Water Hammer Damage Protection

Screw Blowers for Wastewater Aeration

September 2010

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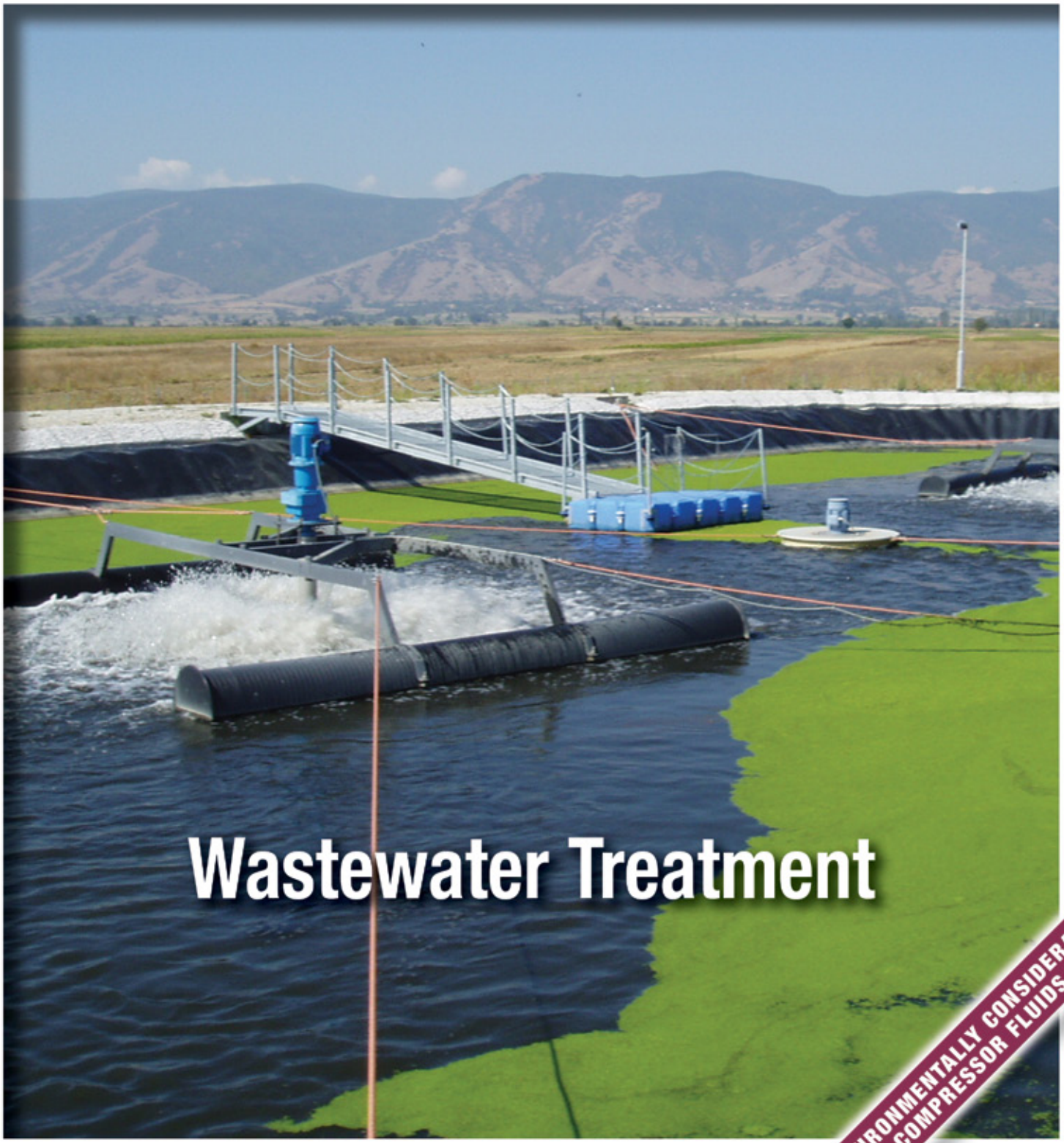

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FROM THE EDITOR

Wastewater Treatment Plants

The reason I enjoy this job is that I am always learning about new ways to save energy. Though I must admit, I can't find anyone at dinner parties who wants to talk about these things…("Hi there, guess what the average sewage aeration efficiency is at an activated sludge wastewater treatment plant?"). For this, I am grateful to the readers of Compressed Air Best Practices®, who also find these topics interesting! I know that you share my pain.

So, this month was no different! Wastewater treatment really is one of the most exciting industries and areas of opportunity in North America. Opportunities abound in both energy-conservation measures and in biogas renewable energy.

"Energy Efficiency in Municipal Wastewater Treatment Plants," a 1993 study conducted by Lawrence J. Pakenas, P.E. for the New York State Energy Research and Development Authority (NYSERDA), reached several interesting conclusions:

- The 570 wastewater treatment plants (WWTPs) in New York State consume about 1.5 billion kWh per year of electricity for sewage treatment and sludge management
- Electricity use in sewage treatment goes to aeration (67%), pumping (21%), other loads (9%) and lighting (3%)
- There are three types of commonly used aeration processes:
  - Mechanical Aeration: oxygen transfer efficiency of 2–4 lbs. of oxygen transferred per horsepower-hour
  - Diffused Air Coarse-Bubble Aeration: oxygen transfer efficiency of 2–4 lbs. of oxygen transferred per horsepower-hour
  - Diffused Air Fine-Bubble Aeration: oxygen transfer efficiency of 4–8 lbs. of oxygen transferred per horsepower-hour
- In the activated sludge process, aeration systems typically supply much more air than is required for mixing and biological activity. This occurs due to oversized equipment, inefficient operation and a lack of controls
- If an existing aeration system were retrofitted with automatic controls to maintain a setpoint concentration of dissolved oxygen in the aeration tanks, aeration energy could be lowered up to 30%

In this month's edition, we are able to provide you with an article from Atlas Copco that discusses applying rotary screw blowers to WWTPs as a way to save energy. Hycomp also provided an article on how their systems provide protection against water hammer damage. Finally, we provide a case study on a WWTP in Washington where a blower system retrofit saved energy and a new cogeneration system enabled the facility to use the methane as a renewable source of energy. I hope we've given you some "biofuel" for your next dinner-party conversations!

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

ROD SMITH
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rod@airbestpractices.com

Editor's Correction: The article in our July 2010 Edition titled, "Compressed Air Auditing — What You Should Expect!", by Scot Foss had incorrect contact information for the author. It is as follows: Scot Foss, Air's a Gas, Inc., 3728 Berenstain Drive, St. Augustine, FL, 32092, Tel: 904-940-6940, Fax: 904-940-6941, email: airsagas@aol.com.

SUSTAINABLE MANUFACTURING NEWS

GE and Environmental Defense Fund Collaboration and Wastewater Best Practices

SOURCED FROM THE WEB

EPA Invests $500,000 in Mississippi Wastewater Treatment System Project

U.S. Environmental Protection Agency (EPA) Acting Regional Administrator, Stan Meiburg, joined Congressman Bennie Thompson and a host of state and local officials at a news conference to announce the start of construction of a wastewater treatment system costing approximately $1 million in Bolivar County, Mississippi. Of the $1 million, Bolivar County received approximately $500,000 from EPA in addition to approximately $500,000 from the Department of Housing and Urban Development, Community Development Block Grant program.

"This project represents a sustainable approach to solving problems in communities with inadequate or nonexistent wastewater treatment," said Meiburg. "We are delighted at this opportunity to work with Congressman Bennie Thompson and other strong partners at the federal, state and local level, to invest in communities and protect human health and the environment."

Initially in early 2008, the Lamont project was to be a grinder pump collection system, package activated sludge treatment system, followed by land application. Following discussions with EPA, the project was modified to a Decentralized Wastewater System. This type of system can be a sustainable approach for rural, underserved communities, because it will utilize simple treatment processes with several advantages over traditional wastewater alternatives, such as simple operation and maintenance, lower energy requirements, lower operation, lower maintenance costs and an opportunity to reuse wastewater.

Source: www.energystar.gov

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SUSTAINABLE MANUFACTURING NEWS

GE and Environmental Defense Fund Collaboration and Wastewater Best Practices

GE, EDF Collaborate to Improve Energy Efficiency, Reduce Costs for Cities, Universities and Private Industry

In an effort to help cities, universities, customers and members of private industry improve energy efficiency and cut costs, GE (NYSE: GE) and Environmental Defense Fund (EDF) are collaborating to identify energy savings opportunities for partners. Through New York City Mayor Michael Bloomberg's Hospital Challenge, Continuum Health Partners' (CHP) Roosevelt Hospital served as the first site for the ecomagination Treasure Hunt program, where opportunities for $2.1 million in energy savings with a payback of 2.6 years were identified, leading to more than 7,500 metric tons of emissions reductions annually.

"Without the involvement of our private-sector partners in innovative programs like the Mayor's Hospital Challenge, we will never reach the ambitious carbon-reduction goals we set in PlaNYC," said Mayor Bloomberg. "Hats off to GE and Continuum for their efforts to help our hospitals and other large institutions save on energy costs and reduce our carbon emissions."

"Rather than having a consultant write a report on potential energy projects, the Treasure Hunt process allowed for Roosevelt employees to share ideas that were quantified in energy dollars and metric tons of carbon dioxide saved," said Continuum Health Partners assistant vice president of Corporate Engineering, Stephen Monez.

Through its ecomagination initiative, GE has made significant progress on its own energy reduction goals by utilizing Treasure Hunts, an internal process where GE leaders work with onsite staff to apply technology expertise and process improvement tools to identify, quantify and recommend enhancements to sources of energy waste — including electricity, natural gas, water, wastewater, compressed air and steam. Since 2005, the company has performed more than 200 internal Treasure Hunts, contributing to energy savings of over $130 million. The CHP opportunity was identified through Mayor Bloomberg's Hospital Challenge, where thirteen of New York City's largest hospital systems have agreed to work together to lower their overall energy footprint. In conjunction with the mayor's staff, GE has provided critical information to participants of the Challenge regarding the four key steps in solving energy problems: identification, technology, implementation and financing.

"Extending our Treasure Hunts to external partners and helping them reduce costs and save energy is a logical next step for GE," said Steve Fludder, GE's vice president of ecomagination. "This initiative has already revealed significant results, as demonstrated by our first partnership with Continuum Health Partners. We look forward to working with EDF in this effort to show how energy efficiency progress can be accelerated through partnership and collaboration."

GE is collaborating with EDF, a global non-profit focused on finding solutions to society's most urgent environmental problems, in an effort to drive energy efficiency awareness and action throughout the country. EDF is helping GE explore avenues for sharing best practices from the Treasure Hunt process more widely across industries and sectors and has helped select targeted sites for this initiative. Over the next few months, EDF and GE will work to verify energy efficiency opportunities and identify industry best practices at select sites, including facilities run by the cities of Atlanta and Orlando, the University of Illinois at Urbana-Champaign, Merck and others. The ecomagination Treasure Hunts at these sites will require staffing resources, but there is no direct fee charged for the opportunity.

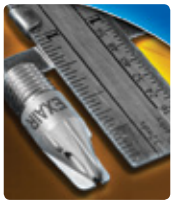
"Trillions of dollars in energy savings are up for grabs in the United States," said Gwen Ruta, EDF vice president for Corporate Partnerships. "Working with GE, we're making it possible for cities and towns, hospitals and universities and businesses of all sizes to ferret out the valuable energy treasure buried in their own backyards."

More information about ecomagination Treasure Hunts can be found at ecomagination.com/projects/treasure-hunts and edf.org/treasurehunts.

Source: www.ecomagination.com

Nano Super Air Nozzle for precision blowoff

The Nano Super Air Nozzle is the smallest available. EXAIR's "precision blowoff" provides optimum air entrainment for a directed high volume, high velocity airflow. The compact size permits mounting where space is limited.



www.exair.com/78/nano.htm

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www.exair.com/78/blast.htm

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www.exair.com/78/2san.htm

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www.exair.com/78/jet.htm

Super Air Nozzles™

The aerodynamic design of EXAIR's Super Air Nozzles provide a high thrust, concentrated stream of high velocity airflow. The sound level is as low as 71 dBA with hard-hitting force up to 23 pounds. All meet OSHA noise and pressure requirements.

www.exair.com/78/super.htm

A breeze to a blast

These Safety Air Nozzles are adjustable, making them suitable for a wide variety of blowoff applications. EXAIR's design allows you to "tune in" the force and flow to the application requirements, thereby minimizing air consumption. A micrometer like dial indicates the gap setting.

www.exair.com/78/adjust.htm

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33 SCFM (copper tube) - 14 SCFM (Super Air Nozzle) = 19 SCFM compressed air saved. For this example, the blowoff is continuous.

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SCFM saved **x** 60 minutes **x** cost/1000 SCF **=** Dollars saved per hour.
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SUSTAINABLE MANUFACTURING NEWS

GE and Environmental Defense Fund Collaboration and Wastewater Best Practices

Best Practices: Austrian Wastewater Plant Is a Net Producer of Energy

Did you know that wastewater contains ten times the energy needed to treat it? Located near Strass im Zillertal, the Strass wastewater treatment plant (WWTP) serves 31 communities in the Achental and Zillertal valleys east of Innsbruck, Austria. It provides wastewater treatment for a population that ranges from approximately 60,000 in the summer to 250,000 during the winter tourist season, and has treatment requirements that include organic and nitrogen removal. An energy-independent facility, the plant produces more electrical energy than it requires for its operation.

The peak winter flow and load is equivalent to a plant treatment capacity of 10 mgd. Using a two-sludge system (high-rate BOD removal followed by nitrification/denitrification), it provides for both nitrogen and phosphorus removal, biologically and chemically, respectively. The plant was commissioned in 1999 and successive optimization efforts over the past decade have resulted in significant cost and resource reduction. Highlights of these efforts include:

- Reduction of chemical costs for sludge thickening by 50%
- Reduction in sludge dewatering costs by 33%
- Reduction in energy consumption on mass treated basis from approximately 6.5 euro/kg NH4-n removed in 2003 to 2.9 euro/kg NH4-n removed in 2007/2008, primarily through active management of dissolved oxygen (DO) setpoints and conversion of the aeration system from conventional fine bubble to ultra-high efficiency strip aeration
- Reduction in energy consumption for sidestream treatment from 350 kwh/d to 196 kwh/d by implementing a novel sidestream nitrogen removal system (DEMON®)
- Enhanced utilization of the digester gas by converting to a state-of-the-art cogeneration unit, boosting electrical efficiency from 33% to 40% and overall usage efficiency from 2.05 to 2.30 kwh/m3 of digester gas

Treatment Processes Operated at the Strass Plant

The Strass plant provides two-stage biological treatment (A/B plants) to treat loads varying from 60,000–250,000 population equivalents (weekly average), with higher loads during tourist seasons. The high-loaded A-stage with intermediate clarification and a separate sludge cycle eliminates 55–65% of the organic load. The A-stage is operated at half-day sludge retention time (SRT), while the target SRT in the B-stage is about 10 days. Nitrogen elimination in the low-loaded B-stage is achieved by pre-denitrification to produce an annual N-removal efficiency of about 80% at a maximum ammonia effluent concentration of 5 mg/L. All activated sludge tanks can be operated aerobically if required. Airflow and aeration periods are controlled by on-line ammonia measurement.

All excess sludges are thickened, anaerobically digested and dewatered. The sidestream from dewatering is treated prior to re-introduction into the main plant processes using Sequencing Batch Reactor (SBR) technology, adapted for ammonia removal using the DEMON® process.

The two-stage biological treatment approach results in the high-rate entrapment of organics without excessive aerobic stabilization in the A-stage system. Due to the reduced SRT, organic compounds are removed mainly by adsorption from the A-stage onto solids, and are immediately conveyed through thickening and digestion, where the conversion of organics to biogas occurs.

The Transformation from Energy Consumer to Producer

The annual rate of energy consumption in 2005 was 7,860 kWh/day. The electricity demand of the B-stage represents 47% of the total consumption. Due to site constraints, the Strass plant has relatively high energy consumption rates for influent pumping (9%) and for off-gas treatment (13%).

Air supply to the B-stage biological process is primarily governed by nitrification requirements; air supply is not required for heterotrophic nitrate reduction in anoxic zones of the bioreactor. The Strass WWTP employs swing zones that can be used in either aerobic or anoxic modes, alternating to minimize air supply and energy requirements. The reactor volume required for aerobic nitrification is adjusted to maximize the denitrification volume while still achieving full nitrification, which depends on the instantaneous actual load. Intermittent aeration of the swing zones is operated between two setpoints of the on-line ammonia control, leading to extended aerobic intervals in the afternoon. If the ammonia concentration increases to a maximum threshold value, then all of the swing zones are aerated rather than used for denitrification. This control strategy results in stable ammonia removals and fluctuating effluent nitrate concentrations.

Electricity production by the biogas-driven generators was 8,490 kWh/day in 2005. As the collective result of many individual measures, the percentage of energy self-sufficiency improved steadily from 49% in 1996 to 108% in 2005. A major step forward in energy production was the 2001 installation of a new, higher-efficiency, eight-cylinder co-generation engine that provides 340 kW of power. The new co-generation units have an average conversion efficiency of 38%, which is 20% higher than the 33% efficiency provided by the previous units.

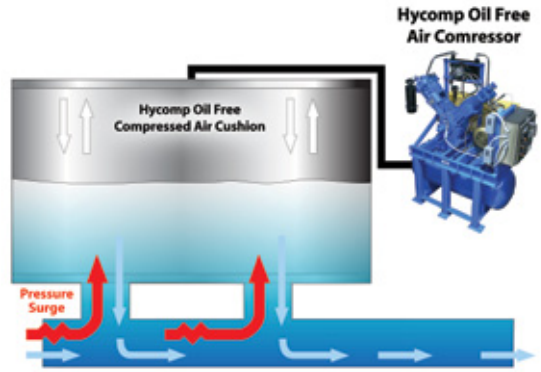
From 1997 until 2004, Strass operators applied an SBR strategy for nitrification/denitrification using excess sludge from the A-stage system as a carbon source. After 2004, the plant implemented the DEMON® process for deammonification, which does not require supplemental carbon (Wett, 2006). This achieved two favorable outcomes: energy requirements for nitrification of the sidestream ammonia were reduced, and the organic sludge previously required for denitrification of the sidestream was now available for conversion to biogas within the digesters. The higher proportion of A-stage sludge in the feed to the digesters increased the methane content from about 59% to 62%. The combined benefits of the savings in aeration energy and additional methane result in an overall reduction of 12% on the plant-wide energy balance (Wett and Dengg, 2006). BP

Source: Water Environment Research Foundation: Case Study: "Sustainable Treatment: Best Practices from the Strass in Zillertal Wastewater Treatment Plant," www.werf.org.

THE TECHNOLOGY PROVIDER

Protection Against Water Hammer Damage

BY ROGER ANDERSEN AND MATT LOGAN, HYCOMP INC.



The air cushion provided by a hydropneumatic tank absorbs the shockwaves from water hammer.

Properly sized hydropneumatic tanks are often bigger than most people may think. Tanks that are too small are dangerous, as they provide very little protection and a false sense of security.

When installing various water systems and specifically, municipal culinary water systems, engineers tend to focus on two main points: 1) designing an efficient system, and 2) protecting that system against potential problems.

What Is Water Hammer?

One major problem that causes severe damage or system failure for any water treatment station is water hammer shock waves. *"Water Hammer"* or *"Hydraulic Shock"* is a pressure surge or shockwave resulting when a fluid (usually a liquid but sometimes also a gas) in motion is forced to stop or change direction suddenly (momentum change). The reversed momentum then continues to multiply the farther it travels before being stopped.

Cause and Effect

This pressure wave can cause major problems — from noise and vibration to pipe collapse and total system failure. If the flow is suddenly closed at the outlet (downstream), the mass of water before the closure is still moving forward with some velocity, building up high-pressure shock waves. When that flow hits the closure it has nowhere to go but backwards towards the source.

In residential plumbing, this is experienced as a loud banging resembling a hammering noise, which usually occurs near the home's internal water source, i.e., the utility closet. Most homes built in the last 20 years in the United States have miniature protection tanks or pulse dampeners similar to hydropneumatic tanks built into industrial water treatment systems.

These residential dampener tanks are usually four or five gallons in size, and unlike their industrial counterparts, there is no compressor providing pressurized air. The residential tanks tend to be located near the water heater tank and buffer the shock of water hammer with an air bladder. The end result of industrial water system protection and home pipe protection is on a different scale, but is virtually the same in theory.

Solution

Protecting water treatment plants or pipelines against water hammer is not a new idea and is used in pressurized and non-pressurized systems alike. In non-pressurized systems, air traps or stand pipes (open at the top) are sometimes added as dampers. These methods provide a cushion to absorb the force of moving water,

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Protection Against Water Hammer Damage

or a route to divert the surge of water hammer. At some hydroelectric generating stations, what appears to be a water tower is actually one of these devices, known as a surge drum.

In pressurized water systems, a very effective protection against water hammer damage is the use of hydropneumatic tanks. Similar to a surge protector for electronic devices, a hydropneumatic tank is designed for water storage and provides a pressurized air cushion needed to absorb or dampen the surge before it reaches the water treatment system.

The density of water is 800 times greater than that of air. As a result, air is compressible, while water is not. A hydropneumatic tank utilizes the vastly different densities of water and air by applying compressed air to cushion water stored in the surge tank. Air pressure in the tank will vary as the volume of water rises and falls, based on system demand.

Sizing hydropneumatic protection systems, including the proper compressor(s) and tank(s), can be difficult. Specifications frequently request a tank that is too small for the system, and therefore an underpowered and overworked compressor is also recommended. Using an improperly sized hydropneumatic system is like putting truck breaks on a freight train — it's not going to work and it could fail in a catastrophic fashion.

The Hycomp Answer

When dealing with culinary water systems, it is very important to keep the water clean from contamination. Hycomp Inc. manufactures an oil-free air compressor that has proved very successful in providing the clean air cushion needed to buffer hydropneumatic tanks and protect water systems, without introducing contaminates.

Hycomp oil-free air compressors manufactured for hydropneumatic tank protection are built to provide true continuous operation. This means that they are built to run 24 hours day/7 days a week, which is a standard requirement of compressors being used to protect water systems. The standard capabilities for Hycomp oil-free compressors used for this application are 150–575 psig and 5–40 scfm.

Hycomp Inc. manufactures compressors that are tailored to their specific use, and as such, they can be configured to any application's exact needs and conditions. An intuitive and easy-to-use digital control panel provides precise controller settings and monitoring. Precise settings are always found on screen, such as: oil, inlet and discharge pressures and discharge temperature. Preventative maintenance monitors and trouble alarms using event history screens and troubleshooting guides ensure system reliability and protect against unexpected downtime using event history screens and troubleshooting guides.

Many Hycomp hydropneumatic tank compressors are in use today. The need for this type of system protection is much more prevalent in the Western United States, as there is more variation in the geographic topography. Conversely, surge drums resembling water towers are more widely utilized in the Eastern United States, where the landscape is much flatter.

Whether the conditions are at nearly 6,000 feet above sea level in the mountains of Utah and Colorado or the rugged desert climates of Nevada, California and Arizona, Hycomp compressors provide the compressed air cushion required to protect the water system. Hycomp engineers design each compressor to thrive in their environment and run continuously under whatever conditions are required of them. The following case studies illustrate the quality and adaptability of Hycomp engineering.

Case Study 1:

Model: 3AN44V
Gas: Air
Suction Pressure:
Ambient at 5682 ft. ASL
Discharge Pressure: 520 psig
Flow: 20 scfm

A water conservancy company was installing a pump station in Lost Canyon, Utah and needed to protect the station against water hammer damage. It was paramount to have an oil-free air compressor that would not contaminate the culinary water supply. They also needed to create 520 psig continuously, at 5862 ft. above sea level (ASL), to provide the required cushioning.

Hycomp's 3AN44V air compressor system was chosen to meet their process needs. A custom support frame system to mount the compressor on top of a 120-gallon storage tank was also designed to reduce the installation footprint of the equipment. A pair of identical compressor systems was installed to provide guaranteed redundancy of equipment.

Once installed, the customer reported that the Hycomp air compressors ran smoother, quieter and cooler than they had anticipated. More importantly, the water system is protected from water hammer and surge damage with no additional contamination exposure.

Case Study 2:

Model: 3AN44V
Gas: Air
Suction Pressure: Ambient
Discharge Pressure: 250 psig
Flow: 34 scfm

The City of North Las Vegas required a new culinary drinking water system. Hydropneumatic tanks were recommended to dampen and absorb water hammer shocks. The compressors needed to be oil-free, air-cooled and rated for true continuous duty at 250 psig.

Because of the high discharge pressures and requirement for continuous duty, two Hycomp 3-stage oil- free air compressors were specified and installed. An air-cooled after cooler and separator were also installed to ensure cool air temperatures for the surge tanks. Continuous operation at 250 psig was no problem for the two Hycomp air-cooled units, and these oil-free air compressors met the strict regulations for drinking water. BP

Blower Advancements
for the Wastewater Industry

BY JOHN CONOVER
ATLAS COPCO COMPRESSORS

A Rotary Screw Blower Package with Variable Speed Drive.

The Numbers Don't Lie

It's a popular saying that everyone has heard before and can be applied to a variety of situations — political statistics, figures backing up an athlete's performance and budget data.

Thirty percent is a big number. Applied to the above scenarios, it could entail a landslide victory or a hitter gaining entry into the Baseball Hall of Fame. But just imagine, if the manager of a wastewater treatment facility were to trim 30% from operating costs, he or she might also consider that a landslide victory of his/her own.

Energy costs are a central figure in facility management, and, in many areas of the country, they have more than doubled in recent years. Appropriately, energy conservation and the associated cost savings, as well as a mitigated impact on the environment, have become primary factors for today's facility managers.

Air Blowers

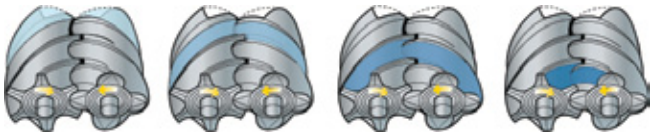
Air blowers are critical to this process, but can consume a large amount of total electricity costs required for wastewater treatment. Consider these quick facts from the Environmental Protection Agency (EPA) about energy use at wastewater treatment facilities:

- About 3% of the total energy usage in the United States is used to power processing operations at drinking water and wastewater treatment facilities
- Wastewater treatment facilities collectively account for energy costs that total nearly $3 billion each year (about 56 billion kWh) and add an estimated 45 million tons of greenhouse gases to the atmosphere annually
- In a typical biological wastewater treatment plant, the aeration blower system alone can account for up to 70% of the facility's entire energy usage

When costs loom this large, it's easy to see that even a little savings goes a long way. Even an annual energy savings of just 10% in this sector could collectively save about $400 million every year. Multiply these figures by three, and the impact is tremendous.

Rotary Screw Blowers

In aerobic wastewater treatment, bacteria feed on organic waste and break it down into carbon dioxide, nitrogen and water. Because the bacteria need oxygen as part of this process, large quantities of air are bubbled into aeration tanks. To help reduce energy use, Atlas Copco has introduced an entire line of ZS screw blowers that replace the conventional technology represented via the rotary lobe positive displacement blower. This new and proven energy-efficient range for air blowing applications has been demonstrated in third-party independent testing to average 30% more energy-efficient operation than conventional lobe blower technology. Saving 30% is not the product of myths or dreams anymore.



About 3% of the total energy usage in the United States is used to power processing operations at drinking water and wastewater treatment facilities.

BLOWER ADVANCEMENTS FOR THE WASTEWATER INDUSTRY

Wastewater treatment facilities collectively account for energy costs that total nearly $3 billion each year (about 56 billion kWh) and add an estimated 45 million tons of greenhouse gases to the atmosphere annually.

The 150-year old technology employed in rotary lobe positive displacement blowers uses two or three lobed rotors that spin inside a casing, drawing air into the blower and pushing it through the outlet. Air pressure throughout the process remains constant, until the rotor lobes uncover the exit port. Some air from the discharge piping flows back into the blower, increasing pressure and reducing volume in the trapped pocket. The rotor lobes continue to turn until this volume of air is pushed out of the casing. The process results in high-pressure pulsations and the classic "thumping" noise or "whine."

The technology employed with the new screw blowers is essentially a scaled version of the principles used in an air compressor. Paired male and female rotors trap and then squeeze air between them. Air is progressively compressed during each rotation.

At the start of the compression cycle, air fills the space between the fluted and lobed rotor. As the rotors turn, the intake closes, trapping a given volume of air. The rotors continue to turn, reducing the volume between the male and female rotor halves. The rotors continue to mesh with one another until the air exits the outlet port.

Side-by-Side Comparison by TÜV

Because the process of compression occurs internally, less energy is required to move the compressed air to its end use.

To compare the performance of a rotary lobe blower versus an oil-free screw blower, laboratory testing was conducted comparing the two technologies in the same environment under equal operating conditions. The energy consumed by each machine was measured at the power source, as were the flow levels at each machine's respective outlet.

In a recent case study, when screw blower and rotary lobe technologies were examined in side-by-side comparisons under identical conditions — 2,000 cfm for 8,760 hours, or one year, at $.052/kWh — the screw blower technology realized a savings of nearly $15,000 a year, or $150,000 over 10 years, compared to conventional rotary lobe positive displacement blowers.

In this particular test, a tri-lobe rotary blower was sized with a 110 kW motor and connected to a separately installed frequency converter. For comparison, an oil-free screw blower was fitted with a 75 kW motor with an integrated frequency drive. The resulting measurements, taken at maximum volume flow of each machine, showed that the rotary lobe displacement blower needed an average 32% more energy to move the same amount of air.

Additional testing conducted by the Technische Überwachungs-Verein (German Technical Monitoring Association or TÜV), an independent, third-party organization, witnessed the testing, and then compared the performance of the new oil-free screw blower against a tri-lobe blower (TÜV Certification is often compared to both ISO Standards and Underwriters Laboratories Certifications in the U.S.; German-made automobiles also are not cleared for operation in that country until they receive TÜV Certification). Test results showed that the screw blower averaged a 23.8% betterment improvement in energy efficiency than a tri-lobe blower at 0.5 bar(e)/7 psig, and showed a 39.7% improvement at 0.9 bar(e)/13 psig.

Sound, Range and Temperature Considerations

As a side benefit of the screw blower technology, these energy-efficient blowers are also significantly quieter, operating at 75 dBa versus the 85–90 dBa of rotary lobe blowers. That's a difference comparable to exposure to the noise levels in a busy restaurant (about 80 dBa) versus standing next to a running lawnmower (about 90 dBa). And, as an indication of how much better these noise levels are for employees, the Occupational Safety and Health Administration (OSHA) mandates that employers must administer a continuing hearing conservation program for employees who experience occupational noise levels that meet or exceed an eight-hour period of exposure level to 85 dBa. No additional or special precautions to safeguard the employee's exposure are mandated below this level.

Equally as important, the discharged air temperature from a screw blower is, on average, about 40˚ F less than a lobe blower, giving wastewater plants many more options on the piping systems they can utilize.

Where this screw blower technology really outshines traditional technology is in its very broad operating range. The rotary screw technology can operate from 100% capacity to 25% capacity with very little change in specific power. This means that as the plant's biological demand changes, the blower can adapt its capacity to the demand and provide greatly improved overall operational efficiency.

In a typical biological wastewater treatment plant, the aeration blower system alone can account for up to 70% of the facility's entire energy usage.

Conclusion

Wastewater treatment facilities provide critical functions that know no holidays or weekends. Because manufacturing facilities and residents in cities and towns depend on clean water, it is essential that these operations continue without fail. Embracing new technology that has been proven to cut costs by as much as one-third without compromising quality is also essential for managers who consider the bottom line equally as important. BP

For more information, contact John Conover, Product Manager, Low Pressure Blowers & Compressors, Atlas Copco Compressors, LLC. www.efficiencyblowers.com/efficiencyblowersus/.

FSCOMPRESSION

A new compressed air sales and service company has opened for business in Stafford, Texas. FS-Compression Co., LLC is a direct sales and service company launched by Fusheng Group to support FS-Curtis and FS-Elliott compressed air system products for southern Texas and southwestern Louisiana.

Expanded Service Capabilities

One of the company's main objectives is to provide local service capabilities for the large installed base of FS-Elliott centrifugal air compressors in the local petrochemical and refining industries. "The facility has 12,000 square feet of space, 9,000 of which is dedicated to the shop area," says Ronald Stewart, Vice President of FS-Compression.

The main intent of the shop is to do air end overhauls of centrifugal air compressors. "Houston is one of our largest markets, and our customers will save time and money by being able to receive local factory service," continued Stewart.

"Houston is one of our largest markets, and our customers will save time and money by being able to receive local factory service."

— Ronald Stewart,
Vice President of FS-Compression

Sales and Stocking Center for FS-Curtis and FS-Elliott

FS-Compression strengthens the direct sales efforts of FS-Elliott centrifugal air compressors to our customers in the refining and petrochemical industries. The business also serves as a master distributor for FS-Curtis rotary screw and reciprocating air compressors. The company is carrying an inventory ranging from 5–300 horsepower of FS-Curtis air compressors. It also carries a full range of compressed air treatment products. The warehouse is designed to support the distributors of FS-Curtis, who will be able to buy complete units and service parts locally. BP

For more information, please contact Ronald Stewart, FS-Compression Co., LLC, Tel: 1-562-243-1916, Email: rstewart@fs-elliott.com.

Rather than shipping the air compressors to another location, customers will see a several-week reduction in time to get the overhaul complete. Another benefit cited is that customers can come and witness the overhaul being performed and provide input.

The shop has two Schenck balancing machines, which allow the facility to balance the rotors of the centrifugal compressors. All rotors have to be balanced at partial speed. FS-Compression has all the factory specifications and the full support of the engineering group at FS-Elliott. After a rebuild, the machine will receive a one-year warranty on parts and labor. A complete overhaul will consist of:

1. Receiving the air end and inspecting external parts
2. Disassembling the machine
3. Determining what parts need to be replaced
4. Inspecting rotors
5. Re-assembling and balancing rotors
6. Rebuilding the air end

SUSTAINABILITY PROJECTS FOR INDUSTRIAL ENERGY SAVINGS

Water Treatment Plant Receives $1.7 Million Energy Grant

BY COMPRESSED AIR BEST PRACTICES®

Introduction

A new cogeneration system installed at the Budd Inlet Treatment Plant by the LOTT (Lacey, Olympia, Tumwater and Thurston County) Clean Water Alliance late last year uses treatment by-products as fuel to generate electricity and heat energy. This renewable energy system, combined with an aeration blower retrofit currently underway at the Budd Inlet Treatment Plant, is expected to save LOTT more than $228,000 per year in utility costs.

Puget Sound Energy Provides $1.7 Million

Puget Sound Energy (PSE) provided a $1.7 million Energy Conservation Grant to install the cogeneration system. PSE is Washington State's oldest and largest energy utility, with a 6,000-square-mile service area stretching across 11 counties. They serve more than 1 million electric customers and nearly 750,000 natural gas customers. The PSE grant represents 70% of an estimated total project cost of $2.4 million for the cogeneration system project. The estimated PSE grant for the aeration blower upgrade is more than $300,000, which represents 70% of the total project cost. The combined projects are expected to result in an energy savings of more than 2.8 million kilowatt-hours (kWh) per year, enough to power more than 210 Thurston County homes.

The new cogeneration system supports plans to earn LEED Certification for the LOTT Regional Services Center.

The New Cogeneration System

Methane gas is a by-product of the wastewater treatment process. The gas can be used to produce renewable energy through a cogeneration system. LOTT's cogeneration system converts methane gas to heat and energy for use in the treatment processes at the Budd Inlet Treatment Plant, as well as for heating and cooling of LOTT's new Regional Services Center.

Staff selected the cogeneration system because it is expected to produce the most usable energy per pound of CO_2 released, in comparison to the other alternatives studied. Employing the cogeneration process includes adherence to strict emissions standards, as well as combusting approximately 99.9% of the methane, dramatically reducing LOTT's greenhouse gas emissions.

Prior to project completion, LOTT's Budd Inlet Treatment Plant burned off some of its methane gas into the atmosphere. Installation of a cogeneration system enabled the gas to be captured, cleaned and used to produce heat and electricity.

The cogeneration system included the installation of a new gas treatment system, a reciprocating engine with a heat recovery unit and two small natural gas boilers. The new system is expected to save the facility nearly $180,000 per year in utility costs, provide all of the heating required at the site as a "district heating" plant, eliminate the need to burn off excess digester gas and greatly reduce the emissions of the site.

Heat recovery units capture and transfer heat from the engine to an existing heated water loop at the plant. The loop was extended to the LOTT Regional Services Center and WET Center on the Budd Inlet Treatment Plant site and to the Hands On Children's Museum, adjacent to the plant. The heat generated from the system is anticipated to be more than enough to serve the new LOTT building, the future Hands On Children's Museum and LOTT's process needs at the plant.

As an innovative, renewable energy technology, the cogeneration system supports plans to earn LEED Platinum Certification for the LOTT Regional Services Center.

WATER TREATMENT PLANT RECEIVES $1.7 MILLION ENERGY GRANT

Anaerobic Digesters

Aeration Blower Retrofit

The aeration blower retrofit replaced one of the large existing blowers with a smaller, high-efficiency high-speed turbine blower, while retaining the remaining three existing blowers to meet future demand. The new blower will become the primary operating unit, serving approximately 95% of the plant's aeration system needs. This will enable the plant to increase overall aeration system efficiency and meet future aeration process demands.

The existing system had several large 200 horsepower motors that could only run at constant speed, producing far more air than was needed. The new system replaced one of the blowers with a high-efficiency blower that has a variable frequency drive that can meet variations in demand.

The aeration blower retrofit, scheduled for completion in August 2010, is expected to save more than $48,000 in utility costs for the LOTT Alliance.

Energy Performance Contract with Trane

A Washington State Department of General Administration Energy Performance Contract was used to procure services associated with the design and installation of the two projects. This option provides a method for organizations to manage and optimize their energy use, enabling them to support strategic business objectives.

"As a public wastewater treatment facility, responsible use of community resources represents the core of our work," said Doug Mah, president of the LOTT Clean Water Alliance board of directors and mayor of the City of Olympia. "We're pleased that we can further our commitment to environmental stewardship with these improvements and that these upgrades will also benefit our new neighbors at the museum. Even better, we'll achieve it all with minimal costs to the utility."

About the LOTT Clean Water Alliance

The mission of the LOTT Clean Water Alliance is to preserve and protect public health and the environment by cleaning and restoring water resources for our communities. LOTT is a non-profit corporation formed by the cities of Lacey, Olympia, Tumwater and Thurston County, and is governed by a board of directors consisting of one elected official

"We're pleased that we can further our commitment to environmental stewardship with these improvements and that these upgrades will also benefit our new neighbors at the museum. Even better, we'll achieve it all with minimal costs to the utility."

— Doug Mah, President of the LOTT Clean Water Alliance Board of Directors and Mayor of the City of Olympia

from each of the four partner governments. LOTT provides wastewater treatment and reclaimed water production services for approximately 90,000 people. LOTT owns and operates facilities in all four partner jurisdictions, including the centralized Budd Inlet Treatment Plant, Budd Inlet Reclaimed Water Plant, Martin Way Reclaimed Water Plant, Hawks Prairie Reclaimed Water Ponds/Recharge Basins, three pump stations and 28 miles of sewer interceptor pipelines. For more information, visit www.lottcleanwater.org.

About Trane

Trane, a business of Ingersoll Rand — the world leader in creating and sustaining safe, comfortable and energy efficient environments — improves the performance of homes and buildings around the world. Trane solutions optimize indoor environments with a broad portfolio of energy-efficient heating, ventilating and air conditioning systems, building and contracting services, parts support and advanced controls for homes and commercial buildings. For more information, visit www.Trane.com. BP

Environmentally Considerate Compressor Fluids

BY ZACH SWITALSKI,
SULLAIR CORPORATION

While biodegradable, energy efficient and recyclable are terms that come to mind when thinking about protecting the environment we live in today, these three terms are also, ironically, directly related to protecting a company's bottom line...its profit.

The fact is, "green" initiatives are literally taking the world by storm. There is a "Green Czar" in Washington, electric vehicles and clean power technologies, and now many compressor manufacturers are following suit. These days, everyone is looking for better ways to reduce their carbon "footprint."

One way to greatly reduce your carbon footprint is to select the right compressor fluid for your company, your manufacturing process and the environment. But with a multitude of compressor fluids on the market today, how does one choose the brand that is best suited for their current manufacturing and business environment? Do you choose the brand that gives you the best sales pitch…the best pricing...or simply the one that offers the best overall value for the money? Believe it or not, the lowest price does not always determine the long-term cost.

Before making a significant decision on a new compressor fluid, many variables should be considered to ensure you are making the right decision to maintain the best interests of your company and the environment.

Why Do Compressors Need Fluids?

To really understand compressor fluids, one should first understand the main function a fluid performs in a rotary screw air compressor. In many ways, compressor fluid is to an air compressor as blood is to the human body. In fact, you might say fluid is the lifeblood of an air compressor. While your heart pumps and circulates blood to keep your body functioning, an air compressor circulates fluid to keep the machine functioning properly. So according to this analogy, the compressor air end is equivalent to the body's heart.

To optimize their value, all air compressor fluids should effectively perform three primary functions:

1. **Remove the Heat of Compression.** The heat is not caused by friction, but by the physics of the air compression itself.
2. **Seal the Rotors.** Because the rotors do not touch, the fluid creates the airtight seal between rotors.
3. **Lubricate the Bearings.** This ensures smooth, trouble-free performance.

ENVIRONMENTALLY CONSIDERATE COMPRESSOR FLUIDS

The two primary enemies of rotary screw air compressors are HEAT and VARNISH. Both are directly related because high temperatures tend to create more varnish, while more varnish, in turn, generates more heat. When combined, the two create a vicious circle.

Know the Base Stocks

In the current market there are hundreds of compressor fluids, dozens of fluid manufacturers, and hundreds of resellers striving to earn your business. While most of these fluids have different base stocks, each is unique and has different properties — some good, and some not so good. We'll uncover the factors that make certain base stocks more environmentally compatible and bottom-line friendly than others.

Base Stocks Commonly Used in Compressor Fluids Today:

Hydrocarbons

Hydrocarbon-based lubricants have been around nearly as long as the rotary screw air compressor itself. Originally, all rotary screw compressors used hydrocarbon-based fluids. However, today's greatly improved technology has literally left hydrocarbons in the rear view mirror.

Most hydrocarbons lubricate well, seal the rotors and contain anti-corrosive additives. And, although these products are usually the lowest priced, they are frequently accompanied by hidden added costs. Hydrocarbons do not transfer as much heat as synthetics, and they also varnish easily in the compressor. As we mentioned earlier, varnish is the number one problem for rotary screw compressors. Unlike other base stocks, the condensate produced by compressors using hydrocarbons is not biodegradeable.

Bottom Line: Hydrocarbons have the potential to cause varnish, which leads to a less efficient air compressor, and could potentially cause up to 10% more energy consumption. The compressor condensate produced by hydrocarbon-based products is also not biodegradable, which leads to expensive condensate disposal costs. The fact is, hydrocarbons do not offer the combination of properties to effectively reduce your environmental footprint.

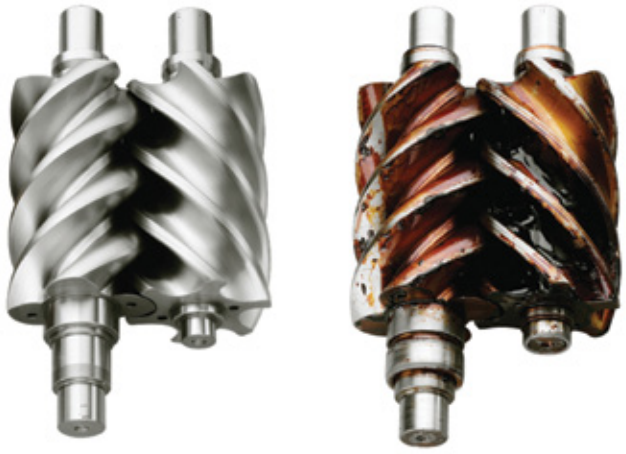
Polyalphaolefin (PAO)

Essentially the best fluids the petroleum companies have to offer, PAOs comprise the top-of-the-line hydrocarbon-based products. While most offer a higher purity level than the basic hydrocarbons, they still suffer from many of the same drawbacks as basic hydrocarbon fluids. For instance, PAOs are as limited in heat transfer as the rest of the hydrocarbon-based oils and will varnish if run at high enough temperatures. In addition, the compressor condensate produced by these products is also non-biodegradable.

Bottom Line: PAOs do offer better performance than hydrocarbons, but they do not offer the right combination of features to reduce your environmental footprint. In addition, they have the potential to cause varnish and can ultimately lead your compressor down a path of major inefficiencies. Finally, the compressor condensate produced by PAOs must be disposed of, which can directly affect both the company's bottom line and the environment.

Why Do Hydrocarbon-Base Stocks Varnish?

- All components are liquid at ambient temperature
- Some become solid at higher temperatures
- Some tend to plate on metal parts
- The varnish they create will insulate and reduce heat removal, thus causing temperatures to rise and solid components to form



Dangers of Varnish (as shown on the photo above)

- Can cause air end failure
- Creates an inefficient machine
  - Leads to 10% loss of efficiency, or 10% increase in energy costs
- Increases operating temperature
  - High temperatures shorten fluid life and lead to high temperature shutdowns, which ultimately result in costly plant downtime

- Could plug separators and oil return lines
- Could coat and restrict oil cooler

Diesters

Diesters were initially developed for use in reciprocating air compressors to help control both carbon buildup on the valves and high operating temperatures. However, in rotary screw compressors, they are not only incompatible with many elastomers, but they have the potential to form sludge.

Diesters are often used as the primary ingredient in compressor fluid blends. However, users should BEWARE that many Polyglycol/Ester blends actually turn out to be a Diesters base with a minimum amount of Polyglycol.

Bottom Line: Diester-based fluids have the potential to cause sludge, which can not only become very costly to a company's bottom line, but also can also reduce compressor efficiency and become quite costly to remove once it forms in a compressor system. What's more, the condensate produced by diester-based fluids is non-biodegradable, so diesters do not reduce your carbon footprint.

Polyglycol/Polyol Esters (PAG/POE)

PAG/POE fluids are among the most environmentally compatible and economical fluids offered by compressor and fluid manufacturers today. First of all, these fluids will not varnish in the machine; rather, they will remove existing varnish when performing a flush conversion. They also provide a higher level of thermal conductivity, which helps equipment run cooler, making it easier to stabilize operating temperatures. PAG/POEs also offer the safety features of the highest flash point, very low carryover and biodegradable condensate. Keeping the "green" initiative in mind, most PAG/POE fluids are also recyclable due to a high BTU value per pound low ash content.

PAG/POE fluids are also compatible with virtually all air compressor components, so conversion can be accomplished without any major issues. In addition, the compressor condensate produced by PAG/POE fluid-filled machines is biodegradable, enabling condensate to be directly discharged into sanitary sewer systems.

Study of Biodegradability

Sullube™ Biodegradability

Traces of Sullube present in compressor condensate have been shown to be biodegradable in a sewage treatment plant environment (EPA test method 796.3100 – 82% degradation in 28 days).

Prior to disposal of condensate in a sanitary sewage treatment system (POTW), written permission must be obtained from your local authority.

ENVIRONMENTALLY CONSIDERATE COMPRESSOR FLUIDS

One way to greatly reduce your carbon footprint is to select the right compressor fluid for your company, your manufacturing process and the environment.

Bottom Line: Polyglycol/Polyol Ester-based fluids offer a company multiple benefits. Compressors utilizing these fluids produce condensate that is biodegradable, thus reducing a company's environmental footprint, as well as its costs for condensate disposal. Better yet, PAG/POE fluids do not varnish and will also remove existing varnish that may have built up in a compressor, thus creating a more energy-efficient machine. Once the life of these fluids has expired, they can be recycled. This will not only create a more favorable bottom line, but also help the company achieve their own "green" initiatives.

A Sustainable Future

As previously noted, companies can reduce their environmental footprint in many ways. But choosing the right compressor fluid for each application is by far one of the simplest ways to achieve a higher level of "green." Before rushing into a quick decision that could change the environment and a company's bottom line, don't forget to consider fluids that stress the following:

- Biodegradability
- Energy efficiency
- Recyclability. BP

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Compressed Air Best Practices® is a technical magazine dedicated to discovering **Energy Savings** and **Productivity Improvement Opportunities** in Compressed Air Systems for specific **Focus Industries**. Each edition outlines "Best Practices" for compressed air users — particularly those involved in **managing energy costs in multi-factory organizations**.

Utility and Energy Engineers, Utility Providers and Compressed Air Auditors share techniques on how to audit the "demand-side" of a system — including the **Pneumatic Circuits** on machines. This application knowledge allows the Magazine to recommend "**Best Practices**" for the "supply-side" of the system. For this reason we feature **air compressor, air treatment, measurement and management, pneumatics, blower and vacuum** technologies as they relate to the requirements of the monthly **Focus Industry**.

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ENERGY INCENTIVES

Energy Trust of Oregon's Production Efficiency Incentive Program

BY ROD SMITH, COMPRESSED AIR BEST PRACTICES®

Ray Hawksley, Industrial Technical Manager, Energy Trust of Oregon.

Compressed Air Best Practices® Magazine interviewed Mr. Ray Hawksley, Industrial Technical Manager of the Energy Trust of Oregon, Inc.

Please describe the Energy Trust of Oregon to our readers.

Energy Trust of Oregon is an independent, nonprofit organization dedicated to helping utility customers benefit from saving energy and tapping renewable resources. Our services, cash incentives and energy solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural and Cascade Natural Gas save nearly $600 million on energy bills. Our work helps keep energy costs as low as possible, creates jobs and builds a sustainable energy future.

Energy Trust has invested public purpose funds since March 2002 to help Oregon utility ratepayers save money, improve energy efficiency and generate renewable energy. Energy Trust contributes to local economies statewide and demonstrates how Oregon's least cost-sustainable energy goals can be accomplished, with valuable benefits for Oregon ratepayers and without using government funds. Electricity efficiency programs are funded by a portion of a 3% charge on utility bills established in 1999 by the Oregon Legislature (SB 1149) and paid for by Oregon's PGE and Pacific Power customers. Additional funding for natural gas efficiency programs comes from a utility bill charge paid by for Oregon's NW Natural and Cascade Natural Gas customers. These charges were requested by the utilities and established in 2003 (NW Natural) and 2006 (Cascade Natural Gas) through Oregon Public Utility Commission tariffs. Out of the 3% public purpose charge, 74% is distributed by ETO, 16% goes Oregon Housing and Community Services for low-income housing weatherization and 10% goes to the Oregon Department of Energy for energy efficiency of K–12 school buildings.

> "Energy Trust of Oregon is an independent, nonprofit organization dedicated to helping utility customers benefit from saving energy and tapping renewable resources."
>
> — Ray Hawksley,
> Industrial Technical Manager of the Energy Trust of Oregon, Inc.

Please describe the energy savings realized, in compressed air systems, by the Production Efficiency incentive program offered by the Energy Trust of Oregon.

In 2008, the program delivered energy savings, related to compressed air systems, of 15.3 million kWh per year. The ETO has three categories of incentive offerings: custom-track, small industrial and prescriptive. Custom-track incentives generated 14.0 million kWh of the savings, small-industrial incentives generated 1.2 million kWh and prescriptive incentives generated 7000 kWh.

In 2009, a poor economic year, the annual kWh savings related to compressed air systems equated to 10.2 million per year. Custom-track projects totaled 7.3 million kWh, small industrial was 2.8 million kWh and prescriptive was almost 30,000 kWh.

Our 2010 forecast calls for 18 million kWh of energy savings per year, as related to compressed air systems. Custom-track projects are projected to be nearly 16 million kWh, while small industrial is 2.3 million kWh. More than 5% (2.8 million kWh) of the increased energy savings from custom-track projects will be from "O&M" energy efficiency measures (EEMs).

Crews at Oregon-based steel mill prepare for installation of new energy-efficient material handling system.

ENERGY INCENTIVES

Energy Trust of Oregon's Production Efficiency Incentive Program

Retrofits to Fume Filtration System at precious metals smelter cuts use of compressed air by nearly 70%.

Please describe the new "O&M" measure and incentive.

A 2009 pilot enhancement to the custom-track process added compressed air Operations & Maintenance (O&M) as an allowable EEM, which clearly identified the opportunity for significant energy conservation throughout the industrial business realm. As opposed to supply-side capital equipment upgrades, we wanted to focus on O&M opportunities like leak detection and repair, tuning of the systems (running compressors efficiently), minimizing use of compressed air and behavioral modifications.

An example of behavioral modifications is operating and maintaining existing air compressor control systems. We find a high percentage of the control systems (up to 40%) that are hanging on the wall are not being used. We guess that changes in personnel and ownership responsibilities can lead to situations where personnel do not understand how the control systems work.

The old-school industrial thinking is that compressed air is free and changing this mentality requires a behavioral change. We focus on helping companies learn how to set up and manage their control systems. A big part of this behavioral-change process is top-down. We help a company put together an energy team. It's important to get employee buy-in for making these changes. We also help them make changes to their standard operating procedures for O&M duties.

We provide tools, such as low-cost compressed air flow meters, so participants now have a tool to monitor changes in their "dead load," or the situation when all process equipment is off while the compressed air system remains pressurized. The dead load is any compressed air being consumed that isn't benefiting production. Some of this dead load is necessary, while the remaining load is typically a result of air leaks. This "leak load" occurs primarily from leaking pipe connections and fittings or from air leaks at the production equipment.

The flow meters we provide help with persistence strategies designed to maintain energy savings. They are normally installed after the compressed air treatment equipment and before the general distribution piping to the plant. Flow meters will also be placed in different areas during the data logging process, when establishing the baselines of a system assessment. In 2010, O&M incentives became a standard offering of our Production Efficiency program.

"Our work helps keep energy costs as low as possible, creates jobs and builds a sustainable energy future."

— Ray Hawksley

Describe the actual incentive program structures.

When determining custom-track incentives, we have to separate capital measures from O&M measures. The main difference is in the measure life period that we claim energy savings for as a result of the action taken. It is a 10-year life for capital measures and a 3-year life for O&M.

The custom-track incentives for capital projects pay $.25 per kWh saved, up to a maximum of 50% of the total project cost. If the ROI is less than one year before incentives, it drops to $.02 per kWh. Many facilities in Oregon will not implement energy-efficiency projects without an incentive. There are incentive dollar limits of $500,000 per site/per year combined, no matter what type of project or incentive. The small-industrial track project incentive has the same structure as custom-track.

Custom-track incentives for O&M projects are $.08 per kWh, capped at 50% of a project's cost. If the ROI is less than one year before incentives, it drops to $.02 per kWh.

For those who wonder why paying these incentives makes sense to the rate payers of Oregon and our utilities, consider this: from a utility perspective, every $1.00 investment in energy efficiency offsets $4.00 of investment in new generation. Energy conservation is considerably more cost effective than energy generation, so incentive programs are the most effective use of capital.

Dust Collection System Replacement improves workspace air quality while cutting Compressed Air consumption by 47% in glass manufacturing facility.

ENERGY INCENTIVES

Energy Trust of Oregon's Production Efficiency Incentive Program

"Our services, cash incentives and energy solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural and Cascade Natural Gas save nearly $600 million on energy bills."

— Ray Hawksley

What process does one follow to qualify for an incentive?

We have a few key energy-efficiency engineering organizations working as Program Delivery Contractors (PDCs) for the program, which will do energy evaluations within the state of Oregon. The PDCs help participants identify opportunities, quantify energy and cost savings and streamline the receipt of Energy Trust incentives through completion and coordination of paperwork and other program requirements. They have targets and goals to meet, including a specific amount of kWh savings per year.

These evaluations (scoping reports) can be initiated by the PDC (contractor) or by the customer/participant. Sometimes, the participant will initiate and ask the PDC to come out. They may ask the PDC to come help evaluate a purchasing decision. Let's say they are using a non-VFD controlled air compressor and it's not energy efficient. We will help them buy a VFD and have it installed to improve the efficiency of the compressor. There is no cost to the participant for the evaluation. The scoping report typically includes rate schedule, production schedule, process description, references to similar projects done in the past, a discussion of potential energy efficiency opportunities and a forecast of energy-savings to be realized. I review these scoping reports to verify that the potential energy savings opportunity is sound.

If further engineering study is required to determine the current energy use baseline, efficiency improvement options, estimated project costs and/or how much energy use will be reduced, I will solicit proposals to complete a Technical Analysis Study (TAS). We have a pool of well-qualified engineering contractors who perform technical studies in areas of their expertise, like for compressed air. The participant has not paid a single penny for any of these services. They are getting many thousands of dollars of engineering done for them on energy efficiency — at no cost. This is a tremendous service when one considers that we routinely find, in compressed air, several hundred thousand kWh in energy savings per site.

Energy efficiency improvements reduce power consumption of kiln by more than 30% at remote mining operation.

How important is speed to the process?

Speed is very important to making the incentive program work. The TAS comes to me for review. If it's deemed to be acceptable and justifiable, then the study is shared with the participant and they can determine what measures they want to implement. Based upon that, we put together an incentive offer based upon the kWh savings. The whole process, from scoping to an offer made to the participant, typically takes three to eight weeks, depending upon the data logging required. Data logging can last 1–3 weeks, depending upon the operation. If the operation is very consistent, it may only take one week. If it's erratic or cyclical, where things are changing, up to three weeks may be necessary. If a facility has a SCADA system and is able to provide the required data without logging, we can cut the time down.

Once the participant signs an incentive offer, they can start purchasing equipment. We like the projects to be done within a few months — but some take a year or two. Once implementation is complete, the PDC goes out and verifies that the new equipment was installed, that the old/inefficient equipment is decommissioned, that the recommended set points are being used and that the projected energy savings should be realized. Once this is verified, the PDC sends a verification report into Energy Trust and we process the incentive payment at this point.

I understand you sometimes offer "Blue-Light Specials"?

Yes! Sometimes the Energy Trust will provide a limited-time special incentive bonus offering, depending on a variety of factors. We have notably higher goals in 2010, and thus have decided to focus a lot of effort on short-cycle projects that will complete by the end of this year.

Right now for example, we have a "90 by 90 Industrial O&M Special Offer" incentive for O&M projects. "90 by 90" means we will offer $.08 per kWh for up to 90% of the project cost — if the implementation is done within 90 days of the incentive offer being made. Since this offer was announced on April 1st, the volume of projects has increased significantly. Participants have until August 31st to receive an offer of this type. All projects have to be done by November 30th. This special 90 by 90 incentive offer motivates participants because the "bang for their buck" is tremendous. BP

Thank you for describing the compressed air incentive programs offered by the Energy Trust of Oregon.

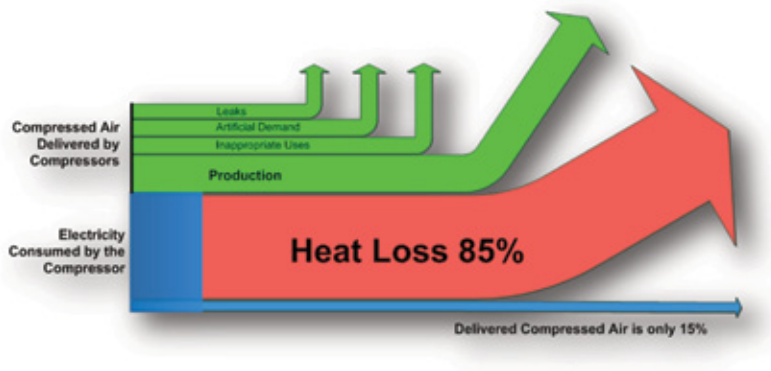
For more information, please contact Ray Hawksley, Tel: 503-445-2941 or email: ray.hawksley@energytrust.org, www.energytrust.org.

HEAT RECOVERY AND COMPRESSED AIR SYSTEMS

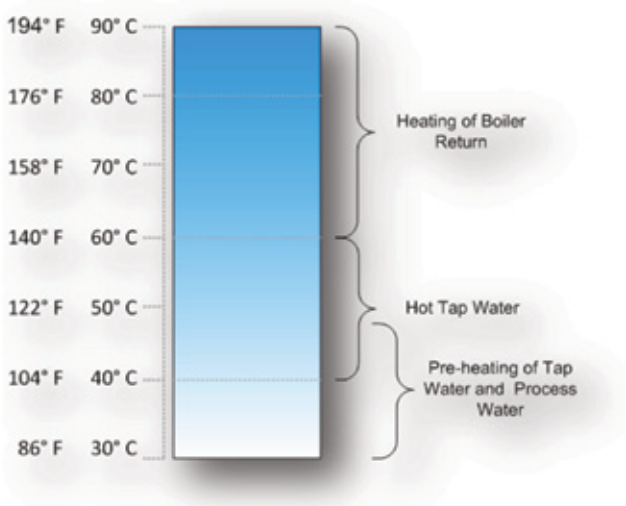
BY FRANK MOSKOWITZ FOR THE COMPRESSED AIR CHALLENGE®

KNOW PRESSURE
COMPRESSED AIR CHALLENGE®

Having a fundamental understanding of how your plant's compressed air system works and what forces influence it will help you improve its performance. The overall efficiency of a compressed air system can be as low as 10–15%. The figure below shows two main components of inefficiency — one is from the wasted air due to losses through leaks, artificial demand and inappropriate uses, the other is due to heat of compression. With some basic understanding, as much as 90% of this heat can be recovered for use in your operation.



It's simple physics that compressing air gives off heat. The heat energy is concentrated in the decreasing volume of air. To maintain proper operating temperatures, the compressor must transfer excess heat to a cooling media before the air goes out into the pipe system. As much as 90% of that heat can be recovered for use in your operation. If you can supplement or replace the electricity, gas or oil needed to create hot water for washrooms, or direct warm air into a workspace, warehouse, loading dock or entryway, the savings can really add up. The possibilities to recover this waste heat via hot air or hot water are good. The return on investment for energy recovery is usually as short as one to three years. In addition, energy recovered by means of a closed loop cooling system (for water-cooled compressors) is **advantageous to the compressor's** operating conditions, reliability and service life due to an equal temperature level and high cooling water quality to name but a few.



Fundamentals of Compressed Air Systems WE

The Compressed Air Challenge® (CAC®) is pleased to announce that the Winter 2010 session of ***Fundamentals of Compressed Air Systems WE*** (web-edition) is coming soon. Led by our experienced instructors, this web-based version of the popular ***Fundamentals of Compressed Air Systems*** training uses an interactive format that enables the instructor to diagram examples, give pop quizzes and answer students' questions in real time. Participation is limited to 25 students. Please visit **www.compressedairchallenge.org** to access online registration and for more information about the training.

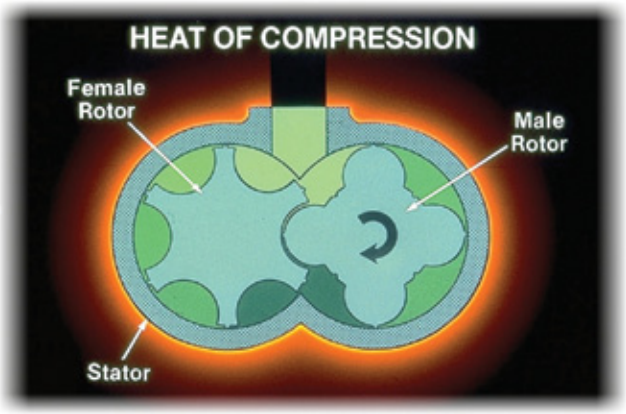
If you have additional questions about the new web-based training or other CAC® training opportunities, please contact the CAC® at **info@compressedairchallenge.org** or call 301-751-0115.

The temperature level of the recovered energy determines the possible application areas and thereby, the value.

This diagram illustrates some of the typical application areas for energy recovery available from the compressors cooling water in different temperature ranges. In the highest temperature levels (from oil-free compressors) the degree of recovery is the greatest. The highest degree of efficiency is generally obtained from water-cooled installations, where the compressor discharge cooling water can be connected directly to a continuous-process heating requirement. For example, the heating boilers' return circuit. Surplus energy can then be effectively utilized all year round. Most new compressors from the major suppliers can be adapted to be supplemented with standard equipment for recovery.

"Compressors are better at producing heat then compressed air," says Tom Taranto of Data Power Services.

HEAT RECOVERY AND COMPRESSED AIR SYSTEMS



Heat Recovery with Air-Cooled Lubricant Injected Rotary Screw Compressors

Air-cooled, packaged, rotary screw compressors are very amenable to heat recovery for space heating or other hot air uses. Ambient atmospheric air is heated by passing it across the system's aftercooler and lubricant cooler, where it extracts heat from both the compressed air and the lubricant that is used to lubricate and cool the compressor. This is relatively low-temperature heat (under 100 °F) and is therefore pretty limited in its application.

As a rule, approximately 50,000 British thermal units (BTU) per hour of energy are available for each 100 cfm of capacity (at full load). This value is based on 80% recoverable heat from the compressor and a conversion factor of 2,545 BTU/bhp-hr. Air temperatures of 30–40 °F above the cooling air inlet temperature can be obtained. Recovery efficiencies of 80–90% are common. Caution should be applied if the supply air for the compressor is not from outside and the recovered heat is used in another space, because this can cause a decrease in the static pressure in the cabinet or room and reduce the efficiency of the compressor. A decrease in static pressure or "negative pressure" has the same effect as throttling the inlet of the compressor, which changes the compression ratio, thus reducing efficiency. If outside air is used, some return air may be required to avoid damaging the compressor with below freezing air.

Because packaged compressors are typically enclosed in cabinets and already include heat exchangers and fans, the only system modifications needed are the addition of ducting and possibly another fan to handle the duct loading and to eliminate any back pressure on the compressor cooling fan. These heat recovery systems can be modulated with a simple, thermostatically controlled hinged vent. When heating is not required — such as in the summer months — the hot air can be ducted outside the building. The vent can also be thermostatically regulated to provide a constant temperature for a heated area. Hot air can be used for space heating, industrial drying, preheating aspirated air for oil burners or any other application requiring warm air.

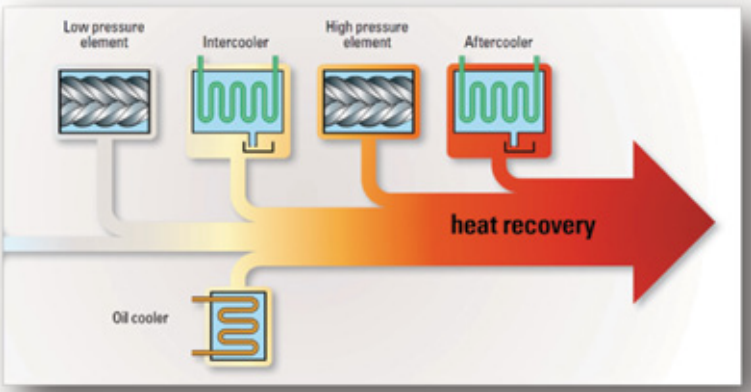
Energy recovery from air-cooled compressor installations will not always give heat when it is required and perhaps not in sufficient quantities. The quantity of recovered energy will vary if the compressor has a variable load. In order for recovery to be possible, a corresponding energy requirement is needed, which is normally met through an ordinary system supply. Recovered energy is best utilized as additional energy to the ordinary system, so that the available energy is always utilized when the compressor is running.

Heat Recovery with Water-Cooled Lubricant Injected Compressors

Heat recovery for space heating is not as common with water-cooled compressors because an extra stage of heat exchange is required and the temperature of the available heat is lower. Because many water-cooled compressors are quite large, however, heat recovery for space heating can be an attractive opportunity. Recovery efficiencies of 50–60% are typical. With water-cooled, lubricant-injected rotary screw compressors using a heat exchanger, it is possible to extract waste heat from the lubricant coolers and produce hot water. (Because of the possibility of a tube failure, a double-wall lubricant cooler is often recommend.) Depending on design, heat exchangers can heat non-potable (gray) or potable water. When hot water is not required, the lubricant is routed to the standard lubricant cooler.

Hot water can be used in central heating or boiler systems, industrial cleaning processes, plating operations, heat pumps, laundries or any other application where hot water is required. Heat exchangers also offer an opportunity to produce hot air and hot water, and enable the operator some ability to vary the hot air/hot water ratio.

The key to the value of heat recovery is that there must be a thermal match between the heat recoverable and needed, and an hourly match between when it's produced and needed. The installation cost must also be considered. Just because there is heat available does not mean that it is economical to recover it. Often on small units, it just doesn't pay to spend a lot of money on heat recovery systems — there just aren't enough BTUs there. Also, a heat bypass system should still be installed for times when the air compressor is running and the heat is not needed.



Heat Recovery with Water-Cooled Oil-Free Compressors

Oil-free rotary screw compressors offer a much better opportunity for heat recovery. As is typical with all compressors, the input electrical energy is converted into heat. Discharge temperatures from the low- and high-pressure elements can be over 300 °F. This heat appears at the low-pressure and high-pressure compression elements, the oil cooler, the intercooler and the aftercooler. Some manufacturers offer built-in energy recovery systems, which circulate cooling water through all four of these components and, as a result of the heat transfer, can yield hot water at up to 194 °F.

Heat Recovery with Engine-Driven Compressors

Engine-driven compressors have the same kind and volumes of low-grade heat available off the air end, but there is also a higher-temperature option off the engine. Depending on the size of the engine, it is even possible to generate low-pressure steam off the exhaust. Engine jacket water is available at 180–220 °F. A general rule of thumb is that 30% of the gas input energy is available as high-temperature heat. If the application temperature is low enough, up to 90% of the input energy could be recovered.

A typical engine-driven air compressor requires about 11,000 BTUs/horsepower input. Therefore, a 200 hp unit would require about 2.2 million BTUs input and the heat recovery potential would be at least 660,000 BTUs. That is comparable to a small boiler, running the same hours as the air compressor. Larger industrial-grade engines (greater than 250 hp) can have gas inputs as low as 7,500 BTUs/hp.

CAC Qualified Instructor Profile

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fmoskowitz@drawproservices.com

KNOW PRESSURE COMPRESSED AIR CHALLENGE®

Mr. Frank Moskowitz has an extensive background, with more than 30 years of experience in plant engineering. He has a degree in mechanical engineering and education, including the refrigeration, electrical and plumbing trades. For the past 20 years, Frank has been an associate of Draw Professional Services, primarily in the auditing, consulting, training and system design fields. His specialty consists of compressed air systems (oil-flooded and oil-free), vacuum systems, contaminate removal, system design and energy management. Frank is a Compressed Air Challenge® instructor for the Fundamentals and Advanced levels of training, an AIRMaster+ instructor and a Department of Energy (energy-savings) expert on compressed air systems. Frank is also vice-chair for ASME Standard EA-4-2010 "Energy Assessment for Compressed Air Systems" and is a member of International Standards Organization (ISO) technical committee for air compressors and compressed air systems energy management TC118/SC6/WG4.

The instructors featured here are available to lead a Compressed Air Challenge seminar at your facility. Visit www.compressedairchallenge.org for more information.

HEAT RECOVERY AND COMPRESSED AIR SYSTEMS

Calculating Energy Savings

When calculating energy savings and payback periods for heat recovery units, it is important to compare heat recovery with the current source of energy for generating thermal energy, which may be a low-price fossil fuel, such as natural gas. The equations in the text box below illustrate the annual energy and costs savings available by recovering heat for space heating from an air-cooled, rotary screw compressor. Applications where the existing heater is less than 85% efficient will see proportionally higher savings.

These equations appear in the CAC® "**Best Practices for Compressed Air Systems**." (This 325-page manual is available at the CAC® **bookstore**)

Annual Energy Savings (BTU/yr)=
0.80 x Compressor bhp x 2,545 BTU/bhp-hour x hours of operation

Example: A 100 hp compressor running two shifts, 5 days per week

(0.80) x (100 bhp) x (2,545 BTU/bhp-hour) x (4,160 hours per year) = 846,976,000 BTU per year

Where:
0.80 is the recoverable heat as a percentage of the unit's output
2,545 is a conversion factor

Cost Savings ($/yr) =
([Energy Savings in Btu/yr]/[Btu/unit fuel] x [$/unit fuel])/Primary Heater Eff

Example: Waste heat will be displacing heat produced by a natural gas forced-air system with an efficiency of 85%

([846,976,000 BTU per year]/[100,000 BTU/therm] x [$0.40/therm])/0.85 = $3,986 per year

* Cost of operating an additional fan for duct loading has not been included.

Source: Compressed Air Challenge

Conclusion

Your compressed air system represents an excellent source for heat recovery and could improve the efficiency of the system overall. Improving the performance of your compressed air system reduces your plant-wide energy costs. It can reduce downtime, increase your production throughput, lower your scrap rate, improve product quality and create longer equipment life.

You can find much more information on improving plant compressed air system performance and regaining the lost energy at **www.compressedairchallenge.org**.

This web site provides details on the Compressed Air Challenge®, a voluntary collaboration of industrial compressed air users, compressed air equipment manufacturers, distributors and their associations, compressed air consultants, state research and development agencies, organizations for efficient energy use and power utilities.

This group has one purpose in mind — helping you obtain and enjoy the benefits of improved performance of your compressed air system. BP

Frank Moskowitz
Draw Professional Services

Source of Information:
Compressed Air Challenge®
Atlas Copco Compressors
Draw Professional Services

RESOURCES FOR ENERGY ENGINEERS

TRAINING CALENDAR

TITLE	SPONSOR(S)	LOCATION	DATE	INFORMATION
Compressed Air Challenge® Fundamentals of Compressed Air Systems	Purdue, USDOE	Portland, IN	9/8/10	Tel: 317-275-6822 Monica Cannaley email: mcannale@purdue.edu
Compressed Air Challenge® Fundamentals of Compressed Air Systems	Compressed Air Challenge®	Web-based	9/13/10	Tel: 301-751-0115 www.compressedairchallenge.org info@compressedairchallenge.org
Compressed Air Challenge® Fundamentals of Compressed Air Systems	Ohio Center for Industrial Energy Efficiency, Dayton Power & Light, First Energy	Dayton, OH	9/21/10	Tel: 216-323-1898 Larry Boyd email: boyd@energyinohio.com
Energy Efficient Compressed Air System Design	Air Centers of Florida Ingersoll Rand	Saint Lucie West, FL	9/24/10	John Teneriello email: j.teneriello@acfpower.com www.acfpower.com
Compressed Air Challenge® AIRMaster+ Specialist Training	Efficiency Vermont, Burlington Electric DOE ITP	S. Burlington, VT	9/27–30/10	Peter Wilhovsky Tel: 888-921-5990 x1328 www.compressedairchallenge.org
Compressed Air Challenge® Fundamentals of Compressed Air Systems	Manitoba Hydro Compressed Air Challenge®	Winnipeg, MB	10/26/10	Veronica Walls Tel: 204-360-7229 email: vwalls@hydro.mb.ca www.compressedairchallenge.org
Compressed Air Challenge® Advanced Mgmt of Compressed Air Systems	Manitoba Hydro Compressed Air Challenge®	Winnipeg, MB	10/27–28/10	Veronica Walls Tel: 204-360-7229 email: vwalls@hydro.mb.ca www.compressedairchallenge.org
Compressed Air Challenge® Fundamentals of Compressed Air Systems	Purdue University Indiana University	Fort Wayne, IN	11/17/10	Tel: 317-275-6822 Monica Cannaley email: mcannale@purdue.edu

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.

PEOPLE

Atlas Copco Announces New Sales Manager

Atlas Copco announced that Mark McKean has joined the company as the AIRnet Sales Manager — East Region.

Over a decade ago, Mark was instrumental in the initial launch of aluminum compressed air piping into the United States, and he has more than 14 years experience working with compressed air piping systems, having held a wide variety of sales and marketing positions. Throughout his career, Mark created many of the development tools used in the industry today, such as sizing guides and web sites, and authored several articles on compressed air piping best practices.

Mark's mission is to continue the rapid growth of the expansive range of AIRnet products across the U.S., through a combination of marketing, training and technical support.

Atlas Copco Compressors
www.atlascopco.com

PRODUCTS

New Cooling Air Units

Kaeser announced their new Cooling Air (KCA) units. These dryers provide cold, dry compressed air for industrial processes, including cooling molds, metal and glass production, maintaining inks at consistent temperatures and more.

With a capacity of 10–330 cfm, KCAs produce an outlet air temperature of 40 °F in normal operation. These non-cycling refrigerated dryers have an air-to-refrigerant heat exchanger, a 3-micron KFS separator and a drain. Smaller models include a float-type drain, and larger models include a capacitance sensor-operated Kaeser Eco-Drain. All units are easy to install and require little maintenance.

Kaeser Compressors
Tel: 800-777-7873
www.kaeser.com/cleanair

RESOURCES FOR ENERGY ENGINEERS

PRODUCTS

New High-Speed Centrifugal Blower

Gardner Denver, Inc., the manufacturer of Hoffman® and Lamson® centrifugal blowers and exhausters, announced a new line of high-speed centrifugal blowers that use break-through technologies. Marketed under Gardner Denver's Hoffman® brand of centrifugal aeration blowers, the **Revolution** is designed to be the world's most advanced energy management blower system.

The first in this family of blowers, the R-200 and R-300 are capable of flows from 2,500–8,500 cfm and pressures from 3–15 psig. The **Revolution** is a highly efficient and environmentally friendly centrifugal blower for applications in the gas and oil, air separation, renewable energy and water and wastewater treatment markets. The **Revolution** utilizes active magnetic bearing technology, patented surge control technology, permanent magnetic synchronous motor, integrated human machine interface and programmable logic controller and variable frequency drive, all factory prewired and tested in an ergonomically designed sound enclosure.

Benefits include simple operation, 25–45% energy savings, increased reliability with little or no maintenance, no contaminating or flammable lubricants, significant sound reduction, small footprint and reduced construction and installation costs. Uniquely, the **Revolution** knows the exact position of the rotor, the actual surge point regardless of changing environmental conditions and precisely controls surge and speed to leverage turndown to maximize power savings.

Gardner Denver, Inc. has over 150 years of experience and is the worldwide leader of multi-stage centrifugal technology.

Gardner Denver, Inc.
www.HoffmanRevolution.com
Tel: 770-632-5028

New Screw Blower

Atlas Copco announced its new energy-efficient technology for air blowing applications: the ZS Screw Blower. Screw technology is on average 30% more energy-efficient than lobe technology. Atlas Copco is convinced that the lobe technology, widely used at present, no longer meets the needs of today's low-carbon economy.

Industries and applications such as wastewater treatment, pneumatic conveying, power generation, food and beverage, pharmaceuticals, chemicals, pulp and paper, textiles, cement and general manufacturing will greatly benefit from energy savings by replacing the conventional lobe with the leading screw technology. The ZS screw blower will replace the company's entire range of "roots"-type rotary lobe blowers.

Stephan Kuhn, president of Atlas Copco's Compressor Technique business area, says, *"Atlas Copco continuously innovates to ensure sustainable productivity for our customers. They will greatly benefit from the average 30% energy savings achieved from our leading-edge screw technology, compared to conventional lobe type blowers. Atlas Copco customers are able to take advantage of tomorrow's blower technology today."*

According to the United States Environmental Protection Agency (EPA), for example, "…approximately 56 billion kilowatt hours (kWh) is used for drinking water and wastewater services. Assuming an average mix of energy sources in the country, this equates to adding almost 45 million tons of greenhouse gases to the atmosphere. Just 10% of energy savings in this sector could collectively save about $400 million annually."

In a typical biological wastewater treatment plant, the aeration blower system accounts for up to 70% of the total energy usage. Today, the majority of these plants use less efficient lobe technology, a technology that has had little development since its introduction in the late 19th century. By reducing the energy usage of their aeration blower system, these plants will decrease their energy costs, while operating in a more environmentally friendly manner.

Chris Lybaert, president of Atlas Copco's Oil-Free Air Division, adds, *"Energy consumption typically represents 80% of the lifecycle costs of a blower. By introducing screw technology to our air blower range, we now offer a complete product portfolio of compressors and blowers for all applications and processes below 4 bar(e)/58 psig. Atlas Copco's screw technology helps customers to save energy, which is a major advantage in a highly competitive marketplace."*

The performance of the new ZS screw blower was tested against a tri-lobe blower by the independent Technische Überwachungs-Verein (German Technical Monitoring Association or TÜV), according to the international standard ISO 1217, edition 4. It was proven that the ZS is 23.8% more energy efficient than a tri-lobe blower at 0.5 bar(e)/7 psig, and 39.7% at 0.9 bar(e)/13 psig. The world-class efficiency of the ZS is mainly attributed to the superior screw technology. Other important features that secure increased efficiency and reliability are the integrated gearbox, the oil system and the innovative design that integrates all individual components into a plug-and-run solution.

Atlas Copco Compressors
www.atlascopco.com
www.efficiencyblowers.com

PRODUCTS

New Pressure Transmitters Assist VSD Pumps

Improvements in pump speed control combined with competitive prices have made variable-speed booster pumps a popular choice for processing applications that supply and treat water. But, like most water applications, liquid hammer and electromagnetic interference (EMI) can impede performance and damage system components. In China, booster pump manufacturers are turning to the Danfoss MBS1900 pressure transmitter to get the best performance from their products. And since its launch in June 2009, the MBS1900 has gained a reputation for great performance and reliability.

In a variable-speed booster pump, a variable frequency converter adjusts the pump's motor speed according to demand, and a pressure transmitter monitors the water pressure, relaying this information to a programmable logic controller (PLC). If there is little or no water flow in the system, the PLC will slow or put the motor on standby to increase pump efficiency and conserve energy. But without a pressure transmitter designed to withstand liquid hammer and EMI, pump performance will be affected. Based on tried and tested Danfoss technology, the MBS1900 has that covered.

In China, booster pumps have a 5.5 kW, 7.5 kW or 11 kW capacity. However, larger pump capacity means greater Radio Frequency (RF) conducted interference from the frequency converter — which adversely affects pressure transmitter performance, making it the main source of EMI. But because the MBS1900 has good PCB design and a shielded cable, it keeps RF conducted noise to a minimum and maintains a stable output signal. In addition, the MBS1900 is EN61000-6-2 certified and meets immunity requirements in industrial environments.

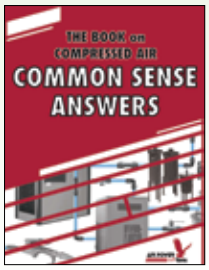
In water systems, rapid changes in flow velocity, such as pump starts and stops, can cause liquid hammer or pressure peaks. To cope with this, the MBS 1900 uses advanced piezoresistive silicon sensor technology, providing overload pressure up to three times the working pressure.

The MBS1900 is available with a variety of output signals, pressure ranges and with a choice of pressure and electrical connectors to meet pump manufacturer demands.

Angela Peconi
Danfoss Industrial Automation
Email: Angela.Peconi@danfoss.com
www.danfoss.us/ia.

LITERATURE & SERVICES PICKS

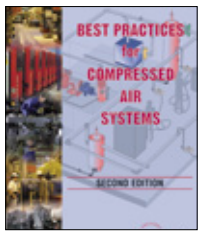
The Book on Compressed Air Common Sense Answers



NEW! Providing practical solutions to the everyday issues facing plant staffs who operate and maintain plant air systems and the engineering staffs who design and evaluate air systems. Real life experiences flow throughout covering common problems and opportunities that touch all industries. New electronic energy-saving products are reviewed in detail, and how to apply them through the complete air system, from the compressor room to the shipping dock, is explained. Savings calculation methods and measurement protocols are identified. Features "Ask the Experts" section answering questions posed by real users to Air Power USA staff. (Red book, Hard cover. 1st edition — 2009).

Black/white print copy $85.00 U.S.
Color print copy $105.00 U.S.
To purchase, call Air Power USA at 740-862-4112
or visit www.airpowerusainc.com

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



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

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

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

Compressed Air Challenge®
www.compressedairchallenge.org

WALL STREET WATCH

BY COMPRESSED AIR BEST PRACTICES®

The intent of this column is to provide industry watchers with publicly held information, on publicly held companies, involved with the sub-industry of compressed air. It is not the intent of the column to provide any opinions or recommendations related to stock valuations. All information gathered in this column was during the trading day of August 20, 2010.

AUGUST 20, 2010 PRICE PERFORMANCE	SYMBOL	OPEN PRICE	1 MONTH	6 MONTHS	12 MONTHS	DIVIDEND (ANNUAL YIELD)
Parker-Hannifin	PH	$63.23	$59.35	$59.18	$48.97	1.71%
Ingersoll Rand	IR	$35.22	$36.39	$33.43	$30.53	0.76%
Gardner Denver	GDI	$49.26	$50.53	$43.77	$31.54	0.41%
Atlas Copco ADR	ATLCY	$13.80	$15.26	$12.95	$11.25	2.83%
United Technologies	UTX	$68.12	$68.01	$68.84	$57.68	2.50%
Donaldson	DCI	$43.26	$44.94	$40.94	$38.94	1.16%
SPX Corp	SPW	$59.49	$56.40	$60.69	$55.82	1.68%

United Technologies Reports 2nd Quarter Earnings

United Technologies Corp. (NYSE:UTX) reported second quarter 2010 earnings per share of $1.20 and net income attributable to common shareowners of $1.1 billion, both up 14% over the year ago second quarter.

Revenues of $13.9 billion for the quarter were 5% above prior year, including 4 points of organic growth and 1 point of net acquisitions. Segment operating margin at 14.6% was 160 basis points higher than prior year. Adjusted for restructuring and one-time items, segment operating margin of 15.7% was 80 basis points higher than prior year. Cash flow from operations was $1.4 billion and, after capital expenditures of $155 million, exceeded net income attributable to common shareowners.

"UTC's results this quarter reflect strong execution in an improved end market environment," said Louis Chênevert, UTC chairman and chief executive officer. "The return of revenue growth, combined with our cost reduction actions, led to solid earnings growth. Our relentless focus on cost drove the segment operating margin to a record high."

"Based on the strong first half performance and continuing improvement in order rates, we are increasing our 2010 earnings per share guidance to a range of $4.60 to $4.70, up from $4.50 to $4.65. Earnings per share is now expected to grow 12–14% over 2009 on revenues of $54 billion," Chênevert added. This range still includes $0.20 of net charges for anticipated restructuring and one-time items.

New equipment orders at Otis were up 12% over the year ago second quarter, including favorable foreign exchange of 1 point. Commercial HVAC new equipment orders grew 6% (including favorable foreign exchange 1 point) and Carrier Transicold's organic orders were up 39%. Commercial spares

orders at Pratt & Whitney's large engine business grew 8%, and at Hamilton Sundstrand were up 7% over the year ago second quarter.

"Cash generation remains strong and working capital performance improved both sequentially and from the second quarter last year. We continue to expect cash flow from operations less capital expenditures to meet or exceed net income attributable to common shareowners for the year," Chênevert said. "With year-to-date share repurchases already over $1.1 billion, we now expect share repurchases for the year to be around $2 billion, up from our prior guidance of $1.5 billion."

Acquisition spend was $260 million in the quarter and $2.4 billion year to date. UTC continues to anticipate that acquisition spend for the year will be around $3 billion.

Source: www.utc.com

Ingersoll-Rand Reports 2nd Quarter Earnings

Ingersoll-Rand plc (NYSE:IR) announced that total reported revenues increased by 7% for the second quarter of 2010 compared with the 2009 second quarter. Orders increased by 10% and diluted earnings per share (EPS) from continuing operations exceeded the prior guidance range.

The company reported net earnings of $196.4 million, or EPS of $0.58, for the second quarter of 2010. This compares to net earnings for the 2009 second quarter of $122.1 million, or EPS of $0.38.

"Our second quarter 2010 earnings exceeded our prior expectations, primarily driven by higher revenues," said Michael W. Lamach, chairman, president and chief executive officer. "The increase in orders we saw in the first half, coupled with a growing backlog and key new product introductions, give us increased confidence that we will achieve better revenue and earnings growth than we anticipated when we began 2010. We are seeing continuing improvement in several of our key markets, including global demand for refrigerated transport and industrial, and strength in Club Car, North American residential HVAC and commercial HVAC in Asia. Our innovation and productivity initiatives are driving results, as Ingersoll Rand employees continue to find new opportunities to serve customer needs, enhance operations and improve financial performance."

Revenues: The company's reported revenues increased 7% to $3,703.4 million, compared with revenues of $3,451.7 million for the 2009 second quarter. Total revenues excluding currency were up 8%, compared with 2009. Reported United States revenues were up 6%, and revenues from international operations increased by approximately 10% (up 11% excluding currency).

Operating Income and Margin: Operating income for the second quarter was $383.0 million, an increase of 48% compared with $259.1 million for the second quarter of 2009. The second quarter operating margin was 10.3%, an increase of 2.8 percentage points compared to an operating margin of 7.5% for the same period of 2009. Higher volumes and continued strong productivity drove the increase in operating profits and margins. These improvements were partially offset by inflation and currency.

Interest Expense and Other Income/Expense: Interest expense of $71.1 million for the second quarter of 2010 decreased compared with $81.8 million in the 2009 second quarter, due to lower debt balances. Other income totaled $11.2 million for the second quarter, compared with $2.8 million of income for the second quarter of 2009. The year-over-year difference is primarily attributable to higher interest income and lower currency losses in 2010.

Taxes: The company's reported tax rate for the second quarter was 18.8%, slightly above the initial projected rate of 18%, due to higher earnings in the U.S.

Second Quarter Business Review

The company reports the results of its businesses in four segments based on industry and market focus. The company's four segments include: Climate Solutions, which includes the Trane commercial HVAC Systems, Hussmann and Thermo King businesses; Industrial Technologies, which includes Air and Productivity Solutions and Club Car; Residential Solutions, which includes the residential HVAC and security businesses; and Security Technologies, which includes the commercial security businesses. Segment operating margins for both 2009 and 2010 include restructuring expenses.

WALL STREET WATCH

Industrial Technologies provides products, services and solutions to enhance customers' productivity, energy efficiency and operations. Products include compressed air systems, tools, fluid power products and golf and utility vehicles. Total revenues in the second quarter of $625 million increased approximately 16% (up 16% excluding currency) compared with the second quarter of 2009. Air and Productivity revenues increased 13%, with volume increases in all major geographic regions. Revenues in the Americas increased 16% compared with last year as industrial markets continued to improve. Air and Productivity Solutions revenues outside the Americas increased by approximately 10% (up 12% excluding currency) compared with 2009, from improved activity in Asia. Bookings increased 29% year-over-year.

Club Car revenues increased 27% compared with the second quarter of 2009, due to improving golf and utility vehicle markets and market share gains in golf carts. Bookings were up 19%.

Second quarter operating margin for Industrial Technologies of 12.6%, including $4.5 million of restructuring/productivity investments, increased by 5.5 percentage points compared with 7.1% last year, due to productivity, higher volumes from recovering industrial markets and new product introductions and lower restructuring expenditures, partially offset by inflation.

Balance Sheet and Liquidity

During the second quarter, the company reduced its debt by $46 million. By year-end, the company expects to repay approximately $510 million of maturing term debt with available cash flow. During the quarter, the company entered a new three-year $1 billion revolving credit facility that replaced a credit facility expiring in August 2010.

"We are continuing our focus on reducing debt and generating cash flow through higher earnings and managing our balance sheet," said Lamach. "Second-quarter working capital management was significantly improved compared with the second quarter of 2009. Working capital was 2.9% percent of revenues and improved by 3 points year-over-year. Available cash flow for the second quarter and the first half of the year was above our initial target, and we expect to reach $1 billion in available cash flow for full year 2010."

Productivity Actions

The company achieved total gross productivity of 4.4% in the second quarter compared with the second quarter of 2009. Second quarter was affected by $26 million of supply chain inefficiency costs incurred to meet higher volumes. These additional costs diminished total reported productivity by 80 basis points. The company remains on track to achieve 5% gross productivity savings for the full year.

2010 Outlook

"A number of Ingersoll Rand's major end markets continued to show signs of recovery in the second quarter of 2010, although some challenges remain," said Lamach. "Second-quarter orders were up approximately 10% compared with last year. Our sustained order growth in the first half of the year and growing backlog underpin our confidence that we can reach our new revenue forecast for 2010, which we have revised upward. We see signs of recovery in worldwide industrial and refrigerated transport markets, Club Car, North American residential HVAC and Security, overall aftermarket activity and across several of our businesses in Asia. However, we expect challenging U.S. and European non-residential construction markets to continue to dampen results for Trane Commercial HVAC equipment and Commercial Security for the balance of the year.

"We anticipate revenues for full year 2010 in the range of $13.7 to $13.9 billion, an increase of 4–6%. Full-year 2010 EPS from continuing operations is expected to be in the range of $2.06–$2.26 (including health-care tax expense of $0.12). Costs related to discontinued operations are expected to equal $(0.27) per share. This full-year forecast increases the midpoint of our EPS from continuing operations range by $0.11 per share. This forecast also includes the effect of $0.25 per share of restructuring/productivity investments and also reflects a tax rate of 19% for continuing operations. Average diluted share count for full year 2010 is expected to be 341 million shares. Available cash flow for 2010 is expected to approximate $1.0 billion, based on projected earnings and working capital requirements.

"Given our current macroeconomic view, our third-quarter 2010 revenue forecast is $3,650– $3,750 million, which would be an increase of approximately 5–8% compared with the third quarter of 2009," said Lamach. "We expect to capture significant additional benefits from productivity programs. However, some of these benefits will be eroded by inflation. EPS from continuing operations for the third quarter are expected to be in the range of $0.70–$0.80. The third-quarter forecast includes the effect of approximately $38 million of restructuring/productivity investments (EPS of $0.08). The third quarter forecast also reflects a tax rate of 19% for continuing operations and an average diluted share count of 340 million shares.

"Our internal business fundamentals continued to improve in the second quarter. We have globally recognized brands and leading market shares in all of our key businesses. Our balance sheet is solid and we will be reducing debt further in the third quarter. As the slow recovery of the world economy progresses, we will continue to invest in new products and innovations. We will relentlessly strive to improve our operations and to become a more efficient company," said Lamach.

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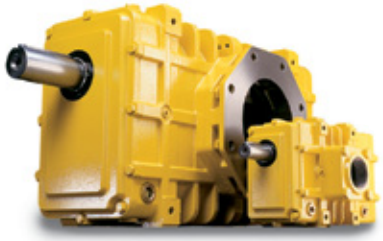

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