investigation target list for personnel use.

It is important to point out that this variance is very site specific. It depends not only on the specific power of the base compressors, but also the effectiveness of the controls, maintenance, piping, etc.

Summary

Too often, when a press and blow glass container plant is reviewed for compressed air savings and productivity improvements, the "hot end" is ignored because of perceptions that any changes are improbable if not impossible.

Over the years, Air Power has found that great steps can be taken by identifying and reviewing the actual cost per scfm/yr of using high-pressure air, instead of low pressure air, with operating personnel,. In order to do this, significant knowledge of what is going on in an IS machine is required in order to find intelligent ways to increase the productivity of these critical production process. BP

For more information contact Hank van Ormer, Air Power USA, tel: 740-862-4112, email: hank@airpowerusainc.com, www.airpowerusainc.com

To read more ***System Assessment*** articles, visit www.airbestpractices.com/system-assessments/end-uses

THE COMPRESSED AIR SYSTEM ASSESSMENT

An Aging Plant Air System Gets a Face-Lift

By Gary Wamsley, JoGar Energy Services

Does your plant have a 'mature' compressed air system with on-going challenges? If yes, this story may be of interest. It discusses up-grades to the compressed air system in a large manufacturing plant that resulted in significant energy system cost savings, better ownership of the asset by plant personnel and improved production operations.

Introduction

The Technical Director of a large facility in the Midwest (producing valves and meters) hired us to assist with a Site Energy & Utility Systems assessment. The compressed air system quickly became one of the main issues identified. The plant was built in the 1960's and had expanded over the years. Recent reduction-in-force programs (to reduce costs) had impacted the maintenance department and the plant air system was high among the systems that were the most affected. Over the next several months, as management became attuned to all of the air system issues affecting utility costs and process quality concerns, resources were provided and significant improvements occurred.

Identification of Opportunities

- Compressor reliability was low and rentals were being utilized frequently
- The maintenance program was in need of some technical oversight
- System pressure was much higher than necessary
- Motor failures were a regular occurrence — frequent 'starts'
- Fouled intake filters and coolers
- Water in the air lines: Dryers in need of better operational oversight
- Controls and instrumentation needed up-graded

System Description

There were two compressor service rooms, each with two 350 hp rotary air-cooled units. Generally three units were in continuous service near full load on two shifts. Two units operated on afternoon shift and weekends when the Foundry was 'DOWN'. Minor service items were handled by a small maintenance crew and major repairs were under a 'Service Contract' with the equipment supplier. Coordination between the two groups was minimal. Moreover, the Foundry Superintendent (with years of service) had established that the two compressors in his area must be operated at high pressure to

minimize casting defects (which we quickly learned were the production bottleneck).

Developing a Plan

We installed a 7-day pressure recorder instrument. The main receiver tank at the Foundry compressors would cycle between 106 and 116 psig and the Factory compressors receiver tank at 102 to 112 psig. There was no plant-wide system piping diagram or method to automatically control the air system pressure. Numerous issues had to be investigated.

We visited the plant several times building trust, conducting 'training sessions' for the maintenance crew and identifying and prioritizing issues that needed to be addressed. Numerous staff changes may also have been part of the overall challenge. Thus, a few management level reviews were conducted. Our objective was to convince the new engineering and maintenance managers that the system could be upgraded and operate effectively at or below 100 psig without unscheduled outages and 'rentals'.

We developed a plant air system piping diagram and delineated numerous 'Demand-Side' issues. We outlined system conditions, the cost impact upon the plant due to compressor anomalies and how to go about making effective 'change'. Meetings with a representative from the Compressor Service Company resulted in his accepting 'some' lack in overall service responsibility, but not the level of support and communications that we had expected. It seemed that the service group enjoyed the frequent repair calls and the sales group wanted to install all new equipment, regardless of distribution and process system issues.

Implemented System Changes

- Two compressors required air-end replacements (near end of life hours)

THE COMPRESSED AIR SYSTEM ASSESSMENT | An Aging Plant Air System Gets a Face-Lift

- Two motors were replaced with the 'soft-start' capability ensured
- VSD drive was installed on one unit in the foundry
- The oldest stand-by unit (in poor condition) was replaced with a 200 hp unit
- 'Intelligent' control systems were installed in both compressor rooms
- Piping changes were made to the main air lines at several bottleneck locations
- Local surge tanks were installed in the foundry at the sand mold presses
- Local surge tanks in the factory at the multi-station turret cutting machines
- New pressure transducers were installed at key points in the system
- Leak survey: numerous leaks and defective traps were repaired
- An air dryer service program was developed & implemented

Results

System pressure trials confirmed that the compressors could operate effectively at 98 to 102 psig during foundry operation and at 96 to 100 psig when the foundry was down. The VSD unit could generally control the system pressure at 75% load.

Note: Subsequent to start-up and optimization of the new VSD drive and control systems, it was decided to terminate the service contract with the longstanding equipment supplier (due to more performance issues) and hire a regional services company for major services work. The maintenance crew developed a close working relationship with the new vendor.

Benefits

- The plant electric power bill was reduced by an average of $6,000 per month
- Emergency rental charges that had averaged $30,000 per year disappeared
- Foundry casting operations improved and overtime was reduced
- Exhaust heat recovery ducts were installed on the compressors (into the foundry) reducing winter building heating costs by $40,000 per season
- Cold 70 °F make-up air into the foundry was reduced by 40,000 CFM. Employees were much more comfortable.

Note: Not all projects met the 2-3 year hurdle-rate criteria for industrial energy savings. Some were considered as restoring the integrity of the utility asset. Air-cooled rotary compressors do require a dedicated maintenance program when operating at high pressure in a particulate-laden environment.

Summary

If your facility has a 'mature' plant compressed air system that has undergone changes over the years and encounters frequent 'hick-ups', you may want to consider an overall system assessment by an 'independent' expert. Supply-side issues alone generally cannot resolve all of the anomalies with a large plant air system that has evolved over time. BP

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THE COMPRESSED AIR SYSTEM ASSESSMENT

Optimizing Centrifugal Compressors at a Glass Bottling Plant

By Don van Ormer, Air Power USA

This glass bottle production plant had a complete compressed air audit in 2001 and 2002 at which time many successful projects reduced and stabilized the demand at 3,148 scfm at 95 psig for the high pressure system air and 9,300-9,500 scfm at 58 psig for the low pressure system. Successful application of an oversized 7,200-scfm rated cycling refrigerated dryer completely dried up the high-pressure air, allowing the removal of several non-performing desiccant dryers and savings in direct kW and purge air.

Since that time, the plant has undergone many growth changes and expanded production and subsequently its air usage. The primary changes to the plant production side include:

- EP (Electric Precipitator) system has its own separate air supply and dryers
- Ten more sections have been added to the IS units
- Two additional lines (from 9 to 11)
- One additional Unitizer (palletizer)

Two of the less power efficient compressors were removed from service and a more efficient TA48 was brought in from another plant. This compressor also discharges to a 5,000-scfm rated non-cycling refrigerated dryer.

Annual plant electric costs for air production, as running today, are $3,063,766 per year. If the electric costs of $33,899 associated with operating ancillary equipment such as refrigerated dryers are included, then the total electric costs for operating the air system are $3,097,665 per year. These estimates are based on a blended electric rate of $0.11 / kWh. The air system operates 8,760 hours a year. The load profile or air demand of this system is relatively stable during all shifts.

The Existing Compressed Air System

Low Pressure: The low-pressure system has four centrifugal air compressors. All four are normally in operation providing an average total of 11,956 scfm of compressed air flow at 58 psig.

Unit #5 and Unit #2 both appear to be running at full load in a normal manner with the exception of Unit #2, which had the inlet valve at 81% open in the cooler morning air and up to 74% open during hotter afternoons. The amperage stayed at a constant 132 amps, which is obviously the minimum amp limiter.

Units #6 and #7 are both in full turndown and blow off. We estimate this blow off to be 500 scfm each or 1,000 scfm total. Unit #7 shows a minimum amp setting on the IR controller, but it appears to be pulling up to full turndown at 154 amps. This could be premature! Note that the integral aftercooler on Unit #6 appears to not be performing — 120 ˚F air.

Settings on both units need to be the same so that you are not unloading prematurely.

Check the controls and kW/amp to motor to see if you are at true full load or if there is some extra power left not being utilized.

High Pressure: The high-pressure system is comprised of four centrifugal air compressors. Two are normally in operation providing an average of 3,119 scfm of compressed air flow. These units are complemented by two diesel-driven rental compressors, providing a total of 2,392 scfm. Total high-pressure air flow is 5,511 scfm at 89 psig.

Unit #3 is running at full load, but the blow-off valve (BOV) appears to be leaking significantly, even though it is fully closed. Note that the blow-off line temperature starts at 250 ˚F and is still at 200 ˚F as it reaches the roof. You can also go up on the roof and feel the air blowing. We estimate this to be 350 scfm. This unit also has a cooling problem with the after-cooler. Note the 154 ˚F exit air. The BOV valve needs to be repaired.

Unit #1 is pulling 203 amps according to the controller (7% over 189 max motor amps). However, the unit is at full turndown (60° on IGVs) and in blow-off (29% open BOV). The operating temperature (166 °F discharge / after-cooler water 2 ˚F rise) all indicate the unit is at very low load with significant blow-off (doesn't go through after-cooler). This blow-off can also be observed and felt on the roof. This could be a control problem caused by a faulty transducer reading the amperage incorrectly. Estimated blow-off (1,000 scfm) total air available to recover at true full turndown load (estimated) — 3,036

THE COMPRESSED AIR SYSTEM ASSESSMENT | Optimizing Centrifugal Compressors at a Glass Bottling Plant

COMPRESSOR USE PROFILE — CURRENT SYSTEM							
UNIT #	COMPRESSOR: MANUFACTURER/MODEL	FULL LOAD		ACTUAL ELEC DEMAND		ACTUAL AIR FLOW	
		DEMAND (KW)	AIR FLOW (SCFM)	% OF FULL KW	ACTUAL KW	% OF FULL FLOW	ACTUAL SCFM
High Pressure System: Operating at 89 psig discharge pressure for 8,760 hours							
1	TA48	706.7	4,333	70%	494.7	46%	2,000
3	1ACII15M2	266.8	1,417	100%	266.8	77%	1,119
7	TA28	392.6	2,392	100%	392.6	100%	2,392
8	3CC35M3	550.5	3,457	OFF			
			TOTAL (Actual):	**1,154.1 kW**		**5,511 scfm**	
Low Pressure System: Operating at 58 psig discharge pressure and 8,760 hours							
2	2CV35M2	451.5	3,368	100%	451.5	100%	3,368
4	C95045M2	596.1	4,572	86%	515	65.6%	3,000
5	C40M3	460.9	3,588	100%	460.9	100%	3,588
6	2AC1145M2	530.3	4,011	91.5%	485	49.8%	2,000
			TOTAL (Actual):	**1,912.4 kW**		**11,956 scfm**	
EP System: Operating at 109 psig discharge pressure and 8,760 hours							
9	ZT250	231	1,154	49%	113	36%	416
			TOTAL (Actual):	**113 kW**		**416 scfm**	

* The load on the current diesel rental compressors was transferred to Unit #7 (TA28) centrifugal.

COMPRESSOR USE PROFILE — PROPOSED SYSTEM WITH COMPRESSOR REALIGNMENT AND AIR FLOW AND DISCHARGE PRESSURE REDUCTION							
UNIT #	COMPRESSOR: MANUFACTURER/MODEL	FULL LOAD		ACTUAL ELEC DEMAND		ACTUAL AIR FLOW	
		DEMAND (KW)	AIR FLOW (SCFM)	% OF FULL KW	ACTUAL KW	% OF FULL FLOW	ACTUAL SCFM
High Pressure & EP System: Operating at 80 psig discharge pressure for 8,760 hours							
1	TA6000/TA48	706.7	4,333	100%	706.7	100%	4,333
9	ZT250	231	1,154	92%	212.5	90%	1,035
7	TA28	392.6	2,392	OFF			
3	1ACD15M2	266.8	1,417				
8	3CC35M3	550.5	3,497				
			TOTAL (Actual):	**919.2 kW**		**5,368 scfm**	
Low Pressure System: Operating at 58 psig discharge pressure and 8,760 hours							
2	2CV35M2	451.5	3,368	100%	451.5	100%	3,368
4	C95045M2	596.1	4,572	100%	596.1	100%	4,572
5	C40M3	460.9	3,588	OFF			
6	2ACII45M2	530.3	4,011	100%	530.3	100%	4,011
			TOTAL (Actual):	**1,577.9 kW**		**11,956 scfm**	

Note: ZT250 running at an average of 109 psig regulated down when fed into main high pressure system.

> "This glass bottle production plant had a complete compressed air audit in 2001 and 2002 at which time many successful projects reduced and stabilized the demand at 3,148 scfm at 95 psig for the high pressure system air and 9,300-9,500 scfm at 58 psig for the low pressure system."
>
> — Don van Ormer, Air Power USA

scfm. Unit #1 needs to have the control system reviewed so it can truly run at full load.

On July 18 at approximately 1:30 pm, it was observed that one of the rental diesel-driven compressors had failed and was not running. At this point, we noticed that the high-pressure system's pressure had fallen to 70 psig. The system ran this way until about 4:30 pm when the diesel was brought back on line. Several things were noticed during this time.

- Unit #1 compressor remained at the same load as it was at 89 psig (IGV @ 68° / BOV @ 29%)
- System pressure ran from 70 psi to 68 psi back in the Unitizer area
- We did not observe or hear of any production issues

It is recommended that the discharge pressure of the high-pressure system be lowered to approximately 75 to 80 psig.

EP System: There is one rotary screw compressor supplying compressed air to the plant's EP system. The air compressor is located outdoors under a steel roof. The unit provides an average total of 416 scfm of compressed air flow at 109 psig.

Proposed System Changes

This project reduces compressed air demand by 559 scfm and then consolidates the supply-side.

Efficiency Projects

- Realign the high-pressure system to reduce demand and combine high-pressure and EP systems (22% efficiency gain)
- Realign the low-pressure system (18% efficiency gain)

Air Flow Reduction Projects
(Total Reduction = 559 scfm)

- Replace open blows on 11, 12, 13 Shop Squeezers and other listed equipment (295 scfm)

THE COMPRESSED AIR SYSTEM ASSESSMENT

Optimizing Centrifugal Compressors at a Glass Bottling Plant

SYSTEM COMPARISON	CURRENT SYSTEM		PROPOSED SYSTEM	
	HIGH PRESSURE	LOW PRESSURE	HIGH PRESSURE & EP SYSTEM	LOW PRESSURE
Average Flow	5,511 scfm 416 cfm (EP) (5,927 scfm)	11,956 scfm	5,368 scfm	11,956 cfm
Avg Compressor Discharge Pressure	89 psig	58 psig	85 psig	58 psig
Average System Pressure	85 psig	58 psig	80 psig	58 psig
Electric Cost per Cfm	$201.79 /scfm/yr	$154.13 /scfm/yr	$165.00 /scfm/yr	$127.17 /scfm/yr
ANNUAL ELECTRIC COST:				
Compressor Operation (HP, LP, EP)	$3,063,766		$2,406,205	
Other Air Equipment	$33,899		$10,002 - $45,096 = ($35,094)	
Total Annual Electric Cost	$3,097,665		$2,371,111	
OVERALL PROJECT EVALUATION				
Compressor Operation Savings	$657,561			
Other Project Savings	$68,993			
Total Savings	$726,554			

- Reprogram PLC on Unitizers for vacuum generator timing (23 scfm)
- Repair tagged compressed air leaks (241 scfm)

Other Projects (Total Reduction = $23,897)

- Put non-cycling 5,000 scfm refrigerated dryer into back-up mode ($23,897)

Proposed System Summary

With the air flow reductions considered, the savings potential of the projects related to operating the compressors total $657,561. Adding in the savings potential of $68,993 from other projected related to operating auxiliary equipment (e.g., refrigerated dryers and more efficient compressor motors) provides a total savings estimate for the entire set of projects of $726,554. Together these projects can be completed at a cost of $1,145,192 resulting in a simple payback of 19 months.

Comments to the Proposed High Pressure System

After the compressors are realigned to function properly and with air reduction projects, the high pressure demand falls from 5,511 scfm to 4,603 scfm. This demand is greater than the Unit #1 compressor can produce. There are no air saving projects for the EP system. It is running at 36% load — 416 scfm. This leaves 738 scfm available.

> "This factory illustrates what is so common with compressed air systems. The demands on the system change continually as the demands on the factory change."
>
> — Don van Ormer, Air Power USA

Our recommendation is to install a pressure/flow controller in the tie-in line (already installed) and regulate part of the remaining 738 scfm (namely 270 scfm) from this system into the plant high pressure system. This pressure would have to be the same as the plant pressure of 80 psig.

With this project, a second centrifugal would not have to be run as trim. The EP compressor has to supply higher pressure air to the EP system — 416 scfm. It would increase the load on the Atlas Copco from 36% to 59% load.

With the additional load on the rotary screw ZT250 unit, the cycle times will allow longer load and idle times. This will help to reduce the short cycling.

We also recommend tying the Unit #1 compressor into the header to the cycling dryer, leaving the non-cycling dryer as emergency back up, and then pipe back out to the system. This will utilize the existing oversized full-cycling dryer instead of a non-cycling dryer.

Conclusion

This factory illustrates what is so common with compressed air systems. The demands on the system change continually as the demands on the factory change. This project ended up qualifying for a $626,000 energy incentive from a local utility. This helped provide a simple ROI of less than one year on a project providing the glass bottling plant with annual energy savings of $727,000. BP

For more information contact Don van Ormer, Air Power USA, tel: 740-862-4112, email: don@airpowerusainc.com, www.airpowerusainc.com

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SHOW REPORT:

COMPRESSED AIR, PNEUMATICS AND CHILLERS AT FABTECH

AWS WELDING FMA SME PMA METALFORM

By Rod Smith, Compressed Air Best Practices® Magazine

➤ The 2013 edition of FABTECH was held November 18-21 at McCormick Place in Chicago. The five FABTECH co-sponsors represent a wide variety of expertise and include: SME, the American Welding Society (AWS), the Fabricators & Manufacturers Association International (FMA), the Precision Metalforming Association (PMA), and the Chemical Coaters Association International (CCAI). Together, these associations bring unmatched technical proficiency and industry insight to FABTECH.

A total of 40,667 attendees visited 1,573 exhibitors to see live equipment demonstrations, compare products side-by-side to find cost-saving solutions at product displays spread across 650,000 square feet of exhibits at McCormick Place. Attendees also benefited from the FABTECH educational conference held simultaneously with the four-day expo that included an unprecedented number of expert-led sessions on some of the hottest topics in manufacturing.

"While breaking our own records is impressive, most important were the reports we received from attendees and exhibitors," said John Catalano, FABTECH show co-manager. "Attendees were impressed with the record size and scope of the show and the number of new products and innovative technologies on display. Exhibitors were enthusiastic and report that sales activity was brisk and leads were plentiful."

FABTECH is a major metal fabrication, finishing, welding and laser cutting show. These processes are all automated — none of it can happen without compressed air, pneumatics and chillers.

Processing Equipment Automated by Compressed Air

Trumpf and Amada are the "Big 2" globally in 2D laser metal cutting and machining centers. I spent some time looking at the Trumpf 2D laser cutting and loading/unloading machines. A system will combine a Trumpf TruLaser Series machine with a Trumpf LiftMaster enabling automatic, unmanned production.

I'm always amazed by the human engineering ingenuity behind these huge automated machines. The basic building block of the LiftMaster is the suction frame. It is comprised of suction cups (using compressed air powered vacuum venturis) that transport the raw metal sheets as well as rakes to transport processed sheets. Pneumatic cylinders and on-machine air preparation modules, from FESTO, were also visible throughout the machine. (www.us.trumpf.com)

CO_2 laser cutting systems were all over the show. Many had Kaeser rotary screw compressors supporting their "assist gas" systems. Assist gas is made up of compressed air, oxygen, and nitrogen. The Kaeser rotary screw compressors can provide

Festo pneumatic cylinders and vacuum venturis allow suction cups to transport metal sheets in the Trumpf LiftMaster.

The Mitsubishi High-Speed Flying Optic CO_2 Laser Model ML 3015eX requires nitrogen as the assist gas above 4000 Watts.

The Mitsubishi Flying Optic CO_2 Laser Assist Gas Supply System with a Kaeser SFC Series rotary screw compressor.

SHOW REPORT: COMPRESSED AIR, PNEUMATICS AND CHILLERS AT FABTECH 2013

The Mazak Laser Machine Assist Gas Supply System with a Kaeser ASD Series rotary screw compressor.

Robert Glover, Allan Hoerner, Michael Tasevski and Francois Blain, from Parker, next to the MIDIGAS nitrogen generator used in laser cutting systems.

Don Joyce, from MTA, next to the TAE Series Chiller used at welding stations and in laser cutting systems.

air pressure to 217 psi — an attractive feature for these systems. A Mitsubishi High-Speed Flying Optic CO_2 Laser Model ML 3015eX requires nitrogen (as the assist gas) at 4000 Watts and above to keep the laser beam from diverging. Below 4000 Watts, the machine has an ECO mode where it can switch to compressed air to reduce gas and compressed air use. A machine operator, in the booth, told me they also use compressed air with 14-gauge metal (or less) thickness. This reduces the energy costs of the system. (www.mitsubishi-world.com)

Compressed Air, Pneumatics and Chillers

There are chillers present on most laser cutting and welding centers and there were quite a few booths showing chillers. MTA is growing rapidly as a supplier to this vertical market challenging the incumbents like Riedel. MTA's team, led by John Medeiros and Don Joyce, are seeing significant growth from their reliable TAE Series chiller product line in several key markets. They also reported the compressed air dryer side of their business is growing and shared excitement over an impending new product launch. (www.mta-usa.com)

Parker's FAF team had a very nice booth in the welding area of the show. Jane Sexton and Matt McQuillin said they are stocking heatless desiccant dryer models up to 1,000 cfm in Buffalo. They also said the new non-cycling DNC Series refrigerated dryers, built in Buffalo for 200 to 1,200 cfm flows, has been very well received by the market. The booth also had welder-specific product lines like the Hyperchill chillers and an interesting pneumatic actuator and impact control system for spot welding machines. (www.parker.com)

Anest Iwata displayed their oil-free reciprocating and oil-less scroll air compressors, oil-free scroll vacuum pumps, and their extensive range of spray guns and equipment used in metal fabrication shops worldwide. Steve Larson said their 40 hp modular package made up of eight five horsepower oil-free scrolls is their top seller. Benefits include no big inrush current and very low package energy costs along with clean particle-free air quality used in laboratories and electronics industries. (www.anestiwata.com)

Kaeser Compressors had a big island booth. Bruce Lidie reviewed the "whisper-quiet" (his words) compact SM7.5 hp Aircenter

package that includes a rotary screw compressor, an air dryer, and a receiver. Booth visitors also reviewed the modular aluminum piping systems and a Kaeser SFC 18 rotary screw compressor with the new Sigma Control 2. I reviewed the Sigma Control 2, last year at Hannover, and was amazed at how user-friendly and easy to integrate with personal computers the system is. (www.kaeser.com/cabp)

Parker has become a real authority on nitrogen generation. I think they've done a great job creating product line specialists who focus on specific applications. Robert Glover and Francois Blain, for example, work across North America strictly on nitrogen generation applications. I spent some time in their booth where they shared some very interesting knowledge with regards to what nitrogen purities are required (97% vs. 99.9999%?) in different situations. It's amazing how much energy one can save in compressed air generation if one doesn't over-specify nitrogen purity. (www.parker.com)

SMC's Matt McDonald is a long-time reader of Compressed Air Best Practices (thanks Matt) and has been deeply involved with compressed air system assessments. The number of pneumatic components one can use to optimize pressure and flow or simply improve machine productivity is astounding. Matt showed me CKZ power clamps that hold fixtures in place for spot welding, weld-immune switches able to resist magnetic fields and large air preparation units with robust construction for harsh welding environments. He told me that actuator seals can be ripped by dust containing metal shavings, in weld shops, and showed me an external rod scraper used to remove these shavings. There's always something new! (www.smcusa.com)

FABTECH is an annual show. If you are interested in attending, the next event will be held November 11-13, 2014 in Atlanta. (www.fabtechexpo.com) BP

For more information contact Rod Smith, Compressed Air Best Practices Magazine, tel: 412-980-9901, email: rod@airbestpractices.com

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Steve Larson, from Anest Iwata, next to a cut-away of their oil-less scroll air compressor.

Jane Sexton, Matt McQuillin, and Steve Richardson, from Parker, next to the Hyperchill Series Chiller.

Matt McDonald, from SMC, demonstrated energy-saving pneumatic components.

DIGITAL VALVE POSITIONER ENHANCES THE PERFORMANCE OF PRESSURE/FLOW CONTROL

Written by Bob Wilson, PEMCO Services, for the Compressed Air Challenge®

KNOW PRESSURE
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Specifying a control valve for Pressure/Flow Control service should be a relatively straightforward process. The range of compressed air flow and pressures must be known along with the target delivered air pressure. With this information, the performance specifications published by the various suppliers can be referenced for selecting a valve package. Often, however, the valve selected is too large in size to ensure it will have sufficient capacity to satisfy current and future flow requirements. Valve manufacturers use different design criteria in rating their units and in how their product is presented. There are no standards. For example, some list nominal flows suggesting the valve is about 50% open at the rating point. Others show a range of flows, which can be misleading since most valves cannot be tuned to perform equally well at both the low flow and the high flow conditions. Stated pressures are also an arbitrary number that may require adjusting the rated flow at the site specific facility. **Table 1** is an example of the approximate flow capacities for one such 6" valve.

TABLE 1

SIZE	NOMINAL FLOW @ 100 PSIG	NOMINAL FLOW @ 125 PSIG	NOMINAL FLOW @ 150 PSIG	OVER RANGE MAX FLOW
6" Valve	7,500 SCFM	9,550 SCFM	10,430 SCFM	14,539 SCFM

Where:

- Nominal Flows assumes the valve is about 50% open.
- Over range Flow is the highest practical flow with the valve about 80% open @ 100 psig.

Rated flows assume a 10 psid pressure differential across the valve.

Any of these flows could be listed as a rating point when properly qualified. Besides selecting a valve to meet the highest system flow requirement, the performance capabilities of the valve over the full anticipated system range of flows and pressure profile must be looked at. Manufacturer "A", for example, rates their 6" valve package at 6,500 scfm while Manufacturer "B" shows a range of flows from their 6" package of 800-10,700 scfm. Selecting the "A" valve based upon its rated flow of 6,500 scfm provides for a wide margin of safety. Selecting the "B" valve at its 10,700 scfm rated flow to be safe could create problems if it is also expected to control at significantly lower flows. A valve tuned properly within a PID Control loop for the high flow performance may tend to oscillate or hunt at the low flow condition.

Fundamentals of Compressed Air Systems WE (web-edition)

Learn About Pressure/Flow Controllers

Join Compressed Air Challenge for the next session of ***Fundamentals of Compressed Air Systems WE*** (web-edition) coming in February 24, 2014. Led by our experienced instructors, this web-based version of the popular *Fundamentals of Compressed Air Systems* training uses an interactive format that enables the instructor to diagram examples, give pop quizzes and answer student questions in real time. Participation is limited to 25 students. Please visit www.compressedairchallenge.org, to access online registration and for more information about the training.

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

Another common error is to size a valve based upon the piping header diameter. The thinking is if the valve is the same size as the connected pipe, it will certainly be big enough to pass the pipe flow. While this is technically correct, it usually results in an oversized valve that may have problems operating at the low flow conditions of the air system. If this situation exists, one solution is to retrofit the control valve with a Digital Valve Positioner (DVP). Let's look at the issue and see how a DVP could correct it.

The most prevalent throttling valve used for Pressure/Flow Control service is the butterfly valve. It is mechanically simple, requires a minimum of space, and provides high flow capacity with low pressure loss through the valve. They are relatively inexpensive in terms of flow capacity per investment dollar and match up with standard pipe flanges for ease of installation. **Figure 1** depicts a commonly used butterfly valve configured for Pressure/Flow Control service.

Flow is controlled by rotating a disk in the compressed air stream. The disk stem connects to a quarter turn actuator that is driven by a pneumatic control signal from an electronic positioner. An analog signal to the positioner from a PID Controller is generated in accordance with the outlet pressure sensed.

When to disk rotates, the torque applied to the shaft causes wear on the stem, seal, bearing surfaces, and seat. Improperly sized or misapplied valves that continuously oscillate and hunt put excess wear on these components. If the disk is allowed to get too far out into the

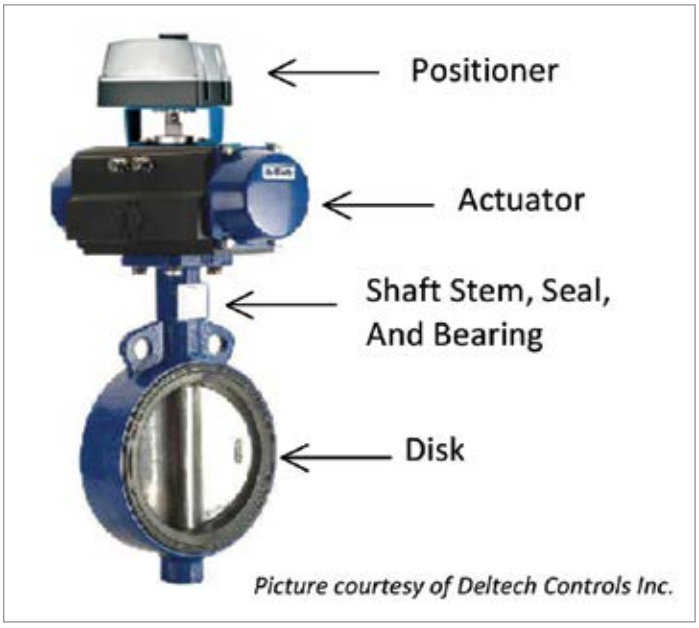

Figure 1. Butterfly Control Valve Assembly

DIGITAL VALVE POSITIONER ENHANCES THE PERFORMANCE OF PRESSURE/FLOW CONTROL

CAC® Qualified Instructor Profile

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- Collaborator, Encyclopedia of Energy Engineering and Technology
- Published Author

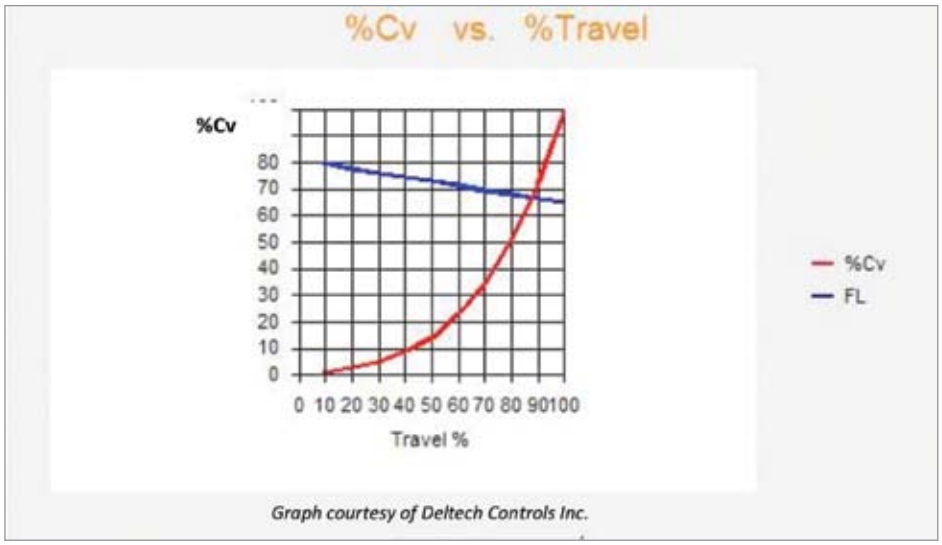


Figure 2. Typical Butterfly Valve Performance Curve

air stream, the torque to bring it back can sometimes snap the shaft. For a dynamic plant air system, alternate valve configurations should be explored in advance and the best one chosen to deal with the site specific performance requirements. For existing installations, the valve can be retrofitted to eliminate hunting by replacing the analog positioner with a DVP.

Butterfly valves have equal percentage flow characteristics meaning the flow capacity increases exponentially with valve trim travel. An **equal percentage** flow characteristic is a non-linear curve of which the slope increases as the valve disk opens. **Figure 2** illustrates a typical butterfly valve performance curve.

Note how a large incremental change in travel produces a small change in flow at the low end of the flow curve while a similar incremental change in travel produces a large change in flow at high end of the curve. Flow in the mid-range from about 25% to 70% is fairly linear. A butterfly valve chosen to operate within this limited mid-travel range can be tuned to perform satisfactorily. A valve chosen to operate at a wider range may have a tendency hunt at the low flow conditions.

"Equipping a Flow Control with a DVP can be a valuable step in improving the overall plant performance and deliver a good return on investment."

— Bob Wilson, PEMCO Services

The FL curve shows the liquid pressure recovery factor for the valve. As the valve travel changes, the directional flow path of the air across the disk also changes. The number is really only important in critical applications. Generally, the higher the number the better the valve will perform. The valve manufacturer will have these numbers if needed for selecting a valve for a critical application.

The recent trend of adding higher efficiency VSD and Variable Displacement compressors to the multiple compressor network changes some of the reasons why Pressure/Flow Control is applied. The increased part load performance capabilities of these types of compressors allow operating the network in a base/trim profile within a narrow pressure band set for the lowest optimal pressure needed to sustain production. Reducing the delivered air pressure by creating a large volume of primary storage in a receiver for release by the Pressure/Flow Control becomes less of a benefit. The new variable flow compressor designs provide reserve energy the system can draw upon from the compressor motor if it is operating at less than full load. The purpose of Pressure/Flow Control now is to supplement to the energy input of the compressors to maintain the optimal energy balance as the demand profile changes. Also, modern day system master network controllers offer new configurations based upon energy algorithms. These allow pressure bands to be set in the +/- 2-3 psi range. The Pressure/Flow Control valve must be capable of operating at lower pressure differential for the system to take maximum advantage of the higher efficiency of the newer compressor networks. **Figure 3** depicts a modern day compressor network operating in a base/trim profile with

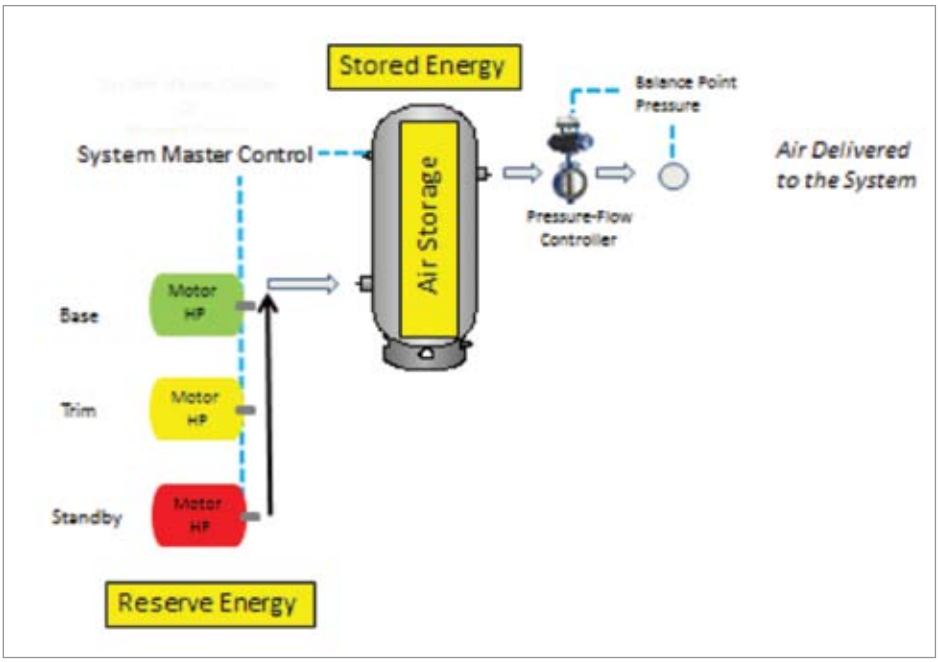


Figure 3. Modern Compressor Room Configuration

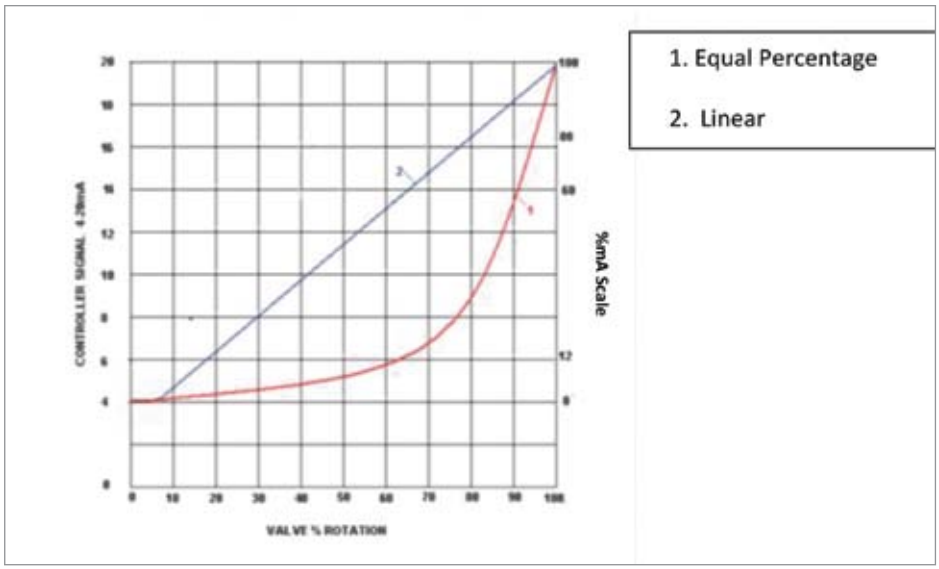


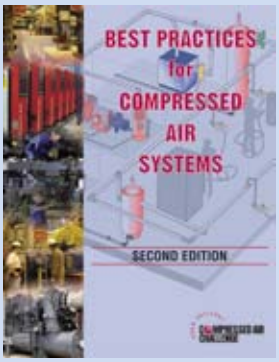
Figure 4. Linear Performance Curve for Valve Equipped with a Digital Positioner

the Pressure/Flow Control supplementing energy input of the compressors to maintain the system energy balance.

Many engineers recognize the performance benefits of the new compressor technology but remain uncertain of how best to implement it in their plants. If an existing Pressure/Flow Control has problems after the addition of VSD or Variable Displacement compressors and/or a System Master Network Control, one solution

DIGITAL VALVE POSITIONER ENHANCES THE PERFORMANCE OF PRESSURE/FLOW CONTROL

Best Practices for Compressed Air Systems Second Edition



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

is to retrofit the analog positioner on the valve with a new advanced technology digital positioner. **Figure 4** depicts a performance curve of a valve equipped with a DVP.

DVPs can be programmed to provide linear performance over the entire valve flow curve. This eliminates the excessive hunting and oscillation of a valve at the lower end of the flow curve. Because of their immediate response to change and accuracy without oscillation DVPs are ideally suited for use in applications like Pressure/Flow Control service where the process variables change rapidly. The performance curve depicted shows that this particular DVP is also programmed to initially rotate the disk about 8% to move it out of its seat so flow begins before the valve starts to control in a linear manner. **Figure 5** is a picture of a butterfly control valve with the DVP mounted on the actuator.

Figure 5. Butterfly Valve with DVP

Most DVP manufacturers offer product training programs to teach about how to mount and set up the unit and how to commission and troubleshoot it. There are many different styles and makes of digital positioners available. They range in costs from about $1000 - $2,000. Criteria must be carefully considered in choosing the right positioner for a site specific application and environment.

Some digital positioners will support an open protocol for digital communications such as HART, FOUNDATION Fieldbus, or PROFIBUS. These provide a means to monitor the health and performance of the Control valve. They can also be equipped with additional inputs and outputs such as dry contacts, and built-in diagnostic software that can provide advance warning of maintenance issues or a pending failure.

Even with the better pressure stability of the new model variable flow compressors, Pressure/Flow Control can still offer cost saving opportunities. The air pressure required by the air treatment equipment limits the extent of the decrease in supply pressure. The Pressure/Flow Control can provide a further reduction in the delivered air pressure. This is an excellent method to reduce and control air leakage. Also, the controlled storage in the receiver buffers the compressor response from the system demands so they have time to react and smoothly add their reserve energy to the system. The application of a DVP will enhance the performance of a Pressure/Flow Control allowing the system to take maximum advantage of higher compressor efficiency. Equipping a Flow Control with a DVP can be a valuable step in improving the overall plant performance and deliver a good return on investment. BP

For more information please contact Bob Wilson at www.pemcoservices.com, tel: 727-580-6319, email: rwilson@pemcoservices.com

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TYPES OF COMPRESSED AIR DRYERS PART 3 — HEAT OF COMPRESSION, SINGLE-TOWER DELIQUESCENT

By the Compressed Air & Gas Institute

➤ Introduction

The Compressed Air and Gas Institute is the united voice of the compressed air industry, serving as the unbiased authority on technical, educational, promotional, and other matters that affect the industry. Mention utilities and energy in a discussion about manufacturing and the Big Three — water, electricity and natural gas — immediately come to mind. But compressed air is commonly accepted as a manufacturing facility's fourth utility. A careful examination of a facility's compressed air system will likely reveal several opportunities to improve the performance of the compressed air system by effectively and efficiently removing moisture from the compressed air system. The Compressed Air and Gas Institute (CAGI) committed to issuing a series of articles discussing moisture in the compressed air system. The first article covered "Why Do Compressed Air Systems Need Drying?" The second article covered refrigerant and regenerative desiccant dryers. This article will provide a brief overview of heat of compression, non-regenerative single tower desiccant, deliquescent desiccant, and membrane dryers.

Compressed Air Dryer Selection

As a refresher, different methods can be used to remove the moisture content of compressed air. Current compressed air dryer types include the following products:

- Refrigerant type:
  - cycling
  - non-cycling
- Regenerative desiccant type:
  - Heatless (no internal or external heaters)
  - Heated (internal or external heaters)
  - Heat of Compression
- Single tower
  - Deliquescent
  - Desiccant
- Membrane

Because of such a wide breadth of product offering, we will cover each of these dryer types in some detail. It is always recommended that the compressed air treatment products be discussed in concert with the entire compressed air system and the application of the products. You should consult a compressed air expert to assure that the compressed air dryer selected is correct for your application.

In this part of the series we will cover the heat of compression and non-regenerative single

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SPX Flow Technology

Van Air Systems

Walker Filtration, Inc.

Zeks Compressed Air Solutions

AND MEMBRANE TYPE DRYERS

tower desiccant dryers, as well as membrane dryers.

Regenerative Desiccant Type Dryers

These dryers use a desiccant, which adsorbs the water vapor in the air stream. A distinction needs to be made between adsorb and absorb. Adsorb means that the moisture adheres to the desiccant, collecting in the thousands of small pores within each desiccant bead. The composition of the desiccant is not changed and the moisture can be driven off in a regeneration process by applying dry purge air, by the application of heat, or a combination of both. Absorb means that the material which attracts the moisture is dissolved in and used up by the moisture as in the deliquescent desiccant type dryer.

Heat of Compression Type Dryers

Heat of Compression Type Dryers are Regenerative Desiccant Dryers which use the heat generated during compression to accomplish desiccant regeneration, so they can be considered as Heat Reactivated. There are two types, the Single Vessel Type and the Twin Tower Type.

The Single Vessel Heat of Compression Type Dryer provides continuous drying with no cycling or switching of towers. This is accomplished with a rotating desiccant drum in a single pressure vessel divided into two separate air streams. One air stream is a portion of the hot air taken directly from the air compressor at its discharge, prior to the aftercooler, and is the source of heated purge air for regeneration of the desiccant bed. The second air stream is the remainder of the air discharged from the air compressor after it passes through the air aftercooler. This air passes through the drying section of the dryer rotating desiccant bed where it is dried. The hot air, after being used for regeneration, passes through a regeneration cooler before

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Membrane Type Dryers with Prefiltration Systems

TYPES OF COMPRESSED AIR DRYERS PART 3 — HEAT OF COMPRESSION, SINGLE-TOWER

Single Tower Deliquescent Type Dryer

being combined with the main air stream by means of an ejector nozzle before entering the dryer.

The Twin Tower Heat of Compression Type Dryer operation is similar to other Twin Tower Heat Activated Regenerative Desiccant Dryers. The difference is that the desiccant in the saturated tower is regenerated by means of the heat of compression from the hot air leaving the discharge of the air compressor. The total air flow then passes through the air aftercooler before entering the drying tower. Towers are cycled as they are for other Regenerative Desiccant Type Dryers.

Advantages of Heat of Compression Type Dryers include:

- Low electrical installation cost
- Low power costs
- Minimum floor space
- No loss of purge air

Disadvantages of Heat of Compression Type Dryers include:

- Applicable only to oil free compressors
- Applicable only to compressors having a continuously high discharge temperature
- Inconsistent dew point.
- Susceptible to changing ambient and inlet air temperatures.
- Booster heater required for low load (heat) conditions

Single Tower Type Dryers

Deliquescent

Single Tower Desiccant dryers are used in smaller, more specialized applications where a continuous supply of clean, dry compressed air is not required. Typically these are point-of-use applications such as paint spraying operations or moisture-sensitive pneumatic tools. Pressure dew points from single tower desiccant dryers are as low as -40 ˚F. Since these types of dryers are not self-regenerative, the desiccant must be replaced, or regenerated outside of the dryer, according to the amount of usage.

The deliquescent desiccant type dryer uses a hygroscopic desiccant material having a high affinity for water. The desiccant absorbs the water vapor and is dissolved in the liquid formed. These hygroscopic materials are blended with ingredients to control the pH of the effluent and to prevent corrosion, caking and channeling. The desiccant is consumed only when moist air is passing through the dryer. On average, desiccant must be added two or three times per year to maintain a proper desiccant bed level.

Deliquescent dryers normally are designed to give a dew point depression from 20 ˚F to 50 ˚F at an inlet temperature or 100 ˚F. This means that with air entering at 100 ˚F and 100 PSIG, a leaving pressure dew point of 80 ˚F to 50 ˚F may be obtained (a reduction of 20 ˚F to 50 ˚F from the inlet pressure dew point). This type of dryer actually dries the air to a specific relative humidity rather than to a specific dew point.

Advantages of Single Tower Deliquescent Desiccant Type Dryers include:

- Low initial capital and installation cost

Laboratory Application for a Membrane Type Dryer

DELIQUESCENT AND MEMBRANE TYPE DRYERS

> "A potential advantage, with heat of compression dryers, is that the desiccant in the saturated tower is regenerated by means of the heat of compression from the hot air leaving the discharge of the air compressor. The total air flow then passes through the air aftercooler before entering the drying tower."
>
> — The Compressed Air & Gas Institute

- Low pressure drop
- No moving parts
- Requires no electrical power
- Can be installed outdoors
- Can be used in hazardous, dirty or corrosive environments

Disadvantages of Single Tower Deliquescent Type Dryers include:

- Limited suppression of dew point
- Desiccant bed must be refilled periodically
- Drainage of dissolved solution
- Regular periodic maintenance
- Desiccant material can carry over into down-stream piping if there is no after-filter and if the dryer is not drained regularly. Certain desiccant materials may have a damaging effect on down-stream piping and equipment
- Some desiccant materials may melt or fuse together at temperatures above 80 ˚F

Membrane Type Dryers

Membrane technology has advanced considerably in recent years. Membranes commonly are used for gas separation such as in nitrogen production for food storage and other applications. The structure of the membrane is such that molecules of certain gases (such as oxygen) are able to pass through (permeate) a semi-permeable membrane faster than others (such as nitrogen) leaving a concentration of the desired gas (nitrogen) at the outlet of the generator.

When used as a dryer in a compressed air system, specially designed membranes allow water vapor (a gas) to pass through the membrane pores faster than the other gases (air) reducing the amount of water vapor in the air stream at the outlet of the membrane dryer, suppressing the dew point. The dew point achieved normally is 40°F but lower dew points to -40 ˚F can be achieved at the expense of additional purge air loss.

Advantages of Membrane Type Dryers include:

- Low installation cost
- Low operating cost
- Can be installed outdoors
- Can be used in hazardous atmospheres
- No moving parts

Disadvantages of the Membrane Type Dryers include:

- Limited to low capacity systems
- High purge air loss (15 to 20%) to achieve required pressure dew points
- Membrane may be fouled by oil or other contaminants (pre-filtration required)

Compressed Air & Gas Institute Support

The CAGI website is an excellent source for more information on the application of compressed air dryers, compressed air dryer and filtration selection and information on the Air Dryer & Filtration Section. BP

*For more detailed information about CAGI, its members, compressed air applications or answers to any of your compressed air questions, please contact the Compressed Air and Gas Institute. CAGI educational resources include e-learning coursework on the **SmartSite,** selection guides, videos and as well as mentioned Compressed Air & Gas Handbook. For more information, contact the **Compressed Air & Gas Institute** or visit our website, tel: 216-241-7333, email: cagi@cagi.org, www.cagi.org*

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Anest Iwata Oil-Free Compressor Earns ISO 8573-1 Class Zero Certification

Anest Iwata Reciprocating Oil-Free Air Compressor has earned ISO 8573-1 Class 0 certification from TUV, the international testing and certification organization based in Germany. This is a significant accomplishment and allows customers in the Food Processing Industry, Clean Room environment & Semi-Conductor manufacturing market to utilize the OF line of Compressors to be used in their products & processes. Utilizing a composite resin piston, proprietary Aluminum Alloy Head and Block as well as a proprietary cylinder wall coating. The OF line has five models in flow rates ranging 9.5, 15, 24, 30 & 42 scfm @120 psi.

New Kaeser 25-40 hp ASD Series Rotary Screw Compressors

Kaeser Compressors, Inc. has achieved the next level of compressed air efficiency with the newly redesigned ASD rotary screw compressors series. These units deliver the "built-for-a-lifetime" reliability, simple maintenance, and sustainable energy savings you expect from the Kaeser name and are available in 25, 30, and 40 hp with flows from 106 - 194 cfm and pressures to 217 psig.

Kaeser has improved the new ASD series' specific power over the previous design by up to 6% through a combination of true direct drive design, premium efficiency motors, lower internal pressure differential, and optimized airends. These units are now up to 30% more efficient than the competition. Additional built-in heat recovery options provide even more energy savings potential.

New features include an enhanced cooling design, eco-friendly filter element, integral moisture separator with drain, and an Electronic Thermal Management system. ASD compressors also come standard with Sigma Control 2™. This intelligent controller offers unsurpassed compressor control and monitoring with enhanced communications capabilities for seamless integration into plant control/monitoring systems. ASD models are also available with an integrated dryer for premium compressed air quality.

To learn more about the new ASD series, visit www.kaesernews.com/ASD. To be connected to your local representative for additional information, please call 877-586-2691.

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TECHNOLOGY PICKS

Atlas Copco Compressors Extends GA VSD+ Range to 50 Horsepower

Atlas Copco Compressors has extended the GA VSD+ range of oil-injected rotary screw compressors through 50 hp (37 kW). Launched in the United States in June 2013, the innovative and award-winning GA VSD+ range reduces energy consumption by up to 50 percent and increases free air delivery by up to 13 percent, compared to a traditional load/unload compressor of the same type.

"The GA VSD+ range was designed with energy efficiency and customer needs in mind, and with this extension, we can now offer VSD+ technology for 75 percent of the oil-injected screw compressor applications worldwide," said Robert Eshelman, vice president, Industrial Air Division, Atlas Copco Compressors. "Customers in most industries can switch to variable speed drive technology, ultimately reducing energy costs and contributing to a more sustainable industry."

With this extension, Atlas Copco is the first in the market to introduce a condensation prevention cycle for variable speed drive compressors. Integrated with the Elektronikon® controller, the cycle prevents condensation in compressor oil, even in extremely low load conditions. "The GA VSD+ range is reflective of our drive for innovation and represents one of the largest and most innovative changes to rotary screw technology since we pioneered the variable speed drive in 1994," said Eshelman. "We believe the future of industrial compressors is 100 percent variable speed drive and expect to see the continued adoption of variable speed drive technology across most industries."

With a patented motor that exceeds the latest NEMA Premium efficiency requirements, the GA VSD+ range features a motor and drive train that share a single drive shaft and are vertically aligned, reducing the total footprint by up to 55 percent compared to other compressors on the market. The motor drive train is completely enclosed, resulting in a NEMA 4 rating for protection against dust, debris and water and the single closed oil-circuit cools the motor and lubricates the element and bearings, resulting in a very reliable and compact compressor that is also extremely quiet.

To make this innovative technology accessible to all compressor users, the VSD+ range is positioned in the U.S. market at the same price level as a standard variable speed drive model. Learn more at www.atlascopco.com.

Siemens Introduces Matched Motor/Drive Package

Siemens Industry, Inc. announced the release of combination motor/drive packages, allowing an OEM or end-user the option to select the optimum solution for a variety of heavy-duty industrial motion control applications from a single source, backed by a full three-year

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warranty. Choosing from a pre-determined list of motor/drive combinations, the customer simply makes the selection best suited to the application. The motor and drive are packaged on a single pallet, shipped and invoiced together.

The motor and drive combinations are power-matched for 480V high-overload operation through a 20 hp range, with I2T protection from thermal damage provided as a standard in both the motor and the drive components. The Siemens Intelligent Operator Panel (IOP) is included with these packages, allowing easy step-by-step drive start-up.

Application macros are provided in the Sinamics G120C drive for easy installation and wiring; the terminals are pre-assigned at the factory and the parameters are automatically set. The SIMOTICS SD100 motors are rugged cast-iron with inverter duty ratings in a 4:1 speed range for constant torque and 20:1 speed range for variable torque. Simotics SD100 units are severe-duty TEFC motors that meet NEMA Premium® efficiency.

Communications selections on these matched motor/drive combinations include RS485 with USS and Modbus protocols. A Profibus variant is also offered for a Totally Integrated Automation (TIA) solution. TIA is the proprietary Siemens solution for achieving optimum performance, energy efficiency and sustainability within a machine or manufacturing environment.

Standard pricing has been established for a wide variety of motor/drive combinations from 1-20 hp and is included in the available literature on this new Siemens service.

For more information about these combination motor/drive packages, visit www.usa.siemens.com/drives.

Festo Introduces New CPX-FB36 Node for EtherNet/IP Communications

Festo introduces the new CPX-FB36 node for EtherNet/IP communications. The CPX-FB36, which is the next generation replacement for the Festo CPX-FB32 communication node, is ideal for production and process automation environments requiring diagnostics from the operational and master controller level on down to the field level.

The CPX-FB36 brings new options and high performance to EtherNet/IP applications. New features include an integrated Ethernet switch that eliminates and/or reduces the need for external switches and thereby lowers cost. The new node supports line, tree, or ring topology for greater flexibility. It also supports device level ring functionality for robust, redundant network connections. It facilitates quick connect functionality for end-of-arm tooling and other quick change applications. For fast response times, Festo

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adopted a new processor design. Requested Packet Interval (RPI) settings now go as low as 1ms.

In addition to these new features, the CPX-FB36 offers industry leading diagnostic and function integration capabilities. For example, multiple pressure zones and power distribution zones allow the machine designer to use one manifold where multiple manifolds would otherwise be required. Galvanic-isolated power for electronics/outputs/valves allows connection to safety relays and systems. There is an integrated web server for diagnostic and parameter monitoring.

Advanced diagnostic capabilities for connected modules include:

- Short circuit protection and detection for individual input and output channels, including solenoids
- Wire fracture monitoring for solenoids and connected I/O
- Configurable de-bounce filtering to support a wide variety of connected sensors
- Configurable signal extension for digital inputs
- Analog input and output modules with configurable signal smoothing and limit monitoring

Functional integration, including integrated pressure sensors and proportional pressure regulators, communicate data in real world units (PSI, Bar, Kpa) for simplified HMI interactions.

For more information on the innovative Festo CPX-FB36, please call 800-993-3786 and visit www.festo.com/us.

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Professional Leak Detection Kit for Oil-Based Fluid Systems

Spectronics Corporation has unveiled the OLK-441 Leak Detection Kit, which finds leaks quickly and efficiently in petroleum- or synthetic-based fluid systems. It's ideal for use with hydraulic systems, compressors, engines, gearboxes and fuel systems.

At the heart of the kit is the OPTI-LUX™ 400 — a state-of-the-art, LED leak detection flashlight that emits less visible light so industrial fluid leaks are easy to spot. This powerful unit features a high-output violet light LED that causes fluorescent dyes to glow far more brilliantly and with greater contrast than with standard blue light inspection lamps, revealing the exact source of every leak. Its power is comparable to high-intensity 150-watt lamps and it has an inspection range of up to 25 feet (7.6 m) or more.

The kit also includes an 8 oz (237 ml) twin-neck bottle of patented OIL-GLO™ 44 concentrated fluorescent dye, an 8 oz spray bottle of GLO-AWAY™ dye cleaner, an AC/DC charger, dye treatment tags and fluorescence-enhancing glasses. All of these components are conveniently packed in a rugged carrying case.

For more information about the Spectroline® OLK-441 Leak Detection Kit, call 1-800-274-8888. Outside the United States and Canada, call 516-333-4840. Website at www.spectroline.com.

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Sustainable Energy Savings with Compressed Air Best Practices®

"Compressed air is the #1 kW user across our 35 factories."
– Doug Barndt, Manager Demand-Side Energy & Sustainability, Ball Corporation

Compressed Air Best Practices® is a technical magazine dedicated to discovering **Energy Savings** in compressed air systems — estimated by the U.S. Department of Energy to represent 30% of industrial energy use. Each edition outlines **Best Practice System Assessments** for industrial compressed air users — particularly those **managing energy costs in multi-factory companies.**

"Do your homework, demand excellence, and don't be afraid to say no to the audit. If you want to audit my plant, you should be able to provide some savings incentive beforehand."

– Rodney Dayson, Sustainability & Energy Manager, Archer Daniels Midland BioProducts. Article published in the Jan/Feb 2013 Edition of Compressed Air Best Practices® detailing a compressed air energy-savings audit saving $422,000 annually at ADM.

"Demand Side" and "Supply Side" information on compressed air technologies and system assessments is delivered to readers to help them save energy. For this reason, we feature Best Practice articles on when/how to correctly apply **air compressor, air treatment, measurement and control, pneumatic, blower and vacuum technology.**

Industrial energy managers, utility incentive program managers, and technology/system assessment providers are the three stakeholders in creating energy efficiency projects. Representatives of these readership groups guide our editorial content. The Compressed Air Best Practices® Editorial Advisory Board guides our mission to help create more energy saving projects.

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Gardner Denver, Inc. has an exciting opportunity for a Territory Sales Manager – Compressor Products. We are looking for an experienced sales professional to be based in and manage the Michigan-Ohio-Indiana-Kentucky sales region. The successful candidate will possess 5-7 years sales and/or technical experience with a bachelor's degree in business, marketing, engineering, or other related field. **Experience with compressors, compressed air systems and related industrial equipment is a must.** This position involves 50-75% travel.

If qualified and interested, please email resume to: hr.compressor@gardnerdenver.com

Learn more about our company at www.gardnerdenver.com

Job & Product Marketplace Advertising Information

Reach 13,000+ readers of Compressed Air Best Practices® Magazine with Marketplace Ads every month! Job Marketplace ads are also placed for one month on www.airbestpractices.com and promoted in our three monthly e-newsletters.

Ad dimensions are 2.36" wide x 3.91" tall. We can help you design the ads. Send us your logo, product photo, and text to anna@airbestpractices.com. We recommend 20-50 total words of text.

Prices are $300.00 per Job Marketplace Ad and $350.00 per Product Marketplace Ad ($300 if 6 or more ads are placed). Contact Rod Smith at rod@airbestpractices.com to schedule your Marketplace Ads.

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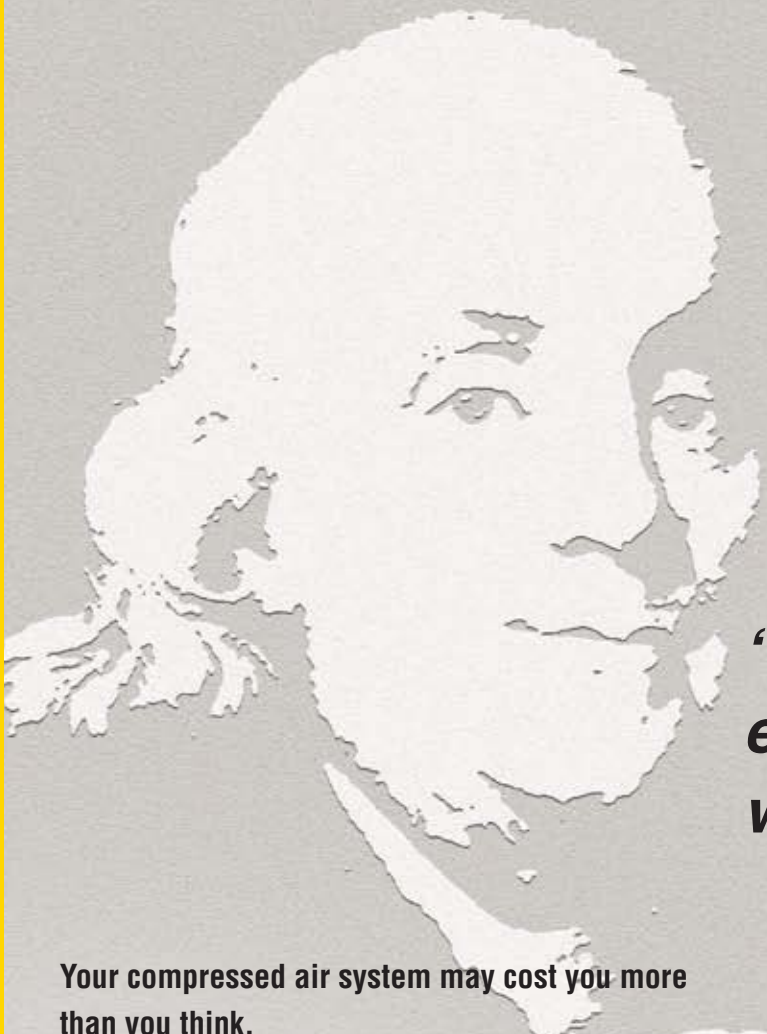

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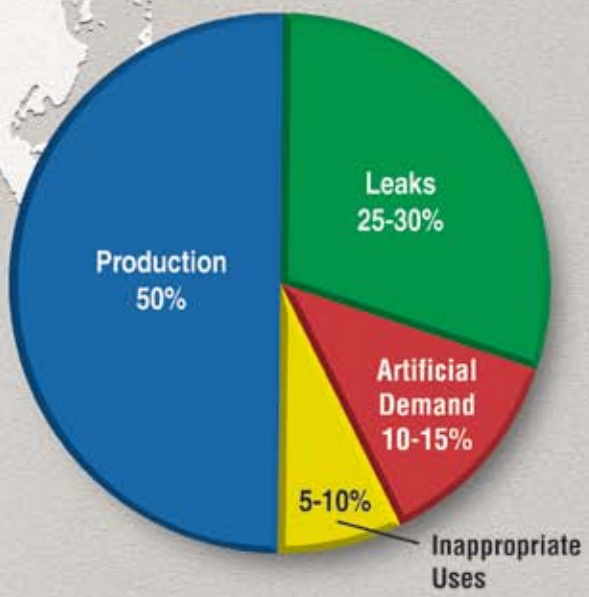

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