Kellogg's Saves 675,000 kWh | Automating Sub-Zones | Hannover Fair

May/June 2011

COMPRESSED AIR BEST PRACTICES®

System Assessments

BALL CORPORATION ENERGY MANAGEMENT

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Our mission is to continue to bring sustainable productivity through safer, cleaner, more energy-efficient, and cost-effective compressed air technology. Simply log onto **www.atlascopco.us/clintusa** or call **866-688-9611** to learn more about us, our products, and how we have earned and will continue to earn our reputation.

Sustainable Productivity

Atlas Copco

HITACHI
Inspire the Next

Ultimate Air Quality
ISO 8573-1:2001 Class 0

Class Zero

Approaching 100 years of compressed air experience, Hitachi has been and continues to be the technology leader via continuous innovation of air compression oriented towards Customer Value. With growing concerns for the environment we live in, along with the products we consume, not only Oil Free, but Contaminant Free air is quite important.

The foundation of Hitachi Innovation is derived from more than 50 years of Oil Free Compressor technology, with the world introduction of Hitachi Oil Free Reciprocating compressors in 1954.

Continuing our pioneering spirit with societal responsibility, Hitachi embarked upon a certification of ISO 8573-1:2001 Class 0 for the Hitachi DSP Series Oil Free Rotary Screw Compressor (15-240kW). To validate our findings for consumer knowledge, third party laboratory testing was contracted with a positive result to standards, which enables Hitachi to provide a variety of Innovative, Technologically Superior, and Value Oriented Product for our Customers.

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Hitachi Industrial Equipment Systems Co., Ltd.

HITACHI
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FROM THE EDITOR

System Assessments

The 2011 Hannover Fair attracted over 250,000 visitors and 6,500 exhibitors. The COMVAC (Compressed Air & Vacuum) Hall was completely full of exhibitors and important new energy-saving technologies for the compressed air industry. Please take the time to read our HANNOVER FAIR REPORT documenting the interesting technologies I saw at the Fair. Plus, you'll learn how to get a $100.00 hotel room (plus farmer's breakfast) during the Fair!

Patricia Boyd, of Ecos Air, provides us with an excellent system assessment story from Kellogg's Eggo factory in San Jose, California. Kellogg's saved 675,000 kWh and received an incentive from the local utility company which drove the project ROI down to 1.4 years. The Eggo factory uses compressed air for production, packaging, cooling, and clean-up processes. In the article, Ms. Boyd provides us with a professional summary of the supply and demand side actions that were taken to save energy.

It's worth it for factories to assess their nitrogen supply situation. In many situations, it makes sense to create a dedicated on-site nitrogen generation system. Over the years, I have seen this to be a significant area of opportunity for many industrial facilities. Paul Humphreys, from Atlas Copco, provides us with an overview of the options available to the customer.

Ball Corporation has an amazing history of success in finding energy savings in their compressed air systems. Doug Barndt, the Manager of Demand Side Energy-Sustainability, was kind enough to allow me to interview him and Joseph Gress (Principal Engineer, Demand Side Energy) for our "Energy Manager" article this month. Also included was Chris Gordon, from Blackhawk Equipment, who has partnered with Ball for over 10 years on system assessments. The system assessment partnership between Ball Corporation and Blackhawk Equipment is an inspiration to those wanting to save energy in industry. I hope you enjoy the article.

Splitting compressed air systems and managing them separately as "sub-zones" is the topic of the article written by J. Ned Dempsey, P.E., of Pneu-Logic. An important topic, the article outlines examples of "sub-zones" like how high pressure systems can be managed separately from medium pressure systems.

Last but not least, Bill Kennedy from Mattei Compressors, provides us with a "Checklist" for automotive collision repair centers considering the switch to waterborne paints. It provides shop owners with a practical list of things to look at that can reduce their compressed air consumption — and potentially offset the increased compressed air demand created by the change to waterborne paints.

We hope you enjoy this edition. Thank you for your support and for investing in *Compressed Air Best Practices®*.

ROD SMITH
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"The system assessment partnership between Ball Corporation and Blackhawk Equipment is an inspiration to those wanting to save energy in industry."

— Rod Smith

SUSTAINABLE MANUFACTURING NEWS

2011 Energy Star Award Winners

SOURCED FROM THE WEB

The U.S. Environmental Protection Agency (EPA) is honoring 111 Energy Star partners who have demonstrated leadership and commitment in protecting American's health and the environment through energy efficiency achievements. 2011 Energy Star award winners include manufacturers, retailers, public schools, hospitals, real estate companies and home builders. Organizations are recognized in one of three award categories: Sustained Excellence, Partner of the Year, and Excellence.

"Year after year, Energy Star award winners reflect American ingenuity at its highest level," said EPA Administrator Lisa P. Jackson. "The innovations at work in the Energy Star program are cost-effective ways to reduce pollution, improve our health and grow our economy all at the same time. Those who have invested in these energy saving technologies display economically-sensible solutions that are good for our communities and our future."

The forty-six Sustained Excellence winners have continued to exhibit leadership year after year in the Energy Star program while remaining dedicated to environmental protection through energy efficiency. 2011 Sustained Excellence award winners include 3M, Bosch Home Appliances, Ford, GE, J.C. Penney, KB Home, Lowe's, and PepsiCo. Forty-four organizations have received Partner of the Year for strategically and comprehensively managing their energy use. These organizations promote Energy Star products and practices in their own operations, and provide efficient products and services to consumers within their community.

2011 Partner of the Year award winners include Boeing, Cleveland Clinic, Colgate-Palmolive, Hanesbrands, HEI Hotels & Resorts, Kohl's, Panasonic, Sears, and Staples. Twenty-one organizations are recognized with an Excellence award for a specific activity for promoting energy-efficient products, homes, or buildings, helping to expand the reach of the Energy Star program.

2011 Excellence award winners include Canon, DirectTV, Lennox, Menards, and Sharp Electronics. Last year alone, Americans, with the help of the Energy Star program and its 20,000 partners, saved approximately $18 billion on their energy bills while preventing greenhouse gas emissions equivalent to the annual emissions of 33 million vehicles. To date, nearly 1.2 million new homes and more than 12,600 office buildings, schools, hospitals and public buildings have earned the Energy Star. Since 2000, approximately 3.5 billion Energy Star qualified products have been sold.

The following is a list of Award Winners. More information and a full list of 2011 award winners: http://www.energystar.gov/awards

3M

St. Paul, Minnesota

3M is a diversified technology company with operations in more than 65 countries and a global commitment to energy management. 3M sets aggressive energy goals that are supported by senior management and monitors progress by tracking monthly energy use at 212 locations worldwide. 3M is receiving ENERGY STAR Sustained Excellence recognition for its continuing energy management and sustainability efforts. Key accomplishments include:

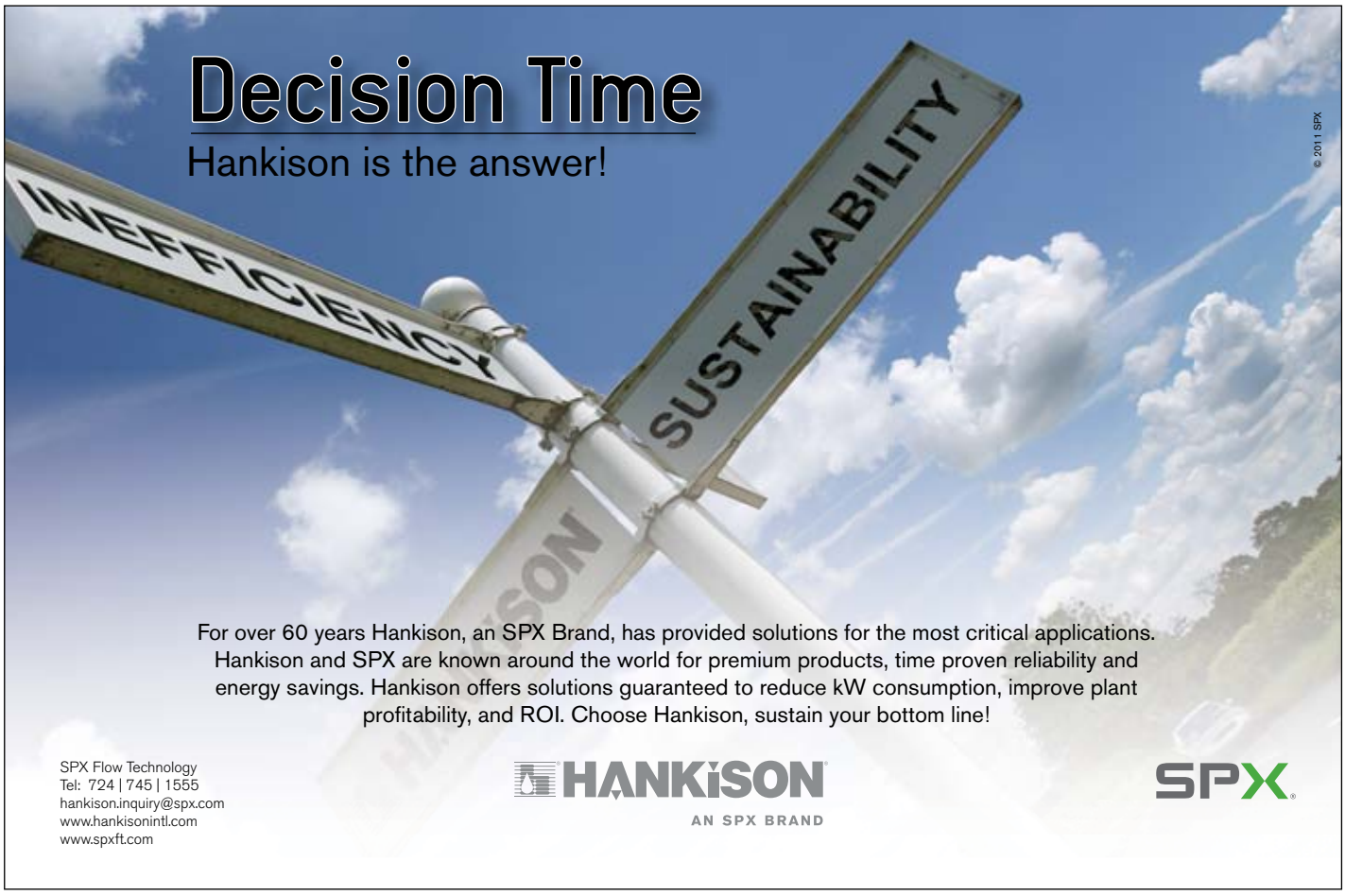
- Improving global energy efficiency by 4.5% compared to 2009, saving more than $18 million in energy costs
- Improving energy intensity by 25% since 2005
- Designating $1 million to fund and launch additional energy projects to support 3M's commitment to continuous energy improvement
- Completing 153 energy efficiency projects in 2010, saving $7.77 million
- Forming research and business partnerships and awarding $150,000 in grants to academicians to address energy and renewable energy issues
- Incorporating energy efficiency into the designs for the new headquarters facilities being constructed in Italy and New Zealand
- Qualifying key suppliers for energy efficiency prior to awarding work to new engineering service providers and contractors. The company also evaluates major raw material suppliers in managing energy use and costs, and assists them in reducing the energy footprint of materials they sell to 3M

ArcelorMittal

Chicago, Illinois

ArcelorMittal is the world's leading steelmaker and provides high-quality steels to the automobile, construction, household appliance, and energy markets. ArcelorMittal is receiving ENERGY STAR Sustained Excellence recognition for its advancement of new strategies in energy management. The company's accomplishments include:

- Attaining a 7.3% reduction in energy intensity across U.S. operations compared to 2009
- Expanding the energy program to 90% of its U.S. sites using the ArcelorMittal Energy Management System Model, which is based on ENERGY STAR best practices
- Hosting an energy roundtable of the company's North and South American energy champions to share case studies and solve difficult energy problems
- Undertaking significant energy projects at various plants, including tuning boilers to reduce natural gas consumption for savings of $50,000 per month, establishing refined procedures for shutting down and restarting equipment systems during production delays, which resulted in more than $70,000 in electricity cost savings, and formalizing its Steam Distribution System Management Program, estimated to save $2.4 million annually
- Building the capacity for a high-quality workforce by training newly hired engineers and plant personnel in energy management
- Communicating the value of energy efficiency and ENERGY STAR through its 2010 campaign, which reached more than 700,000 readers in 14 advertisements and appeared in local newsprint where 300,000 subscribe and 10,000 employees live and work



SUSTAINABLE MANUFACTURING NEWS

2011 Energy Star Award Winners

CalPortland Company

Glendora, California

CalPortland Company is a major producer of cement, ready mix concrete, aggregate, asphalt, and other building materials and provides construction services across the western United States and Canada. CalPortland is receiving ENERGY STAR Sustained Excellence recognition for advancing comprehensive energy management across its energy value chain. Key accomplishments include:

- Reducing overall energy intensity by 4.6%, resulting in the prevention of nearly 33,000 metric tons of CO_2 emissions and decreasing absolute energy consumption by 1.1 TBtu, a 14% reduction over the previous year. Since 2007, the company has improved energy intensity by 10.6%
- Conducting 144 energy efficiency projects expected to save more than 21 million kWh or an estimated $2.3 million per year
- Working with senior executives in national building materials manufacturing associations to encourage energy efficiency practices and participation in the ENERGY STAR program among their members
- Being instrumental in engaging the ready mix industry in ENERGY STAR and supporting the development of energy management tools to aid this industry
- Promoting the value of strategic energy management practices and ENERGY STAR to more than 139,000 individuals through the sponsorship of community events, plant tours, open houses, school presentations, and the company's annual Energy Management Summit
- Implementing a fleet energy management program to reduce truck idle times and improve the fuel efficiency of its mobile equipment
- Working downstream within the company's energy value chain to assist customers in managing energy in their operations

Ford Motor Company

Dearborn, Michigan

Ford Motor Company, a global automotive industry leader based in the United States, manufactures or distributes automobiles across six continents. The company's consistent focus on energy-efficient best practices and creative solutions to energy-related challenges has resulted in Ford receiving ENERGY STAR Sustained Excellence recognition. Key accomplishments include:

- Continuing to reduce energy use and increasing its efficiency from 13.6% in 2009 to 15.7% in 2010 compared to a 2006 baseline. This represents approximately 6.4 million MMBtu of avoided energy consumption and approximately 500,000 metric tons of CO_2 emissions
- Earning the ENERGY STAR for nine commercial facilities and assembly plants—adding two over the previous year
- Implementing measures and new technologies that reduce the energy use of plant air pollution control equipment
- Upgrading more than 50,000 lighting fixtures to energy-efficient models that will reduce electricity consumption by over 18 million kWh through a performance contract that eliminated the need for up front capital
- Rolling out the 3-Wet painting process to Ford plants around the world. This process eliminates one oven and consolidates the spray booth processes into a smaller footprint that uses less energy to operate
- Employing innovative energy-saving designs and technologies as part of the renovation of the Michigan Assembly Plant
- Launching a global Sustainability Strategy for its manufacturing plants outside the United States by incorporating the ENERGY STAR Guidelines for Energy Management as an element of these programs

Merck
Whitehouse Station, New Jersey

Merck is a global research-based pharmaceutical and health care company. Since merging with Schering-Plough in 2009, the company has successfully integrated energy programs to pursue its vision of becoming "the most energy- efficient company in the pharmaceutical industry." Merck is receiving ENERGY STAR Sustained Excellence recognition for its continued improvement and expansion of its energy management efforts. Key accomplishments include:

- Improving energy intensity by 2.7% over the previous year and by 31% between 2004 and 2009
- Earning the ENERGY STAR for three manufacturing sites and two corporate headquarter buildings, including one with a major data center. The company also introduced in 2010 a global real estate program, MerckSpace, to increase energy productivity in its office space
- Responding to the ENERGY STAR Challenge for Industry by achieving a 10% reduction goal for the first three pharmaceutical manufacturing sites in the United States
- Securing more than 7.7 million kWh a year in energy savings by upgrading its Kenilworth site's gas turbine
- Establishing an Energy Efficiency Capital Fund to further drive implementation of energy projects
- Publishing the Merck Energy Handbook, "You Can Make a Difference," for employees that promotes ENERGY STAR at home and work
- Supporting the ENERGY STAR program through public forums and mentoring ENERGY STAR partner companies

MERCK

SUSTAINABLE MANUFACTURING NEWS

2011 Energy Star Award Winners

New York-Presbyterian Hospital

New York, New York

New York-Presbyterian Hospital (NYP) is the nation's largest nonprofit, non-sectarian hospital and encompasses 33 buildings and 8.6 million square feet, making it among the top 2% of energy users in the New York City metropolitan area. NYP is receiving ENERGY STAR Sustained Excellence recognition for its ongoing excellence in energy management. Key accomplishments include:

- Reducing energy use by 5.6% in 2010, for a savings of over $7.7 million system-wide
- Installing a cogeneration plant at Weill Cornell, contributing to an increase in the facility's ENERGY STAR score from 73 in 2009 to 99 in 2010
- Reducing energy use by 18.2% across the entire NYP portfolio since 2002
- Continuing its participation in the Change the World, Start with ENERGY STAR campaign; NYP affiliates pledged to reduce greenhouse gas emissions by 3.9 million pounds, exceeding their goal by more than 125%
- Purchasing 2,000 computers that have earned the ENERGY STAR and implementing a policy to encourage employees to turn off monitors when not in use

NewYork-Presbyterian
The University Hospital of Columbia and Cornell

PepsiCo, Inc.
Purchase, New York

PepsiCo, Inc. is a leading global food and beverage company. PepsiCo is receiving ENERGY STAR Sustained Excellence recognition for its long-term commitment to energy efficiency as part of the company's sustainable growth strategy, known as "Performance with Purpose."

Key accomplishments include:

- Attaining an 8.5% improvement in energy efficiency over 2009 while holding absolute energy use flat despite an increase in production of 10%. The company saved nearly $100 million in 2010 from long-term energy management investments
- Undertaking significant energy projects, including replacing old boiler technology with more efficient gas-fired units to save 42,500 MMBtu and $300,000 annually, capturing biogas from wastewater treatment to reduce natural gas use by 12,500 MMBtu per year, and improving condensate return to boilers for 18,000 MMBtu and $340,000 in annual savings
- Continuing to build upon the successful PepsiCo Supplier Sustainability Outreach program to align U.S.-based suppliers with ENERGY STAR and to assist suppliers in managing energy consumption. More than 150 PepsiCo suppliers are now part of ENERGY STAR—an increase of 60 over 2009, and the suppliers reporting to PepsiCo have achieved an 11% reduction in energy intensity since 2008
- Supporting the industrial energy service and product provider market in the United States by sharing its experience with other manufacturers through ENERGY STAR profiles
- Enabling improved measurement and evaluation of plant energy efficiency by engaging PepsiCo suppliers in the development of an ENERGY STAR plant energy performance indicator for cookie and cracker plants

PEPSICO

SUSTAINABLE MANUFACTURING NEWS

2011 Energy Star Award Winners

Raytheon Company
Waltham, Massachusetts

Raytheon Company is a technology and innovation leader specializing in defense, homeland security, and other government markets. The company operates 57 major locations in the United States and has made employee engagement the hallmark of its successful energy program. Raytheon employee involvement in energy management starts with the CEO and extends through a team of 26 energy professionals to a network of 1,500 Energy Champions and 37,000 Raytheon Energy Citizens. Raytheon is receiving ENERGY STAR Sustained Excellence recognition for its continued commitment to energy efficiency and support of the ENERGY STAR program.

Key accomplishments include:

- Reducing energy intensity by 3% in 2010 and by 22% since 2007
- Cutting more than 2 million kWh in 2010 while preventing 3 million pounds of CO_2 emissions
- Expanding participation in its Energy Citizens program by 10,000 employees over the previous year's levels to engage more than 50% of the company's 72,000 employees
- Integrating ENERGY STAR resources and campaigns into employee training while promoting the ENERGY STAR program externally through conference presentations and other events
- Instituting new systems to bring real-time energy data to operators at key sites to ensure optimal energy performance
- Creating a competitive environment amongst sites and business units to save more energy through the use of a scorecard system

Raytheon

Saint-Gobain
Valley Forge, Pennsylvania

Saint-Gobain operates in 64 countries and is a leading manufacturer of energy-efficient systems, glass containers, high-performance materials, and flat glass. Saint-Gobain is receiving ENERGY STAR Sustained Excellence recognition for its commitment to building an energy-efficient future and reducing the environmental impact of its operations. Key accomplishments include:

- Reducing energy intensity by 3.8%, equivalent to the energy required to produce roofing shingles for more than 1.2 million homes, and preventing nearly 132,000 metric tons of CO_2 emissions. Since 2008, the company has improved energy intensity by 8.5%
- Achieving a corporate goal to engage all U.S. plants, buildings, and business units and its Canadian fiberglass operations in the company's energy program
- Undertaking capital investments to improve energy performance. Specific measures include: providing incremental capital to improve efficiency in glass furnaces during scheduled rebuilds, upgrading boilers, investing in efficient compressed air systems and motors, and allocating funding for increased energy metering
- Initiating a communications campaign around the ENERGY STAR Change the World pledge. The company exceeded its goal with 1,150 employees and their families participating, yielding potential reductions of more than 12 million kWh valued at almost $1.8

Sunoco, Inc.
Philadelphia, Pennsylvania

Sunoco, Inc. is a leading manufacturer and marketer of petroleum and petrochemical products and metallurgical- grade coke for steel production. Sunoco is receiving ENERGY STAR Sustained Excellence recognition for the continuous growth of its energy management program and the company's commitment to energy efficiency and ENERGY STAR. Key accomplishments include:

- Achieving a 6% reduction in energy intensity for its chemical operations and a 1% improvement (normalized to 80% plant utilization) for its refining and supply business. Since 2007, the company has improved the energy intensity of its refineries by 6% (normalized to 80% utilization)
- Completing 51 energy and yield improvements to its refineries and chemical plants in 2010 for a reduction of 1.6 TBtu
- Pledging to improve energy efficiency in each of its three refineries by 10% through the ENERGY STAR Challenge for Industry, the first oil company to make this commitment
- Building a transformative energy management work process system for plant operators and shift organizations that defines measurement and review so that these employees can make greater contributions to energy management
- Establishing a best practice for lighting in its retail stores by upgrading 43 stores in 2010

Toyota Motor Engineering & Manufacturing North America, Inc.

Erlanger, Kentucky

Toyota Motor Engineering & Manufacturing North America, Inc. is the manufacturing headquarters for 15 vehicle, engine, and parts plants. Toyota is receiving ENERGY STAR Sustained Excellence recognition for maintaining strong support for managing energy across its operations and is continuously refining its energy program. Key accomplishments include:

- Reducing energy intensity by more than 9% in 2010 and 16% since 2002
- Reducing the company's carbon footprint by engaging Tier 1 suppliers. 25% were trained to conduct plant energy assessments and provided access to tools, support from its engineers, and encouragement to join ENERGY STAR for further support
- Certifying two assembly plants for the ENERGY STAR by scoring in the top quartile nationally using EPA's assembly plant energy performance indicator
- Leading the auto industry in an expanded benchmarking program to identify best practices and opportunities for improvement with ENERGY STAR
- Strengthening corporate energy management by completing an in-depth analysis of response time to information collected by the company's metering system. Reporting time delays from manual data collection are being addressed in a pilot project
- Studying the potential savings of eliminating steam from the paint air make up units in assembly plants. If applied in all North American plants, the company estimates savings would exceed 1 million MMBtu
- Completing a paint shop energy minimization analysis for opportunities to shift a portion of fixed energy use to variable, making consumed energy more proportional to vehicle production; the company identified reduction opportunities of 185,000 MMBtu, which are underway

TOYOTA

million and saving nearly 23 million pounds of greenhouse gas emissions

- Leading the insulation industry by issuing a personal communication from the President of Saint-Gobain subsidiary CertainTeed Insulation to industry executives recommending they take advantage of ENERGY STAR energy management resources

SAINT-GOBAIN

for an estimated 10% reduction in electric use, equivalent to saving 2.1 million kWh; the company plans to improve 50 more stores in 2011

- Communicating the value of energy efficiency and ENERGY STAR to the public through a public service announcement on the monitors at its pumping stations

SUNOCO

THE SYSTEM ASSESSMENT

Kellogg's Eggo Factory Decreases Energy Consumption by 675,000 kWh

BY PATRICIA BOYD, ECOS AIR[1]

Where: San Jose, CA

Industry: Food Processing

Issues: Lack of storage, multiple compressors controlled by local pressure switches and modulation control.

Audit Type: Supply Side

Reduction in Energy Use: 685,000 kWh

Approximate Annual Savings @ $0.09/kWh: $62,000

Utility Incentive: $71,072

Simple ROI: 1.41 years

Ecos Air worked with subcontractor Capitol Air Systems Senior Auditor Mike Mendoza who is a Department of Energy "Compressed Air System Energy Expert," to perform the assessment of the existing compressed air system. Michael Ludwick who is the Senior Field Service Engineer of Capitol Air Systems performed the subsequent ultrasonic leak detection survey.[3]

Introduction

This article describes a compressed air retrofit project implemented at Kellogg's Eggo (Figure 1) factory located in San Jose, California. Kellogg's continues to realize both annual energy savings and quality improvements because of the upgrade. In addition, Kellogg's received a substantial utility incentive from Pacific Gas and Electric Company, which was based on the achieved energy savings.

Figure 1

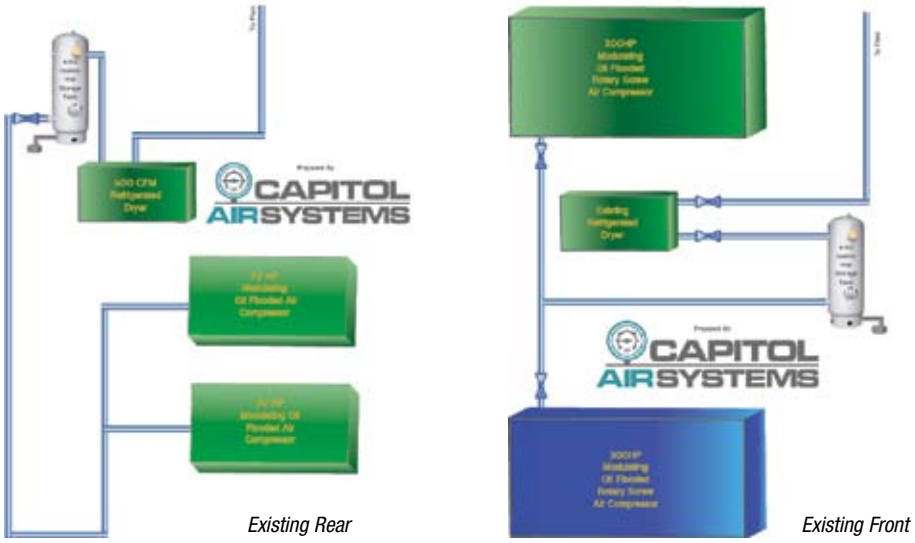
This Eggo factory is one of only two factories in the country currently producing the frozen breakfast treat. Three brothers, Tony, Sam, and Frank Dorsa invented Eggo waffles in the 1930 in San Jose, California. In 1953, the Dorsa brothers introduced frozen waffles — which do not require a waffle iron to prepare — to supermarkets throughout the United States. Eggo waffles get their name from their unique "eggy" batter. When the Dorsas first introduced the product, it was called "Froffles," a portmanteau of frozen waffles. However, people started referring to them as eggos due to their "eggy" taste. The name caught on and the brothers began using the moniker in marketing. Eventually the name became synonymous with the product and in 1955 the Dorsa brothers officially changed the name to the now famous "Eggo." In the 1970s, as a means of diversification, the Kellogg Company purchased Eggo and Mrs. Smith's Pies. Their advertising slogan — "Leggo my Eggo" — is well known from their television commercials.[2]

Ecos Air worked with subcontractor Capitol Air Systems Senior Auditor Mike Mendoza who is a Department of Energy "Compressed Air System Energy Expert," to perform the assessment of the existing compressed air system. Michael Ludwick who is the Senior Field Service Engineer of Capitol Air Systems performed the subsequent ultrasonic leak detection survey.

Baseline System

The Eggo factory uses compressed air for production, packaging, cooling, and clean-up processes. When approached by Ecos Air (see sidebar), Kellogg's realized that in addition to decreasing the continued energy use of their compressed air system while simultaneously improving overall performance, there may also be an opportunity to receive a considerable monetary incentive from their utility, Pacific Gas and Electric (PG&E). The monetary incentive could offset the cost of the suggested energy reduction improvements.

The baseline system (Figure 2) was located on two supply pads (front and rear) with interconnected or looped piping at several locations throughout the factory. Each pad contained two (2) rotary screw air compressors with a total system capacity of 762 hp. In addition, there were two (2) refrigerated air dryers, two (2) line filter systems, two (2) small air receivers, and several timer condensate drains. The compressors were each set-up for modulation control before the upgrade was performed, which is typically the most common and inefficient control method in traditional multi-compressor systems.



Existing Rear *Existing Front*

Figure 2

Baseline Determination

As a requirement of the utility incentive program, the auditor performed an analysis to determine the baseline energy usage of the system. This included collecting compressor power and system pressure data via data loggers and storage equipment. Afterward, the Ecos Air audit team used calculated flow and measured power to determine system overall efficiency by calculating cfm/kW. They extrapolated estimated/expected savings based on this demand profile for a full year. Graphs of the collected data (Figure 3) are shown on page 16 and tallied for the year (Table 1).

THE SYSTEM ASSESSMENT

Kellogg's Eggo Factory Decreases Energy Consumption by 675,000 kWh

Incentive Details

Kellogg's Eggo received a substantial rebate of $71,072 (approximately 45% of the total project cost) from PG&E's Ecos Air Program.

This innovative incentive program works with industrial facilities on behalf of a utility to search for users of compressed air, coordinate walkthroughs and site audits, manage all applications and forms, establish flow and kW baseline parameters, and develop a financial summary with payback. Once the customer implements the project, the Ecos Air team returns to verify final operating conditions to ensure that the savings claimed by the customer are genuine and verifiable when reported to their utility commission.

While there are many utilities that provide kWh reduction incentives for customers that implement efficiency measures, the process is normally administered either by the customers themselves or by the equipment vendor. Alternatively, the Ecos Air Program was developed for utilities willing to fund a vendor-neutral third-party contractor to implement an efficiency program for industrial system compressed air users. In this case, the utility simply establishes a financial budget and leaves program execution to the Ecos Air team.

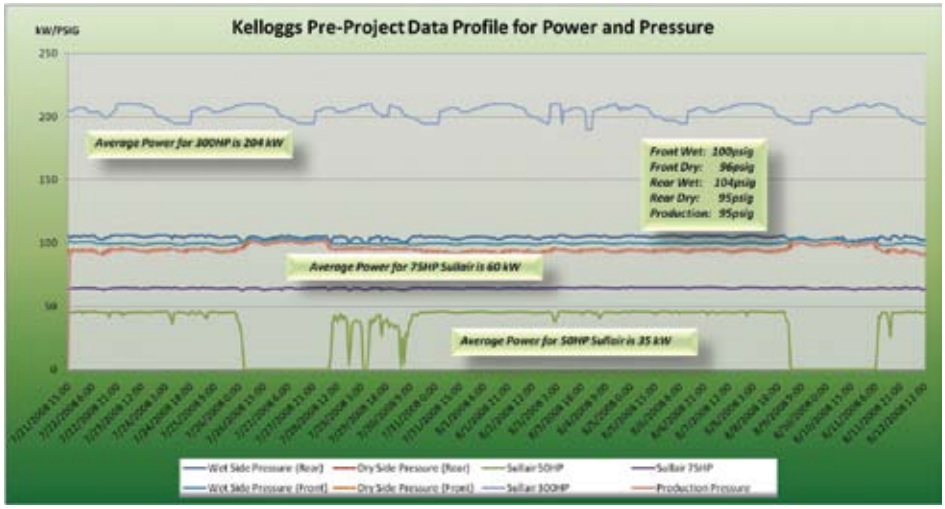


Figure 3

BASELINE ENERGY ESTIMATE			
COMPRESSOR HP	**MONITORED KW**	**HOURS**	**KWH**
300	204	8,760	1,787,000
75	60		526,000
50	35		307,000
Total	**299**		**2,620,000**

Table 1

Issues with the System

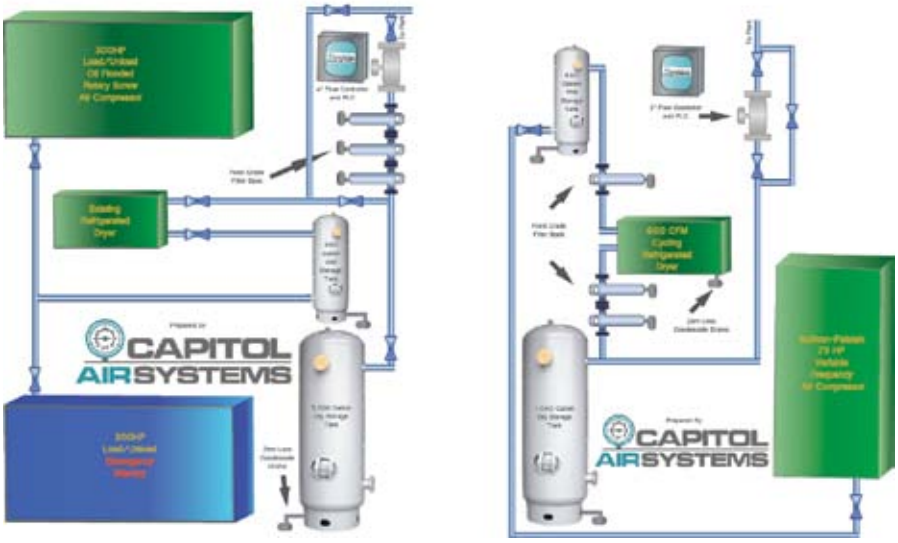
The current compressed air system consists of two (2) 300 hp rotary screw air compressors, one (1) 75 hp rotary screw air compressor, one (1) 50 hp rotary screw air compressor, two (2) refrigerated air dryers, and two (2) line filter systems, two (2) small receivers, and several timer condensate drains.

- Local pressure switches and modulation regulators, typically the most common and inefficient control method, controlled each of the compressors.
- Minimal storage was available with approximately one (1) gallon per cfm.
- Existing piping was mostly galvanized which is dirty and had corroded over time.
- The system lacked pressure/flow control.
- Timed condensate drains were used.
- After implementing the project, and receiving the incentive, customer received the incentive, the Ecos Air audit team analyzed the system via ultrasonic leak detection to find and repair numerous leaks throughout the system.

The New System

After the upgrade, they set one of the 300 hp compressors on the front pad for load/unload control to provide the base load and they set the other 300 hp compressor to emergency standby. A single 75 hp Sullivan-Palatek variable frequency drive compressor replaced both the 75 hp and 50 hp modulation controlled rotary screw compressors on the rear pad (Figure 4).

While the existing system did not have pressure/flow control, they upgraded the new system to include dual patented electronic pressure/flow control valves (Figure 5). On the rear pad, they installed supply system upgrades for the front pad included a 4" pressure/flow controller and a 2" pressure/flow controller. These controllers maintain downstream air pressure within +/- 1 psig. They selected this particular flow controller design for its resilience to inherent system



Front New *Back New*

Figure 4

THE SYSTEM ASSESSMENT

Kellogg's Eggo Factory Decreases Energy Consumption by 675,000 kWh

Figure 5

New System Monitoring Results

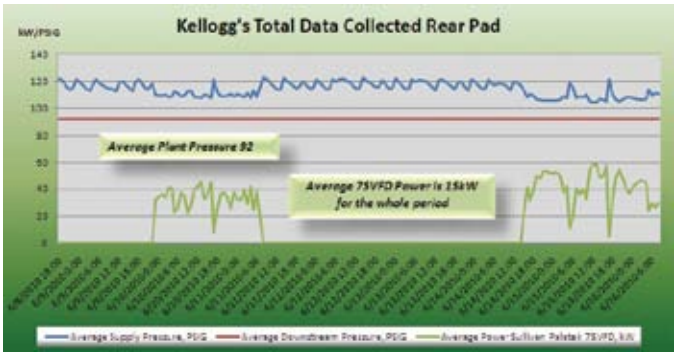


Figure 6

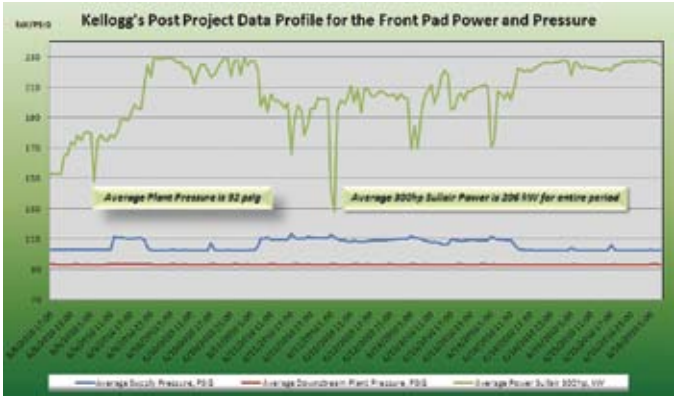


Figure 7

NEW SYSTEM ENERGY ESTIMATE			
HP	**KW**	**HOURS**	**KWH**
300	206	8,760	1,805,000
75	15		130,000
Total	**221**		**1,935,000**

Table 2

contaminants like moisture and oil vapor after Kellogg's determined that their plant operation is too critical to depend on traditionally problematic pneumatic pressure/flow controllers. For example, this controller is impervious to any compressed air contaminants while at the same time it does not have the negative hunting and malfunctioning issues that are inherent to most pneumatic pressure/flow control valves and occur when the performance of dryers or condensate drains begin to degrade. The electronic pressure/flow control valves maintain optimum efficiency in the event of other components in the system failing, thus preventing a domino effect of system component failure.

In order to improve the storage capability of the system, they modified the front pad to include one (1) spooled 5,000-gallon offline dry air receiver, while they added one (1) spooled 1,550-gallon offline dry air receiver to the rear pad. This brought the system storage capacity from approximately one (1) gallon per cfm to more than five (5) gallons per cfm. Next, and keeping in mind that the pressure drop of the filtration system is a large contributing factor to overall system efficiency, they upgraded the line filters to be oversized and include 3,000 scfm of food grade filtration on the front pad and 600 scfm food grade filtration on the rear pad. Throughout the supply pad, they installed new AIRnet™ anodized aluminum piping[4] which does not corrode, is sanitary for food processing, and is easy to work with. This piping is also much safer and ergonomic for the system installation Field Service Engineers.

For condensate control, they replaced the timer drains on the front pad with five (5) zero air loss condensate drains and added one (1) condensate remediation pack. On the rear pad, they added one (1) 600 cfm cycling refrigerated air dryer and replaced the timer drains with six (6) zero air loss condensate drains and one (1) condensate remediation pack.

As previously mentioned, the Ecos Air audit team performed an ultrasonic leak detection audit after the incentivized upgrade was complete. Through this process, they identified and remediated approximately 324 scfm of compressed air leakage through various fittings and machinery. In addition, the facility opted to install CDI flow meters downstream of each of the flow controllers in order to monitor their real compressed air usage in scfm daily and weekly, allowing them to understand and control their current, variable, and future compressed air needs.

1 Ecos Air worked with subcontractor Capitol Air Systems Senior Auditor Mike Mendoza who is a Department of Energy "Compressed Air System Energy Expert," to perform the assessment of the existing compressed air system. Michael Ludwick who is the Senior Field Service Engineer of Capitol Air Systems performed the subsequent ultrasonic leak detection survey.

2 http://en.wikipedia.org/wiki/Eggo

3 This program is funded by California utility customers and administered by PG&E under the auspices of the California Public Utilities Commission.*Pacific Gas and Electric (PG&E) funds the Ecos Air program to identify and implement compressed air projects that result in verified energy savings. As a third party administrator for PG&E's compressed air efficiency incentive program, we at Ecos Air are totally committed to brand neutrality. While Ecos Air may utilize trade allies that also represent specific equipment or service companies, we do not endorse any product or vendor. "PG&E" refers to Pacific Gas and Electric Company, a subsidiary of PG&E Corporation.

4 http://www.youtube.com/watch?v=RzKpJf1CMVQ

ESTIMATED ENERGY SAVINGS	KWH
Existing System	2,620,000
New System	1,935,000
Savings	**685,000**

Conclusion

The average air demands of the system were reduced from 1,347 scfm to 1,296 scfm due to the added receiver volume and a pressure/flow controller set point of 93 psig. Another contributing factor to the reduced air demand was the replacement of 11 timer condensate drains with new zero air loss auto drains. In addition, part-load efficiency of the system was greatly enhanced due to a lower compressor pressure set point and the VFD control on the rear pad in lieu of modulating trim compressors that operated constantly. Now, the peak demand is met in the most efficient manner possible by the VFD trim compressor on the rear pad responding to the factory's periodic peak demand needs.

As a result of the above changes to Kellogg's compressed air system, compressor output more closely matches system demand and continued energy costs have been reduced by approximately $62,000 annually. In addition, Kellogg received a rebate of over $71,000, which lowered the project cost by approximately 45%. Both the process and the project made Kellogg's as a company much more aware of the importance of the compressed air system and its impact on their processes. The company is now more educated on the significance of inefficiencies and waste that can occur in compressed air systems. BP

For more information, please contact Patricia Boyd, Ecos Air, Technical Lead at 415-399-0661, email pboyd@ecosconsulting.com, www.ecosair.com, or Mike Mendoza mike@capitolair.net, http://www.capitolair.net/contact.html

	EXISTING SYSTEM		NEW SYSTEM	
	FRONT	REAR	FRONT	REAR
Compressors	1 x 300 hp Modulating 1 x 300 hp Modulating	75 hp Modulating 50 hp Modulating	1 x 300 hp Load/Unload 1 x 300 hp Emergency Standby	75 hp Variable Frequency Drive
Storage	1,060 gallon Wet	660 gallon Wet	1,060 gallon Wet 5,000 gallon Spooled Dry	660 gallon Wet 1,050 gallon Spooled Dry
Dryer	1,800 cfm Refrigerated	400 cfm Refrigerated	unchanged	600 cfm Refrigerated
Flow Control	N/A		4" Flow Controller and PLC	2" Flow Controller and PLC
Average Pressure	95–109 psig supply 95–107 psig downstream	97–115 psig supply 97–114 psig downstream	103–112 psig supply 93 psig downstream	108–122 psig supply 93 psig downstream
Estimated Annual Energy	2,620,000 kWh ($236,000)		1,935,000 ($174,000)	

THE TECHNOLOGY PROVIDER

The Benefits of On-site Nitrogen Generation

BY PAUL HUMPHREYS, ATLAS COPCO

Nitrogen gas provides a number of diverse uses for a wide variety of manufacturers. As a sister function of compressed air, on-site nitrogen generation can provide additional opportunities for cost savings and other efficiencies for manufacturers who shift from delivered liquid nitrogen service.

A number of variables factor into any capital purchase or process change decision-making method for most manufacturers. Will these changes make our workplace a safer environment for our employees? Do the decisions we make in turn make us better environmental stewards, more responsible neighbors and a leader among our industry peers? And, finally, can we realize greater efficiencies as well as a quick return on our investment with these changes, and how will moving in a new direction translate into exponential savings in the long run?

When the answer to all of these questions is a resounding "yes," it becomes difficult to find reasons not to change the status quo. That's why a number of manufacturers who depend on nitrogen gas as a critical function of their business are shifting from liquid nitrogen delivery to on-site nitrogen gas generation. It becomes easy to justify the change when these companies realize they can generate savings of 40% to 80%, depending on current liquid nitrogen market prices, with a shift to on-site nitrogen generation.

An On-site Nitrogen Generation Installation

Reduce Costs

The cost of delivered liquid nitrogen in the industrial marketplace can range, depending on market costs and delivery location, from $0.35 per hundred cubic feet to $1.50 per hundred cubic feet. In cylinders, the price can jump as high as $3 per hundred cubic feet. Shifting to the use of on-site nitrogen generation can initially drop costs to around $0.21 per hundred cubic feet, regardless of the user's location.

Even with the capital costs associated with onsite nitrogen generation (for equipment such as nitrogen generators, air compressors, receivers, site preparation, power and associated maintenance), customers can realize a return on investment in as few as nine to 24 months depending on what equipment they already have at their facility. In each subsequent year, regular operational expenses can drop even further to about $0.11 per hundred cubic feet – just maintenance and energy costs.

These savings do not include supplementary costs from nitrogen suppliers, which vary by region. A set number of variables — liquid nitrogen costs per hundred cubic feet, tank rental fees, delivery charges, hazmat charges and numerous other miscellaneous costs are regular sights on delivery invoices. The environmental impact is also compounded by the delivery vehicle when considering the required diesel fuel and associated carbon emissions.

Additionally, liquid nitrogen delivery requires that the nitrogen gas first be converted to a liquid for truck transport before being converted back to nitrogen gas once onsite. Making liquid nitrogen requires a great deal of electric energy, as the liquefaction point of nitrogen is -320 °F. Yet 80% of nitrogen uses are as a gas and not a liquid.

Product loss during the transportation process — nitrogen facility to truck and truck to manufacturing facility — contributes to exponential product waste. Delivered nitrogen must also be stored onsite prior to use. In a cooled tank, customers who have nitrogen delivered to their facility will lose an automatic 10% of the delivery volume to waste. Furthermore, a tank with a good vacuum will lose a minimum of .4% of the volume each day if internal pressures are allowed to build when product off the top of the tank is not immediately used. Purging to relieve this pressure only contributes additional unnecessary waste.

On-site nitrogen equipment providers like Atlas Copco can work with manufacturers to develop a spreadsheet to help them identify the ultimate savings that are waiting with a shift from delivered liquid nitrogen to on-site generation in a variety of industries.

Food manufacturing facilities, utility manufacturers, including petroleum refineries and other power-based generation facilities, electronics, chemical and pharmaceutical operations that depend on compressed air often rely on nitrogen gas. In some industries and locations having membrane or PSA supply nitrogen applications on-site is a necessity, like offshore drilling and mining where vehicular delivery is difficult or cost prohibitive. On-site nitrogen generation can also help achieve greater purity levels — particularly with sensitive or delicate applications like pharmaceutical, electronics and chemical manufacturing fields.

Atlas Copco NG Series Nitrogen Generators

Increase Employee Safety

Employees are a manufacturer's greatest resources, and providing a safe work environment is any employer's primary concern. With on-site nitrogen generation, the potential for worker injury associated with storage tank leaks and possible exposure to the -320 ˚F liquid nitrogen during the delivery and unloading process is automatically eliminated. Remember the high school science classes where a teacher donned rubber gloves and dipped a delicate rose into liquid nitrogen before shattering the immediately frozen petals on a table top? Serious burns from exposure to skin are very dangerous and also very possible with delivered nitrogen generation.

Minimize Environmental Impact

Another concern for manufacturers is their ability to mitigate a facility's environmental impact. While labeling practices as green or sustainable has become all too common, unfortunately too few manufacturers follow through on this pledge. Savvy customers are more vigilant than ever and can access records and reports through quick online searches. It is not enough that the manufacturer assume responsibility to ensure that their practices are just compliant. Taking steps to go above-and-beyond shows true commitment while providing measurable results that prove rhetoric is actually regular practice. Reducing carbon footprint is one way to put words into action while lowering operational costs as well.

Manufacturers can quickly increase efficiency and reduce costs with a shift to on-site nitrogen generation from delivery. And, the peripheral benefits associated with this process change will also make a lasting impact on your employees and customers. BP

For a free copy of Atlas Copco's 136-page Compressed Air Manual 7th Edition, please send an e-mail to paul.humphreys@us.atlascopco.com. Put "Manual – CABP" in the subject line and provide your delivery address in the body of the e-mail, and Atlas Copco will send you a complimentary copy.

THE ENERGY MANAGER

Compressed Air at the Lowest Energy Cost; Energy Management at Ball Corporation

BY ROD SMITH, COMPRESSED AIR BEST PRACTICES® MAGAZINE

Compressed Air Best Practices interviewed Doug Barndt (Manager, Demand Side Energy-Sustainability), Joseph Gress (Principal Engineer, Demand Side Energy) from Ball Corporation and Chris Gordon (Compressed Air System Specialist) from Blackhawk Equipment.

Good morning. Please describe Ball Corporation's manufacturing operations.

Good morning. Ball Corporation is a supplier of high-quality packaging for beverage, food and household products. Ball employs more than 14,500 people worldwide and had 2010 revenues of more than $7.6 billion. We have significant manufacturing operations in Europe and also have a presence in South America and China with several facilities. In North America, we operate twenty (20) aluminum beverage can plants and fifteen (15) plants in our food and household products division where we manufacture three products — steel food cans, aerosol bottles and aluminum slugs.

Please describe Ball's approach to system assessments together with Blackhawk Equipment.

Blackhawk has been working with Ball for >10 years now on doing system assessments in our facilities and helping us drive down the energy cost associated with compressed air. Chris Gordon, from Blackhawk, has become very familiar with the manufacturing processes we have at Ball. The compressed air demand-side knowledge Chris has helped us develop is very important to us. It's a collaborative process where Chris collects the data in any given compressed air system and provides us with a concise 7–10 page report.

We use software called ViewAir where both Ball and Blackhawk can view the data and we have meetings and webcasts based upon the data. It's a collaborative process. Chris collects the data, we own the data and look at it at corporate and at the plant. In some ways, we are buying data and the expertise to interpret the data.

We own the data and review his report together and then review different alternatives and action plans. We've used Blackhawk for system assessments, in so many of our plants that Blackhawk understands our operations and we provide economies of scales where we can implement previous solutions and can leverage those prior experiences. There is a unique synergy between our two companies.

How much energy does Ball use?

Ball consumed 11 million gigajoules of energy during 2010, in our manufacturing operations. Our energy use profile is 54% electricity and 46% natural gas. We use drive power for production equipment like can-forming machines. We operate a lot of blowers and vacuum pumps. We use cure ovens, that consume a lot of natural gas, in our heating processes. We operate hot water heaters and some plants have regenerative thermal oxidizers. Our energy use is described in detail in our 2010 Sustainability Report at www.ball.com.

Compressed air is the #1 user of electricity in most of our manufacturing plants. Compressed air normally accounts for 20–30% of our electric bill, in terms of both kW and kWh, particularly in our beverage container plants. We estimate our current energy costs, for compressed air, to be $40 million per year — down from $50 million per year five years ago after a lot of system assessment work.

TABLE 1: BALL CORPORATION ENERGY USE IN OPERATIONS

ELECTRIC	NATURAL GAS
Compressed air	Cure Ovens
Drive power <125 hp	HVAC
Vacuum	Boilers/hot water heaters
HVAC	Oxidizers
Lighting	

THE ENERGY MANAGER

Compressed Air at the Lowest Energy Cost; Energy Management at Ball Corporation

How is the energy management function structured at Ball. Who is involved?

We've been focused on this for about five years, as a formal program, in North America. We are adopting the EPA Energy Star model for industrial energy management. We have two full-time employees that help lead the program. In each plant, we have an energy management champion who is most often the engineering manager. Joe Gress and I (Doug Barndt) are a corporate engineering service shared between the two divisions (metal beverage container and food household products).

We focus on a lot of communication. We are doing more webinars with plants on subjects like vacuum, HVAC controls, and compressed air. We are trying to have more verbal communications between the plants.

We summarize the status of all energy-efficiency projects with in a monthly activity report. It covers what all the plants are working on in a two-page summary to our senior operations people. This information, together with other sustainability metrics, is reported to the highest levels of corporate management on a monthly basis.

We have a company intranet site where we post a lot of information on energy metrics, best practices, and plant visit reports. The site also includes supporting guidance reports and useful calculators. We provide links to reports on completed energy projects in our plants. It's really a database of major accomplishments and a library of information that our plant people can leverage.

Our performance reports are also linked to energy management. We have monthly performance review meetings with senior level management. Once a quarter the senior operations people report to corporate-level people on progress against our energy management goals. All groups have annual goals and we track against them. Each plant has an energy management plan to accomplish their goal.

What metrics are used to measure energy use?

We look at how much product is produced vs. how much energy is used. It's an energy intensity measure. In our metal beverage group we are producing cans, so we use an "energy-per-thousand-cans" number. In the food and household products group we are using different energy intensity measures that match up with the products they manufacture.

We analyze our utility bill data that is consolidated into a utility bill database service. Our plants now submit utility bills to the database service in a uniform and timely manner. We have over 250 utility bills to deal with, per month, in North America. The down side to using utility bills is that you are working 4–6 weeks behind. We'd like to move to real-time data. Our goal is to move toward real-time metered data on the utilities.

Please describe how compressed air is measured and monitored.

We've been working over the last several years to improve measurement. Some plants still don't have direct measurement taking place. Working with Chris Gordon from Blackhawk Equipment, we are bringing some Bay Controllers in to make systems work together. With that, we can start getting data back from those compressors with regards to flow

A vacuum project at a California plant was a huge success, providing Ball with a 50–70% drop in energy use. We saved 1,279,000 kWh/yr. and $143,000 per year in energy costs. We received a $128,000 utility incentive so the ROI was very attractive.

produced and energy consumed. Operations managers, at the plants, are driving this effort to collect this data. We want a flow device put in at the headers on the supply side — as well as a flow meter for each air compressor. We'd like to put pressure and flow meters in the four major users of compressed air out at the plant. We want to see at each piece of major equipment what is happening with flow and pressure, and mange compressed air use with statistical process control (SPC), like we do in other manufacturing aspects. For example, why is the cupper using 30% more air than is normal?

Please describe how Ball and Blackhawk Equipment work together.

Ball's relationship with Blackhawk Equipment has grown over the years. At Ball we aren't looking for adversarial relationships with customers and suppliers. If we do well by our vendors, they will do well by us. With Blackhawk, we've become partners and our relationship has led to success for both of us.

While Blackhawk can and does sell air compressors, they have proven that their goal is to help Ball Container optimize the compressed air systems. Chris Gordon is often backlogged with start-ups, system configurations, implementations and system assessments. Blackhawk looks at Ball plants globally and understands Ball manufacturing processes. The local compressed air provider, in some locale, will look at a Ball plant as a sales opportunity and have less knowledge of Ball processes. Many Ball plants also do their own air compressor maintenance, that also reduces the interest level of local service providers. Blackhawk's vendors have given us a global supply arrangement for Ball. The result is a true "win/win" relationship.

Blackhawk has over $300,000 worth of auditing equipment they ship around in a big crate to our plants. Over the years, they have trained Ball to remove the data logging equipment, allowing the costs of the system assessments to come down and fit into their M&R budgets and provide ROI's, on average, of under six months. Consequently, Chris is on-site 3–5 days, rather than 10 days.

Blackhawk also does not provide us with "boilerplate" 200-page audit reports. Whether it's a dewpoint audit, a vacuum audit, or a compressed air system audit, the reports summarize the data and reflect the knowledge that Blackhawk has developed on the demand side in our systems. Our plants sometimes receive unsolicited "audit marketing" that often recommends flow control and air storage. We think this is a bandaid approach. Let's not store compressed air at 120 psig and go out at 90 psig. Let's figure out how to produce compressed air at 92 psig.

Blackhawk Equipment has done system assessments at all our plants. Through Chris Gordon's work, we have collected data and can now look at all plants in the same way. It's a data-driven audit. We understand the supply and demand side of compressed air systems and how they relate to each other. If one plant has old air compressors, but the data tells us that demand and supply are still matched up, new equipment is not necessary.

How does it all work between Ball corporate, the plants, and Blackhawk?

We get the plants involved with the audits so they are part of the data review process. Chris teaches them about their compressed air system and takes a collaborative approach when looking at the data. We look at the data and ask them what they think it indicates and

THE ENERGY MANAGER

Compressed Air at the Lowest Energy Cost; Energy Management at Ball Corporation

what the solutions might be. It's helped us understand our operations better and increase our production intelligence. We understand how much air it should take to do certain processes and how it fits into the big picture.

The guys in plant operations are very cooperative. This way of working affects how we do projects. When Ball is adding a production line, we all say "let's do the right thing." Chris Gordon will do a system assessment for us and sometimes tell us that no air compressors are needed - even when he knows he would get the orders for any new equipment. Sometimes Chris is making demand-side recommendations for products he doesn't sell — products that will make our system more efficient and meet our goal: to have reliable, quality air at the lowest energy cost.

Sometimes we have to work through differences in opinion with people at the plant. We have situations where a certain plant wants new air compressors and they don't think that fixing eight vortex coolers (reducing air demand) is the answer. It can get delicate. We are "corporate guys" yet we work for the plants because they pay the bills.

Describe the initiatives taken to reduce compressed air pressure.

Reducing compressed air pressure in our facilities is something we are working hard at. We believe that plant employees at Ball are unique in that when we are working to reduce pressure and someone yells "Uncle!", the reaction is usually to figure out why we can't keep lowering pressure. We believe in engineering solutions into our processes to allow us to keep lowering pressure. If it's a clutch, a brake, or a pressure-switch, our plant engineers are aggressive at pursuing these low-cost, low-hanging fruit solutions on the demand side of our systems. It's also a great help that we have data to show plants that other plants, doing the same process, have figured out how to operate at lower compressed air pressures!

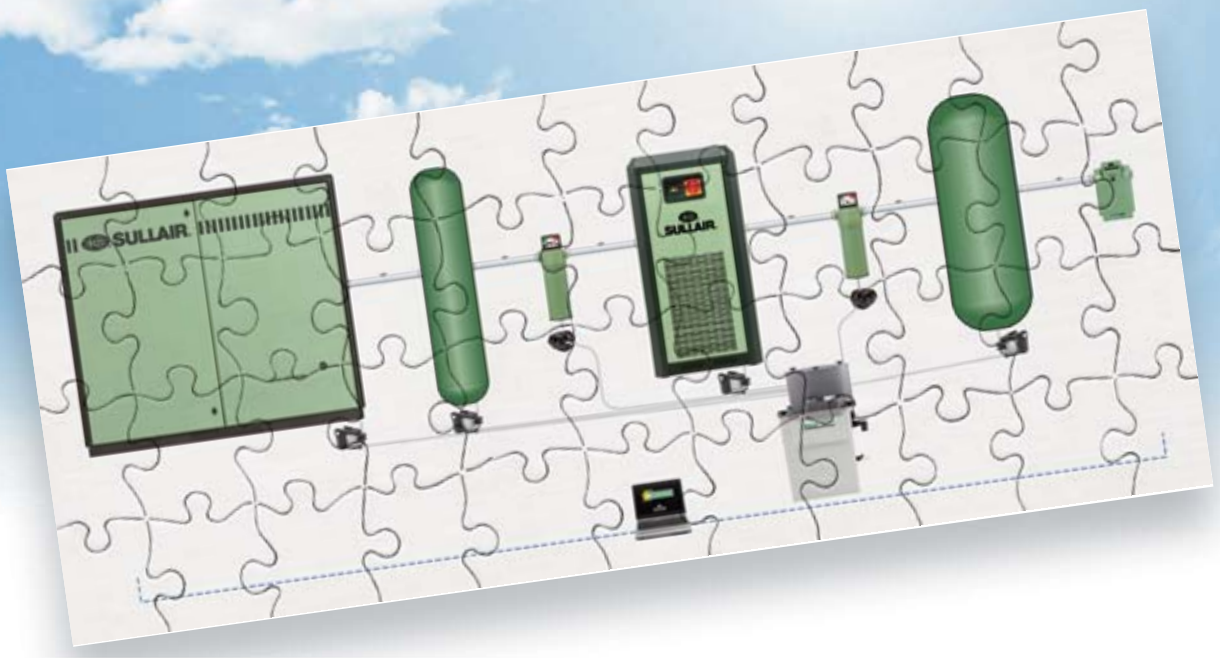
Our printers, for example, have a wheel loaded with 18 blank aluminum cans. It meets a pad and rolls the label onto the can. For a specific process, the printer uses a two-inch pneumatic cylinder with a six inch stroke requiring 125 psig. In the past, this was supplied by the compressed air system. When we were working to lower plant air pressure, we installed a 2 to 1 amplifier to supply it with the needed 125 psig. We are stroking once a minute, so it's very low volume. This is an example of a "Best Practice" that we've learned to deploy in our plants. This is a good example of how Ball finds an issue and we engineer past it.

At some plants, we have two separate compressed air systems. One system at 100 psi and another at 50 psi. Some plants have one user at 120 psi — so we might put in a dedicated compressor for that higher pressure application. It's depends upon the production equipment and how the OEM designed the machine, requiring different compressed air pressures and volumes.

Please describe the importance OEM machinery has on Ball Container's energy costs.

The OEM's that take the time to understand the energy costs, in compressed air, associated with running their machine — will be appreciated by Ball. Here's an example. A cupping press takes a sheet of aluminum and punches up to 26 circles in the sheet. A standard Minster cupping press uses around 400 cfm. About 50 scfm is needed at 100 psi, while the other 350 scfm was regulated down to 40 psi. In the past it was all fed by 100 psi compressed air. We separated out the supply arrangement and modified the inlet piping to the press to make it possible.

In the past, we may have trained our OEM vendors to look at cost and then production output. We are working on ways to ask our vendors to provide us with lifecycle energy costs (including those associated with compressed air) when presenting their products. Now, there may be more of an incentive for the OEM to use a $1,200 rotary valve assembly rather than a $100 solenoid valve, because it will reduce compressed air consumption and save energy costs over time.



The benefits of a Sullair Stationary Air Power System: reliability, integrity, and always a perfect fit.

Sullair offers total compressed air systems with each component of the system carefully matched for capacity and pressure to provide maximum performance and energy efficiency.

Sullair offers:

- Plant air audits
- Energy efficient products
- Compressed air system controls
- Equipment to monitor and manage systems
- Air distribution products
- After-purchase support

This integrated system helps you reduce your energy costs and improve productivity by analyzing, managing and controlling your compressed air systems.

Always air.
So dependable, the total Sullair Stationary Air Power System provides you with our exclusive air quality guarantee.

Always there.
Trust your knowledgeable Sullair distributor to give you the best system for your application. They not only provide all the pieces, but assemble them into a complete package that will optimize your system performance.
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THE ENERGY MANAGER

Compressed Air at the Lowest Energy Cost; Energy Management at Ball Corporation

What efforts have been done to reduce compressed air consumption?

We are focused on *fixing* compressed air leaks. In the past, it could take too long to get the leaks fixed. To address this, we encourage planning leak detection surveys to fit the schedules of our maintenance teams. We don't think it works to ask maintenance to work around the schedule of the leak audits. Beverage plants have one or two days a month, in a 3-line beverage plant, when there is a maintenance day. So we plan our leak detection survey two weeks before so the leaks can get fixed on maintenance day.

We do a lot of projects to reduce compressed air consumption in our plants. One process is necking the top of the can so you can have a smaller lid. This machine uses a lot of compressed air. The manufacturer made a change (retrofit) so that it would use 50% less compressed air. We retrofitted our plants with the modified necker machines. We are very happy with this OEM vendor.

Our food and household products group uses a lot of compressed air to separate sheets of metal with air. We are working with magnets and substitute blowers where compressed air is used. We are doing audits at plants that had audits 3–4 years ago. Just because you did an audit 5 years ago, doesn't mean you shouldn't keep monitoring it. We keep re-auditing things to see what has changed.

What "supply-side" projects are you working on?

A priority right now is the re-control of existing air compressors. We have done a variety of projects in the past year. One project had many air compressors and we put in Pneu-Logic controls. We have also put in some VFD air compressors. We are replacing some old centrifugals with a new machine with newer controls.

Our most progressive plants are installing continuous, real-time compressed air system management systems. We are monitoring our flow out to the significant users of compressed air and managing the cost to supply it — just like we do with other processes. We are in this process now and have it implemented in several facilities.

Please describe your vacuum-efficiency projects.

We are excited about vacuum efficiency projects. A vacuum project at a California plant was a huge success , providing Ball with a 50–70% drop in energy use. We saved 1,279,000 kWh/yr. and $143,000 per year in energy costs. We received a $128,000 utility incentive so the ROI was very attractive.

We reviewed all our equipment using house vacuum. Our old approach was we ran all three vacuum pumps 100% of the time. All we had was fixed-speed machines. Working with Chris, we did a retrofit project in this facility where we now use one third of the power to run vacuum than we did in the past. We used conservation valves to shut off the supply when vacuum was not needed and to open when it was needed. We put an Allen Bradley VFD control, two soft starts, and a PLC on to the plant's three 200 horsepower units allowing them to act as a coordinated supply system.

Chris worked with us to start it up the system and make sure we didn't damage anything. Sullair Compressors, meanwhile, worked closely together with Chris and ran with this idea and introduced a new product line of VFD vacuum pumps. Ball may never buy another fixed speed vacuum pump.

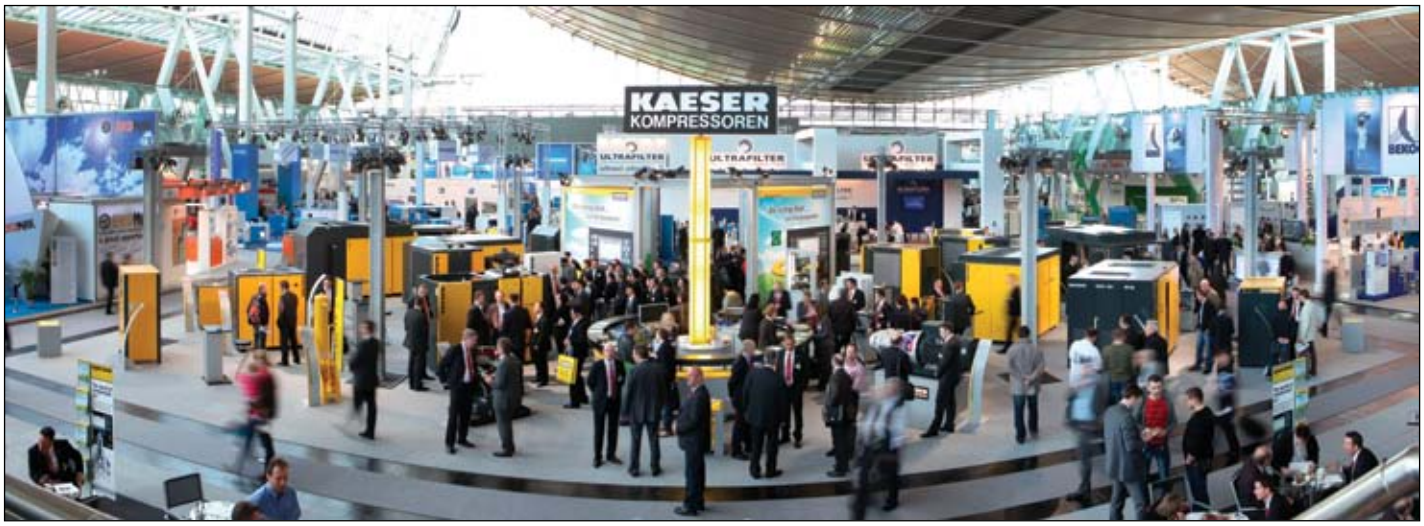
Chris was just down in Brazil starting up two new 150 hp rotary screw VFD vacuum pumps. He's going to Thailand now to do another start up and will be doing two more in the U.S. soon. We can make 2800 cfm with the machine with 80% turndown. We now have a range of 500–2800 cfm on one machine. Before, with liquid ring pumps, all we could say was that we wanted 21 inches — if there was too much capacity too bad. Now we can load and unload precisely to meet a certain vacuum pressure. In the past, we couldn't control vacuum pressure. These three pumps now operate as a energy-efficient system. BP

Thank you for your insights and your time.

Please contact Rod Smith, Compressed Air Best Practices, with any questions.
Tel: 412-980-9901, email: rod@airbestpractices.com

The 2011 HANNOVER FAIR REPORT

BY ROD SMITH, COMPRESSED AIR BEST PRACTICES® MAGAZINE



Kaeser displayed the Sigma Air Manager (SAM) with adaptive 3D Control

The Hannover Fair (Messe) is, without a doubt, one of the most incredible industrial shows in the world. For me, it's the equivalent of going to a World Exposition. There is literally more to see and learn, than is possible, during the one week it is open. The 2011 edition of the Hannover Fair exceeded both my expectations and those of the Deutsche Messe Managing Board Chairman Dr. Wolfram von Fritsch at the shows conclusion, "Over 6,500 businesses from 65 countries came to Hannover to display their solutions."

Hannover Messe 2011 attracted a total of well over 230,000 visitors. This represented growth of his represents growth of 10 to 15% over the comparable 2009 event. Some 60,000 of these visitors were from abroad, which is over a third more than in 2009. "Our foreign visitors, alone, would have filled over 150 jumbo jets," said a delighted von Fritsch. "Attendance was up from every country, thus bringing tangible benefit to exhibitors in every sub-section of the event." One in every three visitors was a member of top management, marking a 20% increase in this category.

The COMVAC Hall

I spent three full days walking the entire COMVAC (Compressed Air & Vacuum) Hall and literally ran out of time. It was literally filled to capacity with exhibitors from all over the world. This article will provide the reader with a glimpse of just a few of the exhibitors as we just don't have enough pages to go around.

The Kaeser booth is always a site to behold. The booth is always more aptly described as "a section" of the hall. There were many, many technologies on display one being the Sigma Air Manager (SAM) with adaptive 3D Control. Active rather than reactive, the new self-adjusting 3D software responds to the three dimensions that affect air system efficiency: switching losses, control losses, and pressure flexibility. People at the booth explained to me that the results are (1) reduced compressor run and idling time (2) better pressure stability; and (3) reduced leaks and artificial demand. The CSD (60 to 125 hp) and ESD (250, 300, and 350 hp) single-stage fluid injected screw compressors were also on display as they've been redesigned for compactness and higher energy efficiency.

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Atlas Copco's New ZH 350+ Three-Stage Centrifugal Compressor. Pictured from left to right are Dr. Uwe Pahner, Sanjay Safaya, Conrad Latham, and Herman Geyskens from Atlas Copco.

The Atlas Copco booth featured their "most energy-efficient oil-free compressor" ever – the ZH 350+. Using a permanent magnet motor and magnetic bearings, this three-stage, oil-free, centrifugal compressor also eliminates the gearbox (and the associated power transmission losses) and uses titanium impellers permitting faster load-unload cycles. Optimally sized coolers reduce pressure drop and the system blows off before the aftercooler reducing air losses when air demand decreases. Another advancement is the new MD/ND rotary drum dryer now able to reach dew points down to -40 °F (-40 °C). This allows this energy-efficient (and very low lifecycle cost) design to compete with twin-tower desiccant dryer designs in this important dew point category. I was very impressed by the new ES360 energy management system allowing end users to split their compressed air systems into different sub-systems to be monitored and managed. This has excellent application in the blow molding industry, for example. I also really liked the centralized heat recovery package (heat exchangers allowing hot compressor lubricant to heat water) on display allowing multiple air compressors to hook up to one system.

Rolf Tappen, from Ekomak Compressors, in front of their 75 kW Rotary Screw VSD Air Compressor.

One of the fastest growing companies in Europe is Ekomak Compressor. European

Masanori Sugimoto and Nitin Shanbhag (left to right), from Hitachi Compressors, with the world premiere of the world's largest oil-less scroll compressor (7.5 kW).

General Manager Rolf Tappen said, "The growth of Ekomak in Germany and all over Europe is thanks to the hard work of our partner distributors." Ekomak, whose manufacturing is done primarily in Turkey, has been particularly successful in developing a strong distributor network in Germany and Eastern Europe. The company has a full range of rotary screw air compressors. Particularly impressive has been their success with 50 kW to 250 kW machines in Central Europe.

Celebrating their 100th birthday, Hitachi introduced their new oil-less 7.5 kW (10 hp) scroll air compressor. The "biggest-ever" oil-less scroll air compressor, the product was launched at the Hannover Fair. Hitachi America General Manager Nitin Shanbhag said the new scroll compressor is ideal for multiple OEM applications served by oil-less reciprocating air compressors.

AIRLEADER displayed an upgraded version of their compressor management system. Jan Hoetzel showed me the upgraded panel

Werner Weidner and Jan Hoetzel (left to right), from AIRLEADER, in front of their newly upgraded compressor management system.

design and how easy it is to monitor the energy consumption of all the individual components in a compressed air system. It's really amazing to see such high-tech applications deployed to our "good 'ol" compressed air systems!

CS INSTRUMENTS GmbH

Innovative and reliable measuring equipment for compressed air systems

Company Name:
CS Instruments GmbH

Headquarters Location:
Am Oxer 28c - 24955
Harrislee - Germany

Contact Person:
Gabi Nolte-Hoetzel
gabi@sigacas.com

Contact Information:
Tel +1 (616) 828 1024,
www.cs-instruments.com

Portable Dew Point Meter DP300 kit

Flow station DS 300 with directional counter

CS Instruments develops and manufactures innovative solutions for compressed air and gas systems. The product range covers high precision dew point meters, pressure sensors, flow meters, ultrasonic leak detection equipment, data loggers and other cost effective measuring equipment.

The DP300 provides dew point documentation for your quality system. The sensor comes with a self-testing unit to verify accuracy.

The DS300 measures compressed air flow. This kit comes with a highly precise thermal mass flow meter and an optional directional indicator for looped systems.

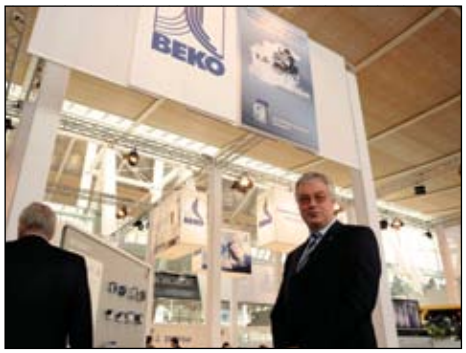
For more information visit www.sigacas.com or contact Gabi Nolte-Hoetzel, gabi@sigacas.com, Tel +1 (616) 828 1024

THE 2011 HANNOVER FAIR REPORT

SPX displayed the very energy efficient combination refrigerated and blower purge desiccant compressed air drying system.

SPX displayed their very energy efficient combination refrigerated and blower purge desiccant compressed air drying system. What I like about this system is that it makes it simple to capture energy savings. The system includes bypass piping so that customers can easily use the refrigerated air dryer in the summer (with lower energy costs) and the desiccant dryer in the winter.

BEKO Technologies once again not only had the best draft beer, but they continue to be pushing forward with new technologies. Compressor-room products like the Clearpoint 3E Series and the refrigerated and desiccant dryers are growing. Interestingly, the METPOINT compressed air measurement products (power, pressure, flow, dewpoint) are also growing segments for their business, according to Tilo Fruth, President, of BEKO Technologies Corp. in the U.S. I hear more and more from Corporate Energy Managers about how they'd like to start measuring compressed air going to different parts of the factory — and to start



Manfred Lehner, from BEKO Technologies GmbH, oversees the global expansion of the firm.

charging for it. I'm glad to see the growth of measurement products in our industry.

FESTO once again impressed me with their knowledge and tools to improve the energy efficiency of pneumatics. Anyone who knows me is aware that I'm obsessed with "The Dirty

ULTRACHEM INC
PREMIUM SYNTHETIC LUBRICANTS

High-performance synthetic oils and greases

Available in a wide variety of packaging options

Company Name:
Ultrachem, Inc.

Headquarters Location:
900 Centerpoint Blvd
New Castle, DE 19720, USA

Contact Person:
Mr. Glenn Krasley,
Director - Sales & Marketing

Contact Information:
Tel: 1-302-325-9880
Email: info@ultracheminc.com

Year Company Began Business:
1965

Product Lines:
Premium Grade Synthetic Lubricants

Company Description

Ultrachem is one of the oldest specialty synthetic lubricant compounders and has become a leading supplier to the OEM and industrial maintenance markets. Ultrachem sells worldwide under a variety of brand names and can also provide private label synthetic products.

Product Description

Ultrachem's synthetic lubricants, oils, greases, gels and food-grade oils are ideal for use in compressors, vacuum pumps, chains and gears. Products are well-suited for applications where petroleum-based lubricants can't meet the necessary requirements for performance and reliability under adverse conditions of time, temperature and wear.

Product Features

- High performance
- Longer life
- Greater efficiency
- Lower maintenance cost
- Less environmental impact
- NSF / Kosher approved (food-grade)

Dr. Axel-Andreas Gomeringer, from Festo, demonstrated impressive OEM machine-level monitoring systems and software aimed at driving energy savings from the pneumatic systems.

Thirty" in a compressed air system (the last 30 yards!). I had a long talk with Dr. Axel-Andreas Gomeringer, Festo's Head of Innovation & Technology Management. He showed me Festo's new sizing software allowing OEM machine designers to see the energy costs, associated with compressed air, corresponding to the pneumatic components they select. He also showed me a OEM machine-level monitoring system capable of monitoring compressed air pressure, actual flow, and a flow-profile average. A Air Preparation unit was also on display featuring an integrated flow measurement device. He also told me that "Energy-Saving Service" work is growing in Europe.

Aaron de Koning, from JORC, stands in front of the compact oil/water separator designed to be integrated into rotary screw compressor packages.

JORC had an interesting innovation in their booth. The firm has designed a compact oil/water separator to be integrated into air compressor packages of up to 15 horsepower. It has a 1.8 m³/min. rating and is called the SEPREMIUM 2. Another favorite product of mine on display was the AIRSAVER — a motorized ball valve allowing users to isolate the compressed air piping system after the receiver — so that air leaks don't cause air compressors to turn on at night.

BOGE COMPRESSED AIR SYSTEMS

Company Name:
BOGE America, Inc.

Contact Person:
Gavin Monn, President

Year Company Began Business: 2001

Headquarters Location:
3414 Florence Circle, Suite 100,
Powder Springs, GA 30127,
USA

Contact Information:
Tel: 1-770-874-1570
Email: usa@boge.com
Website: www.boge.com/us

Product Lines:
Complete range of oil lubricated and oil free screw and piston compressors from 1 to 450 hp

BOGE SR Series high pressure Boosters

BOGE K series oil-free piston compressors

Company Description

BOGE America, Inc. is a Daughter Company of BOGE International GmbH, one of the oldest and most experienced German compressor manufacturers. BOGE manufactures a comprehensive range of oil lubricated and oil free screw and piston compressors which includes;

SR Boosters

These oil-lubricated piston compressors provide a flexible, cost effective and energy efficient solution for generating up to 600 psi at point of use — ideal where high pressures are required at specific points within a compressed air network.

- 220 or 600 psi
- Effective F.A.D (depending on booster pressure) 33–258 cfm
- Rated power 7.5 to 25 hp

K Series

This innovative range of oil-free piston compressors now includes 220 and 600 psi options, providing the smaller air user with a compact, energy and cost effective oil-free solution.

- 150, 220 or 600 psi
- Effective F.A.D 8.5–46 cfm
- Motor range 3 to 15 hp

THE 2011 HANNOVER FAIR REPORT

Pascal van Putten, from VP Instruments, displays the new VP Flowscope flow meter with integrated differential pressure monitor.

VP Instruments also had an innovation on display. Their new VP Flowscope dP integrates flow and differential pressure into one device. VP does a great job of measuring compressed air and then providing the "off-the-shelf" software to make it easy to provide reports.

ALMiG's Rainer Haja and Daniel Fritz took the time to provide an excellent overview of their new technologies. This company always impresses me with how enthusiastic and "hungry" they are. They demonstrated air compressors designed for rail cars and a full range of oil-less and oil-free air compressors. The exciting innovation, still in the prototype stage, was a single-screw "spindle" air compressor. It has a dry compression chamber and is direct-coupled and speed controlled. It has one twin-shaft airend which can go from 0 to 25 bar (367 psig) in pressure. It consumes between 11 and 22 kW and has no intermediate cooling. Cooling is internal with fluid inside the rotor.

GARDNER DENVER had an impressive booth where one could see the international scope of the company and the many brands that are

Daniel Fritz, from ALMiG, in front of the prototype of the innovative single-screw spindle compressor.

now under their umbrella. COMPAIR had a large booth as well. BOGE had a significant booth where they displayed their new booster packages. SULLAIR was present as was PARKER (over in the Fluid Power Hall). Anest Iwata had a booth and their manager told me they had

just begun selling scroll air compressors in the U.S. out of their new Cincinnati subsidiary. THERMAL TRANSFER was there (I learned the term "tchotchke" from Tim McDonald) with their heat exchangers and ULTRACHEM had a very nice booth for their lubrication products.

MTA had a cool biogas dryer on display representing their interest in using their expertise in refrigerated dryers and chillers for this growing niche market. The unit is similar to a horizontal heat exchanger refrigerated dryer, but then uses SS 316 materials for the acidic condensate and has a vacuum circuit to suck the gas out and blow it downstream. PENTAIR displayed membrane dryers and told me their helically-wound membranes have purge rates down to 14% for 38 °F dew points. They also have a good business in customizing membranes for specific applications.

Finishing Notes

I have been going to the Messe since 1992 and this year was as interesting and fun as any. PLUS, I made a big discovery — how to find a good room and breakfast for $100.00 per night! I used the "private accommodations" system organized by the City of Hannover's Tourism Department. My hosts' apartment was located just one mile from the Fairgrounds. I had a nice room, a private bathroom, and a farmer's breakfast every morning. My host told me how to use the bus and train to get to the Fair in 15 minutes and I was good to go! I highly recommend it to all who (like me) don't spend much time in the hotel and who have certain budget limits to hotel prices.

Philippe Cluchague and Lucas Ferreres (left to right), from MATTEI, in front of their MAXIMA 75 kW PLUS rotary screw compressor.

I'm already looking forward to the 2013 Edition of the Hannover Fair. Hope to see you there. BP

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

Automating Energy Efficiency in Compressed Air System Sub-Zones

BY J. NED DEMPSEY, P.E., PNEU-LOGIC CORPORATION

Improving the Energy Intensity KPI

The objective of a compressed air management system is to improve the Key Performance Indicator (KPI) of "Energy Intensity" as it relates to compressed air. This translates into improving the ratio between the volume of product shipped and the net electricity (kWh) consumed by the compressed air system. How many thousand bottles, per compressed air kWh consumed, were shipped this month?

Compressed air management systems automate the continuous measurement and fulfillment of the appropriate volume, pressure, and quality of compressed air for each unique sub-zone in a compressed air system.

Energy Efficiency Awaits in the Sub-Zones of a Compressed Air System

The opportunities for energy savings often come from moving away from the traditional "one system for the whole plant" approach. Dusty Smith, P.E., (Director of Engineering, Pneu-Logic) commented, "Energy efficiency gains are unlocked when we find ways to optimally manage each sub-zone of a compressed air system." Compressed air management systems, like the Pneu-Logic PL4000, are designed to allow for the on-going measurement and optimal fulfillment of the appropriate volume, pressure, and quality of compressed air for each unique sub-zone in a compressed air system.

Compressed air systems assessments, focusing on the demand-side of the system, normally identify many different sub-zones with unique compressed air needs and requirements. Providing data that is normally not available to management, the system assessment will measure compressed air pressure, flow, and dew point, out on the factory floor where the machinery and processes are that use compressed air. This is a learning process where engineers discover the different sub-zones in their compressed air system — the sub-zones where the energy efficiency opportunities are waiting!

A compressed air management system, like the Pneu-Logic PL4000, provides the ability to monitor and manage unlimited inputs from the compressed air system — permanently. The data inputs, from each sub-zone, turn the PL4000 into a powerful monitoring and trending system capable of providing management with the metrics they can manage. According to Eric Bessey, P.E., (Chief Project Engineer, Pneu-Logic), "Our technology differentiates itself with its ability to absorb data from a multitude of factory floor and compressor room inputs provided from sensors we install (typically flow, temperature, pressure, dewpoint, and kW). Our control algorithms are able to take this data and continuously direct the most energy efficient way to supply the demand for compressed air in all sub-zones of the system."

Compressed Air Pressure Sub-Zones

System assessments often identify processes requiring different compressed air pressures. Identifying these "sub-zones" and providing each with the appropriate pressure provide some of the biggest gains in energy efficiency. Dusty Smith, P.E., (Director of Engineering, Pneu-Logic) commented, "In plastic blow molding processes, the facility will use compressed air at both 600 psig and 100 psig. These two systems typically have a crossover point wherein 600 psig air can be expanded down to 100 psig air to augment low pressure air supply. Significant improvements in energy intensity metrics are realized by optimizing the interaction between these two compressed air pressure sub-zones: one managed sub-zone for blow molding at 600–725 psi and another subzone at 100 psi for plant air functions."

"Another typical application is when systems are split between 30–40 psi air and 90–110 psi compressed air", continued Mr. Smith. "Food preparation plants are identifying energy-saving opportunities by supplying blow-off applications with lower pressure air supplied by blowers." Managing these two sub-groups of a system is made possible by the Pneu-Logic PL4000 compressed air system management technology.

Stabilizing Air Pressure by Monitoring Signals from Storage Sub-Zones

Unstable compressed air pressure will reduce production output in a plant. It's like having an intermittent supply of electricity. To help stabilize plant pressure, compressed air storage and demand controllers are common recommendations coming from compressed air system assessments.

The PL4000 will take the inputs from pressure sensors at the storage tank(s) and flow and pressure inputs from the demand controller. The control algorithms can take this data from both sub-zones and select the optimum mix of air compressors to run.

If multiple compressor rooms are supplying air to the storage tanks, the Pneu-Logic PL4000 is able to centralize and coordinate the control of these air compressors located in different parts of the plant.

Eliminate Air Leaks by Shutting-Off Compressed Air Flow to Production Sub-Zones

Most industrial facilities have areas, supplied by compressed air, which do not run 24 hours a day, 7 days a week, all year-long. These areas however, due to compressed air leaks in the piping, normally consume compressed air 8,736 hours per year. Corey Farrens described the scenario, "A metal stamping plant we worked with has many different production lines. They wanted to shut-off compressed air supply to these lines when they weren't in production in order to save energy." The plant installed flow meters and electro-pneumatic gate valves (in each sub-zone) able to provide signals to the Pneu-Logic PL4000 on when to supply compressed air and when to open and shut the valves."

Managing and measuring compressed air flow heading out to different sub-zones is considered by many as, "the next frontier", in optimizing compressed air systems. Many factories now understand their total compressed air costs because they are monitoring kW demand of their air compressors. The next step is to implement on-going measurement and management of compressed air flow heading to different sub-zones in the facility. In this way, different sub-zones can be accurately assigned kW costs that correspond to their production processes and thereby accurately manage their energy intensity.

Critical Use Sub-Zone: Compressed Air Used for Breathing Air

There are some applications, for compressed air, where lives literally depend upon safe supply of breathable compressed air. Mr. Smith described one such scenario "An enormous mine had stationary electric air compressors supplying compressed air to many, many zones. They experienced periodic power disruptions and wanted an automatic way to switch their breathing air supply over to the back-up diesel-powered air compressors." Along with managing the efficient supply of compressed air for the entire mine, the centralized PL4000 was able to provide this automated solution as an identified sub-zone.

Manufacturing facilities also use high quality compressed air in sandblasting and painting applications. Dew point and CO_2 monitors are installed and can send alarm signals to the PL4000. The PL4000 will use this data to warn and ultimately shut-off the air supply and even the air compressors as a safety protection to personnel and manufactured product.

AUTOMATING ENERGY EFFICIENCY IN COMPRESSED AIR SYSTEM SUB-ZONES

Air Quality Sub-Zones: Reducing Production Spoilage Rates

A fast way to reduce a plant's performance, with the energy intensity KPI, is to have product spoilage rates go up due to the presence of moisture and oil in the compressed air system. Direct-contact environments with food, delicate semiconductor chips, and surface painting processes have zero tolerance for specification deviations on pressure dew point, oil and particulate filtration. "Customers often ask us to measure, monitor, and manage air quality in critical process areas of their facility", said Mr. Bessey. "Dewpoint measurement devices are installed downstream and our management system provides visibility to engineering. We also monitor differential pressure on the filtration products to ensure that the elements are changed in a timely manner to ensure that oil and particulate filtration specifications are met."

Some facilities operate separate oil-free and oil-flooded air compressed air systems. Many plants have both types of air compressors. Compressed air system management, with the PL4000, allows both air compressor systems to be controlled simultaneously.

Energy efficiency is also discovered when creating sub-zones for compressed air quality requirements. "It's common to see one dew point specification for a whole facility, based upon the highest air quality required in the plant — even if it's only 20% of the total air volume, " said Corey Farrens (Director of Sales, Pneu-Logic), "Our system assessments often recommend the installation of lower energy-cost refrigerated dryers for the portion of the factory that requires a +38 ˚F dew point". The PL4000 compressed air system management product will monitor dew point to ensure that each sub-zone of the facility receives the quality of air it requires.

PL500 control board

Pneu-Logic — Meeting All Compressed Air System Management Needs of a Multi-Factory Organization

Corporate energy management teams are challenged with improving the efficiency of many different types of plants in their operation's portfolio. Some facilities have simple single compressor room designs with two air compressors. Other facilities deploy several different production processes and support them with a campus of multiple buildings, housing compressor rooms using varying compressed air system technologies. Pneu-Logic provides corporate accounts with the appropriate technology solutions for all the different types of compressed air systems in their operational portfolio.

The PL500 is designed to control two air compressors in a single-room environment.

The PL1000 is designed to control up to eight air compressors and to allow management to monitor and trend system performance.

The PL4000 is customized to manage unlimited numbers of air compressors and sub-zones present in multiple on-site compressed air systems. It also provides a powerful monitoring and trending system compatible with all communication protocols.

Cost-Effective, Open-Architecture, Non-Proprietary, and Configurable Technology

The PL4000 high-tech compressed air system management has matured over the past few years. Mr. Smith commented, "Communication flexibility is important. Our technology works extremely well with all protocols like Rockwell Automation's EthernetIP, and also with Modbus, CAN, and DeviceNet protocols Our engineers are also experienced in the details of how to write custom drivers for specialized IO scanners or to implement protocol bridges to get the myriad of air compressor controllers on the market, to communicate inwardly to the PL4000."

The PL4000 SCADA server is ready for outward client connection and individual plants are given the "invisible codes", memory map and configuration files (as requested) to configure the system to the needs of their plant. There are also no technology licensing fees.

Innovation has also brought down the average selling price of the technology. Mr. Farrens said, "We can now customize the product to meet the needs of any customer. Solution prices can start at as little as $4,500. An innovative new payment option is also available. It allows customers to pay solely based upon realized energy savings. Pneu-Logic will provide a free system assessment and the installed PL4000 compressed air system management technology.

Conclusion

Compressed air management systems automate the continuous measurement and fulfillment of the appropriate volume, pressure, and quality of compressed air for each unique sub-zone in a compressed air system. They are a critical resource allowing facilities to improve the energy intensity KPI of their compressed air systems. BP

For more information please contact Mr. Corey Farrens, Director of Sales, Pneu-Logic, tel: 503-616-7782, email: corey.farrens@pneulogic.com, www.pneulogic.com

A Compressed Air Checklist for Waterborne Paint Conversion

BY BILL KENNEDY, MATTEI COMPRESSORS

Introduction

Encouraged by government regulators, the conversion to waterborne paints is now moving into the collision repair and refinishing industry. The conversion to waterborne paints is proving to have implications for the compressed air systems in the shops. This document provides a checklist of compressed air system topics to ensure a successful conversion to waterborne paints.

Reasons to Switch to Waterborne Paints: the Environment and the Law

It is estimated that the automotive industry releases, to the atmosphere, over 210,000 tons of solvents each year. This is because ready-to-use conventional base-coats have a solvent content of around 85%. Solvents fulfill their main task when the paint is applied. They regulate the required viscosity of the material and affect the build-up as well as the surface quality of the freshly applied coat. Once the process of application has been completed, the solvents have done their job and should evaporate as quickly as possible.

However, the fact that they escape into the air means the solvents contribute to air pollution. Especially in summer, when high pressure predominates, they promote the formation of ozone close to the ground. Now, ozone is a natural component of the atmosphere and protects the Earth from over-intensive irradiation by the sun. However, closer to ground level, too high a concentration of ozone can have damaging consequences as far as living things are concerned. If humans breathe in too much ozone it can lead to chest pains, coughing and asthma attacks. The proportion of organic solvents that escape into the air during the manufacture and application of paint is currently around 32% of all VOC emissions.

Following legislation already enacted in the U.K., the U.S. EPA decided to regulate VOC's emitted by the collision repair industry. There are two significant changes, in U.S. regulations, affecting how the collision repair industry paints automobiles.

1. National Emission Standard for Hazardous Air Pollutants, NESHAP (Subpart HHHHHH) Final Rule issued by the U.S. EPA (Environmental Protection Agency). This "6H Paint Standard" focuses on controlling air emissions from paint stripping and surface coating operations. Compliance deadline: January 10, 2011.
2. National Emission Standard for Hazardous Air Pollutants, NESHAP, 40 CFR Part 63, Subpart H issued by the U.S. EPA (Environmental Protection Agency). This "Paint Rule for Motor Vehicle Coating Operations" specifies, amongst other things, that all spraybooths/stations must be fully enclosed and ventilated with proper ambient air filtration. Coatings must be applied with HVLP guns which will be cleaned after use. Compliance deadline: January 9, 2011.

The paint industry and the EPA offer up other reasons like increased productivity, increased painter retention, reduced insurance costs, and enhanced customer satisfaction. They are, however, debatable points. Whatever reason a collision repair center chooses, the move is undeniably underway to adopt waterborne paints.

More Water Means Slower Flash-Off Times

Waterborne paints have effectively replaced solvents with water. The SPIES HECKER Permahyd® waterborne base coat is made up of water (70%), solids (20%) and solvent (10%). Compare this to the make-up of a conventional base coat of solvent (84%) and solids (16%). Obviously, there is a lot more water present and this is causing longer flash-off times and affecting through-put in shops. Brad Kennison, the National Sales Manager for Nova Verta USA (www.novavertausa.com) commented, "Before taking corrective actions, we've seen shops decrease their paint booth through-put from 5–6 cars to 3–4 cars per day when they switched to waterborne."

Checklist Item #1: Venturi Paint-Drying Systems Reduce Flash Times — But Select an Efficient System!

Venturi blow-gun paint-drying systems (using compressed air) help shops decrease flash times. According to Nova Verta, their system reduces drying flash times from 20 minutes down to 3–10 minutes, depending on the paint manufacturer. The systems were also designed with energy efficiency in mind, "The Nova Vortex nozzles use less compressed air. In order to reduce flash times, you have to create turbulence — not blast air," said Mr. Kennison. "Turbulence breaks the boundary layer of air, on the paint surface, allowing moisture to evaporate. Air flow needs to be constantly moving over the car to create turbulence — many people think they have to blast away at one spot and then move to the next spot." The engineered nozzles deliver 600 feet per minute and just two wall-mounted nozzles cover the entire car. Nova Verta also manages compressed air consumption with an engineered control board featuring flow measurement, adjustable start and stop timers and pressure regulation devices that are set by the installer to match your paint product being used.

There is a widespread misperception on the proper use of the venturi system. "You need to be aware of what you are buying and putting into your shop," according to Mr. Mike Bertrand, President of Hedson Technologies (www.hedsonna.com). "It's important to get an apples-to-apples comparison of the input cfm of compressed air driven drying products." Hedson manufactures a line of "air moving products", called the Trisk Hydromate. It's published rating is of 240 liters per minute at 14.7 psi pressure. Blasting in one spot does not create turbulence and so people increase the compressed air consumption. Often called "trees", these paint-drying systems feature two hand-held blow guns, mounted on a portable structure. Some shops will have one "tree" on each side of the car. Venturi air nozzles can be worthwhile investments because they speed up the flash cycle significantly. Shop owners, however, need to ensure they purchase systems that will create turbulence, otherwise they will consume too much compressed air.

Compressed air driven paint drying systems can significantly reduce flash times.

Checklist Item #2: Ensure Your Venturi Paint-Drying Systems Reduces the Baking Cycle by 30%!

A second efficiency gain has emerged from focusing on turbulence. "Our wall-mounted design, focused on creating turbulence helps our customers realize 30% gains in efficiency during the bake cycle," said Mr. Kennison. Agitating the air over the entire car, during the heating cycle in a paint booth, allows heat to move quickly to the challenging areas — like the side panels. "We need to reach 140 ˚F and the side panels usually struggle to get over 125 ˚F — thus prolonging the bake cycle. Our nozzles agitate the air and elevate the temperatures to 140 ˚F within 3–5 minutes." On average, the company says their system will reduce average baking cycle time from 30 minutes to 20 minutes. "A 30% reduction in bake-cycle time reduces natural gas costs for the heater, kW costs for the blowers, and increases shop throughput", said Mr. Kennison.

Compressed air flow and pressure instrumentation can ensure the most efficient management of the flash and cure (bake) cycles.

Checklist Item #3: Reduce Shop Air Consumption by 30% by Eliminating Air Leaks and Optimizing Blow Gun Nozzles

Waterborne paints have created a new user of compressed air in the paint booth. There is a high probability that shops can partially offset this by finding ways to reduce compressed air consumption. Compressed air leaks are the top opportunity. Leaks typically account for 20 to 30% of over-all compressed air use , according to the Compressed Air Challenge®. Compressed air leaks are typically found in fittings and pipe joints, FRL's, valves, condensate drains and tubing. Repair costs are insignificant. Another area of opportunity is to install high-efficiency venturi nozzles on the blow-guns in the shop. This can decrease the compressed air use, of each blow-gun, by 50–75%.

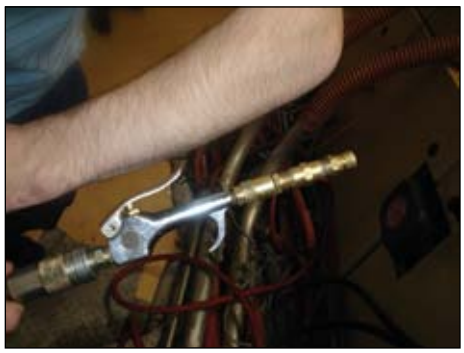
Checklist Item #4: Stabilize pressure while eliminating scaling and flow restrictions in the piping system

Collision repair shops often have piping systems creating problems without anyone being aware of it. Mike Rigdon, the owner of The Paint Booth Guy Company located in Augusta, Georgia, (www.therealpaintboothguys.com) has installed air compressors and paint booths

A COMPRESSED AIR CHECKLIST FOR WATERBORNE PAINT CONVERSION

Air Leaks on FRL's

Multiple compressed air leaks can be found on holes present in shop tubing and fittings.



Venturi nozzles on blow guns can reduce compressed air consumption by 50–75%.

for over twenty years, "Compressed air piping systems should be loop systems with storage tanks on each side of the shop. They are also frequently undersized, in pipe diameter, causing flow restrictions to the paint booth." Mr. Rigdon told the following story, "A client of ours installed their own piping system using ¾" copper pipe for the whole shop. When they went to waterborne, we had to re-do the whole shop to 1¼" pipe to eliminate the flow restrictions to the paint booth." Mr. Rigdon evaluates the following areas in a compressed air piping system:

- Air Storage: Air storage tanks will stabilize shop air pressure
- Piping Design: A loop system should be used with piping diameters large enough to not create any flow restrictions
- Piping Material: Avoid cast iron pipe, which due to moisture, creates pipe scale that clogs orifices in the HVLP spray guns. This creates the need for costly point-of-use filters. Use non-scaling aluminum or copper piping systems

☑ **Checklist Item #5:** Install a centralized air treatment system

Collision repair shops typically have poorly functioning compressed air dryers (or none at all) centrally located next to the air compressor. The dryers are often undersized for the high outlet temperatures of a reciprocating air compressor. This causes moisture to bypass the dryer and enter the cast iron piping system and ultimately send moisture, particulates, and oil to the HVLP guns and other points-of-use. For this reason, the collision repair industry typically installs a multitude of point-of-use filters and single-cannister desiccant dryers. "We estimate that 70% of the shops we visit are in a problem situation when it comes to compressed air quality," says Mr. Kennison. "As long as the piping isn't exposed to freezing temperatures, we recommend an appropriately sized refrigerated air dryer, a particulate filter, an oil-coalescer, and a activated carbon filter — next to the air compressor and after the receiver in a shop with scale-free piping."

Modern industrial factories install centralized air treatment dryers and filters — correctly sized for worst-case ambient temperatures and inlet temperatures to the dryer. This eliminates pressure drops and flow restrictions caused by the point of use filters and single-cannister desiccant dryers (which are eliminated). It also eliminates the extra maintenance time and costs they require. Mr. Kennison cautions, "Be sure to purchase the filters with differential pressure gauges so you know when to change the filters."

Tank-mounted air compressors offer a space-saving way to provide compressed air storage.

A properly sized centralized air treatment system will eliminate the need for point-of-use filtration products.

Checklist Item #6: Review Air Compressor Type and Sizing

Active in installing paint booths across the Southeast, Mr. Rigdon's company has over twenty years experience with air compressors. "The Mattei rotary vane type of air compressor is bomb-proof AND it delivers more compressed air at lower air temperatures", says Mr. Rigdon. "We service everything we sell and the Mattei air compressor uses half the oil and runs at 1800 rpm — instead of 8000 rpm like other rotary screw designs." Piston-type air compressors have elevated outlet air temperatures averaging 200 °F and many designs of rotary screw air compressors run at elevated speeds up to 9000 rpm.

Proper air compressor sizing can only be done when an understanding is reached of exactly how much air is required. Bill Kennedy, Sales & Products Manager for Mattei Compressors, (www.matteicomp.com) stated, "Mattei Compressors' automotive reps conduct shop air system assessments before they size the air compressor. Only after we've calculated the air usage rates from all areas including the paint booth, the sanding machines, and the shop air, do we go about sizing the air compressor." All too often, shops fall prey to the "how much horsepower do you want?" question. The answer to any vendor should be, "How much air (cfm) do I need and at what pressure (psi)?"

Body shops that have piston compressors tend to operate at up to 175 psig, which is the nature of that type of compressor as opposed to their actual requirements. But, this is too high of a pressure level for their air demands as most air tools require 90 psi. So, unless the shop is running old air-over-hydraulic floor lifts (which require 150 psi) they are fine with 115 psig.

Most body shops don't realize that their air compressors typically represent 50–70%

Mattei Compressors USA automotive reps conduct shop air system assessments before sizing up an air compressor.

of their monthly electric bill. Consider that every 2 psi requires 1% more energy. Thus, operating an energy efficient compressor system at the proper pressure range for your specific application offers significant energy savings. People think the higher the pressure the more air they'll have. The opposite is true as the higher the system pressure, the more air is consumed through air tools and air leaks. Once air leaks have been eliminated and the air users optimized, then an air compressor can be selected with the appropriate controls. Mr. Kennedy concluded, "Every shop is unique and deserves the time to have the right compressor air system sized and installed."

Conclusion

Collision repair shops are adopting waterborne paints for environmental and legal reasons. Flash and curing times can be reduced by using properly designed, venturi air-gun nozzle systems designed to create turbulence in the booth. Compressed air systems and components (air treatment and air compressors) can be optimally sized and designed after a complete shop air system assessment is conducted. BP

For more information or to request a shop air system assessment, please contact Bill Kennedy, Mattei Compressors, email: bkennedy@matteicomp.com, tel: 410-521-7020, www.matteicomp.com

All too often, shops fall prey to the "how much horsepower do you want?" question. The answer to any vendor should be, "How much air (cfm) do I need and at what pressure (psi)?"

RESOURCES FOR ENERGY ENGINEERS

TRAINING CALENDAR

TITLE	DATE	LOCATION	SPONSOR(S)
Visit www.compressedairchallenge.org for more information.			
Fundamentals of Compressed Air Systems WE (web-edition)	May 18, 2011	Online Training	—
Advanced Management of Compressed Air Systems	May 18–19, 2011	Sacramento, CA	Sacramento Municipal Utility District, California Energy Commission, Compressed Air Challenge, DOE EERE
Fundamentals of Compressed Air Systems	May 24, 2011	St. Louis, MO	St. Louis University, Atlas Copco, Illinois Department of Commerce and Economic Opportunity, Ameren Illinois, Ameren Missouri, Act on Energy, Association for Facilities Engineering, Compressed Air Challenge, DOE EERE
Advanced Management of Compressed Air Systems	May 25–26, 2011	St. Louis, MO	St. Louis University, Atlas Copco, Illinois Department of Commerce and Economic Opportunity, Ameren Illinois, Ameren Missouri, Act on Energy, Association for Facilities Engineering, Compressed Air Challenge, DOE EERE
Airmaster+	June 7–10, 2011	Ann Arbor, MI	Michigan Industry Energy Center, University of Michigan Industrial Assessment Center, Compressed Air Challenge, DOE EERE
Fundamentals of Compressed Air Systems	June 21, 2011	Rocklin, CA	Capitol Air Systems, Compressed Air Challenge, DOE EERE
Fundamentals of Compressed Air Systems WE (web-edition)	September 12, 2011	Online Training	—
Fundamentals of Compressed Air Systems	October 11, 2011	Navy Pier – WEEC 2011 Chicago, IL	Association of Energy Engineers, USDOE, Compressed Air Challenge
Fundamentals of Compressed Air Systems WE (web-edition)	November 9, 2011	Online Training	—

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

PRODUCTS

Kaeser Announces Next Generation CSD and ESD Units

Kaeser Compressors announced, at the Hannover Fair, that the CSD and ESD single-stage fluid injected screw compressors have been redesigned to make them more compact and more energy efficient. New airend designs provide more flow per kW for best performance at design pressures. On the SFC (variable frequency drive) versions, all controls are in the main electrical cabinet. CSD Series models range from 60 to 125 hp. ESD Series range includes 250, 300 and 350 hp models.

Contact Kaeser Compressors, tel: 800-777-7873, e-mail: info.usa@kaeser.com, www.kaeser.com

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- **Compressed Air Users — Focus Industry**
  - A. Energy and utility managers share experiences
  - B. Audit case studies and "Best Practice" recommendations
- **Utility Providers & Air Auditors**
  - A. Utility company rebate programs
  - B. Case studies by expert compressed air auditors
- **Compressed Air Industry**
  - A. Profiles of manufacturers and distributors
  - B. Product technologies best suited for the focus industries
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RESOURCES FOR ENERGY ENGINEERS

PRODUCTS

Atlas Copco Launches the New ZH 350+

Atlas Copco announced, at the Hannover Fair, the launch of a new, highly energy-efficient, high-speed 3-stage turbo 100% oil-free air compressor. It is the first medium pressure industrial three-stage centrifugal compressor to be commercialized with high-speed motors and without a gearbox. The ZH 350+ (350 kW, 7-8 bar) is up to 4% more energy-efficient than the company's top-performing oil-free compressors. This new "three-stage turbo" design results in average lifecycle costs which are lower by 3% as compared to an oil-free screw design and by 18% when compared to a two stage turbo design.

Contact Atlas Copco, tel: 866-688-9611, www.atlascopco.us or www.classzero.com

New BEKO Technologies Clearpoint Filters

BEKO Technologies announced the new Clearpoint 3E technology for filter fibres. 3E is the abbreviation for Energy Efficient Element and defines the development-related concept of the filter series. The central point of the 3E technology is the employment of a highly-efficient new filter material. In a wet-saturated condition, an energy-optimised pressure difference of between merely 0.05 and 0.2 bar results from it. It consists of a poly-fibre compound with thermally fused borosilicate and polyester fibres. Through the thermal fusing, no disturbing adhesive residues occur between the fibres. Simultaneously, intrinsic particle release and thus contamination of the compressed air is reliably avoided. The oil- and water-repellent coating of the fibres provides excellent coalescence properties.

BEKO Technologies Corp., tel: 404-924-6900, email: beko@bekousa.com, www.bekousa.com

BOGE SR Series Boosters

Oil-lubricated piston compressors provide a flexible, cost effective and energy efficient solution for generating up to 600 psi at the point of use - ideal where high pressures are required at specific points within a compressed air network. Pressure ranges are 220 or 600 psi. Effective F.A.D. (depending on booster pressure) is 33–258 cfm. Rated power is 7.5 to 25 hp.

Contact BOGE America Inc., Tel: 770-874-1570, e-mail: usa@boge.com, www.boge.com/us

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 during the trading day of May 3, 2010.

MAY 3, 2011 PRICE PERFORMANCE	SYMBOL	OPEN PRICE	1 MONTH	6 MONTHS	12 MONTHS	DIVIDEND (ANNUAL YIELD) 12 MONTHS
Parker-Hannifin	PH	$93.92	$96.44	$78.06	$69.87	1.59%
Ingersoll Rand	IR	$50.45	$48.33	$39.95	$37.16	0.65%
Gardner Denver	GDI	$86.01	$80.00	$58.93	$50.42	0.23%
Atlas Copco ADR	ATLCY	$25.97	$24.34	$19.43	$14.50	1.50%
United Technologies	UTX	$90.00	$85.67	$75.21	$75.26	2.13%
Donaldson	DCI	$60.84	$61.80	$49.44	$46.37	0.85%
SPX Corp.	SPW	$86.37	$80.75	$67.43	$70.38	1.16%

Donaldson Reports Fiscal 2nd Quarter 2011 Earnings

Donaldson Company, Inc. (NYSE: DCI) announced its financial results for its fiscal 2011 second quarter.

	THREE MONTHS ENDED JANUARY 31			SIX MONTHS ENDED JANUARY 31		
	2011	2010	CHANGE	2011	2010	CHANGE
Net sales	$537	$436	23%	$1,074	$864	24%
Operating income	67	39	73%	142	91	55%
Net earnings	45	31	44%	98	66	49%
Diluted EPS	$0.56	$0.39	44%	$1.24	$0.83	49%

"We delivered a better quarter than anticipated as we established second quarter records in sales, operating margin, and EPS. We experienced a continued strengthening in many of our end markets and all of our regions, and our cost structure has continued to improve from our ongoing *Continuous Improvement* initiatives," said Bill Cook, Chairman, President and CEO. "As our sales have grown we have added people and significantly increased our investments, but at a slower rate than our sales growth."

"In the quarter, sales in our Engine and Industrial Products' segments increased 29% and 15%, respectively. Business levels improved in all of our regions as local currency sales increased 31% in the Americas, 20% in Europe, 21% in South Africa, and 18% in Asia."

"Purchased raw material costs were up slightly in the quarter, and we expect further increases in the future. During the second half of our fiscal year, we plan to offset the majority of the impact of these cost increases through our *Continuous Improvement* initiatives and selective price increases."

"With a projected operating margin performance of between 13.0 and 13.8%, we now forecast our full year EPS to be between $2.57 and $2.77, a new record, and up between 22 and 32% from the previous year."

WALL STREET WATCH

Gross margin was 35.3% for the quarter and 35.2% year-to-date, compared to prior year margins of 33.5% and 34.1%, respectively. The increase in this year's second quarter gross margin was the result of better fixed cost absorption and our ongoing *Continuous Improvement* initiatives, partially offset by increases in purchased raw material costs and a change in our sales mix. In addition, last year's second quarter gross margin included restructuring charges of $3.4 million.

Operating expenses for the quarter were $122.1 million, up 14.2% from $106.9 million last year. As a percent of sales, operating expenses decreased to 22.7% from 24.5% last year primarily due to the increased sales volume. Operating expenses year-to-date were $235.7 million, or 21.9% of sales, compared to $202.9 million, or 23.5% of sales, last year.

FY11 Outlook

We expect a continued recovery in many of our end markets in FY11, with higher growth rates in the emerging economies.

- We are planning our total FY11 sales to be over $2.2 billion, or up about 18 to 20% from the prior year. Our current forecast is based on the Euro at US$1.35 and 83 Yen to the US$.
- Our full year operating margin is forecasted to be 13.0 to 13.8%.
- Our full year FY11 tax rate is anticipated to be between 28 and 30%.
- Our full year FY11 EPS is expected to be between $2.57 and $2.77.
- Cash generated by operating activities is projected to be between $240 and $270 million in FY11. Capital spending is estimated to be between $70 and $80 million.

Engine Products: We expect full year sales to increase 21 to 26%, including the impact of foreign currency translation.

- Our sales to our construction, agricultural, and mining equipment OEM Customers are anticipated to remain strong globally. We will also benefit due to increased market share on our Customers' new Tier IV equipment platforms.
- We are forecasting moderately lower sales for our Aerospace and Defense Products due to the decreases in U.S. government spending.
- In our On-Road Products' business, we believe that build rates for heavy- and medium- duty trucks at our OEM Customers will continue accelerating consistent with current industry forecasts.
- Sales of our Aftermarket Products are expected to remain strong based on current utilization rates for both heavy trucks and off-road equipment. We should also benefit as our distribution networks continue to expand in the emerging economies and from the increasing number of systems installed in the field with our proprietary filtration systems.

Industrial Products: We forecast full year FY11 sales to increase 10 to 15%, including the impact of foreign currency translation.

- Our Industrial Filtration Solutions' sales are projected to increase 14 to 19% as the demand for new filtration equipment continues to improve as general industrial capital spending increases, primarily in Asia and the Americas.
- We anticipate our Gas Turbine Products' sales to be up approximately 5% due to strength in the oil and gas market segment.
- Special Applications Products' sales are forecasted to increase approximately 7% due to growing sales of our membranes products, which are partially offset by slower disk drive filter sales.

UTC Reports First Quarter 2011 Earnings

United Technologies Corp. (NYSE:UTX) reported first quarter 2011 earnings per share of $1.11 and net income attributable to common shareowners of $1.0 billion, up 19% and 17%, respectively, over the year ago quarter. Sales for the quarter increased 11% to $13.3 billion with 9% organic growth. Favorable foreign currency translation and net acquisitions each contributed 1% to the sales growth.

Results for the current quarter include $0.02 per share in restructuring costs. Earnings per share in the year ago quarter included $0.05 in restructuring costs. Before these items, earnings per share increased 15% year over year. Foreign currency translation and currency hedges at Pratt & Whitney Canada accounted for $0.01 of the earnings per share increase.

First quarter segment operating margin at 14.7% was 100 basis points higher than prior year. Adjusted for restructuring costs, segment operating margin at 15.0% was 80 basis points higher than prior year. Research and development costs increased year over year by $88 million to $485 million. Cash flow from operations was $1.36 billion and, after capital expenditures of $180 million, exceeded net income attributable to common shareowners.

"This was another solid quarter for UTC with broad-based acceleration in organic growth, as well as strong earnings momentum and cash generation," said Louis Chênevert, UTC Chairman & Chief Executive

Officer. "Nearly 20% growth in earnings per share reflects excellent conversion, especially as we continued to increase our investments in game changing products and technologies."

"Based on the strong start to the year, particularly in Carrier's short cycle businesses, we are raising the full year earnings per share expectation to $5.25 to $5.40, from $5.20 to $5.35 previously. We now anticipate 2011 EPS growth to be 11 to 14% on sales growth of 5%," Chênevert added. "The global economic recovery continues to gain traction as evidenced by the momentum of our end markets and we now expect 2011 sales of $57 billion, at the high end of our prior range of $56 billion to $57 billion."

New equipment orders at Otis were up 17% over the year ago first quarter including favorable foreign exchange of 3 percentage points. Commercial HVAC new equipment orders at Carrier grew 26% including favorable foreign exchange of 2 points. Commercial spares orders at Pratt & Whitney's large engine business grew 33% and at Hamilton Sundstrand were up 23% over the year ago first quarter.

"Continued focus on working capital drove strong cash generation even with the increase in inventory. We continue to expect UTC's cash flow from operations less capital expenditures to meet or exceed net income attributable to common shareowners for the year," Chênevert said.

Share repurchase in the quarter was $750 million and acquisition spending was $106 million. Full year expectations remain unchanged for both share repurchase and acquisitions at $2.5 billion and $1.5 billion, respectively. BP

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