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April 2009

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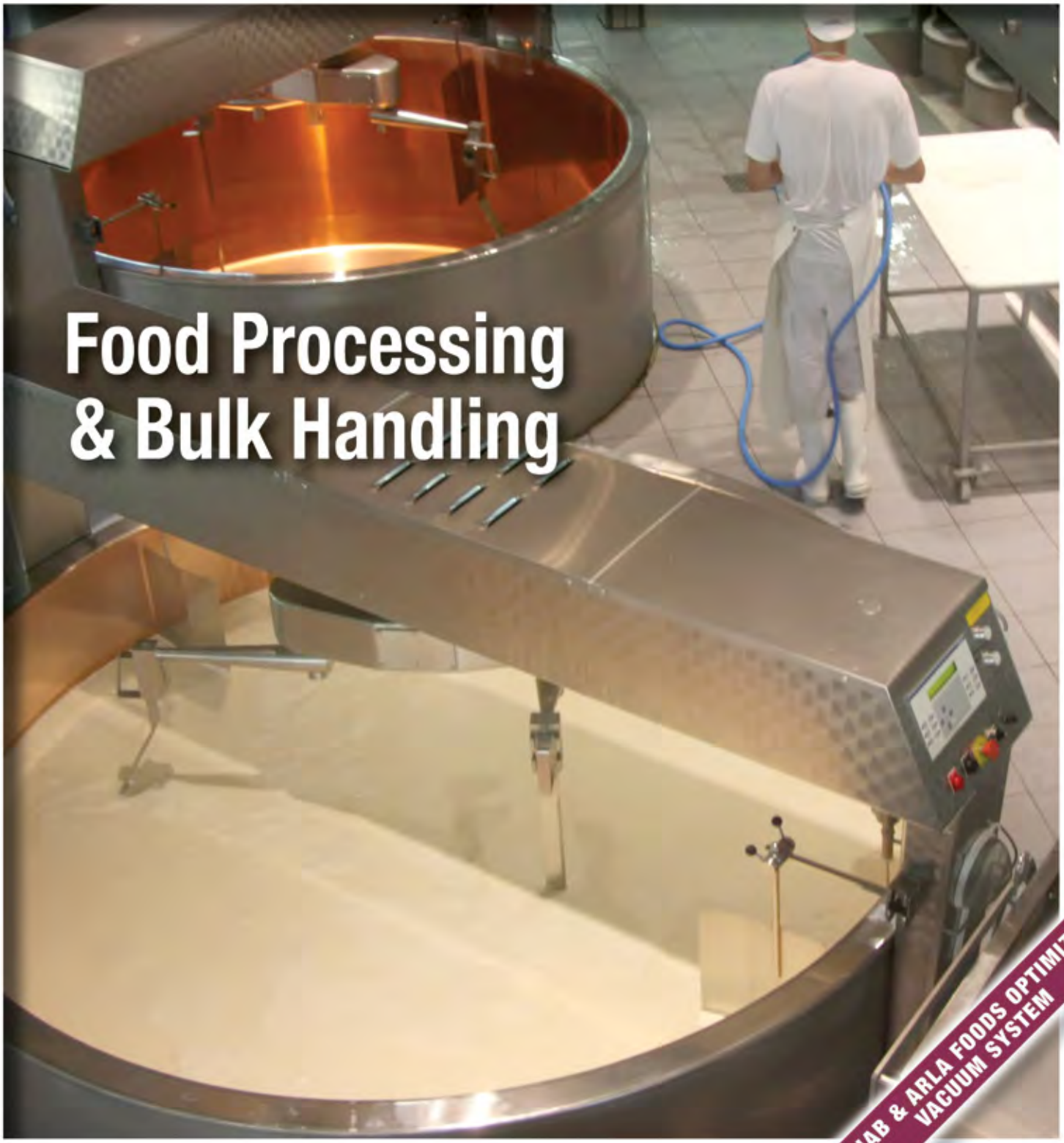

Food Processing & Bulk Handling

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FROM THE EDITOR

Win/Win Scenarios for Food Processing & Bulk Handling

Energy conservation/efficiency initiatives often fall under the umbrellas of Corporate Sustainability and Corporate Responsibility within the large corporations in North America. Operations and engineering management are charged with reducing energy costs per unit produced — or reducing the "energy intensity" of a process. It is a race against time as utility costs threaten to increase and global markets place more pressure on operations to be competitive.

The Win/Win nature of these efficiency projects is exciting. Managers do them for the ROI as they continue to safeguard the viability of their companies. Strong ROI energy efficiency projects are the only projects that this magazine publishes. The "green factor" is simply a positive offshoot of this work — whether or not one agrees with the threats of global warming.

The System Assessment of the Month, written by Hank Van Ormer, details the steps he took to help a major food processor reduce energy costs by 33% to the tune of $215,000. The simple ROI on the project was 3.8 months — not bad. The environment saw a reduction in energy use of 2,540,700 kWh. This equates to a reduction of 1,811.5 metric tons of CO_2 emissions.

The Energy Manager feature describes how Xcel Energy helped Northwest Airlines save $70,000 annually and over 1,900,000 kWh. Xcel Energy funded both the system assessment and a significant portion of the project. The Energy Managers at Xcel Energy and Northwest Airlines have partnered with compressed air and other processes to deliver many Win/Win scenarios for both firms.

The Technology Provider feature story describes how PIAB helps the food industry optimize their vacuum systems. The company was able to optimize the vacuum system in the cheese production process at Arla Foods in Sweden. The result was a reduction of their compressed air costs by 50%. Mr. Ed McGovern, of PIAB North America, shares with us some of the opportunities to be leveraged in vacuum ejectors and vacuum gripping systems.

A second Technology Provider Feature story discusses opportunities in bulk handling applications like cement. Readers will be interested to read about how to reduce compressed air energy costs by 50%, as associated with running air cannons.

The food processor saved $215,000 and 2,540,700 kWh per year in energy costs

We hope you enjoy this edition, and thank you again for your support and for investing in industrial energy efficiency.

ROD SMITH
Editor
rod@airbestpractices.com

SUSTAINABLE MANUFACTURING NEWS

SOURCED FROM THE WEB

Nestlé Creates Shared Value

Nestlé's principle, in the global context, is to manufacture when possible in countries for which commodities are sourced rather than export the raw materials. Regional manufacture for regional markets means our products have fewer miles to travel, resulting in lower transportation costs and less environmental impact. Today, about half of Nestlé factories are in the developing world.

Nestlé has reduced greenhouse gas (GHG) emissions by 17.3% since 2003. Along with over 2,000 of the world's largest companies, Nestlé participates in the Carbon Disclosure Project (CDP), in order to share our strategy and results.

Nestlé improves its energy efficiency, saving around CHF 33 million in 2007. The company has also reduced water withdrawal in our direct operations by 28% since 1998. At the same time, production volume has increased by 76%.

Ash Grove Cement's AGem Program

Ash Grove's AGem Initiative is an aggressive energy reduction process to reduce thermal energy use by 17% per metric ton of clinker produced and to reduce electrical energy use by 10% per metric ton of cement produced.

We will strive to accomplish these targets in 2012 by renewing our "Back to Basics" process engineering program through:

- Striving to increase our use of alternative fuels and raw materials
- Formulating our cement chemistry to use less thermal energy
- Installing electrical monitoring and measuring equipment
- Converting to more efficient motors and lighting
- Reviewing our electrical usage and turning off lights and equipment when not needed
- Using state-of-the-art technology when we rebuild our facilities

In 2007, Ash Grove's specific gross CO_2 emissions were 885 kg per metric ton of cementitious material, which is an 11% reduction from our 1990 specific gross emissions. In 2004, Ash Grove Cement Company committed itself to sustainable development when it became the only United States-based cement company to join the World Business Council for Sustainable Development's Cement Sustainability Initiative.

Source: www.cargill.com

Cargill Reduces Environmental Footprint

Cargill is an international producer and marketer of food, agricultural, financial and industrial products and services. Founded in 1865, our privately held company employs 160,000 people in 67 countries. Cargill has intensified efforts to reduce their environmental footprint with the following 2010 goals:

- Improve **energy efficiency** by 20% against fiscal year 2001 baseline
- Increase use of **renewable energy** to 10% of energy demand
- Improve **greenhouse gas** intensity by 8% against fiscal year 2006 baseline
- Improve **freshwater efficiency** by 2% against fiscal year 2006 baseline

In addition, Cargill made a voluntary but legally binding commitment to reduce absolute greenhouse gas (GHG) emissions from U.S. locations by joining the Chicago Climate Exchange® (CCX®). That commitment requires the firm to reduce emissions by 6% by 2010 (from a 1998–2001 baseline) and to achieve annual milestones along the way.

Source: www.cargill.com

SUSTAINABLE MANUFACTURING NEWS

The U.S. Environmental Protection Agency (EPA) has awarded CalPortland Company the National 2009 ENERGY STAR Award for Sustained Excellence in recognition of its continued leadership in protecting our environment through energy efficiency.

Nourishing the Future at General Mills

General Mills formalized its sustainable development initiative in 2003, which focuses on improving the management of the natural resource base used in running their business. In the last two years, five-year goals for the plants were established to reduce:

- Water usage rate by 5%
- Energy consumption rate by 15%
- Greenhouse gas emission rate by 15%
- Solid waste generation rate by 15%

In fiscal 2007, General Mills facilities used the equivalent of 585 kilowatt hours (kWh) per metric ton of production. In the second year of the five-year goal, General Mills used the same amount of energy per metric ton of product as the two previous years. This is partially explained due to changes in product mixes each year as well as the fact that most of the first two year's efforts have focused on education and awareness of energy usage. General Mills expects to report energy reductions over the next few years as a consequence of all of the work done over the last two years.

In fiscal 2007, our total emission of greenhouse gases due to energy use in production facilities, expressed as carbon dioxide (CO_2) equivalents, was 0.23 metric ton equivalents per metric ton of production — the same as in 2006.

Our total water use rate in fiscal 2007 was ca. 2.23 cubic meters per metric ton of production — the same as in 2006. Water is critical to food manufacturing. It is used as an ingredient, a coolant and to clean and sanitize manufacturing equipment. We track the usage of water at each facility to identify areas of high usage and to target opportunities for water conservation.

The General Mills plant in Joplin, Missouri, was able to reduce its water usage by more than 14 million gallons per year by reusing water from air compressors for its cooling towers, switching to more dry cleaning than wet cleaning and installing a high-pressure, low-volume cleaning system.

Source: www.generalmills.com

GENERAL MILLS

Hormel Foods Is Committed

Hormel Foods Corporation is a multinational manufacturer and marketer of high-quality, brand name food and meat products for consumers throughout the world. We offer a wide variety of products including hams, bacon, sausages, franks, canned luncheon meats, stews, chilies, hash, meat spreads, shelf-stable microwaveable entrees and salsas.

Hormel Foods is responsible for energy, solid waste, air, water and wastewater in 41 plants in the United States. All 41 locations will have benchmarks established by FY 2009. The goals are:

- **Water Consumption:** 10% reduction total, 2% per year for 5 years
- **Solid Waste:** Increase recycling to 40% by November 2008 and to 50% by November 2011
- **Energy Consumption:** 10% reduction total, 2% per year for 5 years

SUSTAINABLE MANUFACTURING NEWS

CalPortland Honored with US EPA 2009 National ENERGY STAR® Award for Sustained Excellence

The U.S. Environmental Protection Agency (EPA) has awarded CalPortland Company the National 2009 ENERGY STAR Award for Sustained Excellence in recognition of its continued leadership in protecting our environment through energy efficiency. CalPortland's accomplishment over five consecutive years is a feat that has never been matched by any other U.S. building materials company. Key accomplishments include:

- In 2008, CalPortland reduced overall energy intensity by 6.5% compared to 2007. This resulted in a reduction of 775,607,526 kBtu, or a CO_2 emission reduction of 75,234 metric tons, which is the equivalent of providing electricity for 9,965 American homes. The decreased energy intensity saved the company over $3,000,000.
- All three of CalPortland's cement plants scored in the top 20% of cement facilities nationally based on ENERGY STAR's EPI benchmarking tool. This was accomplished through comprehensive energy assessments, a strong energy management organization, employee outreach at all levels and best practice replication.
- In 2008, CalPortland's Mojave Plant completed a "behind-the-meter" wind project that represents the largest such renewable wind project serving a manufacturing facility in the world to date. Eight 3-megawatt wind turbines (24 megawatts total) generate 60,000,000 kWh/yr of renewable wind energy and supply approximately 35% of the plant's electricity needs each year. This is a reduction of over 42,000 metric tons of CO_2 emissions which is the equivalent of powering 5,255 homes for a year.
- CalPortland has doubled the size of its operations in the past three years. The company's energy management system has grown as well to accommodate these new facilities. The company actively participates in ENERGY STAR's cement industry focus and ranks its cement plants' energy efficiency nationally using the ENERGY STAR Energy Performance Indicator.

"CalPortland is committed to helping protect the environment through our energy management program and sustainability practices," said Jim Repman, President and CEO. "Our long-standing partnership with ENERGY STAR shows our organization's commitment to energy efficiency. We understand that partnering with ENERGY STAR is an important step in improving the environment."

The 2009 Sustained Excellence Awards are given to a select group of organizations that have exhibited outstanding leadership year after year. These winners have reduced greenhouse gas emissions by setting and achieving aggressive goals, employing innovative approaches and showing others what can be achieved through energy efficiency. These awards recognize ongoing leadership across the ENERGY STAR program including energy-efficient products, services, new homes and buildings in the commercial, industrial and public sectors. Award winners are selected from more than 12,000 organizations that participate in the ENERGY STAR program.

"EPA is delighted to recognize CalPortland with the 2009 ENERGY STAR Sustained Excellence Award," said Kathleen Hogan, Director of the Climate Protection Partnerships Division at the U.S. EPA. "CalPortland's leadership on energy efficiency has yielded impressive results for their bottom line and our global environment."

Source: www.calportlandcement.com

Arla Food's Ambitious CO_2 Emissions Reduction Goal

Arla Foods is a global dairy producer with production facilities in 12 countries. Arla has a clear climate target: Before 2020, direct or indirect CO_2 emissions must be reduced by 25% in connection with food production, transport and packaging (compared to 2005).

Arla's annual CO_2 emissions have been estimated at 9 million tons. Food production, transport and packaging each account for 500,000 tons, while livestock production accounts for 7.5 million tons. The enormous emissions in connection to livestock production are due to methane and nitrous oxide.

Arla has defined three principal areas of focus in connection with achieving its ambitious goal regarding climate: transport, food production and packaging. "Where energy is concerned, for instance, there is a working group whose job it is to discover the best practices and get them out into the organization," says Jan Dalsgaard Johannesen.

- **CO_2 Emissions:** Declined at Arla dairies from ca. 360,000 tons of CO_2 in 2003 to ca. 310,000 tons in 2007
- **Energy and Water Goals:** By 2010, the goal is to reduce total energy and water consumption by 5% vs. 2005 usage. BP

Source: www.arla.com

"Where energy is concerned, for instance, there is a working group whose job it is to discover the best practices and get them out into the organization."

— Jan Dalsgaard Johannesen, Arla Foods

THE SYSTEM ASSESSMENT OF THE MONTH

Food Processing

BY HANK VAN ORMER, AIR POWER USA

April System Assessment of the Month

Where:	North America
Industry:	Food
Issues:	Excessive Operating Costs
Audit Type:	Supply and Demand Side

System Assessment Win/Win Results

Energy Savings per Year:	$214,907
Project Investment:	$68,350
Simple ROI:	3.8 months
Reduction in Energy Use:	2,540,700 kWh
Equivalent CO_2 Emissions:	1,811.5 metric tons
Equivalent CO_2 for Homes:	240 homes
Equivalent CO_2 for Vehicles:	332 vehicles

System Overview

This facility processes bulk food ingredients into finished packaged food products. The factory belongs to a division of a large corporation and was spending $732,342 annually on energy to operate their compressed air system. This system assessment detailed 12 project areas where yearly energy savings totaling $214,907 could be found with a minimal investment of $68,350. Due to space constraints, this article will detail only the higher-impact project areas. The overall strategy for improving this air system centers on improving specific power performance of the #3 centrifugal air compressor and reducing overall demand with compressed air savings projects.

Over the last decade, the facility has been upgrading their air system. There are two, 400 horsepower class Ingersoll-Rand 2-stage, oil-free centrifugal compressors delivering a little less than 1500 scfm each at 100 psig. Several years ago, an older (1988) Ingersoll-Rand 600hp class, 2-stage centrifugal was added to the air supply. This unit was rebuilt and upgraded by Air Relief (in Mayfield, Kentucky) to a very power-efficient, 2-stage centrifugal (2128 scfm at 520 input hp). These centrifugals are water-cooled units with the cooling water coming from a full-loop cooling system with open evaporative towers.

The air leaves the compressors and built-in after-coolers to a 3000-gallon vertical air receiver and on to 4900 scfm (rated at 80 °F inlet air), internal heated regenerative desiccant dryer. This is a Pneumatic Products (PPC) product of excellent quality. Due to a lack of maintenance, the dryer is now delivering large amounts of desiccant dust to the after-filter, which has a 10–12 psid pressure loss, which is quite high.

Prior to the installation of this dryer in 2001, the system had a mixture of refrigerated and desiccant air dryers drying air from the main compressed air room and several satellite compressor operations. Air from this system was generally "wet" in the production areas. In 2001, a new larger centrifugal compressor was added along with the new dryer. Most of the air now comes from the oil-free centrifugals and is dried in the internally heated PPC desiccant dryer. The net result has been a "dry air system."

Today, there are still four lubricant-cooled rotary screw compressors that are located at "satellite" locations throughout the production area. One of these, the Sullair LS16 (75hp) has been taken off-line electrically and, apparently, permanently. The others can be run along with their companion dryer and can be run as part of the compressed air supply. They must be manually started, stopped and restarted.

These satellite units are positive-displacement rotary screw compressors running "deadheaded" against the central centrifugal dynamic units. The screws stay fully loaded, while the centrifugals automatically back down in flow. It will be very hard if not impossible, to gain control around this problem with this situation as it is installed, piped and controlled today:

- The rotary screws will never unload and never shut off by themselves
- The "less power-efficient" rotaries are on base load, while the more power-efficient centrifugals are trimming

Setting the Baseline

The following actions were taken to establish the baseline for flow and pressure:

1. Temperature readings were taken on all units with an infrared surface pyrometer. These were observed and recorded to relate to the unit's performance, load conditions and integrity. The findings were recorded on the table of compressor supply operating data that follows.
2. Critical pressures including inlet and discharge were measured with a single Ashcroft digital, calibrated test gauge with an extremely high degree of repeatability. Findings were also recorded in the table of appropriate compressor supply operating data.
3. All units had the input kW measured with a Fluke motor analyzer and recorded with the Hawkeye kW monitors and MDL logger.
4. Flow was measured and logged from the compressor room with an Eldridge thermal mass heater wire-type flow meter and logged with an MDL multi-line unit. Readings were taken every 15 seconds and averaged every 30 seconds.
5. The same basic measurement and logging activity was carried out for system pressure using an Ashcroft pressure transducer and the same multi-channel MDL data logger and data point collection and analysis.

System Before Assessment		System After Assessment	
Energy Costs per Year:	$692,601		
Operating Hours:	8760 hours	Operating Hours:	8760 hours
Power Cost kW/h:	$0.10	Power Cost kW/h:	$0.10
Avg. Production Air Flow:	3565 cfm	Avg. Production Air Flow:	2441 cfm
Compressor Discharge Pressure:	103 psig	Compressor Discharge Pressure:	95 psig
Avg. System Pressure:	95 psig	Avg. System Pressure:	90 psig

THE SYSTEM ASSESSMENT OF THE MONTH

Food Processing

This system assessment detailed 12 project areas where yearly energy savings totaling $214,907 could be found with a minimal investment of $68,350.

Project #1: Centrifugal Compressor Room:

Enlarge Air Compressor Inlet and Discharge Piping

The three centrifugal air compressors were upgraded with Air Relief designed Control Systems by Allen Bradley. The benefits of the control system upgrade, however, are negated by low inlet pressure of 12.2 psia into the #3 Centac. This is due to 40 feet of 10" inlet pipe (there is no significant loss with the filter). The effect of 12.2 psia inlet pressure on the #3 Centac is dramatic. This is causing a 15% reduction in efficiency of the machine. This corresponds to 319 scfm less air flow or a corresponding 61.8 kW more to deliver the same air from another source. This equates to $45,979 in unnecessary energy costs. Calculations: 100 x 12.2/14.8 = .85 or a 15% reduction in flow; 2,128 scfm x .85 = 1,809 scfm, a loss of 319 scfm; specific power = 1,809/412.2 = 4.39 scfm/kW. This is a 15% reduction from design of 5.16 scfm/kW.

The project will replace the 10" x 40' air inlet pipe to the #3 Centac, which is restricting inlet pressure to 12.2 psig, with 12" x 4' line, which will restrict a negligible amount. The compressor will now deliver about 319 scfm more air at full load. This is a 15% gain in flow. The value of the lost air is 15% of full load kW or 412.2 kW equaling 61.8 kW recovered during 7440 hours/production/year.

The current 6" compressor discharge piping size and design will not allow all three centrifugals to run effectively without severe restrictions, which would preclude all units to be able to stay at full load and feed the plant. This piping will be replaced with 8" pipe. This action, coupled with lowering the air demand, can have a major impact in eliminating any effects of this choke in the interconnecting piping. This will allow us to reduce system pressure and compressor discharge pressure.

The #3 Centac will now be the most power efficient of the three centrifugals and, from an energy standpoint, should always run base load.

Project #2: Centrifugal Compressor Room:

Pressure Drop from the Desiccant Dryer and After-Filter

The plant has run for several months continuously at 85 psig to 89 psig system pressure due to the plugged dryer and dryer after-filter. The desiccant dryer is a 4900 scfm Pneumatic Products internally heated desiccant air dryer with the AMLOC® energy saving control system. This is a high-quality dryer which solved the moisture problems in the facility since it was installed many years ago.

Today, however, there is 14–15 psid loss of pressure across the 4900 scfm desiccant dryer system (including filters) in the compressor room. We are only flowing about 3000 scfm at 89–90 °F compressed air to this dryer, which is about a 50% moisture load and 60% plus capacity load. We would expect full performance and a total of 4–5 psid of lost pressure with proper filtration.

There is 8–10 psid of lost pressure in the after filter, which is being caused by extreme contamination from desiccant dust. The desiccant is over three years old and has been topped off about every six months. In our opinion, the desiccant should be changed at least every two to three years in an internal heated dryer depending on what is happening.

The AMLOC® purge control is on, but the dryer is cycling (switching) every four hours. At these load conditions, we would expect this cycle time or switching time to be in the 10- to 12-hour range. Properly running, we would expect to run the dryer about 30–35% of the time during the year with the correctly working AMLOC® energy saving control system. The annualized electrical energy cost to run the dryer today is:

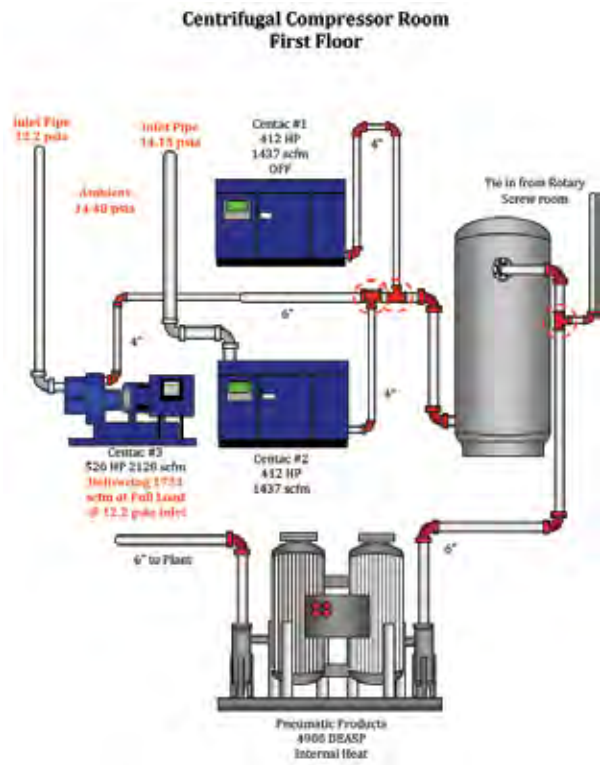
44.25 kW X .10 X 8760 = $38,763 per year.

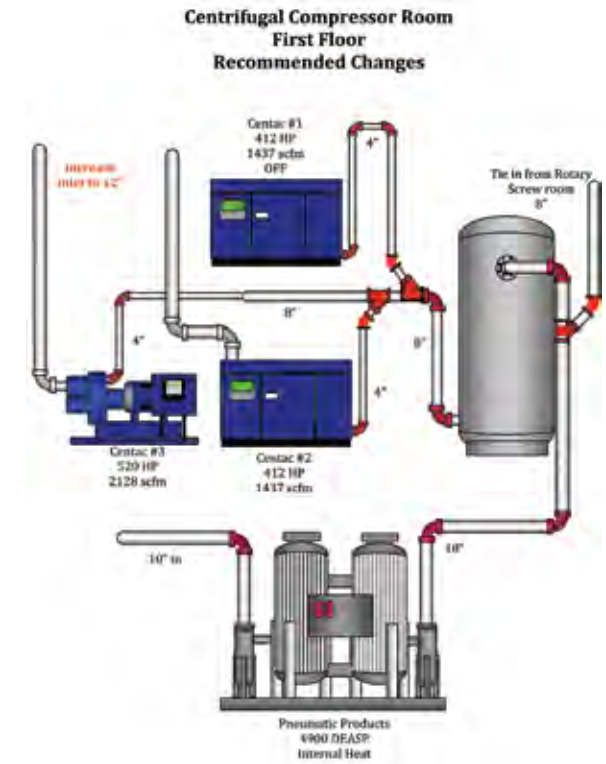
This project will service this PPC dryer by completely replacing the desiccant, replace the pre- and after-filters, and get the AMLOC purge control working normally.

Total annual cost of current dryer (running at full cost today):	$36,763/year
Total annual cost of same dryer with project:	$13,578/year
Net savings in electrical energy cost:	$23,185/year
Repair cost for dryer:	$12,000 (est.)
Purge air saved (120-36 cfm):	84 scfm
Recovered electric energy savings ($150.24/scfm)	$12,624/year
Total net savings ($23,185 + $12,624):	**$35,809/year**

THE SYSTEM ASSESSMENT OF THE MONTH

Food Processing





Project #3 — Centrifugal Compressor Room:

Lower Compressor Pressure Set Points

Immediately after the dryer is cleaned and serviced, lower the centrifugal air compressor set points to hold the system entry pressure to 90 psig or less. Install a pressure gauge in the line to monitor and control.

Pressure reduction:	10 psig
Air system measured reduction in unregulated air: (3,565 cfm x 10% x 1/3 unregulated)	128 scfm
Value of electrical energy cost (scfm):	$150.29 scfm/yr
Total recoverable electric energy cost per year:	$19,237/year
Cost to implement:	Part of Project #2

Project #4 — Leak Identification and Repair

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

- **Short Term —** Set up a continuing leak inspection by maintenance personnel so that for a while, each primary sector of the plant is inspected once each quarter to identify and repair leaks. A record should be kept of all findings, corrective measures and overall results
- **Long Term —** Consider setting up programs to motivate the operators and supervisors to identify and repair leaks. One method that has worked well with many operations is to monitor the air flow to each department and make each department responsible for identifying its air usage as a measurable part of the operating expense for that area. This usually works best when combined with an effective in-house training, awareness and incentive program

A survey of compressed air leaks was conducted at the plant and 53 leaks were identified, quantified, tagged and logged. Potential savings totaled 217 cfm for the 53 leaks that were identified (average leak: 4 scfm). An ultrasonic leak detector was used.

The savings estimates associated with a leak management program are based upon the following:

- The leaks actually getting repaired
- The unloading controls of the compressors being able to effectively translate less air flow into lower cost

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

Estimated reduction of air flow with proposed project:	217 cfm
Recoverable savings from air flow reduction [Section 2.3]:	$150.29/cfm yr
Annual electric cost savings with proposed project:	$32,612/year
Cost of leak detection equipment (if required):	$2,800
Unit cost of leak repairs ($15 materials per leak and $35 labor per leak):	$2,550
Total project cost (materials and installation):	**$5,350**

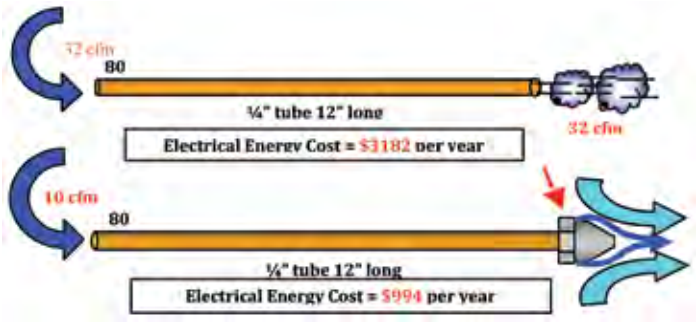
Project #5 — Replace or modify open blow offs with Venturi amplifiers

Regardless of application, there are several guidelines that should always be applied to compressed air being used for open blow off:

- Use high pressure only as a last resort
- All blow-off air should be regulated to the lowest effective pressure — higher pressure means higher flow, which may not be needed
- Use Venturi air amplifier nozzles whenever and wherever possible — this will usually reduce blow-off air at least 50%, freeing up more air flow for other applications
- All blow-off air should be shut off (automatically) when not needed for production

Plants with many ⅛- and ¼-inch lines running as blow off on units will use approximately 10 and 25 cfm each, respectively, at 60 psig.

One savings approach is to use an air amplifier, which requires less compressed air. Air amplifiers use "Venturi" action to pull in significant amounts of ambient air and mix it directly into the air stream, which amplifies the amount of air available at the point of use. Air amplifiers have amplification ratios up to 25:1. Using 10 cfm of compressed air can supply up to 250 cfm of blow-off air to the process and generate a savings of a 15 cfm compressed air per ¼-inch blow off. Savings may be available using ⅛-inch lines, but the cost effectiveness will not be as great.



During this system assessment, we identified 67 locations where open blows should be replaced with Venturi amplifiers. We provided the client with a detailed list. The locations included a mixer, bin cleaning, sheeting machine, packaging filler, bucket conveyor and the James Cartoner knife tower. Timer controls are also needed to optimize usage.

Total average scfm reduction for this project:	344 scfm
Recoverable electrical energy cost (scfm/yr):	$150.29 scfm
Total project electric energy cost recoverable:	$51,700/year
Estimated cost to implement:	**$6,900**

Conclusion

The overall strategy for improving this air system focused on improving the specific power of the #3 Centac and reducing the overall demand with compressed air savings projects. Additional savings projects that were not detailed in this article include:

Replace three timer drains with level activated units in Power House:	6.2 scfm
Move vacuum break on Venturi generators from the vacuum line to the air line:	157 scfm
Replace air-driven vibrators with electric driven:	160 scfm
Replace air hoists with electric:	28 scfm
Replace open blows with Venturi amplifiers or modify:	344 scfm

For more information please contact Hank Van Ormer: tel: 740-862-4112, email: hankvanormer@aol.com, www.airpowerusainc.com BP

THE ENERGY MANAGER

Xcel Energy and Northwest Airlines Partner to Save Energy

BY ERIN MATHE

The Problem: A Lot of Hot Air

How do you test a 747 engine to ensure reliability once it's airborne at 600 miles an hour?

At Northwest Airlines in Minneapolis, among other methods they force an enormous amount of compressed air into it with a 700-horsepower air compressor. It's no small task and takes a huge amount of energy.

The 1.1 million square foot facility uses compressed air to test jet engines and for general plant air.

Background

A 1.1 million square foot facility houses a 700-horsepower air compressor — primarily for those massive compressed air needs — and two 600-hp air compressors at different locations in the facility that were mostly used for other shop tools. Over time, the needs of the facility changed when much of the work done previously at this site moved elsewhere.

The existing air compressors were designed for a facility that used to average over 3,000 cfm, but by early 2007 with the reduced activity in the facility, the average demand was down to about 250 cfm. Much of that daily demand surrounded routine maintenance in the hangar, but all compressors were running most of the time. Suddenly 1,900 hp of compressed air was simply more than they needed.

A reasonable compressed air efficiency should be 5 cfm per kW. Because of the mismatch of the large compressors and the small demand, the system efficiency was only .65 cfm/kW. Much smaller compressors were needed to efficiently supply this lower demand. The complicating factor in the compressed air demand was that occasionally large amounts of air were required to test the jet engines in both the Engine Test Cells and in the hangars.

Ron Toward, Northwest Airlines Senior Facility Manager, knew there was energy and money to be saved. "The compressor system in its existing configuration was costing approximately $194,384 to operate per year," says Toward. "I knew we could do better."

In April of 2007, Ron partnered with Vince Suerth from Ultra Energy, Gary Ruff from Compressed Air Consulting and Patrick Becker from Air Power Equipment to commission an Xcel Energy Compressed Air Efficiency Study. Toward decided to use this trio because of their expertise in managing and executing large-scale energy efficiency projects. The purpose of the study was to investigate alternatives to the compressed air supply system and find ways to reduce operating costs. Xcel Energy co-funded a portion of the study cost to provide additional incentive to commission the study and find leaks, as well as to identify other opportunities for energy savings.

The Xcel Energy Compressed Air Efficiency Study led to savings of over 1,900,000 kWh and $70,000 annually.

Save Before You Buy — Commission a Study

All of the consultants agree that a best-practices baseline approach is to always consider efficiency first.

The Department of Energy finds that the typical compressed air system uses only 50% of its air supply for production while the other 50% is lost due to leaks and wasteful measures.

"If you can't measure it, you can't manage it," says Tim Guck of Xcel Energy. "We always recommend commissioning a study to find the leaks and waste first because there's usually a possibility of doing more with less. Adding more or larger capacity air compressors should really be a last resort."

Toward understood the numbers and the method. "We're always looking for ways to run the factory more efficiently," says Toward. "We knew we had some leaks, but the study revealed much more."

Step One — Find and Fix Leaks

Nine significant air leaks were found totaling an estimated 47 cfm. The study identified that reducing leaks to a constant level of 15 cfm was achievable. Repairing the leaks helped them save $3,063 annually.

In that very first step alone, NWA increased efficiency more than 30%.

"We couldn't believe it," says Toward. "It really helped us understand how our systems were working and how the needs had changed."

Step Two — Downsize

The first phase of the survey showed that there was an opportunity to save significant energy dollars by purchasing new, smaller compressors to supply the normal plant air demands. The challenge was to figure out how to continue to supply the surge demands of engine testing. The second phase of the air study was devised to quantify in more detail the character of the existing supply and distribution system during the engine testing as well as take a more protracted look at the general plant air needs. Equally important was to get more detailed information on the actual testing procedures to more accurately determine the needs from the air supply system.

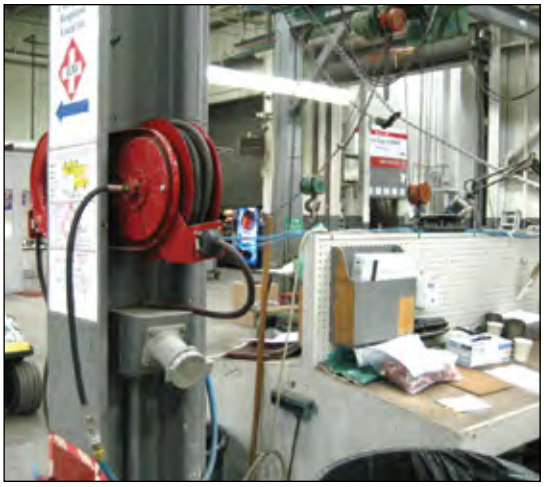
The new system included a 100-hp, fixed-speed rotary screw compressor and a cycling refrigerant air dryer.

To facilitate this quantification phase, two engines were tested in the test cells and the results were measured. They found that even the existing system was barely adequate for most large-engine tests.

By reconfiguring the Test Cell System with a larger air compressor and storing compressed air in the existing storage tanks at 125 psig instead of the previous 95 psig, there was a marked improvement to the system. The Test Cell System was connected to the general Plant Air System to supplement supply for large engine starts. However, the live tests showed that this supplement was inadequate so modifications to the Plant Air System connection were recommended to improve the supplemental supply.

THE ENERGY MANAGER

Xcel Energy and Northwest Airlines Partner to Save Energy



The recommendation was to replace the older Joy centrifugal compressors in the Main Compressor Room with one new Ingersoll Rand 100-hp Fixed Speed Rotary Screw Compressor and a new Ingersoll Rand Cycling Refrigerant Air Dryer sized for the new compressor. A new Ingersoll Rand Fixed Speed 100-hp Rotary Screw Compressor was also recommended to replace the existing 2–40 hp reciprocating compressors in the Test Cell Compressor Room.

"It's interesting to note that the new design did not include a variable speed drive (VSD) air compressor," says Pat Becker of Air Power Equipment. "The study showed that the amount of system storage and capacitance made the air compressor's online/offline controls as efficient as a VFD. The cost for the Ingersoll Rand VFD Controlled Nirvana was not justifiable."

The new air compressors were also configured to be air cooled for heat recovery. Historically, a work area adjacent to the compressor room was a heating challenge during the cold Minnesota winter months. The air compressor exhaust was ducted directly to the area to provide supplemental heat. The new 100-hp air compressor now delivers 7,300 cfm and 299,000 BTU, providing a valuable reduction in plant heating load.

There were various options presented for the upgrade of both the Plant Air Test Cell compressed air systems.

The 700-hp centrifugal compressor used to be operated almost 24 hours a day but by early 2007 was only used once or twice a week.

"The 700-hp compressor used to be operated almost 24 hours a day but by early 2007 was only used once or twice a week," says Vince Suerth of Ultra Energy. "The 100-hp unit was now running the rest of the time. The operating cost of the new compressed air supply system is approximately $68,700 per year. This is an annual savings of $125,684."

The cost of the new compressed air supply system was $180,000. Xcel Energy rebates of $62,970.00 helped lessen the load of the overall cost of improvements. The return on investment was less than two years.

"This was a big project," says Toward. "We thought the rebate was going to be $39,000 but it ended up almost doubling when we added extra efficiency measures. The fact that the rebate was 33% of the total cost really helped our financial folks understand and ultimately sign off on the project."

"We were really surprised that we could get by with two 100-hp compressors for daily maintenance use," says Toward. "That was major." One compressor was initially factored into the equation, but Toward opted to purchase a second one to meet the daily needs of the shop. Toward says they also improved the reliability of the system.

Utility Partner

Partnering with their utility made a big difference in this case.

"NWA sought study preapproval," says Guck, "and after fixing 50% of air loss, which is a program requirement, they submitted their report to us. We reimbursed their study cost for the amount of $10,725. NWA made recommended capital improvements and, with custom preapproval, they were able to receive a rebate for $62,970. Their collective efforts saved their company over 1,970,000 kWh annually."

"Because of this project's magnitude, the NWA project's rebate and energy savings were based on actual savings. Therefore, the equipment had to be metered both before and after installation," says Guck. "Per Xcel Energy program code, any project over 1,000,000 kWh requires monitoring. Otherwise, we use accepted engineering savings technical assumptions, industry best practices, information provided by the customer and manufacturer data sheets to form our analysis."

Average compressed air demand at Northwest Airlines has dropped from 3000 cfm to 250 cfm. The complicating factor was that occasionally large amounts of air were required to test the jet engines.

Huge Savings

The sheer amount of energy saved combined with the rebate amount and simple payback period made this project a no-brainer for Northwest Airlines. The results speak for themselves.

Financial Summary

Study cost	$14,300
Estimated improvement costs	$180,000
Xcel Energy rebates	$73,695 — Total $10,725 — Study rebate $62,970 — Equipment rebate
Annual energy savings	Over $70,000/yr
Kilowatt hours saved	Over 1,900,000
Payback term (after rebate)	Under 2 years

THE ENERGY MANAGER

Xcel Energy and Northwest Airlines Partner to Save Energy

Compressed Air Efficiency features two steps to help you identify and implement ways to save on energy for compressed air:

Step 1 — Diagnosis

The study includes:

- An assessment of operating compressed air systems, including analysis of supply and demand and airflow and/or electric metering
- A written report that identifies leaks and waste and associated energy costs
- A list of system recommendations, paybacks, rebate opportunities and estimated energy savings
- *Preapproval is required for study funding*

Step 2 — Implementation

- Earn rebates for equipment updates or system improvements that result in lower energy use or higher production from your system
- Customers who participate in a preapproved Compressed Air Efficiency study or whose system is under 50 hp can receive up to $200 per kW saved
- Customers who choose not to participate in an Xcel Energy-funded study can receive up to $50 per kW saved
- *Preapproval is required prior to equipment purchase and installation*

The Big Picture

Toward has partnered with Xcel Energy since 1999 and has implemented a variety of energy saving measures, from energy efficiency studies to equipment upgrades and process improvements. The results have been impressive. To date, NWA has saved more than 18 million kWh — that's more than 24 million pounds of carbon or the equivalent of removing 4,000 commuters from our roads — while reducing annual energy costs by more than $1 million. In addition, NWA has earned more than $1 million in rebates for choosing energy-efficient equipment.

Guck says NWA is a model for embracing energy efficiency.

"Northwest Airlines is one of our larger customers," says Guck. "Year after year, they're also are among the most active companies involved in our energy-efficiency programs. Their continued efforts should serve as a model for organizations across the country."

"We all realized how important it was to take a systematic approach to our energy use and as facility managers," says Toward. "We all work together to do that, and because our energy systems — from lighting to heating to cooling — have a dramatic effect on one another, it makes sense for us to continually re-examine our systems to ensure we are taking the best approach."

Toward also realizes that energy efficiency is responsible business practice, and like any organization, he wants his facility to run as efficiently and effectively as possible. He's quick to add that the financial impact isn't the only factor.

"My goal here is to make this facility as environmentally friendly and reduce as much energy use as we can," says Toward. "We're now in the process of getting LEED certified for all maintenance buildings on the site."

Moving Forward

According to the U.S. Department of Energy, compressed air systems account for $1.5 billion per year in energy costs in the United States, and 0.5% of emissions. Many industries use compressed air systems as power sources for tools and equipment used for painting, moving product around the facility, separating and other applications. Optimization of compressed air systems can provide energy efficiency improvements of 20 to 50%.

To learn more about improving compressed air efficiency, contact any of the following:

- **Air Power Equipment — Patrick Becker**
  www.airpowerequip.com or pbecker@airpowerequip.com
- **Ultra Energy — Vince Suerth**
  vsuerth@ultraenergy.com
- **Compressed Air Consulting**
  gruff@airconsultant.net
- **Xcel Energy**
  www.xcelenergy.com/rebates
  Search for key words "Compressed Air" BP

THE TECHNOLOGY PROVIDER

PIAB Optimizes Food Processing Vacuum Systems

BY ROD SMITH, COMPRESSED AIR BEST PRACTICES®

Compressed Air Best Practices® Magazine spoke with Mr. Ed McGovern, VP Sales & Business Development, of PIAB North America.

Good morning. Please describe PIAB's work with food processing.

Good morning. PIAB's vacuum products are involved from the moment food arrives at the food processing/packaging facility up until it leaves. Our vacuum conveying systems are used to transport and move food products and ingredients to where they need to be in an energy-efficient and hygienic manner meeting USDA, FDA, 3-A, EHEDG and GMP hygienic safety standards. This is often called the "Primary Packaging Process".

Once the bulk food product or ingredient has been conveyed to the packaging line, the phase known as the "Secondary Packaging Process" begins. PIAB vacuum grippers and suction cups efficiently place the food product into its packaging. Bags are sealed, cartons are erected, bags are inserted into cartons and rotary top loaders with suction cups move the packaged product into larger cartons that are erected with vacuum. A robot (using vacuum grippers) will place the carton on a pallet, which is then sent to the outgoing loading dock.

PIAB works with professionals in the food industry to streamline conveying and packaging in the most efficient manner possible. We add value by developing innovative technologies, such as vacuum pumps based on the COAX® principle, which reduce the energy consumption and operational costs. Just as importantly, our field engineers teach food industry professionals how to improve operational reliability and increase production output through efficient vacuum system design. We call this the "Optimized Vacuum Management".

The PIAB VGS™ Vacuum Gripping System integrates Duraflex® suction cups with COAX® technology vacuum cartridges.

Ed McGovern, PIAB North America.

Are there misperceptions out there on compressed air-driven vacuum pumps?

There is a misperception that all compressed air-driven vacuum pumps are inefficient. This idea exists because of the historic use of single-stage venturis, which have a relatively inefficient 1-to-1 ratio (1 scfm of compressed air creating 1 scfm of vacuum flow). This has reflected poorly upon the entire category of compressed air-driven pumps. Also, technology has evolved, enabling us to reduce the size requirement of the vacuum system. This new technology, when applied accurately, improves speed and reduces energy consumption.

All pumps are not created equal. There are dramatic differences. The key to understanding them is a well-rounded education on vacuum systems. PIAB vacuum pumps are of the multi-stage ejector type — a technology patented by PIAB in 1973. Large vacuum flows and high levels of vacuum are characteristic of these vacuum pumps. These pumps offer 3 to 6 times the speed and efficiency of single stage venturis. This is made possible by our COAX® technology.

THE TECHNOLOGY PROVIDER

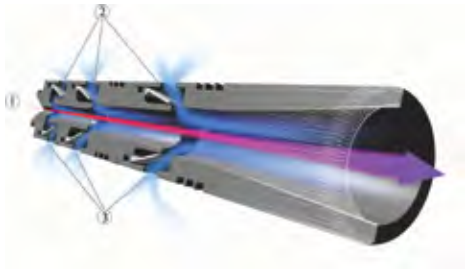
PIAB Optimizes Food Processing Vacuum Systems

Please describe COAX® technology.

Mr. Peter Tell, the Chief Technical Officer at PIAB, invented COAX® vacuum ejector technology at our headquarters in Sweden. His objective was to help industry move away from centralized vacuum systems with large vacuum pumps and extensive tubing and fitting networks. These systems can be inefficient due to pressure losses and possible limitations for the production equipment.

The main design objective for COAX® was to help industry transition from centralized vacuum systems to fast and small decentralized vacuum systems. The result was the world's smallest multi-stage ejector cartridge. It is the size of a match. This allows COAX® technology to be integrated into robots and machines that utilize vacuum. Results include increased speed for higher production outputs, increased reliability because there is a better grip on the product and reduced energy costs.

In simple terms, the way the technology works is that when compressed air (1) passes through the nozzles (2), air is pulled through with the stream of compressed air. "Suction" is thus created at the opening of each stage (3). This creates a dramatic drop in static pressure otherwise known as vacuum.



The special nozzles need very low feed pressures making them less sensitive to pressure losses in feed lines. Our pressure requirements are also typically lower. Most vacuum gripping systems require 80–90 psi. Our technologies, in general, operate between 45–60 psi. More information is available at www.coaxtechnology.com or www.piab.com.

What are the goals of Vacuum System Optimization?

Our methodology is to focus on the unique characteristics of each application. We apply our technology with the following goals:

1. Increase production throughput and piece count by increasing the speed of the machine
2. Reduce waste costs by increasing the reliability of the system and eliminating scrap. PIAB vacuum pumps can be optimized by using a vacuum proportional regulator (called PIAB Cruise Control or PCC). This allows us to reduce energy consumption by optimizing the flow and pressure characteristics of both the compressed air and vacuum system
3. Preventing dropped products and machine interruptions. Porous materials like corrugated have inherent leak rates and these must be factored into the equation. Some metals are oily and require special treatment. The applications affect the selection of the materials used in the PIAB suction cups
4. Significantly reduce decibel levels by eliminating the noise generated by mechanical vacuum pumps
5. Decrease machinery downtime in automated processes by reducing maintenance requirements and increasing the speed of changeover. This is done by deploying a more flexible solution with decentralized COAX® technology
6. Reduce energy costs by deploying our decentralized system, requiring lower feed pressures and only consuming vacuum when engaged. Reductions in compressed air of 50% are common

COAX® multi-stage ejector cartridges.

Each PIAB product plays a role in building the ideal system for each application. The key is to take the time to customize the system for each customer and to select the appropriate technologies. We have found that the above mentioned goals are best met by decentralizing the vacuum system.

Please describe how a vacuum conveying system in the food industry works.

The applications usually involve dry ingredients, such as coffee beans or sugars. To begin with, PIAB vacuum conveying systems meet numerous FDA standards for the food processing industry to ensure hygiene. One of the biggest opportunities here is to improve production efficiency by reducing the need for manual labor.

Time is money, and our vacuum conveying systems can move some powders at a velocity of 65 feet per second. The systems are also powerful as they can move up to 15 tons per hour. Here is how the system works:

1. Vacuum is generated by a compressed air-driven PIAB vacuum pump **A.** The pump can easily be controlled automatically. Since it has few moving parts, the pump is virtually maintenance free
2. The bottom valve **B** is closed, and vacuum is raised in the container **C** and the conveying pipeline **D**
3. From the feed station **E,** the material is drawn into the conveying pipeline and then on to the container
4. The filter **F** prevents dust and fine particles from being drawn into the pump and escaping into the surroundings
5. During the suction period, the air shock tanks **G** are filled with compressed air
6. When the material container is full, the vacuum pump is stopped. The bottom valve opens and the material in the container is discharged. At the same time, the compressed air in the filter tank is released and cleans the filter
7. When the pump is restarted, the process is repeated and a new cycle begins. The suction and discharge times are normally controlled by pneumatic or electrical control systems **H**

THE TECHNOLOGY PROVIDER

PIAB Optimizes Food Processing Vacuum Systems

Please describe a Vacuum Conveying System Optimization.

Sure. We worked with a company who is a global leader in the powdered coffee market. At one of their plants, they were conveying cappuccino coffee and coffee with cream from bulk bags. They were looking for a totally sealed system which would improve process efficiency and quality by reducing cross contamination. They also wanted to reduce scrap and waste, which totaled 30 kg per day or nine tons per year, and to eliminate the extra labor costs involved with manual handling through process automation. They hoped for an improved work environment, particularly in dust control, since the manual handling of coffee conveying emits a lot of dust.

Our optimized vacuum conveying system consisted of two PIAB conveyors and two PIAB Bulk Bag Unloaders. This was a sealed system, which had a direct impact on process efficiency and quality, reducing scrap to zero. Eliminating the nine tons of scrap per year meant a yearly savings of $195,000. Dust was eliminated, so working conditions were improved. The extra staffing was able to be efficiently redeployed. The initial investment was $48,000, so just using the dollar savings from the elimination of scrap, the ROI was achieved in three months.

I know we didn't do justice to PIAB suction cups and Vacuum Gripping Systems, but we'll have to leave that for the Food Packaging edition later this year! Thank you. — CABP BP

For more information, please contact Mr. Ed McGovern, PIAB, email: edmcg@piab.com, tel: 781-337-7309, www.piab.com

PIAB Vacuum Conveying System.

Arla Foods & PIAB Optimize Cheese Handling System

Even in a challenging global economy, it is still vital for suppliers to differentiate themselves from their competitors to stay on top. One global manufacturer that understands this pressure well is Arla Foods, a co-operative owned by approximately 11,600 milk producers in Denmark and Sweden, and Northern Europe's largest cheese manufacturer. The company, headquartered in Sweden, produces 74 different types of cheese every day, from crumbly feta to milky mozzarella.

Proud of its longstanding reputation for providing the highest quality products and a healthy work environment for employees, Arla is always striving to implement the latest technologies to improve overall satisfaction for its customers as well as its staff. Recently, Arla made a significant change in its packaging process which has greatly benefited both parties.

Background: The Cheese Production Process

Well before any of Arla's cheeses make it to the customer level, there are several steps completed in the manufacturing process. First, the milk is aged and poured into large rounds, which are then covered with a protective wax to ensure proper hygienic safety. Once the cheese rounds are covered they are shipped from one of the company's dairy farms to the packaging plant, where they are sent for mass-market distribution.

When the cheeses arrive at the packaging plant they are transferred to large pallets that hold six rounds on each layer. While in the company's cheese storage facility, uncut Präst and other large, round cheeses are stacked to be delivered. As cheese is highly perishable, Arla ensures that the most hygienic handling practices are used throughout the process.

"The primary protection for the cheeses is wax," says Jan Selander, manager of waxing and high-rise storage at Arla Foods. The waxing facility at Gotene's distribution centre (Alexander) is Arla's processing, storage and distribution centre for cheese in Sweden. The company waxes about 500 tons of cheese each week and the cheeses are stored for between three and 12 months. Due to quality reasons, the wax is replaced every six weeks.

"The cheese must be handled many times, and with great care, in order not to damage the protective wax," said Selander.

The Challenge: Reduce Waste and Lower Manufacturing Noise Level

The handling of cheese in this Arla facility has already been automated, using vacuum grippers to lift the heavy rounds. Although the automation process was a major improvement from Arla's original, manual system, the company wanted to upgrade its system in order to improve energy efficiency, reduce waste and decrease noise levels at the facility.

In order to accomplish its objectives, Arla turned to its long-time and trusted partner, PIAB. "We had worked with PIAB in the past and had confidence that they could come up with the most efficient solution to meet our needs," said Selander.

The Solution: PIAB P6010 Vacuum Pump with Cruise Control

After a thorough consultation of the application, PIAB engineers removed Arla's existing vacuum pumps and replaced them with the new, P6010 vacuum pumps, equipped with PCC (PIAB Cruise Control) which allows for an optimum vacuum level and improves energy efficiency.

Based upon PIAB's patented COAX® multi-stage ejector technology, the P6010 vacuum pump provides up to 40% more flow than conventional air-driven vacuum pumps. In addition to being highly powerful, the new pump is whisper-quiet and provides non-heat generating suction at extremely low feed pressures.

The PCC automatically maintains a pre-set level of vacuum to ensure that a consistent vacuum level is provided at the suction point. This feature was particularly valuable for Arla because it allowed for a reliable product hold, which was capable of accommodating the speed of the robot. The P6010 PCC provides sufficient vacuum flow to form a proper seal but without cracking the wax and damaging the cheese.

Arla Foods implemented PIAB's P6010 vacuum pumps equipped with PIAB Cruise Control (PCC) into its existing equipment to reduce air consumption by 53%.

The Results: Energy Consumption and Noise Levels Cut in Half

Arla's purchasing decision paid immediate dividends in fewer product rejections and reduced compressed air consumption, which lowered overall energy costs.

Additionally, the new system cut the noise level in half, meeting Arla's need to provide its employees with a less noisy working environment. "We have measured and found that there is an incredible difference in the noise level," states Selander.

"By using new grippers and the P6010 PCC, the number of damaged cheeses has been drastically reduced. We are now less vulnerable to variations in feed pressure, and we can see that the system is a lot less sensitive to occasional leakage," assessed Selander. "Additionally, we have reduced air consumption by 53%, which is an impressive reduction."

After experiencing such positive results from PIAB's vacuum technology, Arla recently purchased six additional P6010 PCC pumps for its waxing facility in Sweden. "We look forward to a continued partnership with PIAB and we anticipate increased productivity and savings with these purchases," said Selander.

SEVEN SUSTAINABILITY PROJECTS FOR INDUSTRIAL ENERGY SAVINGS

Project #4: Compressed Air Optimization — Shutting Down a Partially-Loaded Air Compressor

BY THOMAS MORT, CEM

Overview

Reducing energy costs and pollution emissions involves many areas within an industrial facility. My studies have found seven key (or common) areas where low-cost practical projects can be implemented. Combined, these projects provide savings exceeding 10% of the annual energy spend with an average payback of less than one year.

Seven Key Sustainability Projects

1. Lighting
2. Demand Control
3. HVAC Optimization
4. Compressed Air
5. Metering
6. Heat Recovery
7. Project Implementation and Funding

This month's article will focus on the opportunities for reducing energy costs with compressed air systems. When presenting an Energy Workshop, a question I always ask the participants is this: "How many of you already know that compressed air is one of the most expensive energy forms to waste?" Everyone acknowledges, "Yes." I then ask the question: "If we all know it is an expensive form of energy to waste, then why have the previous participants identified more than $9 million of savings with low cost projects?" The root cause is primarily due to a lack of measurement. Remember the saying, "You cannot control what you cannot measure." Many facilities use a rough form of measurement. They count the number of compressors that are needed to meet the demand: 1, 2, 3, etc. Having to turn on an extra compressor indicates either air leaks or is excused as due to an increase in production.

This article will briefly review some simple means of measurement, identifying and quantifying the cost of operating a partially loaded compressor and list remedies.

Compressed Air Project Objectives

We can describe our Compressed Air Optimization Project as an effort to reduce operating costs of the compressed air system by benchmarking the energy usage and implementing projects and procedures to reduce load, with a goal to shut off a partially loaded compressor. The symptoms to help identify the opportunities for this project include:

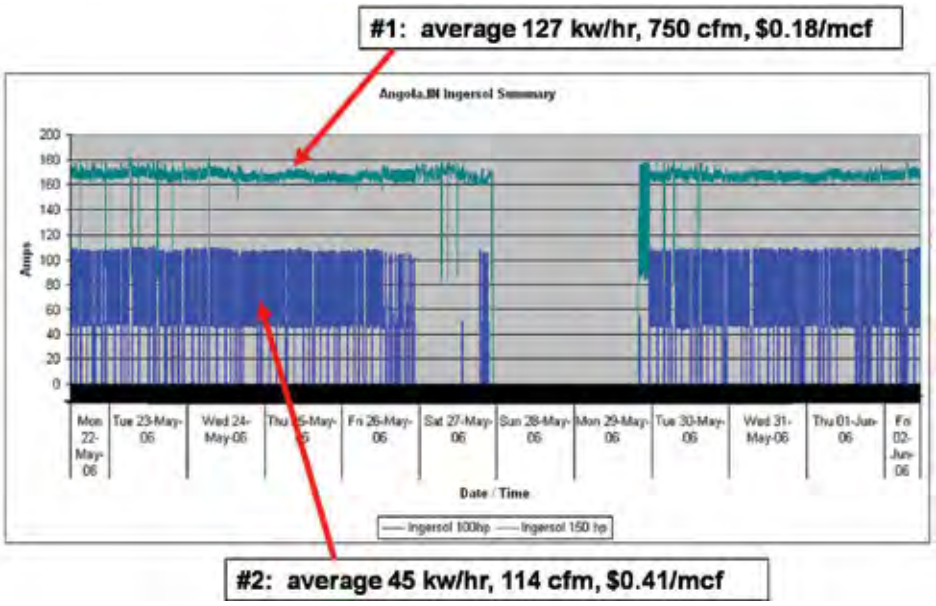
1. The facility operates with more than one air compressor and one is partially loaded
2. Compressed air is used to stir, agitate, cool, dry or position parts or equipment
3. The compressed air system pressure is higher than required for the majority of equipment
4. Supply valves are left open on equipment when it is not producing parts
5. Site surveys identified multiple air leaks
6. The electric load of the compressed air system does not follow changes in plant production

Step #1: Measure energy costs of air compressors

A very useful, low-cost tool to begin analysis is the same that was described in the past article for demand control. Using simple data loggers and current transformers is an effective way to measure the energy use and patterns of use for the compressed air system. Install a data logger and current transformer on each operating air compressor. Set the data loggers to read every 30 seconds and collect readings for at least 7 days. The measured data can then be graphed.

Analysis of this data can give use some key data. In my example, one of the compressors is operating at full capacity and the other is operating partially loaded. From the measured data we can estimate the cost to run both of these compressors.

The partially loaded compressor is more expensive per unit of air produced. Consider that the partially loaded compressor is producing an average output of 114 scfm and yet costs $17,690 per year to operate. This gives us a great potential project. If we can shut down the partially loaded compressor, we can save $17,690 per year.

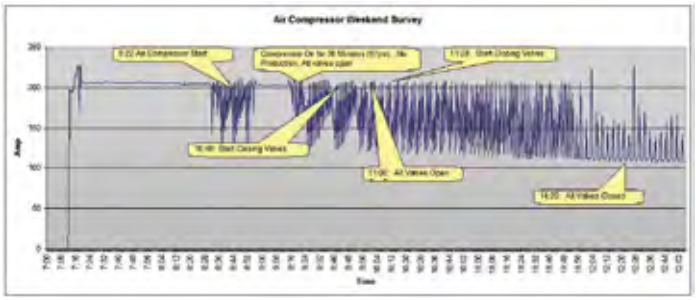


Graph showing a partially loaded compressor and a fully loaded compressor.

Compressor #	average kw/hr	x	hours/yr	x	$/kwh	=	Annual Cost
1	127	x	7448	x	0.063	=	$ 59,591
2	45	x	6240	x	0.063	=	$ 17,690
3		x		x		=	$ -
4		x		x		=	$ -
Total	172	x		x		=	77,282

Annual cost of a partially loaded compressor.

SEVEN SUSTAINABILITY PROJECTS FOR INDUSTRIAL ENERGY SAVINGS



Closing valves on machines without production reduces load.

Step #2: Manage Compressed Air Demand Events

We need to go out into the factory and identify sufficient projects to reduce the compressed air load sufficient to allow shutting off this compressor. (Did you know that 114 scfm is equal to approximately 4 x ⅛-inch air leaks.) If we work from the basis that projects with a payback of less than one year are acceptable, we could spend up to $17,000 to reduce this load. The good news is that we usually don't have to spend even that much money.

One way to reduce some of the load is to ensure that the supply valves to machines or work areas are shut when products are not being produced. The following graph shows the results of a project where the data loggers were installed on the compressor and the valves that workers normally left open were closed in series. As you can see from the graph, as the valves were closed, the load on the compressor continued to decrease. In this plant, procedures were implemented and auto shut-off valves installed on some machines. The results were that the plant was able to run with one less compressor.

Air receiver tank upgrade.

Reducing system pressure is another piece of the puzzle. Often plants run at a pressure higher than is required for the majority of the equipment. The reason may be a certain set of equipment requires a higher pressure or distribution lines restrict flow to sections further away from the compressors. Identifying the specific areas and using an air amplifier to increase the pressure or installing extra air receiver tanks to overcome pressure drops are typical solutions.

Flow controller example.

Often an extra compressor is left running (the partially loaded compressor) to be ready for short-period demands caused by cleaning, special processes, etc. Since it is not known just when this extra demand will arise, the extra compressor is left on. Air receiver tanks coupled with flow controller valves can often eliminate the need for the extra compressor.

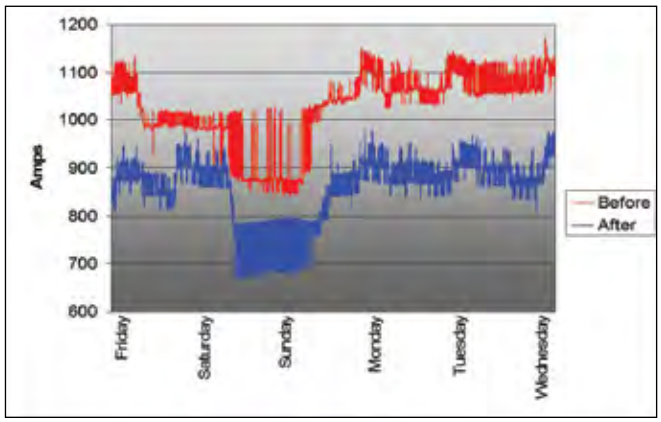
Step #3: Identify Inappropriate Uses of Compressed Air

Surveying the factory to identify areas where compressed air is being used to agitate, mix, cool or dry provides another potential area to reduce the load. Air-powered motors used for mixing can often be replaced by electric motors using more than four (4) times less energy.

When compressed air is being used to dry, cool, or position material there are solutions to use less energy. Air knives can be changed to a design that uses lower pressure, high-volume blowers instead of using the compressed air. I recently reviewed a project where the plant was using compressed air to dry parts after a water bath. Changing the existing air knives to a blower system resulted in shutting down a 150-hp partially loaded air compressor and replacing it with a 25-hp blower. The project saved $30,000 per year with a seven-month payback.

We cannot forget air leaks. Though they are a continuous problem, air leaks contribute to the need for operating a partially loaded compressor. An on-going program of identifying and repairing leaks is necessary. An air leak tagging program, which encourages everyone to find air leaks and tag them for repair, can be quite effective. Utilizing a monthly drawing from the entered tags and giving prizes has shown to be an effective method to keep people involved.

Electric motors can replace air motors for stirring.



Before and after compressor energy usage.

Conclusion:

Running a partially loaded compressor is expensive. Often the partially loaded compressor can be shut down by implementing multiple low-cost projects to reduce air usage in the plant. Closing valves on machines not operating, lowering pressure to that required by the majority of equipment, using blowers to replace compressed air knives and repairing air leaks are all pieces of the project with the final goal to reduce costs. BP

For more information, please contact Thomas Mort, CEM, Thomas Mort Consulting, tel: 210-858-8454, email: tcmort@savingwithenergy.com, www.savingwithenergy.com

THE TECHNOLOGY PROVIDER

Bulk Handling: Reducing the Compressed Air Consumption of Air Cannon Systems

BY CHRISTOPHER SCHMELZER, FLOW AID PRODUCTS MANAGER, MARTIN ENGINEERING USA

Air Cannon Applications

Air cannons, also known as air blasters or just "blasters", belong to a family of products known as flow aid devices. For over 30 years, air cannons have been used widely in industries such as cement manufacturing, electric power generation, coal, metal and non-metal mining and pulp and paper manufacturing.

Applications for air cannons range from emptying stagnant bulk material from storage vessels to cleaning high-temperature gas ducts. Air cannon systems have proven over time to be an effective solution to problems in material flow.

In the cement industry, air cannons have found a number of applications, including the elimination of build-ups and blockages in preheater towers at points such as the riser ducts, feed pipes, kiln inlets and cyclones. They are also used extensively on clinker coolers and in material transfer chutes and storage bunkers.

The Basics of Air Cannon Operation

In its simplest form, an air cannon consists of a fast-acting, high-flow valve and a pressure vessel or tank. Work is performed when compressed air (or other inert gas) in the tank is instantaneously released by the valve.

In a typical air cannon application, 700 liters (25 cubic feet) of free air is compressed to 7 bar (100 psi) inside a 100-liter (3.5 cubic feet) tank. The air cannon valve is designed so that the pressure of the air supply holds the valve closed until a solenoid valve releases the holding pressure. When triggered, the fast-acting valve releases this tank volume in less than 300 milliseconds, creating a high-magnitude force at the exit of the nozzle that is installed through the wall into the vessel or duct. This force is used to breakdown build-ups and blockages to improve material or gas flow through the vessel or duct. Different blast characteristics are achieved by varying the operating pressure, tank volume, valve design and nozzle design.

The general rules of air cannon application are:

1. More efficient valve designs deliver higher blast forces
2. Higher operating pressures deliver higher blast forces
3. Larger tanks deliver longer blast durations
4. Nozzles spread or direct the blast to suit the application

The peak forces generated by an air cannon blast occur during the first few thousandths of a second after the valve is opened. In applications where high-force output is required to perform the needed task, the useful energy is released during these initial few thousandths of a second, and the subsequent discharge of compressed air is wasted energy.

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Bulk Handling: Reducing the Compressed Air Consumption of Air Cannon Systems

As energy prices continue to rise, it becomes increasingly valuable to find ways to reduce the compressed air consumption of air cannon systems.

The Cost of Operating Air Cannon Systems

Air cannon systems are most often connected to the plant air system, sharing this compressed air resource with other equipment and processes. In other operations, the air cannon system is supplied by a dedicated compressor. This may be because the plant has no plant air system or because the air requirements of the air cannons exceed the existing plant air system's capacity. Blast forces vary directly with the air cannon's supply pressure; therefore, an air cannon system's performance suffers when the compressed air system cannot deliver the required pressure and volume.

Compressed air is a relatively expensive source of energy. While it is difficult to know the exact cost of compressed air used within a given plant, a United States government estimate from 2000 calculates it at up to $0.30 USD per 1,000 cubic feet of air. Energy costs have gone up in the past eight years since that estimate and, in all likelihood, will continue to rise. As energy prices continue to rise, it becomes increasingly valuable to find ways to reduce the compressed air consumption of air cannon systems.

For New System Installations

Use Air More Efficiently with Advanced Valve Technology

One way to minimize the use of compressed air is to select an air cannon that uses efficient valve technology. When supply pressures are equal, more efficient valves mounted on smaller tanks can deliver higher blast forces than less efficient valves mounted on larger tanks. This results in a compressed air savings equal to the difference in tank volumes. These compressed air savings are increased further when the operating pressure of the more efficient valve is reduced to the point where it will still deliver the same peak blast force as the less efficient valve.

A real-world example involves two of Martin Engineering's air cannon models: the BIG BLASTER® HURRICANE Air Cannon, which was brought to market in 2007 and uses Martin Engineering's newest valve design, produces roughly twice the blast force output while using about half the volume of compressed air as the BIG BLASTER® XHV design, which was introduced over a decade ago. If the two designs were set to deliver the same blast force output, the BIG BLASTER® HURRICANE design would operate at roughly half the air pressure, further reducing the compressed air consumption to about one-quarter of what the BIG BLASTER® XHV Air Cannon uses.

Selecting the air cannon system with the more advanced valve will cost a little more up front, but the air savings will more than pay back the difference over the life of the system.

To Upgrade Existing Air Cannon Systems

Save Air by Closing the Valve Mid-Blast

Air cannon systems that are currently in operation may also benefit from new air-saving technology. Martin Engineering's BIG BLASTER® XHV TORNADO Air Cannons can be equipped with a Piston Return Reservoir that will close the valve after approximately 50% of the volume has been discharged. The Piston Return Reservoir, also known as a "Canister," is a pneumatic device that momentarily interrupts the exhaust of the air cannon's quick exhaust valve. This interruption allows the valve's pressure to equalize with the tank's pressure, enabling the return spring to close the piston while the tank is still half-pressurized. The air cannon's peak force is unaffected by this process, meaning that the same amount of work can be done with using only one-half the compressed air.

In other words, when equipped with a Piston Return Reservoir, the air cannon produces an initial blast of the same strength, but the duration of that blast (the aftershock, if you will) is reduced. Instead, some air is retained in the air cannon tank, minimizing the overall air consumption without reducing the initial output force. Because the air cannon's main air tank never empties completely, the amount of air required to fill that tank after every discharge is reduced.

The performance of air cannon system before and after the installation of the Piston Return Reservoir is shown in **Figures 1 and 2.**

Figure 1 shows the force and pressure curves of a typical air cannon blast. The blast force output reaches its peak in the moments just after the valve is opened and is reduced as the tank pressure approaches zero.

Figure 2 shows the force and pressure curves of an air cannon blast using the Piston Return Reservoir (canister). As the canister pressure approaches the tank pressure, the valve is closed with approximately 50% of the original pressure remaining in the tank. The peak force output has remained the same, but the addition of the Piston Return Reservoir has reduced the overall air consumption by 50%. This reduces the drain on the plant air system and saves the plant money.

The return on investment derived from the compressed air savings for installing Piston Return Reservoir on a typical BIG BLASTER® XHV TORNADO air cannon system is approximately 18 months. Plants operating standard BIG BLASTER® XHV air cannons can also take advantage of the air savings by upgrading their valves with a TORNADO Exhaust Valve and Canister combination.

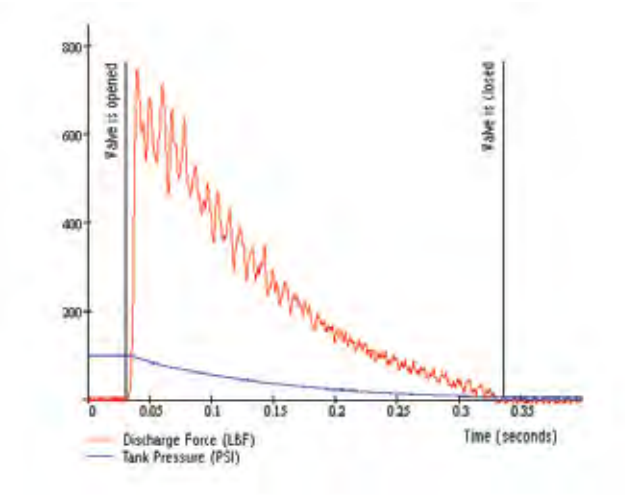

Figure 1

Force and pressure curves of a typical air cannon blast. The blast force output reaches its peak in the moments just after the valve is opened and is reduced as the tank pressure approaches zero.

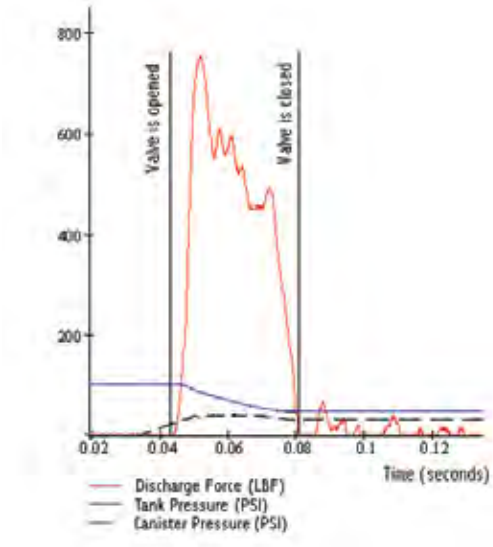

Figure 2

Force and pressure curves of an air cannon blast using the Piston Return Reservoir (canister). As the canister pressure approaches the tank pressure, the valve is closed with approximately 50% of the original pressure remaining in the tank. Closing the valve mid-blast does not affect the peak force output.

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Bulk Handling: Reducing the Compressed Air Consumption of Air Cannon Systems

BIG BLASTER® XHV TORNADO (left) and HURRICANE Air Canons (two on right) installed on a cement plant's primary crusher.

Piston Return Reservoirs installed on BIG BLASTER® XHV TORNADO Air Cannons.

An Upgrade Case History

A Midwestern U.S. cement plant operated a system of four BB4-2030 BIG BLASTER® XHV TORNADO Air Cannons on their limestone quarry's primary crusher. This system, which had a fast cycle time of 30 seconds between firings, demanded 7 cubic meters of free air per minute (250 cfm) at 6.5 bar (95 psi).

When operating conditions required additional cleaning capacity, four BIG BLASTER® HURRICANE Air Cannons were added to the crusher's system. However, the plant's compressed air system could not support the 35% increase in air flow demanded by the new air cannons, and the system's pressure was reduced to 4.5 bar (65 psi). The force output from the air cannon system was correspondingly reduced by 30%, negatively affecting the cleaning performance of the system. In short, the plant had added additional air cannons but was suffering reduced performance of the entire air cannon system because of the added air consumption.

To overcome this challenge, Piston Return Reservoirs were added to each of the four original BB4-2030 BIG BLASTER® XHV TORNADO Air Cannons, cutting their compressed air demand by half. As a result, the operating pressure was raised back to 6.5 bar (95 psi), and the force output of air cannons was raised by 30%. This allowed the system to remove the tough material buildups and keep production running smoothly.

Conclusion:

Improving Air Cannon Efficiency Pays Off

To reduce air costs, reduce air consumption.

On new air cannon installations, the selection of an efficient valve such as the BIG BLASTER® HURRICANE Air Cannon Valve from Martin Engineering will provide effective material movement with reduced compressed air usage.

To reduce air consumption of existing air cannon systems — without reducing peak output force — minimize the length of the blast by installing a Piston Return Reservoir on BIG BLASTER® XHV TORNADO Air Cannons.

Other models of air cannons can take advantage of air savings by upgrading with MARTIN® XHV TORNADO Valve and Canister technology.

The benefits of selecting efficient valve technology for new air cannon projects and of upgrading existing air cannon systems include reduced energy costs, improved air cannon performance and increased compressed air capacity for other processes within the plant. BP

Author Information

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Martin Engineering (Neponset, Illinois) is the originator and leader in air cannon technology. Founded in 1944, the company has operations around the world to make bulk materials handling cleaner, safer and more productive. The company website is www.martin-eng.com

Footnote:
Department of Energy Document DOE/GO-102000-0986, December 2000, Compressed Air Tip Sheet #1

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AIR STANDARDS

ISO 1217, ASME PTC9, CAGI/Pneurop PN2CPTC2 and Other Mysteries of Displacement Compressor Performance Reporting

BY WAYNE PERRY, TECHNICAL DIRECTOR, KAESER COMPRESSORS

Acceptance Test Codes

If you have ever looked at the small print of a compressor brochure or a CAGI Data Sheet or a compressor technical information page, you have probably seen some reference to one of the above standards. At one time or another, compressor manufacturers in the United States have used these standards to test and report compressor performance. These are referred to as "Acceptance Test" codes.

Before beginning a discussion of acceptance test codes, it should be noted that ASME PTC9 is no longer maintained as an active standard. You can still purchase a copy from ASME for reference purposes, but manufacturers are unlikely to test and rate to an inactive standard. The CAGI/Pneurop standard has also been dropped from active status, but since it is based on Annex C of ISO 1217, you may still see references to this standard in literature or technical data that has not been updated to reference ISO 1217, Annex C.

Acceptance test codes were originally written to be a test method that could be used to confirm the flow, pressure and power of a compressor built to a customer's specific requirements. If the requirements were met, the customer would "accept" the compressor, and the manufacturer could be paid. While this is fine for custom-built compressors, most compressors sold to industries are not custom-built. Most compressors are of a standard design and built in batches or in continuous production quantities and are fully piped and wired as a complete, self-contained compressor. For these types of compressors, ISO developed Annex C for ISO 1217. Annex C is a "simplified acceptance test for electrically driven packaged displacement air compressors." The purpose of the simplified test code is to provide a consistent method of measuring the volume flow (at the terminal point of the compressor package and at a standardized set of inlet conditions) and total package input power requirements of a displacement compressor so that interested parties can make a direct comparison on an "apples to apples" basis.

Standardized Reference Terms & Conditions

It is important to understand what the term "volume flow" means. Volume flow has been referred to as actual cubic feet per minute (acfm), cubic feet per minute (cfm), free air delivered (FAD) and various metric equivalents. Manufacturers of compressors in the U.S. have agreed to standardize their terminology and use only acfm when stating volume flow. Volume flow is the volume of air at the standardized reference condition delivered to the terminal point of the compressor package. For example, a 1,000 acfm, 125 psig rated compressor will "inhale" a little more than 1,000 cubic feet of ambient air, compress that air to the rated discharge pressure, perhaps use some of that compressed air for control purposes and deliver the equivalent of 1,000 cubic feet of inlet air to the terminal point of the compressor package. Remember that this is a volume measurement so think of it as a bucket that moves 1,000 cubic feet of something every minute.

If you had a pneumatic device that required 1,000 cfm (at standardized reference conditions) at 90 psig, a 1,000 acfm compressor should do the trick, right? Well, maybe. This is where the standardized reference conditions come in to play. The standardized reference conditions for ISO 1217 are found in Annex E and describe the inlet conditions for the acceptance test. Those conditions are:

Inlet Air Pressure	14.5 psia (absolute)
Inlet Air Temperature	68 °F
Relative Water Vapor Pressure	0
Cooling Water Temperature (if water cooled)	68 °F

Since sea-level air pressure is 14.7 psia, the reference conditions are set at an elevation slightly above sea level. A relative water vapor pressure of zero means that water vapor is not taken into account when determining the volume rating of the compressor. The reason not to consider water vapor in calculating volume flow is because water vapor varies greatly from location to location, and the amount of water vapor that is condensed varies from application to application. By eliminating it from the rating criteria, the customer can use the volume rating as a starting point to calculate his supply volume based on his specific ambient conditions. The customer will also need to use the reference pressure and temperature in that calculation. At these conditions, one cubic foot of air weighs about 0.075 pounds. A compressor rated at 1,000 acfm operating at these conditions would put about 75 pounds of air into the system every minute.

If the facility was in a location where the ambient pressure was 14.5 psia, the temperature was a constant 68 °F and the relative humidity was 7%, the 1,000 acfm compressor would work fine for the 1,000 cfm demand. Under those conditions, with a 90 psig operating pressure, the pressure dew point would be 49.4 °F. Water vapor drawn into the compressor would never see a temperature lower than that, and no water would condense. There would likely be no need to dry the air since the pressure dew point is almost 20 °F lower than the ambient temperature.

Use Correction Factors

If the facility happened to be in Denver, Colorado, some calculations would have to be made to determine whether the compressor would actually operate the device. The ambient pressure in Denver is about 12.2 psia. Assuming a 95 °F summer day with a 30% relative humidity, the calculations go as follows:

Temperature Correction —

(460+Standard Temperature in °F) / (460+Ambient Temperature in °F)

Or

(460+68) / (460+95) = 528/555 = 0.95

Altitude Correction —

Absolute Ambient Air Pressure / Standard Ambient Air Pressure

Or

12.2 / 14.5 = 0.84

Multiplying these two correction factors together give you the total change in density of the ambient air between the site conditions and the standard conditions. The air on that summer day in Denver is only 79.8% as dense as standard reference conditions. Additionally, at 95 °F and 30% RH, the compressor is pulling in about 0.96 pounds of water vapor every minute. At Denver's elevation, that means that about 22 cubic feet of the inlet air stream to the compressor was water vapor. Since water is bad for most pneumatic devices, the compressed air will likely be run through an aftercooler and a dryer to get the pressure dew point down to about 40 °F. This will cause some of the water vapor to condense into a liquid, removing its portion of the inlet air stream from what is available at the discharge point of the dryer. It actually reduces the available inlet air stream by about 16–17 cfm. Therefore, take 16 cfm from the original 1,000 acfm capacity and then multiply by the correction factors.

1,000 – 16 = 984 x 0.95 x 0.84 = 785 standard cubic feet per minute (scfm)

The compressor is still "inhaling" 1,000 cubic feet of volume. However, the air in Denver is less dense (fewer molecules) than the air at the standardized rating condition. The bucket size did not change, but what went into the bucket did: 1,000 cubic feet of volume yields the equivalent of 785 cubic feet of air at the standardized reference condition. At standard conditions, a full bucket held 75 pounds of air, and in Denver the bucket is full with just 58.9 pounds of air.

AIR STANDARDS

ISO 1217, ASME PTC9, CAGI/PNEUROP PN2CPTC2 AND OTHER MYSTERIES OF DISPLACEMENT COMPRESSOR PERFORMANCE REPORTING

Changes in ambient temperature are why some marginal applications work fine in the winter and struggle in the summer.

Sizing the Air Compressor

To find out what size compressor to use to deliver 1,000 cubic feet of air at the reference condition, start by adding 17 to the 1,000. Use 17 (or 18) instead of the 16 used above because the compressor is going to pull in more ambient air and thus more water vapor. Now divide 1,017 by the correction factors:

1,017 / 0.95 / 0.84 = 1,274 acfm

This calculation results in the volume required at the stated summer conditions to deliver the same mass as 1,000 cubic feet of air at standard conditions. In the winter, colder air is denser, and the correction factor may go above 1.0. Changes in ambient temperature are why some marginal applications work fine in the winter and struggle in the summer.

A frequently asked question concerns why compressor manufacturers rate in acfm and dryer manufacturers rate in scfm. The short answer is that a dryer's capacity is based on mass flow through the dryer and not volume flow. A refrigerated dryer, for example, is only capable of cooling a certain number of molecules of air down to its specified dew point. The dryer has to deal with a given number of pounds of air without regard to the volume that it took to make that number of pounds. Theoretically, an 800 scfm dryer would work with a 1,000 acfm compressor at the Denver summer conditions stated earlier. A dryer's capacity is also affected by the temperature of air at the inlet of the dryer and the pressure at the inlet, so "theoretically" this assumes that the pressure is 100 psig and the temperature is 100 °F. Dryer manufacturers have their own set of correction factors if the temperature or pressure varies from 100.

Conclusion

In conclusion, the ISO 1217 rating for a compressor serves as a volume rating, indicating how much ambient air the compressor will deliver to the terminal point of the package at the rated pressure. From there, calculations can easily be made to adjust the volume rating to the actual site conditions. Also worth noting is that ISO 1217 is subject to periodic review and rewrite. A new version is due out soon. This new version will include methods for testing and reporting variable speed compressors at less-than-full load levels. This method has already been adopted by members of the Compressed Air and Gas Institute and made available on members' CAGI Data Sheets. It shows power and flow at minimum speed, maximum speed and at least three equal points between those two speeds. This was done to allow users to look at performance over the flow range they actually need and not at just the full load point. To assure users that they are comparing true performance and not mcfm (marketing cubic feet per minute), the Compressed Air and Gas Institute sponsors a third-party testing and verification program for rotary screw compressors and refrigerated dryers. The testing lab performs random testing on participating manufacturers' compressors to verify that the claimed performance meets the ISO 1217 standard and the appropriate dryer testing standard. For information about this program, visit www.cagi.org. BP

For more information, please contact Wayne Perry at email: wayne.perry@kaeser.com or visit www.kaeser.com

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PERSONAL PRODUCTIVITY

16 Credibility Busters That Are Ruining Your Career

BY SANDY ALLGEIER

Do you have what it takes to be a viable member of the 21st century business community? Are you sure? Globalization, virtual collaboration and the rise of the project-based workforce have changed all the rules. These days, you must be able to influence others, communicate clearly and — most importantly — elicit trust. If people don't trust you, they won't work with you. It's really that simple. According to Sandy Allgeier, there is one sure way to gain the trustworthiness you need to succeed: improve your personal credibility factor.

"Whether you're an employee, a leader or an entrepreneur, personal credibility is truly a 'magic bullet' for success," says Allgeier, author of *The Personal Credibility Factor: How to Get It, Keep It, and Get It Back (If You've Lost It)*. "It forms other people's opinions of you, shapes their interactions with you and helps them decide whether to trust and respect you. In other words, it leads to healthy, productive relationships — and relationships are the vehicles through which business happens."

If you have no credibility, people won't trust you. If they don't trust you, you won't persuade them, and if you can't persuade, you'll never be able to problem solve, innovate or lead. You'll become increasingly irrelevant — and vulnerable to the staggering numbers of others, worldwide, who are vying for your spot. To make it simpler to understand, Allgeier says we should aim to avoid what she calls "credibility busters." Here are some of the most common:

The 16 Credibility Busters

1. Failing to do what you say you will do.

The number one way to bust your personal credibility? Just fail to deliver on the promises or commitments you make. We're all guilty of committing this sin from time to time, but when we do it more often than not, we've got a credibility problem. "How often do you say, 'I'll get that to you today,' and then you don't?" asks Allgeier. "Or 'I'll call you back in a few minutes,' and then you don't? Most people are forgiving when this happens — to a point. However, when you make a regular habit of this, you quickly become labeled as a promise-breaker. If you're not sure you can follow through on your promises, don't make them. Period!" "Yes; life can be hectic and sometimes you have no choice but to reschedule," says Allgeier. "That's precisely why you must do everything in your power to keep your appointments most of the time. Then, when you have to make an exception, it will be just that — an exception."

2. Constantly showing up late.

You say you will meet a client at 11:30. You call her on your cell phone and say, "I'll be right there — I'm caught in traffic," and then you arrive at 11:45. It's bad enough to do this to a friend, but in the business arena, where people tend to be less forgiving, it can be the kiss of death. If lateness becomes the norm, you have taken a virtual hammer to your personal credibility, and it is busted.

"Plan ahead and arrive a little early — consistently," suggests Allgeier. "Not only is your credibility protected, your stress level is reduced by avoiding that last-minute rush!"

3. Being messy and/or disorganized.

Is your desk overflowing with papers that should have been filed (or trashed) months ago? Are you always losing documents or leaving them at home? Do you go to meetings looking disheveled and bearing wrinkled, dog-eared reports? If so, your credibility is almost certainly called into question — and with good reason, says Allgeier. "Sometimes creative people, in particular, think they're exempt from the 'neatness counts' rule," she notes. "They're not. When you're disorganized, important things will fall through the cracks, and if you're sloppily dressed, people assume you're equally sloppy in your work. Allow enough time at both ends of the day to look neatly put together and to file away your papers. It makes a world of difference!"

4. Bringing too much "personal life" into your workday.

Do you get lots of personal calls at work? Is your e-mail inbox cluttered with letters from friends and receipts from Internet shopping you've done on company time? If so, you're losing credibility. "Rest assured, your boss notices when your friends, spouse and kids call 10 times a day," says Allgeier, "and even if you think she never looks at your inbox, the day may come when she does. What if you're out of the office and your boss needs to access an e-mail a client sent you? When she can't find what she needs in the deluge of 'forwards,' she'll assume you're barely working at all! We all take the random personal call or order the occasional birthday gift for our spouse during working hours," she adds. "That's fine, but when personal matters start to interfere with your job — or even appear to do so — you've got a credibility problem."

5. Speaking first, thinking second.

Consider this scenario. On Monday, your boss asks you if you can have a project done by Thursday. Wanting to please him, you immediately answer "yes." However, as you get into the project, you realize there's a lot more involved than you had originally thought. You toil on it for a couple of days, and then late on Wednesday, you sheepishly approach your boss and tell him, "Sorry, I didn't know it was going to be this complicated. I'm not going to be able to have it done tomorrow after all. Always, always do your research before you make a promise," advises Allgeier. "There's nothing wrong with saying, 'Let me think about it and get back to you.' It's far better than undermining your own credibility."

6. Making decisions while keeping others in the dark.

Trust and credibility are built when others feel valued. It is broken when others feel like they don't matter to us. Let's say you head a project team, and after gathering the team's input you have reached a consensus agreement about a key decision. Later you learn additional information and change your original decision. As the leader, you have the authority to do that, right? Yes — but the team needs to understand your thought process. Otherwise, they won't believe you really ever wanted their input, and your credibility as a leader is busted. "It really doesn't matter whether others have the authority to impact the final decision or not," says Allgeier. "What matters is keeping them informed of your thoughts as you work through the process."

7. Telling little white lies that morph into big hairy lies.

You're supposed to be preparing an important presentation for a client but hit an internal snag and miss your deadline. Rather than admit you dropped the ball, you blame your tardiness on a vendor: "Sorry, the printer had trouble getting the color exactly right on the cover and made us a day late!" It turns out that your client had built a few extra days into her deadline, so she's not upset at all (in fact, you get kudos for being such a perfectionist about the color). No harm done, right? Wrong! Over the weekend, your client runs into the owner of the print shop at a party and mentions how nice the cover looks, adding, "…so even though it took a day to get the problem straightened out, the end result was worth it!" Puzzled, the printer asks, "What do you mean? We turned that job around in record time!" With that single chance encounter, your credibility is busted — not only with your client but also with the printer who now knows you sold him down the river. "It would have been so much better to take the blame for the missed deadline, apologize and possibly offer a discount on the project," says Allgeier. "Admitting to a mistake is far better than being forever branded a liar and backstabber. When you lose someone's trust in this way, you can never get it back."

PERSONAL PRODUCTIVITY

16 CREDIBILITY BUSTERS THAT ARE RUINING YOUR CAREER

8. Trying to do everything — but ending up doing it all in a half-a**ed way.

Let's say your manager asks you to help him write a critical marketing proposal. Then, a few hours later, an outside client asks you to do an "emergency" project. You agree to both. The problem is, you are also trying to prepare for a speaking engagement just a few short days away. You don't want to let anyone down, so you cross your fingers, vow to go without sleep for the next 48 hours and try to do it all. It doesn't take a rocket scientist to see that at least one of these commitments is going to suffer — and probably all of them. "Overextend yourself like this and you're sure to make mistakes," says Allgeier. "You'll let down your boss, your outside client and the audience you're speaking to. It's far better to say no to some things than do a poor job at everything."

9. Putting others down to pull yourself up.

Suppose one of your coworkers has recently received a promotion to a position that you wanted. You congratulate this person, but then proceed to have a few "private" conversations with other employees about how unqualified the promoted person is. As you enumerate the areas in which the promoted employee is "deficient" (from your perspective), you are also enumerating your own qualifications. Do you convince them? Not a bit, says Allgeier. "With each put-down you are actually demonstrating your own lack of credibility," she says. "Everyone who hears you talk about this thinks 'hmmm…sour grapes' — and this forms doubts about your ability to be believable and trustworthy."

10. Putting yourself down rather than learning from mistakes.

Surprising as it may seem, self-deprecation is a credibility buster. We're not talking about true humility, but rather the tendency to continually beat ourselves up over past mistakes. We increase our personal credibility when we acknowledge and admit mistakes, both to others and ourselves. We derail it when we continue to rake ourselves over the coals — either mentally or verbally — and fail to learn the lesson and just move on. "It's important to accept ourselves as the real, fallible and imperfect human beings that we all are," says Allgeier. "Others just respond better to people who cheerfully admit that they're not perfect but are trying to learn and grow from their mistakes."

11. Making too many excuses — even if they're legit.

Maybe the dog actually did eat the expense report. Or maybe the check really is in the mail. Perhaps you really cannot finish the project due to someone else failing to do her part on time. All of these things can happen and can be legitimate excuses. We destroy our personal credibility, however, when we frequently offer the same excuses to the same people. It doesn't matter how real these excuses are — when repeated, our personal credibility is down the drain. So what's the remedy? Simple, says Allgeier: Don't focus on the excuse part — rather, focus on what it will take to keep the problem from occurring in the first place! "Ask yourself, 'What should I do to keep the expense report away from the dog?'" she advises. "Or, 'How can I ensure that payments get made early?' In the first case, it's probably just a matter of keeping your work papers out of Rover's reach. In the second, electronic check paying may be the key. Avoid those situations that create excuses — even those that are legit!"

12. Being a rigid rule enforcer rather than a flexible problem solver. (Think Dwight on The Office.)

Rules and policies are helpful; they set guidelines and boundaries so things can get done in an orderly way. However, our personal credibility suffers when we rely only on rules and policies instead of trying to be flexible enough to help others solve problems. "It's easy to say, 'That's against the rules!'" says Allgeier. "But it's no way to win friends and influence people. It's usually better to say, 'Let's figure out what the problem is and see if there is a way to solve it!' People trust problem solvers. They don't trust rule mongers and bureaucrats — people who are hung up on following procedure at the expense of common sense."

13. Losing the balance between accomplishing tasks and maintaining constructive relationships.

Yes — delivering on results is critical for personal credibility, but nothing is more critical than keeping relationships positive while also delivering on results. If you force an employee to cancel her honeymoon in order to meet a deadline for a client, you're probably damaging that relationship beyond repair. "If you must choose between meeting your commitments and damaging your relationships with valuable people in your life, it's probably better to break the commitment and keep the relationship," says Allgeier.

14. Casting blame when you should be solving problems.

Let's say your sales department makes commitments to customers that your operations department can't realistically meet. Operations works long and hard to try to deliver on Sales' commitments and tempers begin to flare. What happens next? Often a power struggle ensues, whereby Sales blames Operations for being rigid and failing to meet customer needs, and Operations blames Sales for sacrificing them on the altar of incentive bonuses. Meanwhile, no one is solving the problem. Everyone loses credibility with each other — and the company loses credibility with its customers. "In situations like this, someone must care enough to stop the squabbling, determine the cause of the problem and work toward developing the solutions," says Allgeier. "Ending the blame game is the only way to restore credibility."

15. Coming across as "all knowing" when you're really just thinking out loud.

Allgeier points out that many of us are extroverts, which means we tend to express ourselves verbally as we are thinking. (If you're one, you know what she means.) Other people, some of whom may be introverts who like to ponder ideas carefully before they speak, assume your "thinking out loud" moments represent firm and definite conclusions. Then, when you do make a final decision, they think, 'Well, here he is flaking out on what he said yesterday — again!' and you lose credibility. "If you have a tendency to think out loud, be sure to tell others that's what you're doing," advises Allgeier. "When they realize that this verbal mulling is just part of your decision making process, they won't assume you're constantly changing your mind."

16. Exhibiting body language and vocal tone that doesn't match your words.

Are you guilty of this? You become a little bored or distracted when someone is talking to you, and your eyes wander around the room. Or, maybe you stifle a yawn while you are attempting to look interested and engaged. Maybe you say "nice things" to someone, but your vocal tone is flat or disinterested. Your credibility is dramatically reduced when your body and tone are not in sync with the words you're saying. "As humans, we react much more quickly to tone and body language than we do to words," notes Allgeier. "Be conscious of your body language and your tone and make sure you're sending the message you mean to send. Work on genuinely staying in the moment when you talk to someone. This way you won't have to 'give the impression' that you're engaged — because you really will be."

Does this list seem overwhelming? It doesn't have to be. Allgeier suggests you focus on one "credibility buster" at a time and work to eliminate it from your life. The results you see will spur you on to keep improving yourself. "Make a conscious effort to stop committing these sins and your life will change in ways you could never have foreseen," she says. "When people feel they can trust you, a seismic shift happens in your relationships. Everything improves: your marriage, your relationship with your kids, your relationship with colleagues and coworkers. "Yes, some of these changes may seem small — for instance, showing up on time instead of always being late — but they all work together organically," she adds. "You're removing roadblocks, one by one, and once they're gone, you'll be amazed at the abundance that flows into your life." BP

About the Author: Sandy Allgeier is a consultant, trainer and facilitator who assists organizations in maximizing their human potential.

For more information, please visit www.personalcredibility.com and www.ftpress.com

"When people feel they can trust you, a seismic shift happens in your relationships. Everything improves: your marriage, your relationship with your kids, your relationship with colleagues and coworkers."

— Sandy Allgeier

RESOURCES FOR ENERGY ENGINEERS

TRAINING CALENDAR

TITLE	SPONSOR(S)	LOCATION	DATE	INFORMATION
Compressed Air Challenge® Fundamentals of Compressed Air	Sacramento Municipal Utility District, California Energy Commission, DOE EERE	Sacramento, CA	4/7/09	Nancy Kenney, tel: 417-455-5402 Kenny-n@mssu.edu www.compressedairchallenge.org
Compressed Air Challenge® Fundamentals of Compressed Air	Hughes Machinery, Alliance for Bus. Education Missouri Southern State Univ. Atlas Copco, DOE EERE	Joplin, MO	4/15/09	Nancy Kenney, tel: 417-455-5402 Kenny-n@mssu.edu www.compressedairchallenge.org
Compressed Air Challenge® Fundamentals of Compressed Air	Northwest Energy Efficiency Alliance, Pacific Power, Consumers Power, Energy Trust of Oregon, BPA, Northwest Food Processors, WSU	Albany, OR	5/7/09	Tel: 888-720-6823 www.compressedairchallenge.org
Energy Management	Atlas Copco	Seattle, WA	5/20/09	Tel: 206-244-3818 (Rawleigh)
Compressed Air Challenge® Advanced Mgmt. of Compressed Air Systems	Sacramento Utility District, DOE EERE	Sacramento, CA	5/27/09	Paul Gillaspy, tel: 916-732-5375 pgillas@smud.org www.compressedairchallenge.org
Compressed Air Challenge® Fundamentals of Compressed Air	PNM, DOE EERE	Albuquerque, NM	9/10/09	Carmen Chico, tel: 505-241-4404 Carmen.Chico@pnm.com www.compressedairchallenge.org

Editor's Note: If you conduct compressed air system training and would like to post it in this area, please email your info to rod@airbestpractices.com.

PRODUCT PICKS

New 350 Horsepower Compressor

BOGE America, Inc. has recently expanded its range of oil-lubricated screw compressors with the introduction of the S 341 — a 350 horsepower air compressor. The unit is designed to maximize cooling air with a cool (intake) section for the motor and electrical cabinet and a warmer compressor section. The horizontal pre-separation system assures the lowest possible oil carry-over in all operating phases. The patented GM drive system along with the multi-function regulation allows a valve-less oil circuit eliminating the need for oil stop valve or check valve. Standard pressures are of 8, 10 and 13 bar. Output capacities range from 1119–1441 cfm.

BOGE America
Tel: 770-874-1570
E-mail: usa@boge.com
www.boge.com/us

PRODUCT PICKS

Compressed Air Seminars

Have questions about how to optimize your compressed air system and control operating costs? Kaeser Compressors' educational seminars cover a variety of topics from beginner through more advanced levels. We offer this series of one-day seminars across the country, so you don't have to go too far for the information you need to reduce wasteful leaks and pressure drops and improve your system's performance.

Topics include sizing equipment, efficient system design, installation tips, measuring energy consumption — and more. Questions are encouraged to ensure each attendee's specific concerns are addressed. Attendees receive a certificate of completion as well as an illustrated manual of information covered during the seminar. Locations through early May include Dallas, TX; El Paso, TX; Atlanta, GA; Minneapolis, MN; Milwaukee, WI; Chicago, IL; Bloomington, IL; and Cedar Rapids, IA. To register for a compressed air seminar in your area, visit www.kaeser.com/seminars.

Kaeser Compressors
Tel: 800-777-7873
Email: info.usa@kaeser.com.
www.kaeser.com/seminars

LITERATURE PICKS

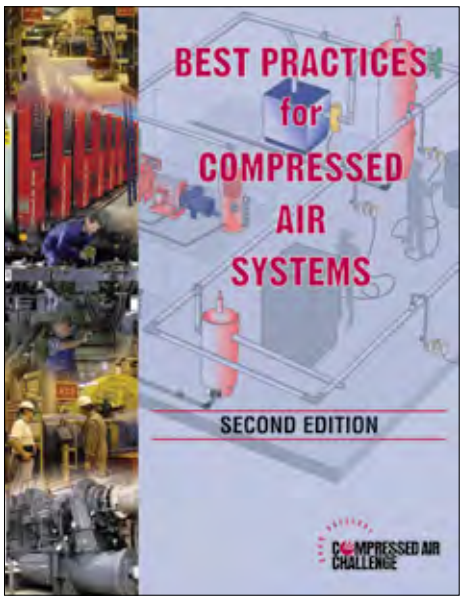
New Edition of "Best Practices for Compressed Air Systems®" from the Compressed Air Challenge®

The Compressed Air Challenge® has released the Second Edition of their authoritative "Best Practices for Compressed Air Systems®."* The Best Practices manual provides tools needed to reduce operating costs associated with compressed air and to improve the reliability of the entire system. The 325-page manual addresses the improvement opportunities from air entering the compressor inlet filter, through the compressor and to storage, treatment, distribution and end uses, both appropriate and potentially inappropriate. Numerous examples of how to efficiently control existing and new multiple compressor systems are provided in one of the many appendices.

The Best Practices manual created by the Compressed Air Challenge® begins with the considerations for analyzing existing systems or designing new ones. The reader can determine how to use measurements to audit their own system, how to calculate the cost of compressed air and even how interpret electric utility bills. Best practice recommendations for selection, installation, maintenance and operation of all the equipment are included in each section.

**The Best Practices for Compressed Air Systems® manual is a product of the Compressed Air Challenge®, co-authored by Bill Scales and David McCulloch, and is not associated with Compressed Air Best Practices® Magazine.*

Compressed Air Challenge®
www.compressedairchallenge.org



Wall Street Watch

BY COMPRESSED AIR BEST PRACTICES®

The intent of this column is to provide industry watchers with publicly held information on publicly held companies involved with the sub-industry of compressed air. It is not the intent of the column to provide any opinions or recommendations related to stock valuations. All information gathered in this column was on March 7, 2009.

MARCH 7, 2009 PRICE PERFORMANCE	SYMBOL	LAST PRICE	1 MONTH	6 MONTHS	12 MONTHS
Parker-Hannifin	PH	$28.63	-31.6%	-52.6%	-54.4%
Ingersoll Rand	IR	$11.84	-28.0%	-66.6%	-72.2%
Gardner Denver	GDI	$18.10	-21.5%	-56.6%	-51.4%
United Technologies	UTX	$38.54	-21.4%	-39.9%	-44.0%
Donaldson	DCI	$22.62	-30.2%	-44.8%	-45.4%
EnPro Industries	NPO	$14.63	-28.6%	-65.1%	-52.9%
SPX Corp	SPW	$41.50	-15.9%	-60.5%	-61.1%

Hamilton, Bermuda, February 11, 2009 — Ingersoll-Rand Company Limited (NYSE:IR), announced that total revenues increased by 58% for the fourth quarter of 2008, compared with the 2007 fourth quarter due to the acquisition of Trane. The company reported a net loss of $3,290 million for the fourth quarter of 2008.

"Despite increasingly difficult market conditions in the fourth quarter, we delivered strong operating results while reducing debt by approximately $428 million. We are also pleased that the fourth quarter synergies from the Trane acquisition exceeded our expectations," said Herbert L. Henkel, Chairman and CEO of Ingersoll Rand. "We are also accelerating productivity and cost reduction actions and have undertaken a major company-wide restructuring to adjust our cost structure to offset slowing end market activity."

On a proforma basis, total fourth-quarter revenues declined by approximately 11.5% including a negative currency impact of 3.5%, compared with 2007. On a proforma basis, North American revenues declined by 14%, while revenues from overseas operations decreased by approximately 7%. In addition, worldwide product revenues declined by approximately 15% and recurring revenues declined slightly compared with the fourth quarter of 2007.

The company classifies its businesses into four reportable segments based on industry and market focus: Air Conditioning Systems and Services (added on June 5 with the acquisition of Trane), Climate Control Technologies, Industrial Technologies and Security Technologies.

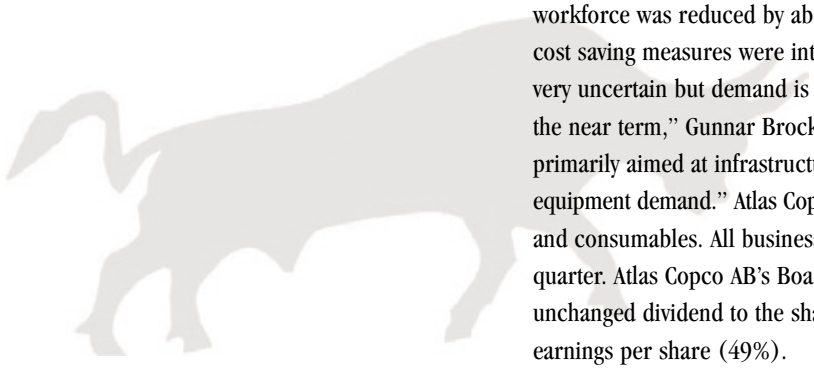
Industrial Technologies is focused on providing solutions to enhance customers' industrial and energy efficiency and provides equipment and services for compressed air systems, tools, fluid power production and energy generation systems. Total revenues of $671 million in the fourth quarter declined by approximately 12% and by 8% excluding the impact of currency translation. Declining industrial, fluid handling and tool markets in North America and Europe caused Air and Productivity Solutions revenues to decline by 11% year-over-year. Revenues in the Americas declined by 5% compared with last year due to a 6% drop in unit volumes and a 3% decline in recurring revenues. Air and Productivity Solutions revenues outside of the Americas decreased by 14% and by 7% excluding currency translation, primarily due to declining industrial activity in Europe and India.

Hamilton, Bermuda, March 5, 2009 — Ingersoll-Rand Company Limited (NYSE: IR), has approved a reorganization of the company from Bermuda to Ireland. "We considered a full range of options and locations for the company and decided on Ireland based on the company's business activities in Ireland, its membership in the European Union, its common law-based legal system and its stable business, legal and regulatory environment," said Herbert Henkel, Chairman and CEO of Ingersoll Rand. "We believe our shareholders will be well served by this decision which provides us with many financial, strategic and operational benefits." Ireland is an important part of Ingersoll Rand's operation, and the company has approximately 700 employees in Ireland employed in manufacturing, sales and corporate roles. Ingersoll Rand's Thermo King business has a major manufacturing site in Galway and many of the company's European Region shared services are based in Dublin.

Stockholm, Sweden, February 2, 2009 — Atlas Copco reported increased revenues for the fourth quarter, while the global economic downturn led to a sharp decline in order intake. Actions to reduce capacity and costs were implemented during the quarter.

Revenues during the fourth quarter increased 12% to MSEK 19 731, with organic growth of 3%. The organic decline in order intake was 19%. Operating profit reached MSEK 3 288 (3 361), corresponding to an operating margin of 16.7% (19.2%). Excluding redundancy costs of MSEK 258, the profit was MSEK 3 546, or 18.0%.

WALL STREET WATCH



"Overall, we are pleased with our financial performance during the quarter, and we have acted quickly and decisively in adapting to the rapid and substantial decline in demand, particularly within the mining industry," says President and CEO Gunnar Brock. "Our businesses have already achieved a great deal and their work will continue throughout 2009." During the quarter, the workforce was reduced by about 1,350 people, affecting all three business areas and other cost saving measures were introduced. "The current economic situation makes the outlook very uncertain but demand is expected to remain very weak in most industries and regions in the near term," Gunnar Brock says. "The government stimulus packages recently introduced, primarily aimed at infrastructure projects, are expected to give support for construction equipment demand." Atlas Copco expects continued growth in demand for service, spare parts and consumables. All business areas recorded growth in the aftermarket during the fourth quarter. Atlas Copco AB's Board of Directors is proposing to the Annual General Meeting an unchanged dividend to the shareholders of SEK 3.00 per share, corresponding to 36% of earnings per share (49%).

> "The government stimulus packages recently introduced, primarily aimed at infrastructure projects, are expected to give support for construction equipment demand."
>
> — Gunnar Brock, President and CEO, Atlas Copco

QUINCY, IL, Feb 12, 2009 — Gardner Denver, Inc. (NYSE: GDI) announced that revenues and operating income for the three months ended December 31, 2008 were $524.2 million and $53.2 million, respectively, and net income and diluted earnings per share ("DEPS") for the three-month period of 2008 were $30.9 million and $0.60, respectively. For the 12-month period of 2008, revenues and operating income were $2.0 billion and $258.2 million, respectively, and net income and DEPS were $166.0 million and $3.12, respectively.

"The global economic environment presented a challenging landscape in the fourth quarter of 2008," said Barry L. Pennypacker, Gardner Denver's President and CEO. For the quarter, orders were less than the previous year in all major product lines except loading arms. "Although end market conditions deteriorated more quickly than our original expectations, the company responded with previously developed contingency plans, including a reduction of the global salaried workforce, implementation of a hiring freeze and strict controls on discretionary spending. By accelerating our restructuring initiatives, I believe we will be better positioned to meet end market demand as the economy improves and we begin to realize organic growth again. I am proud of the efforts of the Gardner Denver team in their responsiveness to the operating environment and needs of our customers.

"In the fourth quarter of 2008, we completed the closure of two manufacturing facilities in the U.S. and the transfer of their activities into existing locations. We also announced the closure and consolidation of a large manufacturing facility in the U.K., which we expect to be substantively completed by the fourth quarter of 2009. Furthermore, we continue to proactively identify and evaluate further cost reduction and rationalization projects.

"I am pleased with the CompAir integration progress made to date and remain excited about the opportunities that will be created by rationalizing the complementary product lines and leveraging the geographic reach of the businesses. When completed, the integration is expected to enhance our combined channels of distribution to serve the global market and we see many opportunities for sales of Quantima®, CompAir's award-winning, oil-free compressor product, among other complementary product lines. We also believe that substantial material cost synergies are available, based on our ability to leverage the combined supply chain."

Commenting on the global demand environment, Mr. Pennypacker stated, "Deteriorating worldwide economic conditions and the financial crisis have clouded our visibility into many of our key end market segments and we remain cautious in our outlook for 2009. In the fourth quarter of 2008, demand decelerated further in North America and Western Europe and began to decline in end market segments in Asia and Eastern Europe. We expect to see demand improve first in our shorter lead-time products that are more susceptible to swings in the economy, such as those that serve light industry and Class 8 trucks and original equipment manufacturers' products for medical and environmental applications. At this point, we have not yet seen signs of that demand improving.

"We have already made changes in 2009 to streamline the company's organizational structure and execute our business plans with greater velocity. In January 2009, Gardner Denver's five divisions were reorganized into two product groups. The Industrial Products Group includes the former Compressor and Blower Divisions, plus the multi-stage centrifugal blower operations formerly managed in the Engineered Products Division. The Engineered Products Group is composed of the former Engineered Products, Thomas Products and Fluid Transfer Divisions. These changes are designed to streamline the company, improve organizational efficiencies and create greater focus on our customers' needs. BP

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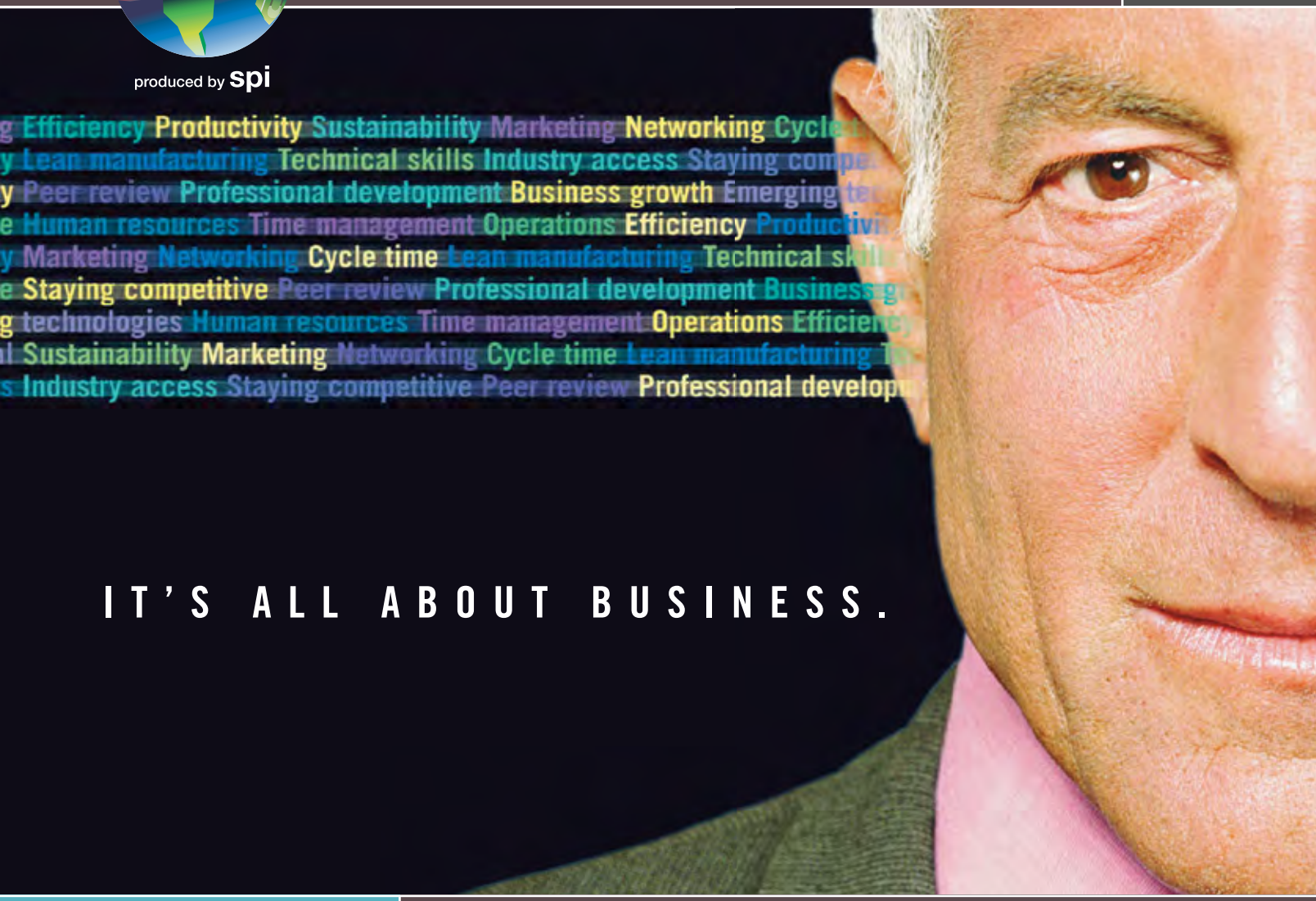

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