Hoffman Revolution | Energy Assessments | Aerzen Delta Hybrid

September/October 2011

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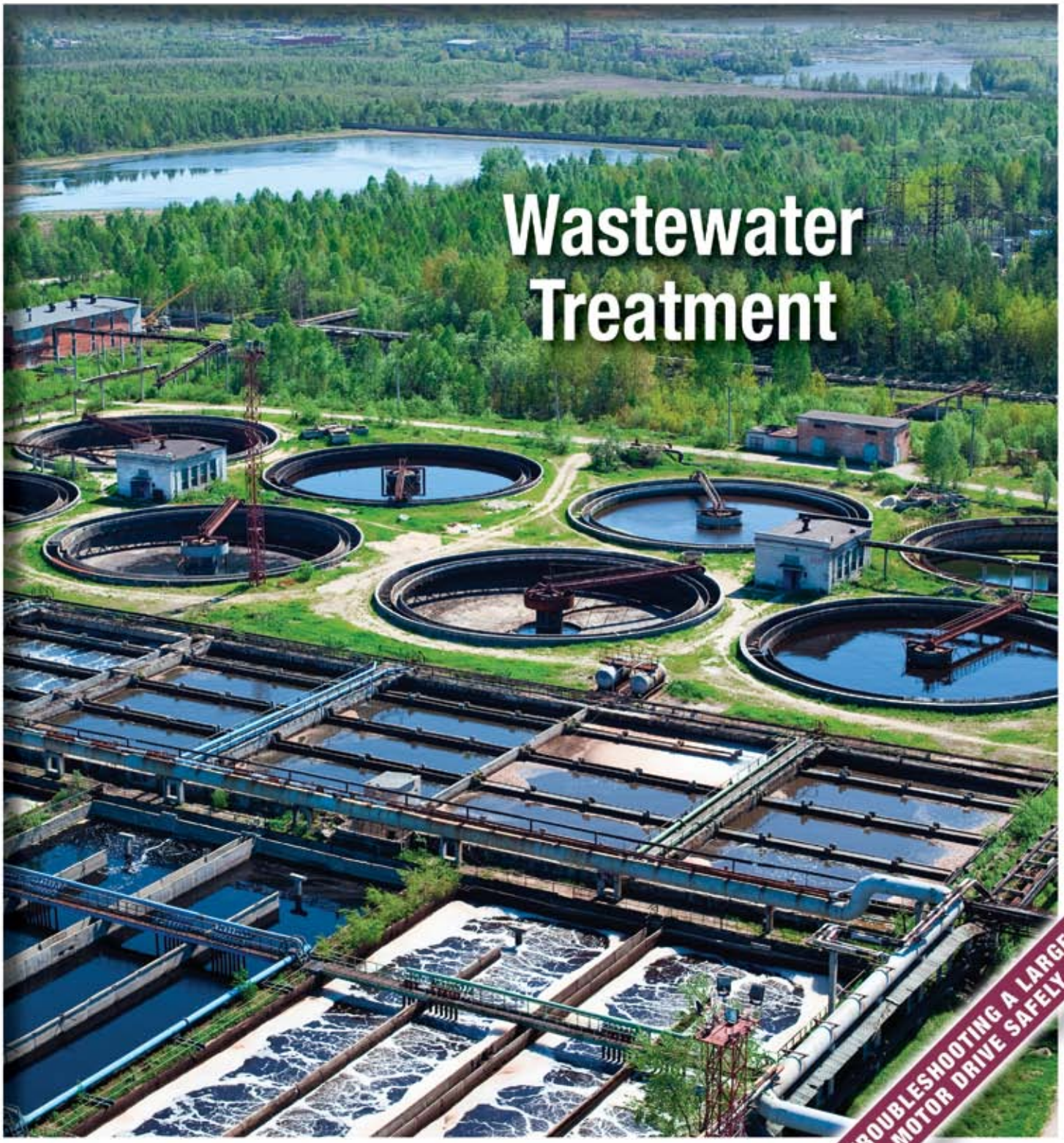

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1911

2011

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•1969: First Vortex Blower

•1976: Oil Injected Packaged Rotary Screw Series

•1977: Smallest 5.5kW Oil Injected Rotary Screw

•1980: First DSP Series Oil Free Rotary screw

•1981: Vortex Blower "E" Series

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•1986: World's Smallest Air Cooled Oil Free Rotary

•1985: World's First Oil Injected Scroll Bebicon

•1992: Vortex Blower "G" Series

•1995: Oil Free Scroll SRL Series

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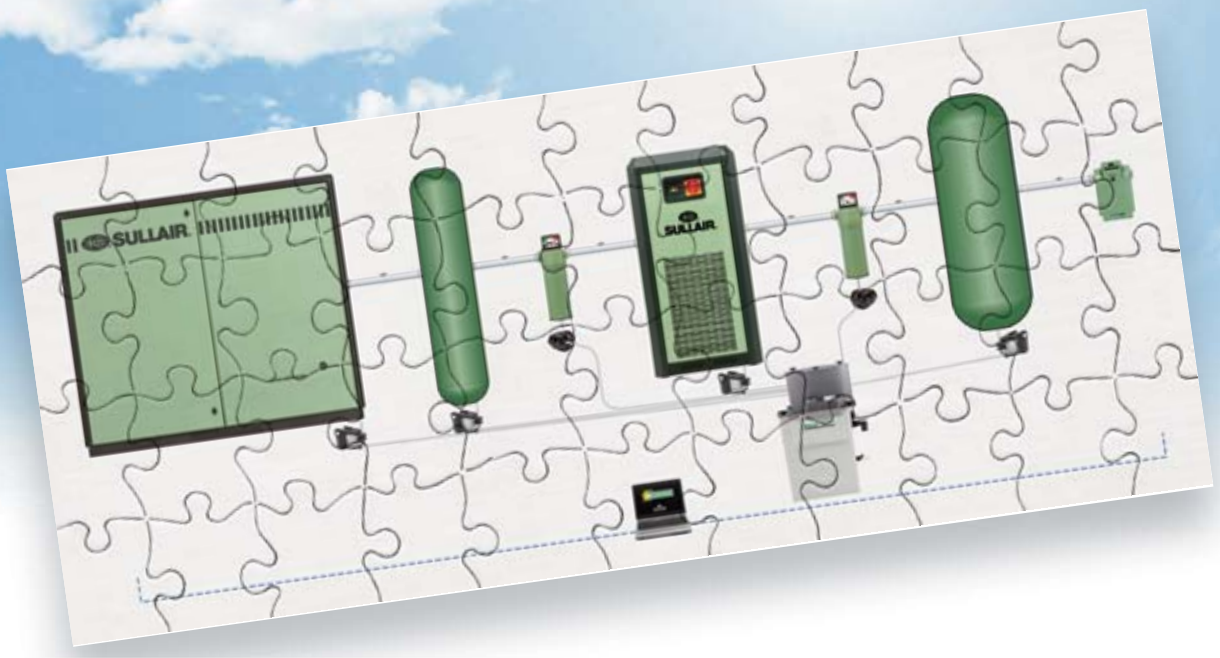

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FROM THE EDITOR

Wastewater Treatment

The United States Environmental Protection Agency (EPA) estimates that drinking water and wastewater systems account for approximately 3-4%, the equivalent of 56 billion kW, or $4 billion, of energy use in the United States. Further, these plants are typically the largest energy consumers of municipal governments, accounting for 30-40% of total energy consumed.

The wastewater treatment industry has emerged as a high-potential market for profitable energy-efficiency upgrades to equipment and systems. Wisconsin's Focus on Energy published a "Wastewater Energy Best Practices Guidebook" asserting, "Energy savings range from 20-40% — while some plants have saved as much as 75%." The Guidebook identifies aeration systems and pumps as the most common areas of opportunity and states, "Aeration systems provided (in their survey) opportunities for the greatest energy savings." While the Guidebook was published in 2006, the Focus on Energy is still using it (and the author) to provide guidance and training on energy-savings to Wisconsin's water industry.

The more I personally learn about wastewater treatment plants, the more I realize the huge energy-savings potential in the blowers forming the backbone of the aeration systems. The load profile, in most systems, is one of intermittent demand with significant changes on the demand curve. The installed equipment, however, is not able to provide a linear relationship between demand and energy consumption.

To address this opportunity, new aeration blower technologies have been introduced to the wastewater treatment market. For this reason, we provide you with a look at the Aerzen Delta Hybrid and the Hoffman Revolution product lines — introduced over the past year to the U.S. market. Both companies have recognized the energy savings opportunity presented by this intermittent and changing load profile on aeration systems. The articles describe the new technologies and controls introduced to provide energy savings to the aeration process in these plants.

On the system assessment front, Hank and Scott Van Ormer, provide us with a detailed article on the types of blowers used in aeration systems. They also provide us with several examples of energy-saving blower retrofits done in different types of wastewater treatment facilities.

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

ROD SMITH
Editor
Tel: 412-980-9901
rod@airbestpractices.com

"Energy savings potential, in wastewater treatment plants, range from 20-40% — with some plants having saved as much as 75%."

— "Wastewater Energy Best Practices Guidebook", Focus on Energy - Wisconsin

SUSTAINABLE MANUFACTURING NEWS

EPA News, Wastewater Best Practices from Wisconsin's Focus on Energy

SOURCED FROM THE WEB

EPA — Wastewater Treatment Plants Can Save 15-30% on Energy Bills

Drinking water and wastewater systems account for approximately 3-4%, equivalent to approximately 56 billion kilowatts (kW), or $4 billion, of energy use in the United States, adding over 45 million tons of greenhouse gases annually. Further, drinking water and wastewater plants are typically the largest energy consumers of municipal governments, accounting for 30-40% of total energy consumed. Energy as a percent of operating costs for drinking water systems can also reach as high as 40% and is expected to increase 20% in the next 15 years due to population growth and tightening drinking water regulations.

The good news? Studies estimate potential savings of 15-30% that are "readily achievable" in water and wastewater plants, with substantial financial returns in the thousands of dollars and within payback periods of only a few months to a few years.

Source: http://water.epa.gov/infrastructure/sustain/energyefficiency.cfm

SUSTAINABLE MANUFACTURING NEWS

EPA News, Wastewater Best Practices from Wisconsin's Focus on Energy

The Focus on Energy Water and Wastewater Program

The Focus on Energy Water and Wastewater Program was developed to support the industry because of the enormous potential to reduce energy use without compromising water quality standards. Through the program, numerous water and wastewater personnel have learned that energy use ***can be managed,*** with no adverse effects on water quality. ***Most locations that have saved energy have found improved control and treatment.***

All water and wastewater treatment facilities can save energy. The improvements are often economically attractive — water and wastewater facilities typically see shorter paybacks on energy efficiency projects than their industrial counterparts due to their longer hours of operation. Also, these facilities are necessary public infrastructure and, therefore, have stable financial commitment for long-term viability. In addition, they will not (cannot) close or move to another community or country as can happen in private industry.

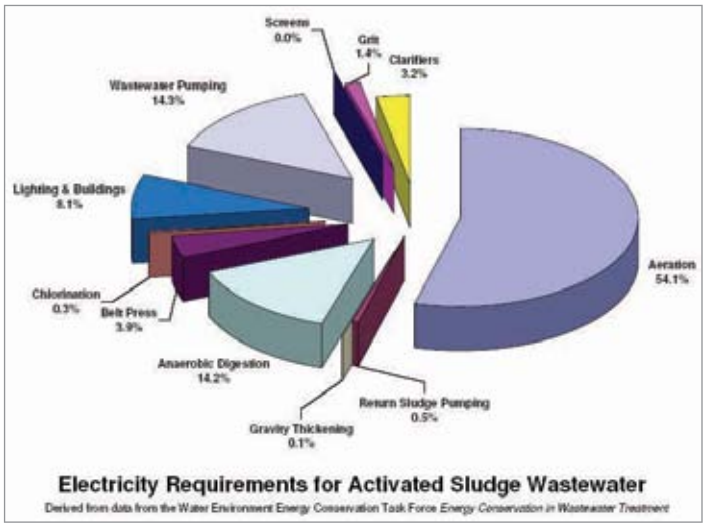


Figure 1

Energy Use in Wastewater Treatment and Collection Systems

Wisconsin has approximately 650 public and 360 private wastewater treatment facilities. A summary of the public facilities' sizes is presented in **Table 1** below.

Note that Wisconsin has many small facilities — approximately 85% of facilities treat less than one million gallons per day (MGD). Though they treat only 12% of the total flow, these numerous small facilities use about 24% of the total energy used to treat wastewater in the state, making them excellent candidates for energy efficiency projects.

The remaining facilities, over one MGD, process 88% of the wastewater. Because of their sheer size, even simple energy efficiency projects at these facilities can lead to tremendous savings.

On average, wastewater treatment facilities spend 7% of their operating budgets on energy, according to the American Water Works Association Research Foundation (AwwaRF).[1] Regardless of size, the breakdown of energy end-uses at a wastewater facility remains consistent. All facilities have at least secondary treatment. **Figure 1** on the left shows how energy is consumed at an activated sludge wastewater treatment facility, which represents the majority of Wisconsin wastewater systems.

The major energy user is the secondary treatment process, partially because this treatment component in this type of facility must operate continuously. Secondary treatment systems are often a good place to start to improve system energy efficiency since even small percentage efficiency improvements will result in significant savings.

TABLE 1 FLOW PROFILE OF WISCONSIN WASTEWATER FACILITIES

MGD	Number of Facilities	% of Facilities	Cumula-tive %	% of Average Design Flow	Cumula-tive %	Total Average Design Flow MGD
0 - 0.25	402	61.8	61.8	3.7	3.7	33.7
0.26 - 0.5	93	14.3	76.1	3.8	7.5	35.3
0.51 - 1.0	55	8.5	84.6	4.1	11.6	38.0
1.01 - 2.0	34	5.2	89.8	5.7	17.3	52.0
2.01 - 5.0	37	5.7	95.5	12.2	29.5	112.1
5.01 - 10.0	11	1.7	97.2	8.2	37.7	75.5
10.01 - 20.0	11	1.7	98.9	18.0	55.7	165.5
20.01 - 50.0	5	0.8	99.7	18.6	74.3	171.4
> 50	2	0.3	100.0	25.7	100.0	236.0
Total	650	100		100		919.5

Steps to Begin

Step 1) Establish a Baseline Energy Use

Compile your last 12 to 24 monthly utility bills to develop an overall energy profile of your facility and put energy in the context of overall organizational operations by comparing it to more widely tracked measures such as flow (MGD), BOD or labor costs (see example in **Figure 10**). Next, develop your facility's

1 Manager's Guide for Best Practices for Energy Management, AwwaRF, 2003

Energy Profile Summary, showing changes in consumption and **Key Performance Indicators** (KPI) such as MWh/MG, by year (**Figure 11**). Then graph KPI for each month. This will set your present baseline for your energy use. Tracking this energy consumption over time provides an indication of the effectiveness of your energy efficiency efforts. Projecting usage forward provides a method to set targets and goals for energy use. It can be useful to plot the energy use per month verses MG per month to show how the energy use changes with flow changes. The y-intercept of the line fit to the data indicates the constant energy use of the facility with no flow. The slope of the line fit indicates variable energy use as flow changes. Both the constant energy use and variable energy use can be impacted by efficiency measures.

Step 2) Estimate Energy Use for Major Systems

Determine the energy used by major equipment and energy-using systems. This will point the way to your largest energy uses and the best places to focus your attention (similar to **Figure 1** on the left).

Step 3) Identify Best Practice Opportunities

Best practices are techniques or technologies generally recognized as being economical and more energy-efficient than common or typical practices. Review best practices in comparison to your existing equipment and system to identify opportunities for energy efficiency improvement. Recommended best practices for water treatment systems and wastewater treatment systems are provided in this booklet. These practices apply to system retrofits as well as to new system designs.

SUSTAINABLE MANUFACTURING NEWS

EPA News, Wastewater Best Practices from Wisconsin's Focus on Energy

Step 4) Quantify Savings and Project Costs of Best Practice Opportunities

Once the best practice opportunities are determined, the next step is to estimate the cost savings associated with each project including energy and maintenance, and the installed cost of the modification. Focus on Energy can provide technical assistance to estimate projected energy savings for projects.

Figure 10
Clearwater Wastewater Treatment Facility

Electric Rate $0.06

Month	MWh/MG	Consumption (MWh*)	Prod Units MG of Wastewater	Billed Demand (kW)	Total Electric Cost
Jan	6.88	330	48	320	$19,800
Feb	6.42	308	48	320	$18,480
Mar	6.22	336	54	360	$20,160
Apr	6.07	364	60	400	$21,840
May	6.14	387	63	420	$23,220
Jun	6.02	397	66	440	$23,820
Jul	6.06	400	66	440	$24,000
Aug	6.00	414	69	460	$24,840
Sep	5.71	394	69	460	$23,640
Oct	5.52	348	63	420	$20,880
Nov	5.67	340	60	400	$20,400
Dec	5.59	302	54	360	$18,120
AVG	6.02			400	
TOTAL		4,320	720		$259,200
5% GOAL	5.72				-$12,960

* One megawatt-hour (MWh) = 1000 kilowatt-hours (kWh)

Figure 11
Facility Energy Profile - Summary
(Does not include gas, water or other utilities that should also be tracked.)
Clearwater Wastewater Treatment Facility

Electricity	2005	2004	2003	% Change 2004 to 2005
Consumption (MWh)	4,320	4,500	4,872	-4.00%
Electrical Cost ($)	$259,200	$247,500	$243,600	4.73%
$ per MWh	$60.00	$55.00	$50.00	9.09%
Key Performance Indicators				
Millions of Gallons(MG/Yr)	720	740	761	-2.66%
MWh per MG	6.00	6.08	6.40	-1.37%
Electric $ per MG	$360.00	$334.60	$320.19	7.59%
Business Indicators				
Operating Costs	$2,700,000	$2,750,000	$2,800,000	
Electricity as % Oper. Costs	9.60%	9.00%	8.70%	

Step 5) Prioritize Projects

Apply criteria such as ROI, energy savings, associated process improvements or ease of installation to help you prioritize among all the possible energy saving opportunities identified. Select the projects that achieve the energy savings goals within time and budget constraints.

Step 6) Project Management

Manage each identified energy project as you would any other project within your organization by clearly defining the project parameters, assigning responsibilities for the project implementation and undertaking specific tasks needed to implement the project.

The Focus on Energy Program has been able to identify tremendous energy saving potential and help facilities receive grants for project implementation. Focus on Energy currently has approximately 150 water and wastewater partners representing a variety of facility sizes — from 30,000 gallons per day to 32 million gallons per day.

Energy savings generally range from 20% to 40%. However, some facilities have been more aggressive and have cut nearly 75% from their pre-program participation energy use. General findings from facility surveys completed by Focus on Energy include:

- All facilities have energy saving opportunities regardless of size
- Savings generally ranged from 20% to 40%, even reaching 75%
- Aeration systems provided opportunities for the greatest savings

- Simple modifications to equipment and/or operation can result in significant demand savings
- Proactive operations can achieve additional savings
- Beneficial use of biogas is available
- When facility operators become aware of energy, energy management follows
- Continuing education and training in energy management are necessary and useful

A few of the common energy saving measures have included:

- Aeration Systems
  - Blowers
  - Diffusers
  - Controls
  - Motors
- Pumps
  - Capacity
  - System Assessment
  - Motors
  - Drives
- Miscellaneous
  - VSDs
  - Automatic Controls
  - Operation Changes

Source: "Water and Wastewater Energy Best Practice Guidebook", Focus on Energy™, Prepared by: Science Applications International Corporation (SAIC), December 2006. Focus on Energy is a public-private partnership offering energy information and services to energy utility customers throughout Wisconsin. www.werf.org, www.focusonenergy.com

THE TECHNOLOGY PROVIDER

Aerzen Delta Hybrid Blower Design for Wastewater Treatment Plant Load Profiles

BY KRISTA RAMSEY

Today's quest for energy- and cost-efficient machinery was the driving force behind Aerzen's endeavor to combines the technology of a positive displacement blower with a screw compressor together in one unit. With 145 years of experience behind it, Aerzen accomplished this feat by building the Delta Hybrid rotary lobe compressor with extremely satisfying results. This unique combination of technologies utilizes the company's experience in the design and production of rotary lobe blowers, which it's been building since 1868, and screw compressors, which it's produced since 1943. The concept offers new possibilities for generating positive pressure or vacuum in a variety of applications. "By applying screw compressor technology to low-pressure air compression, we've greatly improved efficiency," said Pierre Noack, President and CEO of Aerzen USA. The Delta Hybrid has seven patents or patent applications, making it one of the most innovative products in compression technology.

Energy Efficiency, Reduced Life Cycle Costs (LCC)

Over a 10-year operating period, energy costs equate to about 90% of the total life cycle costs (LCC) of a compressor. "Around three years ago, the realization of just how much the industry was spending on energy costs emerged as a major consideration when purchasing equipment, "said Noack. "And less energy consumption results in less greenhouse gas emissions." To meet the demand for energy-efficient equipment, Aerzen looked at the problem from every angle to analyze the big picture. "The solution depends on each individual client and their application and can integrate a combination of products," said Noack. "We consider how we can get the highest efficiency out of the existing situation, taking into account the reality of the customer's operation. Many manufacturers claim their products can save money, but the only way to know is by analyzing the real operating conditions including operating times at various loads, winter and summer, considering system aging and fouling as well as drive efficiency under these varying conditions. We show exactly where the cost savings come from and provide background information as to how we got there *[see case study at right]*."

When building its completely green facility at its U.S. headquarters, Aerzen hosted a design charette — a week-long roundtable discussion for all of the pre-selected architects, contractors, consultants, everyone involved in the project. "This integrated approach to design improves communication and allows us to be creative — one idea

> "Around three years ago, the realization of just how much the industry was spending on energy costs emerged as a major consideration when purchasing equipment. And less energy consumption results in less greenhouse gas emissions."
>
> — Pierre Noack, President and CEO of Aerzen USA

can stem from another, which is not possible with a traditional fragmented approach," said Noack. "The end product resulted in a building that uses 50% less energy and offers better working conditions. This also is how we approach the design of our products; we take the most valuable input from a variety of sources and combine it in the best possible way."

Case Study Proves 30% Energy Savings in WWTP

After testing and refining the Delta Hybrid in Europe for four years, Aerzen debuted it in the United States last October at WEFTEC®, the Water Environment Federation's annual conference, in New Orleans, LA. Following the introduction, the Huntingdon, NY Wastewater Treatment Plant (WWTP) agreed to conduct a side-by-side test of the Delta Hybrid and its two-year-old existing blower system. This provided the first opportunity to demonstrate the machinery in the U.S. wastewater market place. The town had been searching for a solution to the high energy costs of plant's current system and frequent mechanical failures that the manufacturer could not resolve, so Plant Supervisor John Pavlik agreed to design the comparison test and serve as the technical field consultant for the analysis.

Prior to testing, plant operators began collecting operating data from the existing blowers in August 2010 to set a baseline. The Delta Hybrid was installed next to the existing blower in November, and two power demand meters were attached to measure kilowatts used hourly and at peak demand. Operators recorded readings four times daily for two months, as well as checked blower pressures and temperatures. Numbers showed a 28%-29% daily energy reduction, a 30% peak demand reduction, and a 45 °F cooler temperature in the Delta Hybrid. "We were actually shocked at these numbers and even double-checked them," said Pavlik. "The peak demand, which is the maximum amount of electricity a unit uses to start, numbers also differed greatly. The existing units used 85 peak kW vs. 58 peak kW in the Delta Hybrid (28% less). This is significant, as Long Island Power Authority (LIPA) monitors and charges us for that peak (guaranteed) amount."

Aerzen also introduced a new remote monitoring system for the Delta Hybrid,

THE TECHNOLOGY PROVIDER

Aerzen Delta Hybrid Blower Design for Wastewater Treatment Plant Load Profiles

which allows it to track data and trends via Internet connection. "The system monitors the inlet and discharge temperature, vibration, speed, and oil temperature as well as the inlet and discharge pressure to help us provide real-time results to the operators," said Tom McCurdy, Northern USA Regional Manager, Water and Wastewater Blower and Compressor Sales. "Officials at Huntingdon WWTP were thrilled to advise town residents of the projected cost savings these initial results showed." Projections showed an annual savings of $79,320 for the plant, a two-year payback.

Expanded Operating/Pressure Ranges

As blowers are one the biggest consumers of electricity in a wastewater treatment plant, proper selection, considering sizing, range of flow, and pressure for a particular application, is critical on the front end. In all cases, engineers try to ensure that the plant has sufficient capacity to meet the maximum load performance, even on the hottest and most humid day. "To cover this base and account for hypothetical future population growth, engineers sometimes have to implement oversized systems that can't efficiently handle the current operating conditions of the plant," said McCurdy. "I have seen many cases where blowers have been installed in wastewater plants that can handle 100,000 gallons of water per day, and they process only 30,000 gallons per day. Most blowers are not designed for such a turn-down range and waste a lot of electricity when operating at the low end, especially if excess air needs to be vented."

The current cost per kWh and the predicted increase in energy costs are strong motivators pushing companies to rightsize systems. The Delta Hybrid has the capability of operating within a 4:1 range, allowing for a more efficient process and requiring less electricity overall to operate. "A wide turndown capability is crucial in different phases of wastewater treatment, as factors such as the influent load and temperature outside can affect the amount of air needed," said Noack. "The combination of the screw compressor technology to the low-pressure rotary lobe blower application provides the ability to adjust the air flow to achieve the highest level of efficiency even at the low end of the range." The Delta Hybrid expands the reliable operating range of low-pressure positive displacement machines. It comes in two internal configurations to achieve best performance in the most needed pressure range: a 3+3 twisted rotor profile is used for low pressures up to 800 mbar (12 psi), whereas a 3+4 rotor profile is used for pressures up to 1500 mbar (22 psi). Most wastewater treatment plants require 8 psig or more pressure and benefit from a 3+4 screw rotor configuration because the internal compression it produces helps to increase the compression efficiency. Moreover, all the package components are designed and configured to integrate all the benefits.

For applications such as wastewater treatment and food industries, the cooler operating temperature of the Delta Hybrid provide one of its most advantageous features. "Many membranes and diffusion systems, particularly in the wastewater treatment application, are made of synthetic materials that can age prematurely when exposed to higher temperatures," said Noack. "As the Delta Hybrid operates at a lower temperature, the system materials maintain their performance over a longer period of time, which also contributes to lower the energy usage. Moreover, the absence of any absorption material in the silencers of the Delta Hybrid downstream to the inlet air filter eliminates migration of fibers or particles and partial clogging of the diffuser pores, which would altogether defeat the purpose of investing in an energy-efficient machine."

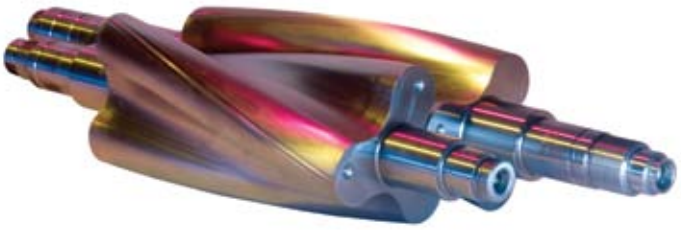
"Our current units require an oil change every 400-600 hours (4-6 weeks), while the Delta Hybrid requires a change every two years, reducing costs dramatically."

— John Pavlik, Plant Supervisor at NY Wastewater Treatment Plant

Additional Advantages

In addition to providing significant energy and cost savings, testing at Huntingdon WWTP showed that the Delta Hybrid holds its ground in fundamental areas such as reliability and durability, maintenance costs, economy of space, ease of handling, and noise level. "Our current units require an oil change every 400-600 hours (4-6 weeks), while the Delta Hybrid requires a change every two years, reducing costs dramatically," said Pavlik. According to Noack, the belt-drive technology is the simple beauty behind the design. "It is very simple, self-tensioning, 97% to 98% efficient, and it enables to optimize the driver speed, regardless of whether the machine is used with an adjustable speed drive (VFD) or not. It provides versatility and adaptability to different applications," he said.

The modular, compact design of the Delta Hybrid allows multiple units to sit side by side, saving space while offering ample access for maintenance, although it did not require much according to Pavlik. He also pointed out that the unit is relatively quiet compared to others. When running with the acoustic enclosure open, he noted that although workers still had to use hearing protection, such as ear plugs, other units require use of double hearing protection, such as plugs and ear muffs.



Aerzen USA Corporation

Founded in 1983 and located in Coatesville, PA, Aerzen USA is a wholly-owned division of the German manufacturer Aerzener Maschinenfabrik GmbH, a recognized world leader in the production of rotary positive displacement blowers, compressors, and vacuum pumps since 1868. The company has 1,700 employees working on all continents with 7 sales offices in Germany, some 40 national and international subsidiary companies, and further representations in more than 100 countries. BP

For more information on the Delta Hybrid, visit www.aerzenusa.com.

HOFFMAN REVOLUTION BLOWER Continues Tradition of Innovative Design

BY PATRICK JAMES, MARKETING MANAGER, HOFFMAN AND LAMSON PRODUCTS

Hoffman Blowers: Born in the USA

The Hoffman U.S. Machinery Division was established in 1905 outside of East Syracuse, New York. The initial product was an exhauster for the dry cleaning industry — pulling a steam vacuum across the garments. The Company grew and soon after began discovering industrial applications for their technologies. After the war period, during which Hoffman manufactured ball bearings and operated it's own foundry, the company began discovering new industrial markets for it's products. A significant part of their business was in the wastewater treatment industry. Hoffman's veteran Sales Manager for the America's Jim Ward said, "In the 1950's, the wastewater treatment market became a significant portion of our business and has remained that way ever since."

For aerobic digestion, Hoffman multi-stage centrifugal blowers became an industry standard. This air is generally 1,500–30,000 scfm, with pressure typically between 6–12 psig, with a maximum of 16 psig. With mainstay models like the 741 Centrifugal Blower, Hoffman has been the premium brand that others measure themselves against for many years. Mr. Ward commented, "Our multistage, cast iron, centrifugal blowers have set the quality and reliability standard for over 100 years."

The company went on to introduce a complete line of multistage blowers and has built a nationwide network of expert sales and service technicians.

Tony Maupin, a Territory Sales Manager for Hoffman said, "All wastewater applications are unique. The application knowledge and experience of Hoffman representatives is unparalleled."

High-speed Blower Imports Using Air-foil Bearings

By 2009, Korean-manufactured, high-speed turbo blowers using air-foil bearings, had begun to win some market share. Now a division of Quincy, Illinois based Gardner Denver Inc., Hoffman managers knew they had to respond. "High-speed blower imports, using air-foil bearings, could in certain applications, provide energy-savings of interest to the customer," said Wes Carl, Hoffman's Director of Centrifugal Technology. "We didn't feel, however, that the air-foil bearing technology provided customers with the same level of reliability and robustness that we expect from Hoffman products."

Air-foil bearings have surface wear during a routine start-up and prior to reaching normal operating speed. A "lift-off" speed is achieved at around 4-7,000 rpm as a wedge is formed between the bearing and shaft. Dave Shanahan, the Applications Engineering Manager commented, "The reliability issue with air foil bearings relates to the fact that

The Hoffman Revolution High-Speed Blower

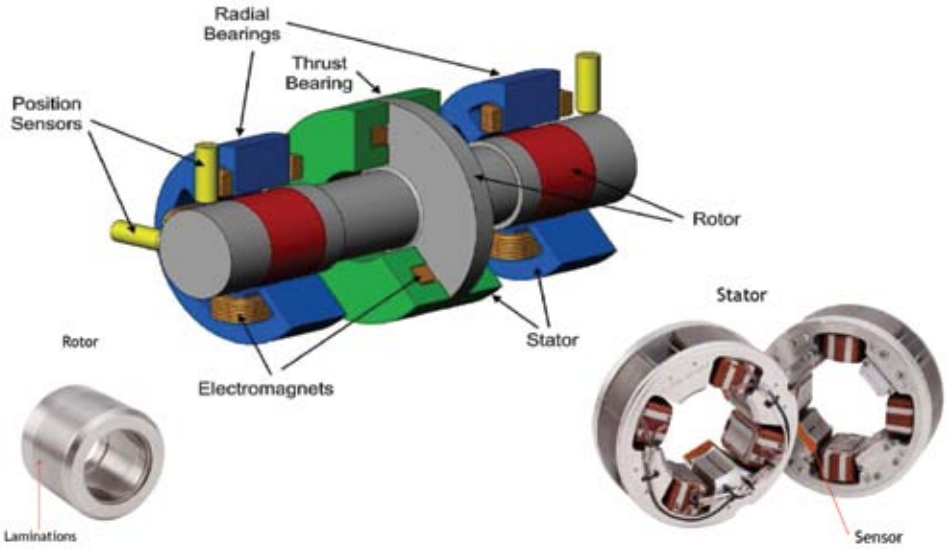
aeration blowers are a start/stop application. Every time the unit is started or the bearing "touches down" on shutdown, wear is taking place and that is going to limit the life of the bearing. Also, the basic plant environment has a practical level of contamination (dirt, dust) build-up that can impact this wear and the air foil bearing life.

Hoffman Engineering Fights Back

In early 2010, Gardner Denver CEO and President, Barry L. Pennypacker, was adamant that the company not lose market share to the imported high-speed blowers. Brian Cunkelman, Gardner Denver Vice President for the Industrial Products Group commented, "Our challenge was to launch a new product that would be more energy-efficient than the imports — while maintaining the integrity of the quality and reliability of the Hoffman brand." Engineering resources were pooled from corporate Gardner Denver labs in Quincy, Illinois and from the Hoffman headquarters in Peachtree City, Georgia. Cunkelman continued, "We are very proud that the combined engineering teams responded with vigor to the challenge and were able to design, test and introduce the Hoffman Revolution during the 4th Quarter of 2010 AND exceed all the market requirements!"

Hoffman Revolution: Designed, Engineered, and Manufactured in the U.S.

The engineering project team (split between Quincy, Illinois and Peachtree City, Georgia) began with a solid VOC (Voice-of-the-Customer) exercise. Tony Maupin talked about the typical customer requirements. "Wastewater plants are often built for future population growth so we will see extra blowers on site for future growth. If peak demand is 9,000 cfm, it's common to have four 3,000 cfm blowers



The Active Magnetic Smart Bearing Components

HOFFMAN REVOLUTION BLOWER CONTINUES TRADITION OF INNOVATIVE DESIGN

installed with three running and one on stand-by." Then came the critical statement, "Load requirements are always changing. In tourist towns, demand goes through the roof in the summer." Another important factor is ambient temperature. Cooler air means you deliver more oxygen within a given volume of air. In July a wastewater plant may need to run two blowers when they only one run blower in January. Maupin concluded, "The market is asking for increased energy efficiency at partial loads while retaining multi-stage blower reliability standards."

In April 2010, a break-through was achieved by the engineering team. Mr. Carl commented, "We discovered a U.S.- designed and manufactured magnetic bearing coupled with a high speed motor that was successful in the HVAC industry. With our design engineering, we felt we could turn this into the blower product the market was looking for." At this stage, a group of ten design engineers, mechanical engineers, electrical engineers, test engineers, packaging experts, controls experts, and cooling circuit experts was assembled. "We gave everyone assignments and we were off to the races," said Mr. Carl. "We did a lot of front-end analysis and concept simulation on this machine to optimize the design and reduce the time to market" including:

The Hoffman Revolution High-Speed Permanent Magnet Motor and Blower

- **Rotor Dynamic Analysis:** The purpose of this analysis is to verify that we didn't have any rotor natural frequencies (vibrations and resonance) from zero to maximum speed including adequate separation margin to ensure proper operation of the blower
- **Impeller/Volute Analysis:**
  - Computational Fluid Dynamics (CFD) Analysis: Used for predicting performance
  - Finite Element Analysis (FEA) for Stress and Modal evaluation of the impeller

Ultimately, the engineering team had excellent convergence between the predicted (calculated) performance vs. the actual measured performance of the prototype.

In between April and September 2010, the product was designed, built, and tested. Mr. Norb Mast, the Research & Development Manager at Gardner Denver, commented, "In Quincy, Illinois we were able to use our Performance Testing Lab and our Sound Testing Room to help with this project." Mr. Mast provided us with the following description of the testing labs and processes:

- **The Performance and Heat Testing Room:** This room has received an investment of approximately $1 million from Gardner Denver. It is equipped with special power and switch gear coming from transformer banks. There is also a data acquisition system with data loggers. The piping is a mixture between carbon steel and stainless steel — it's all 12 inch piping with ASME flow nozzles. The nozzles are used for outlet air flow measurement. Instrumentation in the lab includes RTD's for temperature measurements, electronic pressure transducers, turbine flow meters for coolant flow measurement, and a Yokogawa power analyzer for the incoming power measurements. In order to accurately measure the incoming power on variable frequency drives, you need a more expensive power measurement device like the Yokogawa
  - **Performance Tests:** Power is measured according to the ASME PTC10 Power Test Code. We measure power into the package and measure airflow leaving the package. The computerized system logs flows, temperatures, pressures, and power. Flow nozzles were used to log the flow delivery. All discharge air was channeled into a nozzle run. The nozzle is a differential pressure device. These tests are all designed in accordance to the ASME power test code defining the shape of the nozzle and the equations to be used
  - **Heat Tests:** The entire room is heated up and has temperature sensors all over the blower package. We measure VFD temperatures, blower discharge temperature, cooling circuit temperatures on the closed-loop glycol based circuit as coolant goes through the motor. These tests have ensured that if the Revolution is run in a hot ambient temperature, nothing will affect the machine
- **The Sound Testing Laboratory:** This room has received an additional investment of approximately $1 million from Gardner Denver. This is a semi-anechoic room. We converted

one of the buildings into this laboratory — which has to be large enough to contain even our largest skid-mounted packages. We built walls and a new HVAC system able to maintain ambient temperatures very quietly. It has a concrete floor and all the special acoustical absorption foam wedges located on the ceiling and walls

- **Sound Tests:** We follow ISO Standard 2151 to perform our sound testing. We set up microphones on top and all around the unit. The ISO Standard provides the procedure to calculate sound power and sound pressure from the blower

A Focus on Energy Efficiency

Blowers pull ambient air and send it to the wastewater tanks or lagoons. "The motors that drive the blowers tend to represent 50–75% of the total energy used at a wastewater plant," according to Patrick James, the Hoffman Marketing Manager. An important focus was to be able to run at partial loads using a variable frequency drive (VFD). The overall energy utilized by the equipment is a function of the individual efficiencies of the components (blower, motor, VFD, etc) that make up the package. The Revolution product utilizes a high efficiency permanent magnet (PM) motor and selecting the correct VFD technology was critical. A Current Source Inverter VFD is utilized which was determined as the best fit with the PM motor and provided the optimal package efficiency and reliability.

The Hoffman Revolution at The Sound Testing Laboratory

There are many situations where an older wastewater treatment station is looking to replace a couple of blowers with newer machines. "Equipment upgrades are an ideal application for the Hoffman Revolution,"

HOFFMAN REVOLUTION BLOWER CONTINUES TRADITION OF INNOVATIVE DESIGN

Imported Turbo Blowers Grapple With Buy American Compliance Issues

Recent Headlines: "Feds Seize High-Efficiency Blowers"

Officials responsible for the Airport Parkway Sewage Treatment Plant (located in South Burlington, Vermont) were notified in March 2011 by federal investigators, that their newly acquired high-efficiency blowers, purchased from KTurbo (a Korean firm with a branch in Batavia, Illinois) might be considered contraband through Buy-American provisions of a $1 million federal grant.

South Burlington City Manager Sanford Miller said the Assistant U.S. Attorney involved with the case has characterized the city as "a victim" in the investigation. Although the city has installed one of the blowers, valued at $226,000, they have not paid for the units and the city's legal and financial options are under review. Miller said other cities in the U.S. that recently opted for the KTurbo blowers, had also been targeted by federal investigators.[1]

Debating "ARRA Buy American Compliance"

South Burlington's Department of Public Works Director, Justin Rabidoux said, "KTurbo certified that the units were substantially transformed by its American operation allowing it to qualify for federal subsidies."[2] The question under legal review is if the "transformation" was sufficient to meet with the requirements of the American Recovery and Reinvestment Act of 2009, Made in USA, provisions.

The American Recovery and Reinvestment Act of 2009 (ARRA) provided significant funding for states to finance high priority infrastructure projects needed to ensure clean water and safe drinking water. The U.S. Environmental Protection Agency (EPA) Clean Water State Revolving Fund (SRF) program received $4 billion, from the ARRA. The EPA is making ARRA grants to states to capitalize their State Revolving Fund (SRF) programs, from which assistance is provided to finance eligible high-priority water infrastructure projects.[3]

The EPA has issued a factsheet called "ARRA BUY AMERICAN COMPLIANCE, What you need to know for SRF Projects." In the Fact Sheet the following point is made:

Buy American Applies To:

All manufactured goods brought to the construction site for incorporation into the project by contractors, subcontractors, or vendors (e.g.: pumps, motors, generators, valves, lights, aeration blowers, mixers, air compressors…).

Manufacturing is defined as the substantial transformation of raw materials and components — it results in a change in character of the components and/or requires significant skill, time, and money.[4]

When it comes to the use of ARRA funds, provided by the U.S. taxpayer, the following was written in a 2009 memorandum by Mr. James A. Hanlon, the Director of the U.S. EPA Office of Wastewater Management:

"The objectives of the American Recovery and Reinvestment Act of 2009 (ARRA), as they relate to the State Revolving Fund (SRF) Programs are clear:

- **To provide investments needed to increase economic efficiency by spurring technological advances in science and health."**
- **To preserve and create jobs and promote economic recovery**
- **To invest in transportation, environmental protection, and other infrastructure that will provide long-term economic benefits."**[5]

said Mr. James. Proper selection and utilization of the Revolution can produce annual energy savings of over 20% versus an existing traditional arrangement. Recognizing these savings is achieved through an understanding of the characteristics of the system demand and how to best apply the technology.

In working with the Hoffman sales personnel, these details can be reviewed and the best option for the specific plant can be provided.

Conclusion

The Hoffman Revolution represents another chapter in American resiliency and ingenuity. Faced with imports threatening to take market share, the company invested the resources required to provide a next-generation technology. A new technology emerged in record-setting time, capable of saving energy for the wastewater treatment market while maintaining the traditional reliability and quality standards of a Hoffman product. BP

For more information please contact Patrick James,Marketing Manager, Hoffman and Lamson Products, Tel: 770.632.5028, Email: Patrick.James@gardnerdenver.com

1 "Feds threaten to seize South Burlington sewage blowers", by Joel Banner Baird, Burlington Free Press, March 10, 2011, www.burlingtonfreepress.com
2 "Feds threaten to seize South Burlington sewage blowers", by Joel Banner Baird, Burlington Free Press, March 10, 2011, www.burlingtonfreepress.com
3 "Clean Water and Drinking Water State Revolving Funds", http://water.epa.gov/aboutow/eparecovery/index.cfm
4 United States Environmental Protection Agency Buy American Factsheet, http://water.epa.gov/aboutow/eparecovery/upload/Buy-American-One-Pager_10_14_10.pdf
5 Memorandum written March 2, 2009 by Mr. James A. Hanlon, the Director of the U.S. EPA Office of Wastewater Management and Ms. Cynthia Doughery, Director of the Office of Ground Water and Drinking Water wrote the following memorandum to Water Management Division Directors, Regions I-X. Source:

COMPRESSED AIR IN WASTEWATER TREATMENT

BY SCOTT VAN ORMER AND HANK VAN ORMER
FOR THE COMPRESSED AIR CHALLENGE®

KNOW PRESSURE
COMPRESSED AIR CHALLENGE®

When you hear "water treatment" what is the first thing that comes to mind? Sewer water treatment? Certainly this is often the case. Municipal water treatment is classic water treatment requiring aeration, agitation and continuous fluid movement.

Wastewater Municipal Water & Sewage Treatment:

- Compressed air used for agitation to keep solids in suspension
- Compressed air is often needed to supply oxygen support to the processing bacteria

Air pressure required depends on:

- Liquid/slurry depth
- Actual water head pressure 2.31 feet equals 1 psig
- For estimating we use .5 psig per foot of head of H_2O — specific gravity of water is 1.0. Mixtures and slurries with higher specific gravity will have greater head pressure

COMPRESSORS OFTEN USED FOR WATER TREATMENT AERATION AND AGITATION

AIR COMPRESSORS	ACFM (APPROX.)	HORSEPOWER (APPROX.)	COOLING TYPE	PSIG (APPROX.) * POSSIBLE HIGHER PRESSURE	LUBRICATED OR NON-LUBRICATED
Reciprocating Single or 2-Stage	<1 to 5,000 acfm	<1 hp to 1,000 hp	Air <60 hp or Water >60 hp	30-75 psig 90-150* psig	Lubricated or Non-lubricated
Single-Stage Lubricated Rotary Screw	15 to 3,000 acfm	5 hp to 700 hp	Air or Water	90-150*	Lubricated
2-Stage Lubricated Rotary Screw	500 to 3,100 acfm	100 hp to 600 hp	Air or Water	90-200*	Lubricated
Oil-Free Rotary Screw Single or 2-Stage	75 to 4,200 acfm	40 hp to 900 hp	Air or Water	28-50 90-125*	Non-lubricated
Centrifugal Single to 3-Stage	375 to 5,000 acfm	75 hp to 1,000 hp	Air or Water	28-60 90-150*	Non-lubricated

Fundamentals of Compressed Air Systems WE (web-edition)

Join us for the next session of *Fundamentals of Compressed Air Systems WE* (web-edition) coming September 12th. 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**.

The object of this article is to look at some very typical industrial water treatment processes and various compressed air and energy savings projects that have worked well for our clients over the years. The basic fundamentals with regard to compressed air usage are similar to municipal water treatment — a good starting point.

Disclaimer: This data is not intended to be complete enough to select wastewater air. It is designed to give the reader an overall view of the basic operating parameters of each type.

There are many types of blowers (rotary vane, liquid ring, etc.) used in industry, particularly in the smaller sizes. As in most air and gas compression equipment, larger, well applied central units may well prove to be the most energy efficient solution when conditions dictate. Each opportunity needs a specific evaluation.

COMPRESSED AIR IN WASTEWATER TREATMENT

LOW PRESSURE AIR (LESS THAN 30 PSIG) BLOWERS					
BLOWERS	**ACFM (APPROX.)**	**HORSEPOWER (APPROX.)**	**COOLING TYPE**	**PSIG (APPROX.) * POSSIBLE HIGHER PRESSURE**	**LUBRICATED OR NON-LUBRICATED**
Regenerative Dynamic Compression Blower (Figure 1)	250 to 1,350 acfm **	5 hp to 30 hp	Air	2-4.5	Non-lubricated
Centrifugal Dynamic Compression Blower Single-Stage (Figure 2)	20 to 45,000 acfm	10 hp to 1,000 hp ***	Air or Water	.3-28	Non-lubricated
Positive Displacement Straight Lobe Single and 2-Stage (Figure 3)	75 to 2,500 acfm	4 hp to 250 hp	Air	4-12*	Non-lubricated
Positive Displacement Helical Lobe Single and 2-Stage (Figure 4)	400 to 6,500 acfm	20 hp to 650 hp	Air	10-18*	Non-lubricated
Positive Displacement "Claw" Type Lobe Single-stage (Figure 5)	40 to 350 acfm	5 hp to 40 hp	Air	18-30	Non-lubricated

** Larger units are available

** Note: With single-stage centrifugal blowers the ability to deliver higher pressures increases with the flow volume. The required horsepower to produce the flow varies with flow and pressure selection. The air "mass flow" units and the driving power is a direct function of the mass flow or weight of the air.

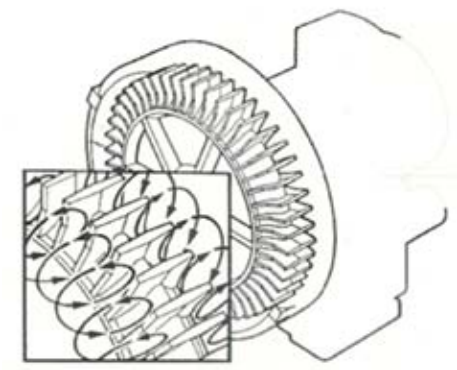


Figure 1. Regenerative Dynamic Compression Blower

Figure 2. Centrifugal Dynamic Compression Blower Single-stage

Figure 3. Positive Displacement Straight Lobe Single and 2-Stage

Figure 4. Positive Displacement Helical Lobe Single-stage

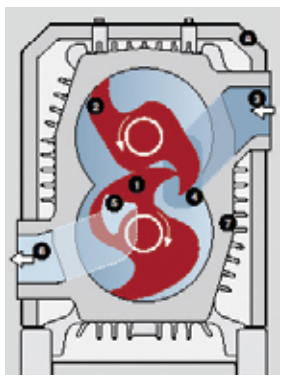


Figure 5. Positive Displacement "Claw" type Lobe Single-stage

The lower the pressure, the lower the energy cost per scfm of delivered volume of compressed air with the same type and class of compressed air operating equipment. This is generally true regardless of the type of compressed air generating unit as long as the pressure flow is within a given units operating parameters.

This looks somewhat simple — just identify the minimum acceptable pressure that works and the required or current actual compressed air flow being used. Then, select the appropriate blower or air compressor. In an existing plant or operation this can often be challenging since many operators do not have nor know this information.

TYPICAL OPERATING COST FOR 500 CFM AT VARIOUS PRESSURES (BASED ON $.06/KWH AND 8,000 HRS/YEAR)		
ELECTRICAL ENERGY COST TO PRODUCE:	500 cfm at 100 psig	$43,000
	500 cfm at 50 psig	$26,000
	500 cfm at 15 psig	$18,000
	500 cfm at 7 psig	$8,000

In the field you can measure the flow and inlet pressure, but to accurately estimate the probable lowest usable discharge pressure you will need to know the specific gravity of the solution and the overall height of the liquid or slurry material (depth) to establish the "head pressure" to be overcome.

Unlike a municipal sanitary sewer wastewater treatment facility this data is often not only not readily available but also may well vary over time and application in the industrial wastewater environment.

Generally compressed air is combined with some type of liquid or slurry pump appropriate to handle the material. Often this is an air operated double diaphragm pump due to its simple design and versatile application parameters. They are also relatively quick to repair and/or change. Electric driven pumps are often not even considered.

There are three primary uses of compressed air in all wastewater treatment applications:

- Aeration to supply the processing bacteria with oxygen support
- Agitation to keep the solids in suspension and,
- A continuous, driving pump to move the material.

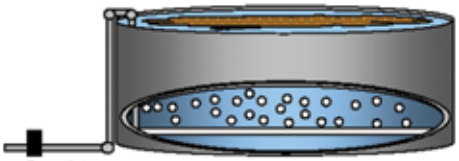
The lower the pressure, the lower the energy cost per scfm of delivered volume of compressed air with the same type and class of compressed air operating equipment.

COMPRESSED AIR IN WASTEWATER TREATMENT

Basic Methods of Aeration / Agitation

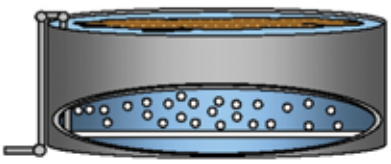
When aeration is required for the oxygen supply then the choices are somewhat limited. The compressed air economic opportunities are:

- Investigate the savings if an electric pump can replace the air driven pump. The primary limiting factors to economic use of an electric in lieu of air driven is the head pressure required (viscosity and depth) and make up of the material
- If an air operated double diaphragm pump is the proper selection, identify the lowest effective inlet pressure and add an electronic stroke optimizer. These controls can reduce the air use 40 to 50%, delivering the same throughput while incorporating automatic starts/stop if applicable
- Identify the proper pressure and flow to select the most effective compressed air supply as described earlier



Regulator
90 psig in 10 psig out

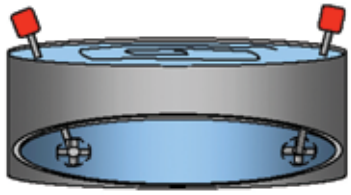
COMPRESSED AIR
44 cfm 10 psig
11 BHP = 8.8 kW
$.05 / kWh
$3,864 / year



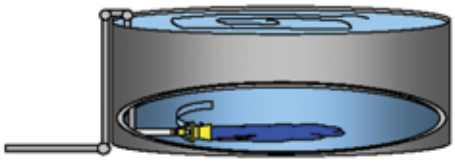
BLOWER AIR
10 cfm 10 psig
3 BHP = 2.4 kW
$.05 / kWh
$1,054 / year

Sandpiper AODD microprocessor stroke optimizer
Courtesy of airvantagepump.com

When aeration is not needed for the oxygen content and the compressed air is used (with or a process pump) primarily for agitation, additional opportunities exist to deliver the same agitation results at a lower energy cost. Even though compressed air power is very expensive, these other actions should always be carefully evaluated on specific case by case conditions to establish an accurate operation energy cost.



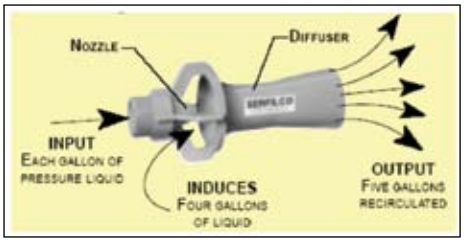
ELECTRIC MOTOR PROPELLER
½ - 1 HP
(2) ½ HP = 1.1 BHP
1.1 BHP = .88 kW
$.05 / kWh
$386 / year



LIQUID PUMP
Liquid Venturi Amplifier Nozzle
½ BHP = .55 kW
$.05 / kWh
$240 / year

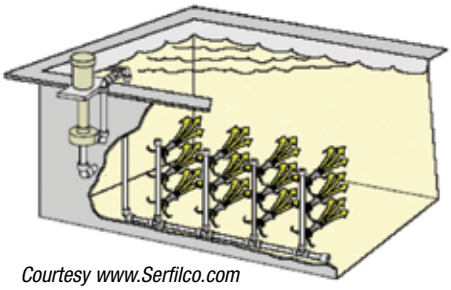
The following case studies cover some of the most prevalent opportunities.

Liquid Flow Eductors



How They Work: Liquid pumped into the eductor nozzles exits at high velocity, drawing an additional flow of the surrounding solution through the educator. This additional flow (induced liquid) mixes with the pumped solution and multiplies its volume five-fold. The source of the pumped liquid (input) can be a pump or filter chamber discharge.

- Eductor agitation delivers five times the pump output at each nozzle. This effectively helps deliver the required level of agitation to critical areas



Courtesy www.Serfilco.com

- When appropriate and properly engineered and installed, this can often supply proper agitation at lower energy input

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

Efficient air guns, comfortable grip

Safety Air Guns use engineered Air Nozzles to provide superior performance. Safe operation is assured along with low air consumption and noise level. Many styles and nozzles are offered. Extensions and Stay Set Hoses are available.

www.exair.com/78/sag.htm

Nozzle cluster, high blowing force

Many blowoff, cleaning, cooling and drying applications require high force and extensive reach. EXAIR's Super Air Nozzle Clusters deliver up to 9.8 lbs of force. Three sizes for handheld and stationary mounting are available.

www.exair.com/78/blast.htm

Unique flat nozzle uses patented technology

The 2" Super Air Nozzle is a highly efficient, unique flat air nozzle. Using EXAIR's patented technology, a precise amount of air is released through the thin slot, across a flat surface. The result is a wide, forceful stream of high velocity, laminar airflow. Force and flow can be easily adjusted.

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

Directed blast of air

EXAIR Air Jets utilize the Coanda effect (wall attachment of a high velocity fluid) to produce a vacuum on one end that pulls large volumes of room air through the unit. Both the outlet and inlet can be ducted for remote positioning.

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 minimizing air consumption. A micrometer like dial indicates the gap setting.

www.exair.com/78/adjust.htm

COMPRESSED AIR IN WASTEWATER TREATMENT

CAC® Qualified Instructor Profile

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Mr. Van Ormer has been associated with the compressed air business for over forty years. He has been employed by several major compressor and mining equipment in major service and sales-marketing assignments. The principal focus has been compressed air equipment.

Mr. Van Ormer has visited more than 5,000 facilities and audited hundreds of compressed air systems throughout the United States and internationally. Clients include Boeing, Ford Motor, General Motors, IBM, John Deere and other Fortune 500 corporations.

In 1986, Mr. Van Ormer formed founded his independent consulting company, Air Power USA, Inc, specializing in compressed air systems. He has developed several accredited training courses for continuing education and complete curriculum for technical colleges.

Qualified For:

- CAC Fundamentals of Compressed Air Systems
- CAC Advanced Management of Compressed Air Systems

Refinery application to replace agitation air with Liquid Flow Eductor

Example: The caustic production utilized two 40' tall tanks with 15' depth. Measured air flow was 240 scfm to both wastewater holding tank. The air was delivered through three 3/4" lines on three sides blowing air to keep the solids off the inside walls. There is also a 20 hp pump that continually circulates the mixture to keep the solids off the bottom and in suspension.

Total energy applied:	
240 scfm at 4 scfm input hp	60 hp
Electric motor driven pump	20 hp
Total energy	80 hp
(80 x .746 ÷ .90 @ $.06 kWh / 8,760 hrs yr)	66.3 kW
Estimated annual current electrical energy cost	$34,847/yr

Project implemented: Install three eductor patterns at appropriate points on the tank walls and a double set on the bottom. Total energy input 10 hp/8 kW centrifugal pump (duplex)

Total electric power operational savings (kW)	54.3 kW
Estimated annual total electric energy savings ($.06 kWh / 8,760 hrs/yr)	$28,540/yr
Total project cost (with installation)	$20,000
Simple payback	8.4 months

The new eductor system held the solids in suspension as required allowing appropriate storage time between cleaning and clearing.

Steel Processing Plant Filter Press Running On AODD During Complete Four Hour Cycle

The filter runs a 4-hr cycle. A 30-minute final press requires 150' of head pressure at end of each cycle. Prior to the final press, head pressure is 30 to 40 feet for 3.5 hour per cycle.

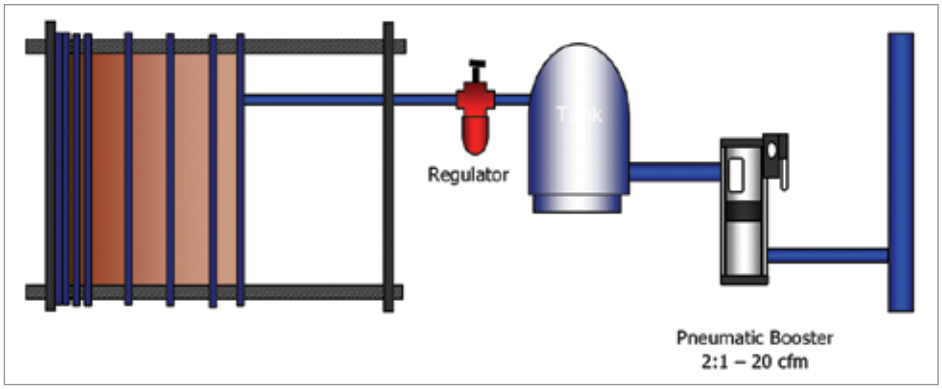
Efficiency measures such as this are taught in the Compressed Air Challenge's Fundamentals and Advanced Management seminars.

The project was to install a 2 hp electric motor driven centrifugal pump to operate the press the first 3.5 hours of the 4-hour cycle. The production processes is 24 hours a day, 7 days a week, 365 days a year with a blended power rate of $.10 kWh.

Current air flow to 2" AODD	80 scfm
80 scfm at 90 psig at estimated input power (20 hp x .746 ÷ .90)	16.6 kW
Estimated annual electrical energy cost (16.6 kW x $.10 kWh x 8,760)	$14,542/yr

Modified operation

16.6 kW (x 1,095 hours (12% 8,760) x $.10 kWh	$1,817.70/yr
1.7 kW (2 hp motor) x 7,665 hrs/yr x $.10 kWh	$1,303.05/yr
Total estimated annual operating air	$3,120.75/yr
Total savings	$11,421.25/yr
Total project cost	$5,000
Simple payback	5.3 months



Chlorine Plant: Two 40' Tall Wastewater Final Stage Polishing Tanks Before Release To Groundwater (Fluid Depth 30 Feet)

Current use measured 220 scfm at 90 psig compressed air regulated to 15 psig to supply agitation to maintain clarity. The air is delivered to the bottom of each tank from which it bubbles up through the water.

Current estimated electric power to produce the 220 scfm @ 4 cfm/input	55 hp
Current estimated electric power x .746 ÷ 90	45.6 kW
Operating cost (8,760 hrs @ $.10 kWh)	$39,945/yr

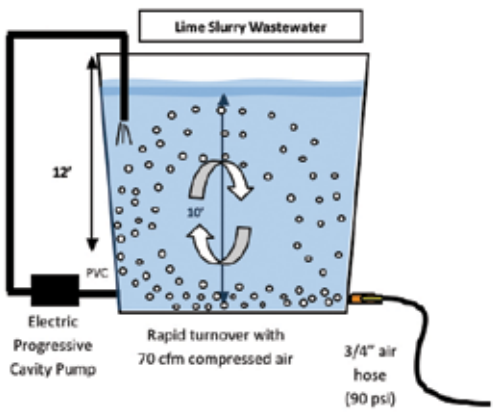
The first alternate technology considered was utilizing the "liquid flow eductors". However, the power to handle this tall and wide tank was 75 hp (62 kW) which was obviously not a calculated savings so the idea was abandoned. Supplying the low pressure air at 16 psig with a single-stage helical lobe blower was next explored.

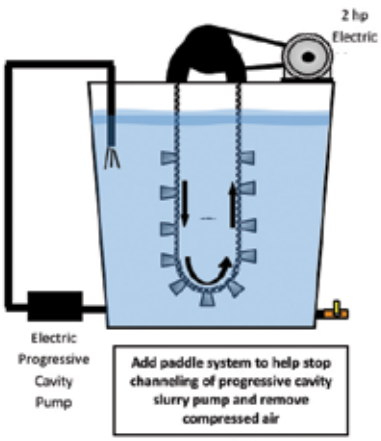
A helical lobe blower using a 25 hp electric motor with 22 bhp power draw (22 x .746 ÷ 90) or 18.2 input kW will deliver 239 scfm at 15 psig. With this, the primary estimated annual energy cost is $15,944/yr (18.2 x $.10/kWh x 8,760 hrs) or an annual electrical energy savings of $24,000/yr. The installed cost of the new blower package and piping was $14,000 (up to $28,000 depending on the package) installed. And a anticipated simple payback of 7 to 12 months.

The last case study example is in a steel mill wastewater treatment area where the limestone slurry tank is agitated with a 30 hp progressive Moyno cavity pump in a 12' tall by 8' diameter tank. The lime must be effectively kept in suspension to avoid channeling

COMPRESSED AIR IN WASTEWATER TREATMENT

Progressive Cavity Pumps Courtesy of www.moyno.com





with solids buildup around the pump entry blocking effective agitation. The solids block the recirculation volume, which accelerate the fouling factor and significantly increases the number of expensive cleanings. This can be a significant environmental and time consuming issue to clean out and in all probability also affecting production.

The goal was to keep the solids and in suspension until the regular scheduled maintenance time. Premature fouling was currently avoided by adjusting fluid tank levels as required when maintenance personnel found time. This situation was not only troublesome but could lead to unplanned significant downtime with the current manpower situation.

After the tank was cleared of solids and reset to avoid a reoccurrence, a 3/4" air line at 90 psig entry pressure was opened into the bottom side of the tank. The measured flow was 80 scfm, it did do the job.

Total estimated pump power (30 hp [x .746 ÷ 90])	24.9 kW
Total air flow 80 scfm (80 ÷ 4 sec/input hp = 20 hp x .746 + .9)	16.6 kW
Total estimated power utilized (8,760 operating hours/yr @ $.10/kWh)	41.5 kW
Total current estimated electrical operating energy cost	$36,354/yr

A mechanical mixing assist with paddles was added to replace the 1" air line (see drawing on previous page). This arrangement was driven by a 2 hp electric motor (2 hp x .746 ÷ .85) or 1.75 kW. This has proven to be very successful.

New configuration electrical operating energy:

30 hp progressive cavity pump	24.9 kW
Mechanical paddle pump	1.75 kW
Total electrical operating energy power	26.65 kW
Total electrical operating annual energy cost	$23,345/yr
Total electrical energy savings	$13,009/yr
Cost of project	$2,540
Simple payback	2.3 months

Summary

If air is needed for the wastewater treatment process and agitation alone is not enough, then there are really two choices — blower air or air compressor air. The proper choice will have a very positive impact on energy cost and, correctly applied and maintained, should enhance productivity.

The second opportunity in this case is pump selection — electric or air driven. With or without flow enhancers such as eductors, if air operated, the use of microprocessor stroke optimized controls on AODD pumps should be considered.

If only agitation is required, it is usually to keep solids in suspension, then there are a range of options to replace or reduce compressed air usage including such mechanical devices as propellers, paddles, etc.

As you look at your wastewater system, let your imagination be your guide. As they say, "think outside the box". BP

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

Table data and figures supplied by:

Spraying Systems Co. — IL (www.spray.com)Continental Blower — NY (continentalblower.com)

Dearing Air Compressor — OH (dearingcomp.com)Elmo Rietschle/ Gardner Denver — IL (gd-elmorietschle.com)

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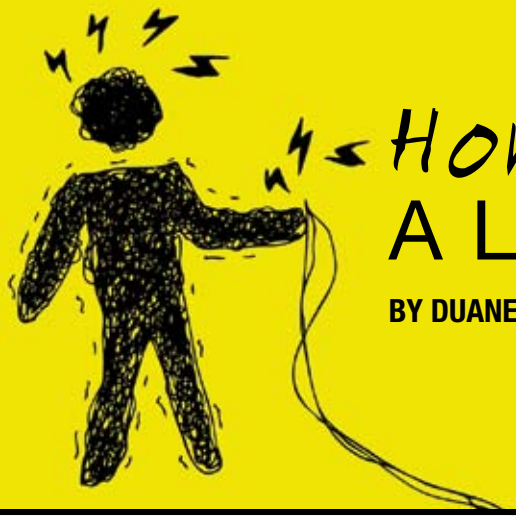

How To Troubleshoot A Large Motor Drive Safely

BY DUANE SMITH, SR. SUPPORT ENGINEER, FLUKE DMN GROUP

Use These Guidelines With Any Motor Drive

Any time you troubleshoot a large motor drive, you run the risk of both electric arc and electrical shock. Arc blasts are less frequent but deadly. They're most commonly caused by a dropped wrench or other tool that lands across high-energy bus bars in an open cabinet. This kind of short circuit is upstream of protective fuse links and lets loose thousands of amperes of fault current.

Electric arcs produce the highest temperatures on earth — up to 35,000 °F (19,426 °C) — causing all materials (metals, liquids, plastics — everything) to vaporize and expand explosively. The blast pressure can throw a person across a room, and spray a person with shrapnel and molten metal droplets. Aside from the primary danger of being burned, intense pressure and sound can cause physical injury and deafness. The input power requirements for a large motor drive puts it in the high-risk category for arc flash.

Electrical shock is more commonplace. A slip of the hand and you or your tool connects with a live component. It happens when you're working too fast, just getting in there quickly to check one thing. Not as destructive as an arc blast, but still deadly.

To guard against either of these dangers, especially when working on large motor drives, always follow basic electrical safety procedures and wear the right personal protective equipment (PPE).

NFPA 70E Regulations Have Changed

The National Fire Protection Agency (NFPA) 70E Standard specifies electrical safety practices and equipment for working on live electrical components. The standard maps out what level and extent of flame-resistant clothing to wear, head to toe, for different risk levels. It also provides rules of safe practice and how to calculate risk.

The 2009 edition of the standard includes substantial changes from previous editions. In particular:

- More safety gear is now required, and starting at lower voltage levels
- Test tools are now officially part of PPE and must meet requirements

The new edition also makes it easier to figure out what kind of PPE to use and wear in a particular electrical environment.

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HOW TO TROUBLESHOOT A LARGE MOTOR DRIVE SAFELY

Correct PPE will go a long way toward protecting you from electrical shock injury. For arc flash, it's a last line of defense. In neither case does PPE substitute for safe work practices or engineering controls that can reduce the danger of the exposure to arc flash.

To assess whether your test tools meet the requirements, look for the symbol and listing number of an independent testing lab such as UL, CSA, TÜV or other recognized approval agency. That symbol can only be used if the product successfully completed third-party testing based on national or international standards. The marking "UL 61010-1:2004," for example, is based on IEC 1010. Only then will you know for sure that a digital multimeter (DMM) or other test gear design has been subjected to rigorous real-world tests, such as 12 kV positive and negative impulses applied to the input jacks.

The Drive Troubleshooting Process

Troubleshooting any motor drive is for trained, certified technicians only. NFPA 70E lists specific rules to follow to avoid personal injury from arc flash or electrical shock.

Caution: never approach a variable-speed motor drive without first obtaining its instruction manual.

Here's an overview of the entire drive-troubleshooting process:

- Complete a job-preparation checklist using NFPA 70E Annex I, the drive instruction manual, and local jurisdiction rules and regulations
- Photograph the drive and note any error codes
- Obtain the electronic or paper maintenance records for the drive
- Obtain the instruction manual (download it from the manufacturer's website if no paper copy exists). Read and understand all the "ATTENTION" (warning, caution) statements in the drive manual
- Disconnect lockout/tagout (LOTO) input power; verify absence of voltage before opening any part of the drive
- Verify that the DC bus capacitors are discharged — wait a full five minutes, then check for 0 V dc.
- Follow the steps in the drive manual for troubleshooting

Prep Checklist: Plan The Job Using Nfpa 70 A Annex I

NFPA 70E provides a "Job Planning Checklist" in Annex I. Begin by reviewing Annex I and the drive instruction manual. Here is what Annex I has to say, paraphrased and adapted for a motor drive:

✔ Identify

- Hazards
- Voltage — input and output of the drive
- Skills required
- Any possible back-feed source once power is off
- Any unusual work conditions
- Number of people needed
- The shock protection boundaries
- The available incident energy (short-circuit fault current)
- Arc flash protection boundary

✔ Ask

- Can the drive be de-energized?
- Can adequate time be set aside for downtime to finish the troubleshooting?
- Who needs to sign off on the shut-down? New rules in the 2009 NFPA 70E revision include:

1. **Greater Hazard.** Energized work shall be permitted where the employer can demonstrate that de-energizing introduces additional or increased hazards
2. **Infeasibility.** Energized work shall be permitted where the employer can demonstrate that the task to be performed is infeasible in a de-energized state due to equipment design or operational limitations

- Is a "safety person" required?

✔ Check

- Plant wiring plans
- Drive manual
- Plant safety procedures
- History of the drive, maintenance records, and who is the in-house expert?
- Need updated information from the drive manufacturer?

To assess whether your test tools meet the requirements, look for the symbol and listing number of an independent testing lab such as UL, CSA, TÜV or other recognized approval agency.

HOW TO TROUBLESHOOT A LARGE MOTOR DRIVE SAFELY

✔ Know

- Who else needs to know?
- Who is in charge?

✔ Think

- About the unexpected event. "What if...?"
- Lock — tag — test — try
- Test for voltage first
- Use the right PPE, tools and equipment
- Check all the grounding to make sure it conforms to the drive manual's instructions
- Install barriers and barricades

✔ Prepare for an emergency

- Is the standby person CPR trained? (Don't work alone.)
- Where is emergency equipment?
- Where is the nearest telephone?
- Where is the fire alarm?
- Might confined space rescue be required?
- How do you shut off everything in an emergency?
- Where is the fire extinguisher?
- Are radio communications established, if possible?

✔ Know the project details

Start with the proper PPE. Determine the risk category for PPE by checking the input power requirements for the drive you're planning to work on. A system capacity of 460 V ac units = 85,000 amps symmetrical fault current capacity (65,000 amps if a circuit breaker is used instead of fuses.)

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HOW TO TROUBLESHOOT A LARGE MOTOR DRIVE SAFELY

✔ Read the drive fault codes

The drive displays alarm and fault codes to assist in troubleshooting when a problem develops during self-tuning or drive operation. If an alarm condition occurs, the drive continues to run and a two-or three-digit alarm code flashes on the display. If a fault occurs, the drive coasts to rest and display a two-or three-digit fault code.

✔ Warning: Discharge the dc bus capacitors

After disconnecting input power, wait five minutes for the dc bus capacitors to discharge, then check the voltage with a DMM to ensure that the dc bus capacitors are fully discharged (0 V dc) before touching any internal components.

Follow the next steps in the drive's instruction manual to isolate the fault:

3. Disconnect the motor from the drive
4. Check all ac line and dc bus fuses
5. If a fuse is open, use a multimeter to check the input diodes and output IGBTs
6. Reconnect the motor to the drive

✔ Look for improper installation as a fault source

- Are the drive and motor grounded exactly as specified in the instruction manual?
- Are control signal wires and power cables in the same conduit? This can cause drive malfunction
- Are unused wires in conduits grounded at both ends? They must be

Following this process will enable you to work safely, avoiding accidental arc flash or electrical shock as you troubleshoot a large motor drive. BP

Duane Smith is a Fluke specialist on digital multimeters. A thirty-year veteran who's seen electrical test tools evolve from benchtop to handheld, Smith trains test tool users, troubleshoots field applications and helps develop new Fluke DMMs and electrical testers. Email: duane.smith@fluke.com

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RESOURCES FOR ENERGY ENGINEERS

TRAINING CALENDAR

TITLE	DATE	LOCATION	SPONSOR(S)
Visit www.compressedairchallenge.org for more information.			
Fundamentals of Compressed Air Systems	September 20, 2011	Cedar Rapids, IA	Iowa Energy Center and the Compressed Air Challenge
Fundamentals of Compressed Air Systems	September 21, 2011	Ames, IA	Iowa Energy Center and the Compressed Air Challenge
Advanced Management of Compressed Air Systems	September 22–23, 2011	Ames, IA	Iowa Energy Center and the Compressed Air Challenge
Fundamentals of Compressed Air Systems	September 27, 2011	Portland, OR	Rogers Machinery and Compressed Air Challenge
Fundamentals of Compressed Air Systems	October 11, 2011	Navy Pier WEEC 2011, Chicago, IL	Association of Energy Engineers, USDOE, Compressed Air Challenge
AirMaster+ Specialist Qualification	October 11–14, 2011	Stockton, CA,	Pacific Gas and Electric, California Energy Commission
Fundamentals of Compressed Air Systems WE (web-edition)	November 9, 2011	Online Training	Compressed Air Challenge

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

PRODUCTS

TIGG Tanks for Municipal Water Treatment

TIGG specializes in providing equipment and services for removal of disinfection byproducts, metals, organics and solids in the municipal water treatment market using activated carbon and other media. In addition to treatment systems for the municipal water market, the company can design and fabricate tanks for surge protection and emergency water storage.

TIGG Corporation has been engineering and manufacturing steel tanks and pressure vessels as adsorbers and filters for over 30 years. We have the capability to fabricate tanks up to 14 ft. in diameter and have supplied numerous systems to the municipal market.

Products include sand filters, multimedia filtration units, pressure filters and other complimentary equipment as part of an integrated treatment system. Other treatment services include rental programs and carbon exchange services. Municipal drinking water treatment equipment includes filtration units, necessary piping and valves, as well as the following media: activated carbon, sand, multimedia, and resins.

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RESOURCES FOR ENERGY ENGINEERS

PRODUCTS

New Kaeser Sigma Control 2™

Kaeser Compressors' new generation of compressor control — the Sigma Control 2™ — presents all the advantages of the Sigma Control plus greatly enhanced communication and control options. Its built-in Web server and standard Ethernet port let you view your compressor information from any PC without any additional hardware or software, and a variety of communications adapters (Modbus RTU, Profibus DP, Devicenet, Profinet,etc.) are available for integration into plant monitoring systems or a centralized control station.

For optimal energy efficiency, you can choose from several pre-loaded operating profiles. The Sigma Control 2 also equalizes runtime, extends maintenance intervals and prevents unnecessary starts with two-unit lead/lag sequencer programming.

The new generation control provides full-time protection, monitoring over 20 critical parameters and will shut down the compressor to avoid component damage. The Sigma Control 2 also tracks operating hours and provides maintenance reminders, as well as stores operating data useful in trouble shooting. Enhanced security with RFID prevents unauthorized access. An easy-to-use operator interface allows for accessing the new model's expanded capabilities.

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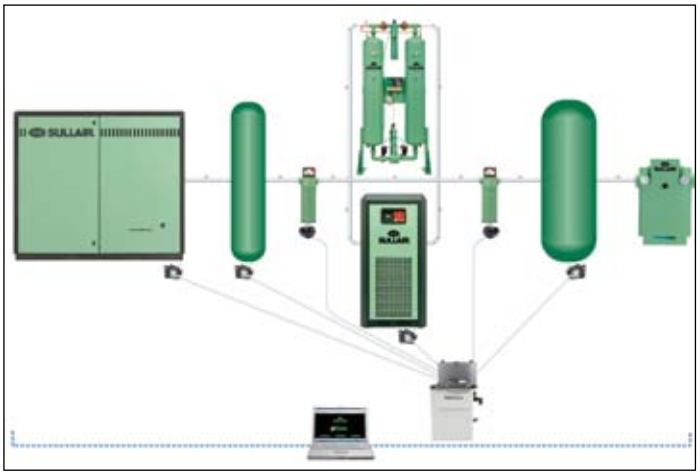
Sullair Introduces New Air Treatment Products

Sullair Corporation is pleased to introduce a new line of air treatment products, integral to the Sullair compressed air system. Designed to meet the demand for oil-free or instrument quality compressed air, the typical Sullair Stationary Air Power System consists of a Sullair rotary screw air compressor, a wet storage tank, a refrigerated or regenerative dryer, customized filters, dry storage and a flow controller. Completing the system are oil/water separator and drains, and ethernet-based eConnect™ to monitor and control the entire system. Each component of the Sullair system is carefully matched for capacity and pressure to provide superior performance and optimum energy efficiency.

Depending on the application and dew point requirements, Sullair offers both refrigerated and desiccant regenerative types. Refrigerated dryers are available in four different configurations, including non-cycling models, digital cycling models, cycling models, and high temperature models. Sullair desiccant regenerative dryers, ideally suited for outdoor compressed air piping or operations that require dew points as low as -40 °F (optional -100 °F), are available in four different configurations: modular, heatless, externally heated, and blower purge.

Designed to protect plant equipment and processes while improving product quality and energy costs, Sullair offers a complete range of filters, for applications covering a wide range of uses from general purpose to the most critical levels of food and pharmaceuticals. Sullair filtration equipment includes pre-filters, high-efficiency, high pressure, high temperature and odor-removal filters and ISO 8573.1 quality classes (ASME/CRN approved).



Sullair's full line of air treatment products includes oil/water separators that effectively remove oil from compressed air condensate. Available in six models, these units not only separate oil/water mixtures, but also purify the condensate. Sullair also helps users protect equipment and maximize energy savings with its full line of high quality zero air loss and timed solenoid drains for efficient removal of pollutant sludge.

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Fluid power (hydraulics and pneumatics) is used in dozens of industries and hundreds of applications to precisely control the movement of machinery and material. Yet many engineers and technicians working in those industries do not fully understand the design concepts critical to developing efficient fluid power systems and the diagnostic and maintenance techniques essential to keep those systems operating at peak efficiency. These concepts and techniques can result in significant energy and cost savings for companies that use hydraulics or pneumatics, as well as for the customers they serve, making fluid power a more competitive technology choice.

The conference schedule will include **breakthrough presentations** from fluid power component manufacturers, distributors, and system integrators, showcasing innovative approaches and emerging technologies in energy efficient fluid power design and maintenance.

Networking events are being organized to help participating engineers and technicians engage with technology providers from fluid power manufacturing and distribution companies.

Sponsorship opportunities will be available for fluid power manufacturers and distributors, and other companies interested in supporting this event and connecting with engineers and technicians from a wide array of fluid power's end-use market industries.

For all the details and how to register, go to www.nfpa.com/Events/EEHPC.htm.

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 31, 2011.

AUGUST 31, 2011 PRICE PERFORMANCE	SYMBOL	OPEN PRICE	1 MONTH	6 MONTHS	12 MONTHS	DIVIDEND (ANNUAL YIELD) 12 MONTHS
Parker-Hannifin	PH	$72.04	$80.50	$86.58	$58.90	2.07%
Ingersoll Rand	IR	$33.16	$37.87	$44.35	$33.05	1.46%
Gardner Denver	GDI	$80.10	$86.53	$71.77	$46.85	0.26%
Atlas Copco ADR	ATLCY	$19.26	$20.62	$22.09	$13.48	3.35%
United Technologies	UTX	$74.38	$83.31	$82.28	$65.12	2.60%
Donaldson	DCI	$59.39	$56.09	$54.99	$40.91	1.02%
SPX Corp	SPW	$57.10	$76.18	$78.29	$56.28	1.77%

Ingersoll Rand Reports 2nd Quarter Earnings

Ingersoll-Rand plc (NYSE:IR) reported that total revenues increased 12% for the second quarter of 2011 compared with the 2010 second quarter; orders increased by approximately 9%; and diluted earnings per share (EPS) from continuing operations were $0.88.

The company reported net earnings of $92.3 million, or EPS of $0.26, for the second quarter of 2011. Second-quarter net earnings included $307.5 million, or EPS of $0.88, from continuing operations, as well as a $215.2 million after-tax loss from discontinued operations. Discontinued operations included the results of discontinued businesses net of tax, as well as an after-tax impairment charge related to the divestiture of Hussmann. This compares with net earnings for the 2010 second quarter of $196.4 million, which included EPS of $0.71 from continuing operations and an after-tax loss of $(0.13) from discontinued operations.

"There were many signs of progress in our second-quarter results," said Michael W. Lamach, chairman, president and chief executive officer of Ingersoll Rand. "We benefited from upward momentum in most of our key end markets, which drove a 12% revenue increase in the second quarter. We leveraged these gains to improve operating income by 31% and to increase our operating margins, earnings and cash flow. Despite these improvements, we had disappointing results in our Residential Solutions segment, where the combination of softening end-market activity and operational execution issues led to a year-over-year decline in both revenues and operating earnings. We are taking corrective actions to ensure that the operating results for the Residential segment will improve during the second half of the year."

Revenues:

The company's reported revenues increased 12% to $3,892 million, compared with revenues of $3,482 million for the 2010 second quarter. Total revenues excluding currency were up 9%, compared with 2010. Reported U.S. revenues were up 6%, and revenues from international operations increased approximately 22% (up 13% excluding currency), primarily due to strong growth in Asia.

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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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WALL STREET WATCH

Operating Income and Margin

Operating income for the second quarter was $475.5 million, an increase of 31% compared with $363.4 million for the 2010 second quarter. The second-quarter operating margin was 12.2%, an increase of 1.8 percentage points compared to an operating margin of 10.4% for the same period of 2010. Higher volumes, pricing actions and operational excellence initiatives drove the increase in operating profits and margins. These improvements were partially offset by inflation.

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 are Climate Solutions, which includes the Trane commercial HVAC systems 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.

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 $772 million increased approximately 24% (up 20% excluding currency) compared with the second quarter of 2010. Air and Productivity revenues increased 27%, with volume increases in all major geographic regions. Revenues in the Americas increased 20% compared with 2010, as industrial and commercial markets for both air compressors and tools continued to improve. Air and Productivity Solutions revenues outside the Americas increased approximately 33% compared with 2010 from strong activity in Asia. Bookings increased 17% year-over-year with substantial gains in all geographic regions. Club Car revenues increased 13% compared with the second quarter of 2010 from increased sales of golf cars and utility vehicles and improved aftermarket activity. Bookings declined slightly for the quarter.

Second-quarter operating margin for Industrial Technologies hit a record level of 15.6% and increased 3 percentage points compared with last year. The margin improvement was due to higher volumes from robust industrial markets, improved pricing and productivity, partially offset by inflation and higher.

Balance Sheet and Share Repurchase

During the second quarter, working capital was 4.1% of revenues, an increase from last year due to additional working capital requirements from higher revenues. Available cash flow for the quarter was on target, and the company expects to generate $1.1 billion of available cash flow in 2011. Cash balances and total debt balances were $1.3 billion and $3.6 billion, respectively, at the end of the second quarter. The company also purchased 1.3 million shares during the second quarter as part of a $2 billion share repurchase program authorized by the board of directors on April 7. The company expects to purchase 18 to 20 million shares for 2011.

Outlook

The majority of Ingersoll Rand's major end markets continued to recover in the second quarter of 2011. Second-quarter orders were up approximately 9%, compared with last year. There are sustained recoveries in the worldwide industrial and refrigerated transport markets, global parts and service activity, and across most of the company's businesses in Asia. The North American commercial HVAC market is also slowly recovering.

Revenues for the full year are expected to be in the range of $14.7 billion to $14.9 billion, an increase of 11 to 12%. Full-year EPS from continuing operations are expected to be in the range of $2.90 to $3.10. The forecast also includes a tax rate of 23% for continuing operations and an average diluted share count for full year of approximately 347 million shares. Available cash flow for full-year 2011 is expected to approximate $1.1 billion, based on projected earnings and working capital requirements.

Third-quarter revenues are expected to be in the range of $3.85 billion to $3.95 billion, which would be an increase of approximately 10 to 13% compared with the third quarter of 2010. EPS from continuing operations for the third quarter are expected to be in the range of $0.85 to $0.95. The third-quarter forecast also reflects a tax rate of 23% for continuing operations and an average diluted share count of approximately 345 million shares.

"Our internal business fundamentals and many of our external markets improved throughout the second quarter," said Lamach. "Our balance sheet is solid and we are generating significant cash. As the slow recovery of the world economy progresses, we will continue to invest in new products and innovation. Our achievements give us a high degree of confidence that we will sustain improved performance in 2011 and beyond."

Parker Reports Fiscal 4th Quarter Results

Parker Hannifin Corporation (NYSE: PH) reported all-time record results for the fiscal 2011 fourth quarter and year ended June 30, 2011. Fiscal 2011 sales were $12.3 billion, an increase of 23.5% from $10.0 billion in the prior year and surpassing the previous record achieved in fiscal 2008. Net income for the year was a record $1.1 billion, an increase of 90.0% compared with $556.4 million in fiscal 2010. Fiscal 2011 earnings per diluted share were a record at $6.37 compared with $3.40 in the previous year. Cash flow from operations for fiscal 2011 was $1.2 billion, or 9.5% of sales, compared with

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— Michael W. Lamach, Chairman, President And Chief Executive Officer Of Ingersoll Rand

cash flow from operations of $1.2 billion, or 12.2% of sales in the prior year period. Cash flow from operations included discretionary contributions to the company's pension plan of $400 million in fiscal 2011 and $100 million in fiscal 2010. Excluding these discretionary contributions, cash flow as a percent of sales in fiscal 2011 and fiscal 2010, was 12.7% and 13.2%, respectively.

Fiscal 2011 fourth quarter sales were a record $3.4 billion, an increase of 22.4% from $2.8 billion in the same quarter a year ago. Net income for the fourth quarter was also a record at $294.7 million, a 32.1% increase compared with $223.1 million in the fourth quarter of fiscal 2010. Earnings per diluted share for the quarter were a record $1.79, compared with $1.35 in last year's fourth quarter. Cash flow from operations for fiscal 2011 fourth quarter was $367 million, or 10.8% of sales, compared with cash flow from operations of $377 million, or 13.5% of sales in the prior year period. Fiscal 2011 fourth quarter cash flow from operations included a $200 million discretionary contribution to the company's pension plan. Excluding this discretionary contribution, cash flow as a percent of sales was 16.6% for the fiscal 2011 fourth quarter.

"Achieving record performance this year is a remarkable accomplishment," said Chairman, CEO and President, Don Washkewicz. "I am especially proud of our global team that delivered this performance. We will continue the focus on executing Parker's Win Strategy and build on this success."

Parker also achieved all-time record sales and earnings per share in the fourth quarter and strong segment operating margin performance. Total sales for the quarter increased 22% as organic sales increased 15%, acquisitions contributed 1% and foreign currency translation was a positive 6%. Profitability in the quarter was strongest in the Industrial segment. Industrial North America segment operating margin reached 16.9% and Industrial International segment operating margin was 14.7%.

Segment Results

In the Industrial North America segment, fourth quarter sales increased 18.6% to $1.2 billion, and operating income was $207.3 million compared with $162.9 million in the same period a year ago.

In the Industrial International segment, fourth quarter sales increased 33.8% to $1.4 billion, and operating income was $202.8 million compared with $140.3 million in the same period a year ago.

In the Aerospace segment, fourth quarter sales increased 9.3% to $521.9 million, and operating income was $70.7 million compared with $64.1 million in the same period a year ago.

In the Climate and Industrial Controls segment, fourth quarter sales increased 15.2% to $276.8 million, and operating income was $22.5 million compared with $20.5 million in the same period a year ago.

Orders

Parker reported an increase of 15% in orders for the quarter ending June 30, 2011, compared with the same quarter a year ago. The company reported the following orders by operating segment:

- Orders increased 11% in the Industrial North America segment, compared with the same quarter a year ago
- Orders increased 18% in the Industrial International segment, compared with the same quarter a year ago
- Orders increased 27% in the Aerospace segment on a rolling 12-month average basis
- Orders increased 1% in the Climate and Industrial Controls segment, compared with the same quarter a year ago

Outlook

For fiscal 2012, the company has issued guidance for earnings from continuing operations in the range of $6.70 to $7.50 per diluted share.

Washkewicz added, "Our earnings range for fiscal 2012 anticipates another record year for Parker. We will continue in fiscal 2012 with a strong focus on the fundamentals defined by the Win Strategy. We will continue to invest in profitable growth through new product and systems innovation, strategic acquisitions, and expansion of our distribution network."

WALL STREET WATCH

SPX Reports 2nd Quarter Earnings

SPX Corporation (NYSE:SPW) reported results for the second quarter ended July 2, 2011.

Second Quarter Highlights:

- Revenues increased 16.4% to $1.38 billion from $1.19 billion in the year-ago quarter. Organic revenues* increased 7.1%, while completed acquisitions and currency fluctuations increased revenues by 3.3% and 6.0%, respectively.
- Segment income and margins were $132.3 million and 9.6%, compared with $135.7 million and 11.4% in the year-ago quarter.
- Diluted net income per share from continuing operations was $0.62, compared with $1.40 in the year-ago quarter. The prior year quarter included net tax benefits of $20.0 million, or $0.40 per share, related to audits of the company's 2006 and 2007 U.S. income tax returns. The current-year quarter included a non-cash charge of $24.7 million, or $0.29 per share, related to the impairment of goodwill and indefinite-lived intangible assets of SPX Heat Transfer Inc.
- Adjusted net income per share from continuing operations*, which excludes the impact of the impairment charge noted above, was $0.91, compared to the company's guidance of $0.80 to $0.90.
- Net cash from continuing operations was $48.2 million, compared with $48.6 million in the year-ago quarter.
- Free cash flow from continuing operations* during the quarter was $17.7 million, compared with $36.8 million in the year-ago quarter. The decline was due primarily to higher capital expenditures in 2011.

"For our second quarter 2011 results, revenue increased 16% and we reported adjusted earnings per share of $0.91," said Christopher J. Kearney, Chairman, President and Chief Executive Officer of SPX. "Revenue growth in the quarter was driven by strength in our early, short-cycle businesses, while results in our late-cycle, power and energy related businesses remained challenged. Orders in our Flow segment remained strong across our key end markets and most regions primarily based on increased demand for our food and beverage, oil and natural gas products. We are also encouraged by the continued recovery of the global automotive market and positive signs of cyclical recovery in the U.S. power transformer market. Our large power transformer plant expansion in Waukesha, WI is on track, and we expect to ship our first unit in the first half of 2012.

"Looking at the second half of the year, we expect organic growth across all segments and improved execution to deliver much stronger sequential and year-over-year results for SPX. We remain confident in, and committed to, executing our long term strategy. With the completion of our recent refinancing actions we are in a strong financial position and have sufficient flexibility to continue making strategic investments as opportunities arise," added Kearney.

FINANCIAL HIGHLIGHTS — CONTINUING OPERATIONS

Flow Technology

Revenues for the second quarter of 2011 were $492.8 million compared to $383.4 million in the second quarter of 2010, an increase of $109.4 million, or 28.5%. Organic revenues increased 14.2%, reflecting increased sales of large-scale systems and components for the food and beverage market and components for the power and energy and general industrial end markets. Acquisitions increased reported revenues by 6.1%, while the impact of currency fluctuations increased reported revenues by Page 1/108.2%, from the year-ago quarter.

Segment income was $56.6 million, or 11.5% of revenues, in the second quarter of 2011 compared to $45.2 million, or 11.8% of revenues, in the second quarter of 2010. The increase in segment income was due primarily to the impact of the organic revenue growth noted above. The decline in segment margin was due primarily to unfavorable revenue mix and raw material price increases.

Test and Measurement

Revenues for the second quarter of 2011 were $288.1 million compared to $239.9 million in the second quarter of 2010, an increase of $48.2 million, or 20.1%. Organic revenues increased 8.0%, driven primarily by increased sales of diagnostic and service tools to vehicle manufacturers and their dealer service networks and increased sales into the automotive aftermarket. The March 2011 acquisition of Teradyne Inc.'s Diagnostic Solutions business increased reported revenues by 6.5%, while the impact of currency fluctuations increased reported revenues by 5.6%, from the year-ago quarter.

Segment income was $29.0 million, or 10.1% of revenues, in the second quarter of 2011 compared to $23.7 million, or 9.9% of revenues, in the second quarter of 2010. The increase in segment income and margins was due primarily to the impact of the organic revenue increase noted above.

Thermal Equipment and Services

Revenues for the second quarter of 2011 were $431.9 million compared to $392.2 million in the second quarter of 2010, an increase of $39.7 million, or 10.1%. Organic revenues increased 3.5% in the quarter, driven primarily by project timing for cooling systems with increases in revenues from projects in the Americas and South Africa offset by declines in high-margin dry cooling projects in China. Additionally, organic revenue benefited from the timing of sales of boiler products compared to the year-ago quarter. The impact of currency fluctuations increased reported revenues by 6.6% from the year-ago quarter.

Segment income was $35.8 million, or 8.3% of revenues, in the second quarter of 2011 compared to $49.1 million, or 12.5% of revenues, in the second quarter of 2010. The decline in segment income and margins was due primarily to the impact of the decline in high-margin dry cooling projects noted above. Additionally, segment income and margins were negatively impacted by a decline in profitability at SPX Heat Transfer Inc.

Industrial Products and Services

Revenues for the second quarter of 2011 were $171.2 million compared to $173.3 million in the second quarter of 2010, a decrease of $2.1 million, or 1.2%. Organic revenues declined 1.9% in the quarter. The impact of currency fluctuations increased reported revenues by 0.7% from the year-ago quarter.

Segment income was $10.9 million, or 6.4% of revenues, in the second quarter of 2011 compared to $17.7 million, or 10.2% of revenues, in the second quarter of 2010. The decrease in segment income and margins was due primarily to the impact of the organic revenue decline and reduced sales prices for power transformers. BP

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A Publication of: Smith Onandia Communications LLC
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THE MARKETPLACE

TECHNOLOGY

AEE is pleased to bring the **WORLD ENERGY ENGINEERING CONGRESS (WEEC)** to Chicago's magnificent Navy Pier. Now in its 34th year, the **WEEC** is well-recognized as the most important energy event of national and international scope for end users and energy professionals in all areas of the energy field. It is the one truly comprehensive forum where you can fully assess the "big picture" – and see exactly how the economic and market forces, new technologies, regulatory developments and industry trends all merge to shape your critical decisions on your organization's energy and economic future.

Also, in order to address the interests and needs of the large number of U.S. government professionals who traditionally attend WEEC, AEE will again offer a section of the program known as **FEMWorks 2011.** This special multi-track portion of the WEEC conference will include a comprehensive series of workshops for federal energy managers.

WEEC's highly acclaimed **GreenStreet expo showcase**, introduced in 2007 and co-presented by the **U.S. EPA's ENERGY STAR®**, will again be a prominent part of the WEEC for 2011. Here you can examine firsthand the latest green / sustainable / environmentally friendly energy technologies now available for both new design and retrofit projects. Conference presentations will facilitate your understanding of these technologies, covering such topics as green building design and retrofit; LEED certification and building commissioning; high performance facilities; federal initiatives; state and local sustainable development programs; the latest developments in renewable energy; reducing carbon emissions; transportation solutions for the future; and green/sustainable project success stories.

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Albert Thumann, P.E., C.E.M.,
Executive Director,
Association of Energy Engineers

Green Solutions that Meet the Needs of Today's Property Owners
Peter Belisle
President, Energy & Sustainability Services, Jones Lang LaSalle

The Great Ocean's: Conservation & Sustainable Management
Alexandra Cousteau
Environmental Advocate & Water Policy Expert

ComEd's Environmental Achievements & Future Outlook
Val Jensen
Vice President of Marketing & Environmental Programs, ComEd

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