

# BLOWER & VACUUM BEST PRACTICES<sup>®</sup>

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April 2016

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## Go with the Flow!

### *Using vacuum blowers for better hold down in CNC router table applications*

#### PROBLEM:

For many years, the compressed air system for an industry leader in furniture manufacturing relied on vacuum instead of flow to provide hold down for their CNC router tables.

Despite having multiple rotary screw vacuum units providing up to 27” Hg vacuum, there was still significant scrap materials and downtime since the sheets would move after portions were cut away. The 40 hp vacuum screw units were upgraded to 100 hp units and special roller bars were added to keep the sheets in place, but the problems continued.

Additionally, the leather fibers and dust that go hand-in-hand with this type of installation were harsh on the vacuum screw units. Filters collapsed and airends had to be replaced due to contamination.



#### SOLUTION:

Kaeser provided a unique solution – it’s not the vacuum that provides the hold down, it’s the flow that keeps the sheets of wood in place. Kaeser recommended an Omega DB 236 with optional external STC controls and additional DB 236C units with integrated controls to replace the multiple vacuum screw units.



#### RESULT:

In addition to providing outstanding hold down, the blower packages have a significantly smaller footprint – almost a quarter of the size of the 100 hp screw compressors. These blower packages require less routine maintenance and are less sensitive to the ambient conditions. They also use less oil and require few consumables, making them a greener solution. Finally, the energy savings have been significant – only 120 hp is needed to provide exceptional hold down instead of the 320 hp previously used for the vacuum screw units. To save on space, energy, and maintenance costs, sometimes you just have to go with the flow!



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By Doreen Tresca, Stamford Scientific International



# FROM THE EDITOR

## Food Processing



General Mills has accomplished an 11 percent energy intensity (BTU/pound) reduction and realized \$13.5 million in annual energy savings. Associate Editor Clinton Shaffer had the opportunity to discuss their energy management program with Graham Thorsteinson, Energy Platform Leader, in his article, “Managing Energy as an Ingredient at General Mills.”

Yeast fermentation is a vital process in the production of many food and beverage products. It is a common application within breweries, bakeries, and wineries, along with other facilities where biogas and ethanol are produced. Glenn Schultz, from PillAerator, has provided an article describing how yeast fermentation applications are realizing significant energy savings when installing high-speed turbo blowers.

Adam Crampton, Russ Ristow, and Tim Wilson of Tuthill Blower and Vacuum Systems sat down with us to emphasize the importance of evaluating applications from a systems perspective. This interesting article ranges from selecting blowers for dense and dilute phase conveying, retrofitting vacuum systems in pickle packaging, and centralizing vacuum systems for whey manufacturing.

According to the International Trade Administration, poor cold chain systems result in the loss of billions of tons of fresh food globally. Mr. Ryoshin Imai, from ULVAC Technologies, has provided a very interesting article on vacuum cooling systems able to improve the postharvest process and almost eliminate spoilage. Under vacuum, free water in the cell tissues of the vegetables begins to evaporate at a pressure of around 12 Torr. The vegetables then cool themselves, to 39°F (4°C) in 20 to 30 minutes, due to the removal of the latent heat of the evaporated water.

Guzzler Manufacturing’s industrial vacuum trucks are used to recover, contain, and carry solids, dry bulk powders, liquids, slurries, and thick sludge from hard-to-reach areas. Blower & Vacuum Best Practices Magazine spoke with Guzzler’s Ben Schmitt who discussed their dense phase offloaders using a Gardner Denver CycloBlower system providing 14.5 psig at up to 700 cfm.

We provide a wastewater aeration story in every issue of this publication. This month we feature diffusers – as their optimization can significantly decrease demands on aeration blowers. Doreen Tresca, from Stamford Scientific International, writes about a Finnish sewage treatment plant increasing aeration capacity by retrofitting diffusers.

Thank you for investing your time and efforts into Blower & Vacuum Best Practices.

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# BLOWER & VACUUM SYSTEM INDUSTRY NEWS

## Atlas Copco Launches New ZB 250 high-speed turbo blower

The new ZB 250 high-speed turbo blower provides wastewater aeration basins with high efficiency air. The new machine features a two-pole permanent magnet motor with rare earth element magnets.

Using an active magnet bearing, the ZB 250 offers maximum reliability. A dedicated bearing controller drives eight radial and two tangential bearing coils, enabling the rotor assembly to spin continually in its geometric center. In the event of a process upset, the bearing controller protects the machine by sensing the change in rotor position and automatically correcting it. If the machine experiences a surge, a shutdown is triggered.

“In over a decade of operation, we’ve never lost a machine from a bearing-related failure,” said John Conover, business development manager - Americas blowers and low pressure compressors at Atlas Copco Compressors. ZB packages come standard in a complete ‘ready-to-run’ trim level and are backed by Atlas Copco’s comprehensive field service guarantee.

*For more information visit [www.atlascopco.us](http://www.atlascopco.us)*



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## BLOWER & VACUUM SYSTEM INDUSTRY NEWS

### Nash Vectra XM-150 Offers New Extended Version

The NASH Vectra™ XM-150 compressor extends the series of popular and reliable Vectra XL compressors to a higher level of performance. Now even more reliable and durable, the XM-150 Extended Version offers robust mechanical seals that are compliant to API 682 category II/III.



*The new, extended version of the Vectra XM-150 is API 682 category II/III compliant.*

The patent-pending design offers a shaft supported between bearings for added durability, no tie rods, and requires less maintenance than traditional liquid ring compressors. When maintenance is required, the design allows for easy disassembly/assembly, which reduces downtime.

Operating at up to 60 psig (4 bar), the Vectra XM-150 standard and extended versions are specifically designed for the higher pressures and performance expected in process applications. This liquid ring compressor was built to withstand the toughest operating conditions in applications that include vapor recovery, flare gas recovery, corrosive gas handling, hydrogen compression, biogas and more.

*For more information, visit [www.gdnash.com](http://www.gdnash.com).*

### Atlas Copco Completes Acquisition of Vacuum Parts and Service Provider

Atlas Copco has completed the acquisition of the assets of Capitol Research Equipment Inc., a U.S. parts and service provider for vacuum pumps.

Capitol Research Equipment, commonly known as Capitol Vacuum Parts, is based in Chantilly, Virginia. The company, which has 15 employees, sells spare parts globally for vacuum pumps and related equipment, while also providing repair and service in the U.S. It had revenues in 2014 of about MUSD 3.1 (MSEK 22).

“This acquisition will strengthen our global vacuum presence by providing more customers with outstanding parts and service,” said Nico Delvaux, President of Atlas Copco’s Compressor Technique business area.

The acquired business becomes part of Edwards Vacuum, LLC within the Vacuum Solutions division in Atlas Copco’s Compressor Technique business area. The parties have agreed not to disclose the purchase price.

*For more information, visit [www.atlascopco.us](http://www.atlascopco.us).*

### Blower & Vacuum Technology at IPPE 2016

The 2016 International Production & Processing Expo (IPPE), held in January 2016, had another great year with 30,277 poultry, meat and feed industry leaders from all over the world in attendance. There were also 1,301 exhibitors, a new record, with more than 464,750 square feet of exhibit space. The Expo is the world’s largest annual poultry, meat and feed industry event of its kind and is one of the 50 largest trade shows in the United States. IPPE is sponsored by the U.S. Poultry & Egg Association, American Feed Industry Association and North American Meat Institute.

Gardner Denver’s Industrial Products Group had a large booth featuring their wide variety of vacuum and pressure technologies used in food vacuum packaging. They offer 6 technology styles (regenerative blowers, screw, claw, lubricated vane, dry vane and liquid ring) in over 420 models. Walking the booth, Paul Mosher patiently described how mixing and matching these technologies can optimize a solution for the myriad



*Gardner Denver’s Industrial Blower & Vacuum team at IPPE: Joe Jorgensen, John Troyer, Craig Burness, Craig Stokes and Paul Mosher (left to right)*



Blower & Vacuum Best Practices Magazine debuted, along with Compressed Air Best Practices® Magazine, in the IPPE 2016 literature bins!

of applications they handle in the packaging industry including food package evacuation, trim removal, filling and closing machines, labeling, volume reduction, packaging materials and blister packaging.

For example, the C-Series Claw technology (Zephyr model) from GD Elmo Rietschle has oil-less compression, service intervals of up to 5 years, and lowest in class 67 to 73 dba. The L-Series Liquid Ring (BL2 model) technology (often used to eviscerate chickens) has patented water reclamation systems – allowing reduced water use. The S-Series Rotary Screw technology (VSI model) goes to deeper vacuum levels (better package seals) than rotary vane with decreased evacuation times equaling increased production output for meat packaging machines.

Next year's International Production & Processing Expo will be held Jan. 31 – Feb. 2, 2017, at the Georgia World Congress Center in Atlanta, Ga. Show updates and attendee and exhibitor information will be available at [www.ippexpo.org](http://www.ippexpo.org).

**Volkman Introduces BBU2 Contained Bulk Bag Unloader**

Volkman, Inc., a market leader in vacuum conveying, now offers an improved version of its popular Bulk Bag Unloading Station, the BBU2, built to the same exacting quality standards as its vacuum conveying

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## BLOWER & VACUUM SYSTEM INDUSTRY NEWS



*Manufactured by Volkmann, the hoist-style BBU with special loss-in-weight features helps optimize dust-free material flow.*

systems. The unit optimizes dust-free material flow from the bag to the vacuum conveyor and downstream processes using advanced features to tailor the level of dust containment to the application without any contamination of the material or work environment.

The BBU2 has been designed with modular components and many optional features to meet a variety of production requirements. It features a 2-ton capacity, a low profile pick-up, and a patented dust-tight connector to the feed hopper. This discharge chute connector keeps product flow contained and also prevents dirt and other waste material that has collected on the underside of the bulk bag from entering and contaminating the product flow.

***For more information, visit [www.volkmannUSA.com](http://www.volkmannUSA.com).***

### FIPA Announces Varioflex® Bellows Suction Cups

FIPA Inc., a leading manufacturer of advanced vacuum technology, gripper systems, air nippers, tube lifters, and End-of-Arm-Tooling (EOAT), announced its Varioflex® bellows suction cups for material handling and packaging automation applications.

Made of oil-, ozone-, and wear-resistant polyurethane composite material, FIPA's SP-BX Series Varioflex bellows suction cups feature a dimensionally stable body (60° shore) that prevents buckling over a broad range of shear forces, and a soft, extremely low-marking sealing lip (30° shore) that delivers a perfect seal on surfaces ranging from oil-free metal sheets to hot injection-molded plastics, and even rough or uneven surfaces, including cardboard and wood. Available with either 1.5 folds (SP-BX1) or 2.5 folds (SP-BX2), SP-BX Series bellows suction cups also deliver long life cycles to reduce machine downtime, and outstanding holding force, recovery force, stability, and reset capabilities to accommodate systems with short cycle times.

“Our Varioflex bellows suction cups deliver high-reliability, long lifetime performance that’s designed to expertly satisfy the needs of a wide range of material handling and packaging automation applications,” said Rainer Mehrer, president of FIPA.

***For more information please visit <http://www.fipa.com>.***



*FIPA Inc. recently introduced its Varioflex® bellows suction cups for material handling and packaging automation applications.*



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# Tuthill Optimizes Vacuum and Blower Systems for Food Plants

By Clinton Shaffer, Associate Editor, Blower & Vacuum Best Practices Magazine

► Vacuum and blower systems are commonplace in food manufacturing facilities. Bakeries, flour mills, breweries, and dairy plants are just a few of the many sites where vacuum pumps and blowers are used. While these facilities may leverage both types of systems, vacuum pumps are more commonly used when processing meats, fish and poultry. Other common vacuum applications include maple sap extraction, confection, vacuum coating, and juice distillation. Blowers are frequently found in pneumatic conveying systems for moving dry bulk materials along a conveying line. In these systems, blowers pressurize the material, helping to move it from one location to another.

“When you talk about the food industry, there is such a wide variety of applications using blower and vacuum systems,” explained Russ Ristow, Regional Sales Manager, Tuthill Corporation. “All you have to do is look in your freezer, refrigerator or your pantry to see all the different products that could relate directly to a vacuum or blower—anything from cheese and dairy, to pickle and meat packaging.”

Several experts from Tuthill recently spoke with Blower & Vacuum Best Practices Magazine to discuss opportunities for improvement regarding vacuum and blower systems at food manufacturing facilities. During the talks, Adam Crampton, Russ Ristow, and Tim Wilson of Tuthill covered a variety of topics—from the design basics of pneumatic conveying systems, to advanced vacuum optimization opportunities within packaging machines. While general considerations are discussed in this article, Tuthill emphasized the importance of evaluating applications from a systems perspective to develop unique solutions for each customer.

## Blowers for Pneumatic Conveying

Before delving into design considerations for pneumatic conveying systems, it is important to understand some of the fundamentals. Pneumatic conveying systems move dry bulk materials through a conveying line. Blowers are commonly used to pressurize the conveying line, which moves the product from one location to another, at a given flow rate or within a certain period of time. There are two distinct types of pneumatic conveying systems—dilute phase, and dense phase—and each is used to transport dry bulk materials of varying size, shape and density.

“Dilute phase pneumatic conveying involves conveying a product, usually some type of a dry bulk material, at a low pressure (less than 15 psig) and high velocity. In doing so, the product is suspended in the conveying line. This is the most common means of conveying dry bulk materials with positive displacement blowers,” explained Adam Crampton,



The most common way to move dry bulk materials is with positive displacement blowers, such as the PD plus pictured above.

Regional Sales Manager at Tuthill. “Dense phase pneumatic conveying, on the other hand, involves conveying products at higher pressures, usually 14 to 15 psig and greater, at a low velocity. The product is not suspended in the conveying line. Cereals, pet food, and other dry, fragile products susceptible to degradation are commonly transported via dense phase conveying.”

### Selecting Blowers for Pneumatic Conveying

Tuthill engineers take a number of variables into consideration when selecting the ideal blower for a pneumatic conveying application. First, the flow rate and pressure required to move the material needs to be understood. Secondly, the temperature of the air or gas at both the inlet and discharge of the blower are significant factors, as they will have a direct impact on the material being conveyed.

“With pneumatic conveying, you are moving a solid material from one location to another by using air as a transportation media,” said Tim Wilson, Project Engineer, Tuthill. “Designating a blower starts with understanding the material. Does the product behave well within that media at a given temperature? If the blower is performing at a high pressure, then we may have to look at sizing an after-cooler downstream of the blower to cool the gas so we still have the pressure we need, but at an appropriate temperature for the material.”

Other material properties also need to be considered, such as bulk density, material hardness, stickiness, and abrasiveness. Additionally, since you are moving the material from one point to another, the transportation path must be evaluated. Variables might include the number of vertical runs, horizontal runs, and elbows along the conveyance line. Those

specifications, in addition to pipe diameters, will help determine the pressure, flow, and blower flange or core size.

Blower operating speed is also evaluated to ensure the blower operates within a healthy area of its performance curve. “Blowers are designed to operate at full speed, or 100 percent of the design, and they work well there,” Wilson said. “In a pneumatic conveying system, the challenge can be sizing the blower. If you size a blower for 100 percent of its rated speed, get it installed, and then need to move more product, then you are limited. Designing the system to operate at about 70 to 80 percent of its design capacity is a good practice—that way the design has some room for adjustments.”

Finally, the installation location of the blower needs to be considered on an application-specific basis, as operating noise can be an issue. “Blowers are, by in large, fairly loud,” Wilson commented. “If it’s outside and no one is around, we won’t often see a noise requirement on an installation. However, it’s common in the food and beverage industry to install blower packages indoors. People are often in the area, so sound enclosures are frequently used.”

Tuthill blower offerings include the CP Series, the Equalizer, the PD plus, and the QX, along with blower packages for installations with sound requirements. In addition, dry bulk and mobile truck blowers are often used in the food manufacturing industry to move materials like flour. Transported on a trailer, mobile blowers from Tuthill include the T650, T850 and T1050. They are used to convey product from a trailer to a silo or rail car, and can be used for vacuum conveying to load material into the truck’s trailer.



*With no need to consider operating noise, this open blower package was installed outside for pneumatically conveying product into railcars.*



*The T850 blower is specifically designed for transport applications where products need to be pneumatically conveyed.*

## TUTHILL OPTIMIZES VACUUM AND BLOWER SYSTEMS FOR FOOD PLANTS

### Opportunities for Retrofitting Vacuum Systems on Manufacturing Equipment

Change can be intimidating, especially if it concerns the reliability of a major piece of manufacturing equipment. The vacuum systems of food processing machines, for instance, could be ripe with opportunity for improving process speed and enhancing reliability, but end users may not want to tweak the system. “Because a rotary vane pump comes with a certain kind of machine, people may be afraid to make a change,” Ristow explained. “The customer may not know it, but there are a lot of other options out there.”

Ristow discussed vacuum pumps in meat packaging machines as an example. Traditionally outfitted with oil-lubricated rotary vane pumps, meat packaging machines can benefit from piston pumps. Normally requiring at least 500 microns of vacuum, or 0.5 Torr, meat packaging applications demand fast cycle times. The most prevalent issue, however, is handling water vapor.

“With a piston pump, you have a much larger oil sump than you would with a rotary vane pump for the equivalent vacuum system, and the gas ballast will actually allow you to handle more water vapor,” Ristow explained. “As time goes by and the oil begins to degrade, the piston pump will last longer while holding ultimate vacuum, because it will pull a little deeper than a standard rotary vane pump. And it’s a lot more rugged. In meat packaging applications, piston pumps are not a bad way to go, but people frown on it because they are not familiar with the technology. You really need to look at the process, evaluate what’s best for the customer, and then decide what technology is available.”

### Retrofitting Vacuum Systems in Pickle Packaging

Keep this in mind: Replacing the vacuum pump on a machine will not automatically solve reliability problems, or improve cycle times. Ristow stressed the importance of evaluating the entire system, and discussed a sliced deli pickle manufacturer located in California as an example. The facility wanted to achieve faster cycle times on a vacuum sealing machine (similar to a roll stock machine). To do so, they brought in a third party, who recommended installing larger vacuum pumps. Much to the plant’s dismay, there was no improvement in production. Frustrated with lack of progress, plant personnel contacted Tuthill to fix the issues.

The packaging process was designed around cycle time using thin film, and needed 28"Hg to properly seal the pickles. With flow requirements of about 300 cfm, the third party recommended replacing the original

50-cfm vacuum pumps with machines capable of providing between 150 and 200 cfm of airflow. What they failed to account for, however, was the size of the inlet piping and orifices.

“We found out it was their plumbing that was the concern,” Ristow said. “They had 1.5-inch piping on the inlet. They thought they would get more capacity, but there was too much friction on the inlet orifice. In addition, they were using right angles instead of using 45° angles, which was affecting the conductance. That is one of the things you need to look for as an end user when you make those changes. You have to make sure your connections are adjusted too.”

In addition to airflow issues, the facility also experienced problems with maintaining the larger, oil-lubricated vacuum pumps. “In pickle packaging, there is a concentration of brine, salt, and other acids that can be corrosive and affect the pH levels,” explained Ristow. “There is a lot of moisture involved in it too, so as you pull vacuum, the water and other ingredients from the pickling process have a tendency to turn into a vapor and work their way into the pump. In this case, it was attacking the oil and the materials of construction on the vacuum pumps, causing maintenance issues.”

Instead of oil-lubricated pumps or dry vacuum technology, Tuthill installed liquid ring vacuum pumps that met the vacuum levels required. Constructed with stainless steel componentry, the liquid ring pumps could more effectively deal with the amount of brine and water vapor involved in the process.



*Tuthill determined that a liquid ring pump could more effectively handle the large amount of brine and water vapor involved in the pickle packaging application.*

“Everybody is moving towards dry pump technology, but I don’t know if I’d necessarily put a dry pump into a pickle packaging application,” Ristow said. “Because of the brine and acids produced from the pickling process, the corrosiveness could eventually attack the screws—unless you put some kind of coating on it. In this case, I think a liquid ring was best because it has wider, or larger tolerances, so it’s more forgiving when it comes to taking in solids or processing a corrosive gas. And you can use different types of sealant other than just water. For this process, water was the best option, but it depends on the vapor pressure of the sealant and how it best fits within the application.”

### Centralized Vacuum System for Whey Manufacturing

Apart from retrofitting packaging machines, engineers at Tuthill design centralized vacuum systems to improve overall performance at food plants. One example involved a dairy manufacturing facility, which primarily produced whey. At this plant, the dehydration process required vacuum levels of 29.9”Hg in order to effectively dry dairy product moving through the plant. The facility originally had individual vacuum pumps installed in each of its stainless steel evaporation vats. Plant engineers contacted Tuthill to centralize the system, and to install it 100 feet away from the end uses on a mezzanine.

Where a traditional vacuum system might run piping to every application separately—with each individual run creating a straight line from the vacuum pump to the process—a centralized vacuum system uses a circular piping header to feed every process. Drops are then made to each application. When installing a central vacuum system, you need to evaluate the plumbing, and understand how pressure drop will impact the system. According to Ristow, it is especially important to understand minimum pipe diameter. “Minimum, I think, is more important than your maximum,” he said. “Obviously cost is a factor: You don’t want to go to 12-inch piping as a minimum, but you don’t want to go too small. You want to use the piping as a receiver, which can be cost effective.”

For the whey manufacturing facility, Tuthill installed the centralized vacuum system per the customer’s requests. They provided a rotary vane pump to supply the system, and the circular header now acts as a larger plenum for more efficient operation. The new system has several other benefits as well, aside from the reduction in horsepower. “Going from multiple vacuum pumps at each vat to two larger ones eliminates a couple of issues,” Ristow explained. “For this system, you need less oil changes. It still might take the same amount of oil, or just a little bit less, but it’s more efficient when it comes to maintenance. Additionally, with multiple pumps, you need to keep more filters on hand, and keep more stock.”

### Replacing Vacuum Pumps with Centralized Blower Systems

Tuthill’s engineers have also identified energy-saving opportunities when changing from individual vacuum pumps to centralized blower systems. One example involved a tea manufacturing plant, where tea was made and then packaged. Their packaging machines each had a 1-hp vacuum pump installed on the unit, as specified by the OEM. Ristow was able to replace those 10 units with a duplex central blower system, thereby reducing the amount of energy required to run the system, and eliminating noise factors.

“For this facility, they didn’t need much vacuum: The pumps could pull 25”Hg, but the requirement was less than 15”Hg, which a blower package could handle,” Ristow explained. “Again, the manufacturer said what you needed, but in reality, it was less. The central blower system also took noise and heat out of the equation, so there are a lot of advantages of a central station other than just energy efficiency.”

By the end of the project, Tuthill replaced the 10 vacuum pumps with a 2 x 3-hp blower package, reducing overall energy use. The central blower package also provided extra capacity for the manufacturing plant to grow. “Another misconception in the food industry is that issues are related just to the vacuum level, when they could be related to flow,” Ristow said. “This facility wanted to grow, which was one advantage of the blower system—you could actually increase the capacity for additional flow demand. All you had to do was change the pulley size to speed that blower up. With a blower package, you have more versatility with flow, and you are not limited just to the standard rpm of an individual vacuum pump. While it could potentially be slowed by a VFD, many times vacuum pumps can’t be run faster than their original motor’s design criteria.”

### Examining Vacuum and Blower Systems in Food Plants

Vacuum and blower systems within food plants are vital pieces of the production puzzle. Consequently, they should be scrutinized to optimize production throughput, energy efficiency, and reliability. Tuthill understands the application-specific nature of these systems, and works to engineer the proper solution every time—whether it is a blower system for pneumatic conveying, a centralized vacuum system for producing whey, or retrofitting individual vacuum pumps on large packaging machines. **BP**

*For more information, contact a Tuthill project engineer, tel: 1-800-825-6937, email: [vacuum@tuthill.com](mailto:vacuum@tuthill.com), or visit [www.tuthillvacuumblower.com](http://www.tuthillvacuumblower.com)*

To read more about *Blower and Vacuum System Assessments*, please visit [www.blowervacuumbestpractices.com/system-assessments](http://www.blowervacuumbestpractices.com/system-assessments).

# Adopting Pillaerator HIGH-SPEED TURBO BLOWERS for Yeast Fermentation

By Glenn Schultz, Pillaerator

► Yeast fermentation is a vital process in the production of many food and beverage products. It is a common application within breweries, bakeries, and wineries, along with other facilities where biogas and ethanol are produced. In these facilities, fermentation tanks filled with a reaction liquid are often supplied with air from blowers. Recently, there has been a trend in the adoption of high-speed turbo blowers for yeast fermentation applications, as the blower technology can yield large energy savings if properly installed and controlled.

## Pillaerator High-Speed Turbo Blowers

Pillaerator, a division of Piller Blowers & Compressors GmbH, has been producing industrial fans and blowers since 1909. Designed for multiple markets, such as mechanical vapor recompression (MVR) and carbon capture readiness (CCR), Pillaerator fans and blowers are versatile machines capable of addressing a wide range of applications. When developing the Pillaerator

high-speed turbo blower in 2008, Piller's engineering and design teams concentrated on producing a high-speed turbo blower that eliminated many of the shortcomings experienced by high-speed blowers currently on the market. This was done by concentrating on the following three basic areas:

- 1) **Aerodynamics:** It was the company's goal to provide a blower with a combination of high efficiency, wide operating range and high rise-to-surge, or the time it takes for a blower to reach a surge condition. The high rise-to-surge was very important to Piller, as we always intended to meet multiple market demands.
- 2) **Mechanical Features:** It has always been clear to Piller that relying on ambient air to cool the blower, which should include the motor, variable frequency drive (VFD) and complete control system, is inadequate. From a long-term operational perspective, cooling the VFD and motor with only ambient air is not a proper solution. In many locations, the temperature is too

high to properly cool the components. This, along with dust and possible chemicals in the air—such as light amounts of sulfur dioxide—would reduce the life and efficiency of the components being cooled. With that in mind, Piller developed an internal glycol/water cooling system to cool the motor and VFD.

- 3) **Control Features:** Pillaerator engineers recognized the need for control flexibility, both with the base unit and sequence system.

## Achieving Energy Savings for Aeration in Wastewater Treatment Plants

The Pillaerator high-speed turbo blower was originally adopted for meeting the aeration requirements of the wastewater treatment market, both for municipal and industrial plants. Pillaerator was quickly received in many applications due to its high efficiency, wide range, and ability to allow unlimited starts and stops without damaging the blower's magnetic bearings.

One great example of how PillAerator blowers help address the needs of the wastewater treatment market is evident at the Victor Valley Wastewater Reclamation Authority, whose two newly installed 400-hp PillAerator high-speed turbo blowers have helped yield annual energy savings of more than \$98,000. To replace its existing two 500-hp centrifugal blowers, the engineering staff at the facility evaluated several types of high-speed turbo blowers, taking into consideration the capital cost, ease of installation, turn-down capacity, and wire-to-air efficiency. Installed between 2011 and 2013, the PillAerator blowers also feature sophisticated controls to maintain optimal operating conditions based on the plant's nutrient load and dissolved oxygen requirements.

### Adopting High-Speed Turbo Blowers for Yeast Fermentation

Other process applications—such as those found in textile plants, printing operations, steel mills, flue gas desulfurization, and conveying—also require wide pressure ranges, which is why the PillAerator turbo blower, with its high rise-to-surge, meets so many process applications. After the initial success in wastewater treatment applications, other markets began to take notice of the many features and benefits of the PillAerator blower. One such market was the yeast production market. In this market, high volumes of air are required to satisfy the process. Not only is a great deal of air required, but the blowers need to deliver



Figure 1: High-speed turbo blowers are beginning to be adopted for yeast fermentation applications, largely due to the technology's energy-saving potential.

a wide pressure range to overcome the depth of the fermentation tank. For one installation, the airflow requirement at the beginning of the process is 4000 cfm, and it rises to 8000 cfm at a higher pressure by the end of its 16-hour duration. Due to PillAerator's aerodynamic design and proven operational reliability, producers of yeast and PillAerator engineers realized they had a good match.

### Understanding the Yeast Fermentation Process

Yeast production facilities serve as an example of how high-efficiency blowers can optimize the energy efficiency of a food processing plant. The fermentation process is not fixed, and it could consist of a single

tank or multiple fermentation tanks. The fermenter tank may be either open or closed, depending upon the yeast process. The height of each fermenter tank is typically about 15 meters. Fermenter tanks experience highly varying levels of liquid, which significantly impacts blower performance. As the level of liquid increases, the blower must operate at a higher pressure level to overcome this liquid height. The smaller the tank and the lower the liquid level, the lower the pressure requirement for the blower. The varying liquid levels create pressure swings of nearly 40 percent. While the pressure swing will vary depending on the type and size of the tank, an example oscillation from 9 psig to 15 psig is not uncommon.

“Varying liquid levels create pressure swings of nearly 40 percent. While the pressure swing will vary depending on the type and size of the tank, an example oscillation from 9 psig to 15 psig is not uncommon.”

— Glenn Schultz, PillAerator



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*“Corning launched a formal Global Energy Management program in 2006. U.S. operations consist of nearly 50 facilities. These management practices have saved more than \$328 million in cumulative energy costs.”*

– Patrick Jackson, Director of Global Energy Management, Corning Inc.

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## ADOPTING PILLAERATOR HIGH-SPEED TURBO BLOWERS FOR YEAST FERMENTATION



Figure 2: For yeast fermentation applications, PillAerator often installs multiple blowers to provide the proper airflow and pressure at the highest efficiency possible.

At the beginning of the fermentation cycle, the level of the reaction liquid, which comprises the mixture of components required for the fermentation process, is at its lowest level. In order to overcome the low level of liquid, the blower must run at a low pressure. Pressures vary depending upon the process and size of the fermenter. As the liquid level increases, the blower pressure must then increase to overcome the additional liquid level. This yeast process increases step by step in a cycle lasting up to 16 hours. Once the fermentation cycle is complete, the entire process begins again. Typically tied in with the plant's supervisory control system, the blower sequencer dictates its operation based on the level of liquid within the yeast fermenter tank.

### Preventing Surge Conditions

As each tank requires both large flow rates of air and variable pressures, multiple blowers may be needed to both supply the air required and provide the air at the highest efficiency point. In some cases, however, single blowers

may satisfy one fermentation tank. Airflow varies from plant to plant, depending on facility size, but PillAerator frequently installs multiple blowers (as shown in Figure 2) to meet both the minimum and maximum flow rates. The aerodynamic design of the PillAerator high-speed turbo blower allows the blower to operate at a wide pressure and flow variation to satisfy the yeast fermentation process without causing surge—an unstable or pulsating airflow condition where a machine can no longer overcome the pressure it is developing internally.

The surge limit defines the flow at which, for a given speed, the operation of a compressor becomes unstable. When the flow is reduced below the surge limit, the pressure at the discharge of the compressor exceeds the pressure-making capability of the compressor, causing a momentary reversal of flow. For the PillAerator, surge simply causes the blower to shut down until the reason for surge is corrected. For the high-speed blower with air-

foil bearings, which rely on inlet air to lift the bearings, such a reversal of airflow will cause catastrophic damage to the bearings.

Preventing surge is very important, and is a major reason why the magnetic bearing has been very successful in the yeast fermentation market, along with many others. Limiting the stall conditions that occur with surge makes high-speed turbo blowers with magnetic bearings more reliable than a high-speed turbo blower that utilizes air-foil bearings.

### Blower Controls Optimize Yeast Fermentation Applications

With their high rise-to-surge, PillAerator high-speed turbo blowers have been recognized as an ideal solution for yeast fermentation applications—with over 50 blowers installed in China alone. These installations have allowed PillAerator to develop the necessary controls to meet the unique demands of the yeast market. Each blower is equipped with a programmable logic controller (PLC) and human machine interface (HMI) that can talk directly to the plant control system. The blower is able to operate at a variety of methods, speed control, DCS or SCADA direct control, pressure control or mass flow control, depending on the particular plant's requirement. In addition, when multiple blowers are required to meet the fermentation process, PillAerator is able to provide a sequence system to ensure that the blowers are operating at peak efficiency—all while meeting the demands to the plant. **BP**

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To read more about **Aeration Blowers**, please visit [www.blowervacuumbestpractices.com/technology/aeration-blowers](http://www.blowervacuumbestpractices.com/technology/aeration-blowers).

# Managing Energy as an Ingredient at General Mills

By Clinton Shaffer, Associate Editor, Blower & Vacuum Best Practices Magazine

▶ If you ever stepped foot in a grocery store, you are probably familiar with General Mills. With brands like Cheerios, Wheaties, Pillsbury, Nature Valley and Green Giant, General Mills products can be found in just about any household, culminating in net sales of \$17.6 billion in Fiscal 2015.

To put this in perspective, on any given day General Mills will provide:

- ▶ 60 million servings of whole grain cereal
- ▶ 27 million servings of Yoplait dairy products
- ▶ 12 million Nature Valley bars
- ▶ 5 million Pillsbury cookies<sup>1</sup>

What you may not be familiar with, however, are the progressive sustainability efforts at General Mills. At the World Energy Engineering Conference (WEEC 2015), Graham Thorsteinson, C.E.M., C.E.A., Energy Platform Leader at General Mills,

discussed the company's energy management program. Influenced by ISO 50001 and the Environmental Protection Agency's (EPA) ENERGY STAR program, General Mills' energy management system measures "energy as an ingredient," treating energy waste in the same way as wasted raw material—with zero tolerance.

The company also participates in the U.S. Department of Energy's (DOE) Better Plants program to help drive its energy management goals. At the end of Fiscal 2015, the energy management program, which has implemented more than 1,000

energy projects, has resulted in the following achievements:

- ▶ \$13.5 million in annual energy savings
- ▶ 11 percent energy intensity (BTU/pound) reduction
- ▶ Reduction of 100,000 metric tons of CO<sub>2</sub>
- ▶ Multiple energy engineers recognized as Association of Energy Engineers International Young Energy Professional of the Year, along with five regional awards<sup>3</sup>



*Sustainability efforts at General Mills have been recognized by both the EPA's ENERGY STAR program and the DOE's Better Plants program.*

Within the “zero-loss” culture at General Mills, plant personnel identify and optimize major energy users in each facility. Common opportunities include: the optimization of dryers, ovens and freezers; compressed air optimization projects; improvements to building heating and cooling system; and lighting replacement innovations. In addition, engineers at General Mills have started to explore new energy-saving opportunities within the vacuum and blower systems at their production facilities. To better understand how any production system is addressed at General Mills, an examination of the company’s energy management methodology is required.

**Zero-Loss Culture at General Mills**

At General Mills, the energy reduction process has been integrated into the already-established production tracking system,

which demands zero loss. As a result, energy is discussed in production meetings just like equipment stops and ingredient overuse. The production tracking system at General Mills is proprietary, and it required the combination of multiple external products to tie energy usage into the overall system. This is a unique aspect to the energy management program at General Mills, and helps provide context to the energy data. As Thorsteinson mentioned at WEEC 2015, “Energy data without the weather and production context is not actionable.”

Under the production tracking system, energy engineers at General Mills view the ultimate product as the combination of both raw material and the energy required for its transformation. Put simply:

$$\text{Raw Material} + \text{Energy for Transformation} = \text{Useful Product}$$

By taking that approach, they manage energy waste in the same way as raw material waste, and optimize their processes accordingly. If viewed from that perspective, energy usage can be monitored the same way raw material waste is managed.

$$\text{Actual Energy Usage} - \text{Minimum Required for Product} = \text{Waste } (\$)$$

The equation above helps engineers at General Mills put energy waste in proper context. By applying best practices from the energy management program, they can then set aggressive targets for reduction.

**Energy Management at General Mills**

The energy management program at General Mills is an internal, continuous improvement initiative. It involves metering energy use, analyzing that data, and correlating energy use

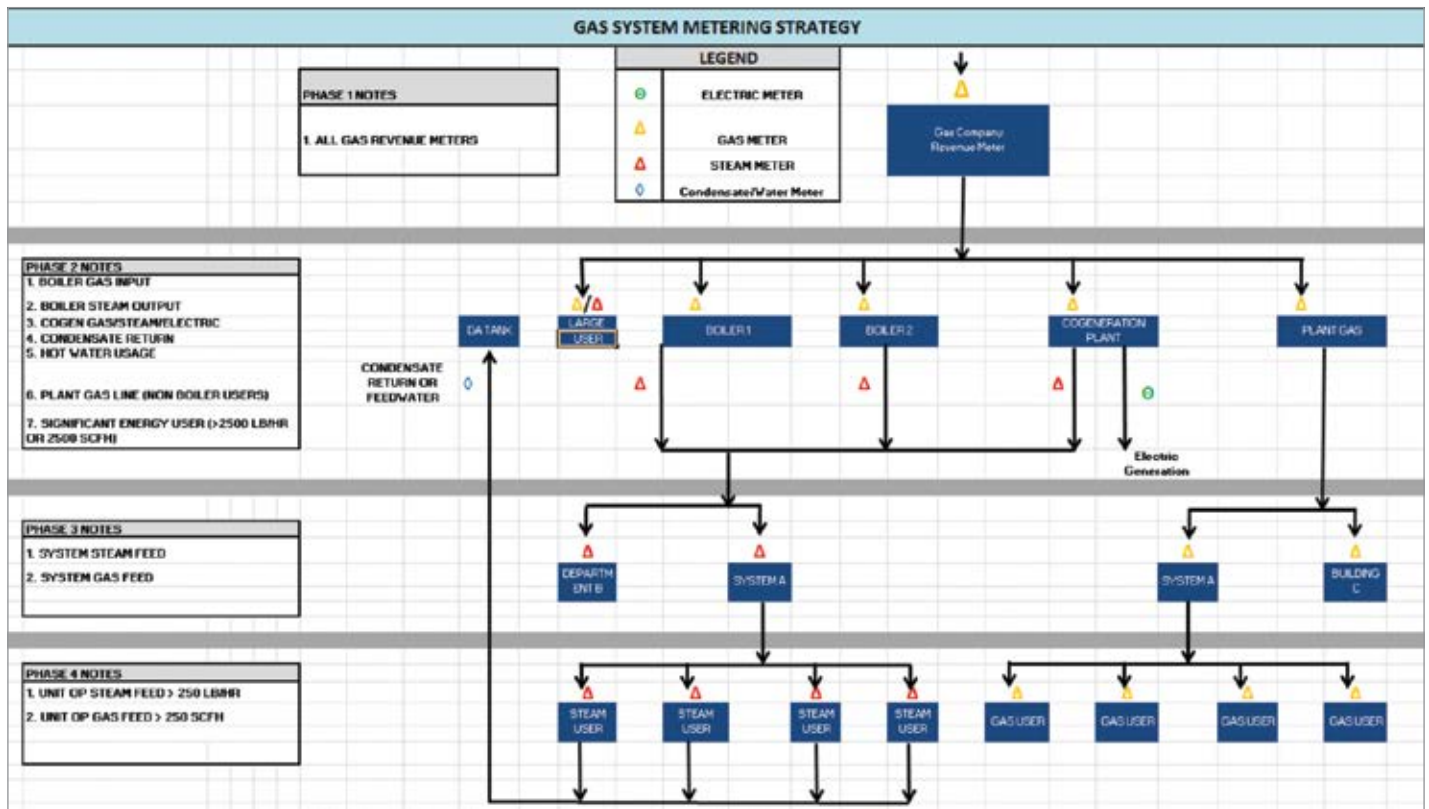


Figure 1: Gas System Metering Strategy

# MANAGING ENERGY AS AN INGREDIENT AT GENERAL MILLS

to the final product (i.e. cereal, granola bars, etc.) in the form of BTUs/pound. The overall energy reduction process has five steps:

- 1. Establish Energy Program:** At the onset of implementing energy management for a given plant, dedicated personnel are designated at the site to lead the program. Specifically, each plant commits an engineer as an Energy Lead, who

% TOTAL ENERGY	
<b>ELECTRICAL ALLOCATION</b>	<b>61.6%</b>
Lighting	6.0%
Compressed Air	11.0%
Refrigeration	17.0%
Utility Support Equipment	1.0%
HVAC	7.5%
Process Fans	3.0%
Pumps	4.6%
Production System 1	3.0%
Production System 2	2.0%
Large Unit Op 1	3.0%
Large Unit Op 2	3.5%
<b>GAS ALLOCATION</b>	<b>38.4%</b>
Hot Water	6.0%
Boilers	12.3%
Ovens	7.0%
Production System 1	3.0%
Production System 2	2.0%
Large Unit Op 1	3.3%
Large Unit Op 2	3.8%
Building Heat	1.0%
<b>Total Energy</b>	<b>100.0%</b>

Figure 2: Electrical/Gas Allocation Chart

begins the process by developing an energy metering strategy (Figure 1, pg. 19). This involves the installation of meters to capture detailed energy usage data.

As energy is invisible, losses can go unnoticed for extended periods of time—making energy metering a vital aspect of the energy management program at General Mills. The company’s plant in Covington, Georgia, for instance, has installed more than 150 energy meters on key pieces of equipment. The meters provide real-time energy consumption data, and help plant personnel to understand the impact of system changes.

- 2. Conduct Energy Analysis (Site Energy Allocation):** Energy team members perform an energy balance assessment at the site to determine how energy is used and in what amounts. The analysis provides a breakdown of specific systems (i.e. lighting, compressed air, pumps, etc.), displaying what percentage of total energy each one consumes.
- 3. Identify Energy Losses:** The next step involves creating program-wide “energy loss tools” to identify energy losses, develop targeted solutions, and calculate potential energy savings. As an example, an energy loss tool might provide a list of best practices for a specific utility. For a boiler, the energy loss tool could include the following energy troubleshooting guide:

- Does the boiler have an economizer to recover heat from exhaust gases to pre-heat feed water?
- Do boilers operate at optimum oxygen levels?
- Can boiler blow-down percentage be improved with an RO or water chemistry improvements?
- Does the boiler have a blow-down system without automatic conductivity control?

Other loss tools, or methods to improve energy use by optimizing operations, include:

- Maintenance
- Proper Operation
- Controls
- New Technologies
- New Innovations to be spread to other plants

A significant aspect to this stage is setting aggressive reduction targets, with the goal to sustain performance and immediately eliminate losses above targeted consumption levels. As General Mills participates in the DOE’s Better Plants program, the company adopted the program goal of reducing company-wide energy use by 20 percent over 10 years.



“Energy is invisible, and losses can go unnoticed for extended periods of time—making energy metering a vital aspect of the energy management program at General Mills.”

— Graham Thorsteinson, C.E.M, C.E.A., Energy Platform Lead – General Mills

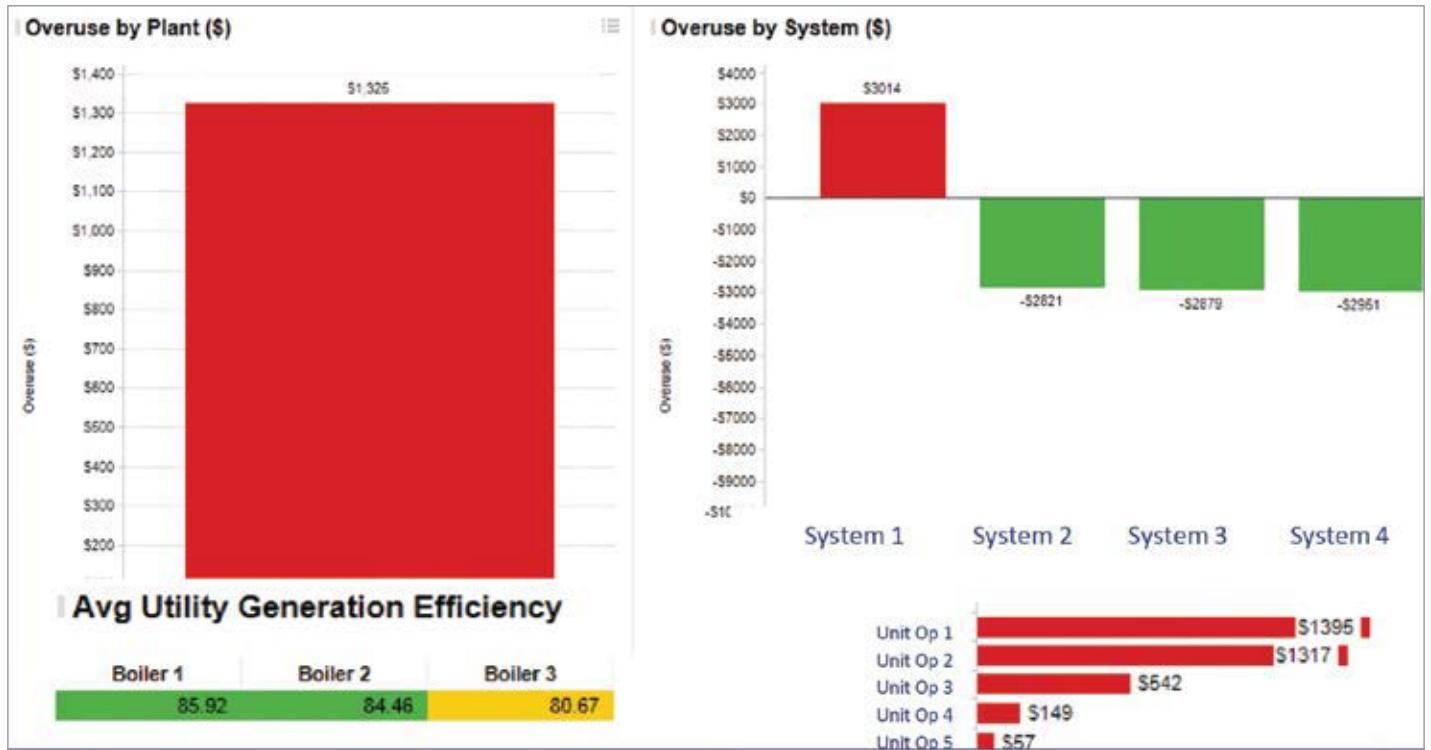


Figure 3: Shiftly Energy Management Summary

- Execute Improvement Plan and Proven Solutions:** To achieve the aggressive goals, energy engineers create a 3-year plan, including energy-reduction projects to implement at each site based on the analysis performed. Best practices established through loss tools are also implemented by plant personnel to reduce energy intensity. Other projects may include lighting retrofits, air compressor upgrades, and optimizing refrigeration compressors.
- Validate and Sustain Results:** The final step to energy management at General Mills is ongoing: Metering and analysis tools are used to continually assess performance improvements and ensure gains are maintained. The company tracks energy intensity and cost savings, comparing those values against the baseline developed in Fiscal 2012. The energy management system

accounts for both weather and production contexts, allowing for real energy metering values.

As shown in Figure 3, the energy management system allows engineers to view data from more than 200 energy meters—all from one plant across four production systems. With just a glance, plant engineer can see the energy consumption of a specific system, including specific metrics for each process, and the efficiency of the utilities involved.

### Real-Time Energy Management to Eliminate Waste

With real-time energy management in place, energy losses can be accounted for in real time, and prioritized at shiftly production meetings to prevent losses. Operations personnel can then be assigned to any issues, and provided with an energy troubleshooting guide for any given unit. This practice frees up energy engineers to focus

on new areas of opportunity—such as vacuum and blower systems.

As part of the production tracking system, energy management at General Mills has been incredibly successful. The unique perspective of viewing “energy as an ingredient” helps keep an invisible cost like electricity from running rampant. At the beginning of each day, you can snack safely—knowing your cereal was made sustainably at General Mills. **BP**

For more information, visit [www.generalmills.com](http://www.generalmills.com).

#### References

- General Mills Overview, 2015: <http://www.generalmills.com/en/Responsibility/Environment>
- General Mills, Reducing energy use: <https://www.generalmills.com/Responsibility/Environment/Climate/reducing-energy-use>
- U.S. Department of Energy, Implementation Models, Energy Reduction Continuous Improvement Program, General Mills: <http://betterbuildingssolutioncenter.energy.gov/implementation-models/energy-reduction-continuous-improvement-program>

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# Vacuum Cooling Reduces Waste in POSTHARVEST COLD CHAIN SYSTEMS

By Ryoshin Imai, ULVAC Technologies, Inc.



► Based on International Trade Administration (ITA) information, global losses in the food industry accumulate to more than \$750 billion on a yearly basis. The losses are primarily due to inadequate facilities, improper food safety measures, and insufficient training of personnel working within the cold chain—a temperature-controlled supply chain developed to extend and ensure product shelf life.

Every year, poor cold chain systems result in the loss of billions of tons of fresh food—particularly in developing markets. While there are widespread efforts on improving agricultural processes to increase food production, nearly half of all food produced never actually makes it to a consumer's table.<sup>1</sup>

## Bringing Benefits to Traditional Cold Chain Systems

During the summer season, vegetables tend to deteriorate quickly once harvested from the field—or during postharvest stage of the cold chain. In traditional cold chain systems, vegetables are put into a chilled cooler for preservation, a process that requires approximately 12 hours for the product to achieve proper temperature. In some instances, as much as 25 percent of food product in the chilled cooler will decay before arriving at a proper storage area. Fortunately, there is a process for improving the effectiveness of the postharvest stage—vacuum cooling.

Vacuum cooling can be applied shortly after harvesting crops, helping to rapidly cool the product and preserve shelf life. The theory of the process is to reduce product temperature from ambient temperature, say 90°F (32°C) during the harvest season, to around 39°F (4°C)—within 30 minutes. The process can be applied to vegetables, fruits, flowers and other food products. It is an excellent way to preserve and extend freshness, and can also ensure product uniformity. By using vacuum cooling, in conjunction with other vital pieces of the cold chain, product freshness can be better sustained.

There are many beneficial features of vacuum cooling process, including:

- There is no time limit for harvesting crops.
- The product is always ready for delivery to supermarkets or dockyards after coming out from a vacuum cooling chamber.
- Product freshness and cleanliness are ensured.
- There is a higher yield per harvest with the reduction in withered and spoiled product.
- It is possible to harvest in poor weather conditions, such as rain.
- Products can be cooled inside cartons.



*Vegetables can deteriorate quickly during the postharvest stage of a cold chain system.*

ULVAC Technologies, Inc., a leading supplier of production systems, instrumentation and vacuum pumps, has introduced vacuum cooling equipment and systems to the agricultural, food and floral markets. The company provides vacuum cooling systems for use in large-scale farms to extend product shelf life. The systems are mainly used for fresh agricultural products, including vegetables, fruits and mushrooms. The company's vacuum cooling equipment can also be used for flowers, meats and prepared foods, such as airplane meals. Over ten systems have already been installed in the United States.



*Vacuum cooling systems can bring tremendous benefits to traditional cold chain systems.*



**“Vacuum cooling can be applied shortly after harvesting crops, helping to rapidly cool the product and preserve shelf life. The theory of the process is to reduce product temperature from ambient temperature, say 90°F (32°C) during the harvest season, to around 39°F (4°C)—within 30 minutes.”**

— Ryoshin Imai, ULVAC Technologies, Inc.

## VACUUM COOLING REDUCES WASTE IN POSTHARVEST COLD CHAIN SYSTEMS

### Cold Chain Requirements

As mentioned previously, a cold chain is a temperature-controlled supply chain designed to maintain the quality of sensitive products. Cold chains comprise storage and distribution systems, and every step of the chain must be maintained in order to deliver a quality product. Cold chain system requirements will vary based on differences in the size, type and amount of products being stored and transported. Agricultural products, like

fruits and vegetables, require cool facilities and storage at about 55°F. Dairy products and meat products are typically stored just below freezing, at 35°F and 28°F, respectively. Finally, frozen products, such as ice cream, could require deep freezing, and the required temperatures vary between -10°F to -150°F.

In regards to vegetables and other agricultural products, the postharvest step is the first step in a cold chain system, and it must maintain the same level of quality as every other step

in the process, such as cold storage in a warehouse or shipping vessel. According to the ITA, “A single breakdown in the chain can result in catastrophic losses of product.”<sup>11</sup> By addressing the postharvest step of the cold chain with vacuum cooling technology, product losses can be dramatically reduced, and product quality can be ensured at the onset of a product’s journey.

### How Does Vacuum Cooling Work?

The vacuum cooling process begins when a large vacuum chamber is filled with agricultural product, such as fresh vegetables. Under vacuum, free water in the cell tissues of the vegetables begins to evaporate at a pressure of around 12 Torr. The vegetables then cool themselves, due to the removal of the latent heat of the evaporated water. Since it takes 597 calories to evaporate 1 gram of water at 32°F (0°C), the vegetables are cooled to 39°F (4°C) in about 20 to 30 minutes. The vacuum chamber is then maintained at a low vacuum level.

As only 2 to 3 percent of the water is vaporized, there is no danger for drying out the vegetable, or reducing the product’s weight. The large amount of water vapor generated inside the vacuum chamber is condensed on the surface of a cooling coil, called a cold trap, and removed from the chamber later. The system uses a refrigerator to maintain the cooling coil at a temperature below 32°F (0°C).



*Within 20 to 30 minutes, vacuum cooling systems cool products to 39°F (4°C).*



**“Under vacuum, free water in the cell tissues of the vegetables begins to evaporate at a pressure of around 12 Torr. The vegetables then cool themselves, due to the removal of the latent heat of the evaporated water.”**

— Ryoshin Imai, ULVAC Technologies, Inc.





Vacuum cooling systems from ULVAC can cool two to six pallets of agricultural products per batch.

Vacuum cooling machines comprise a vacuum chamber, a cold trap with a refrigerated unit, vacuum pumps and a control panel. ULVAC offers four models that can cool two to six pallets of agricultural products per batch. The machine uses reliable vacuum pumps manufactured by ULVAC Japan. It also incorporates refrigeration units manufactured by Copeland. ULVAC vacuum cooling equipment features fully automatic control, and end users can simply press the “start” button to engage the process, which is completed in less than 30 minutes. With LAN connection, ULVAC can diagnose the machine performance anywhere in the world.

### Implementing Vacuum Cooling Systems Globally

Since the development of Japan’s first large-scale experimental system for vegetable vacuum cooling (under the Cold Chain promotion policy of the Japan Science and Technology Agency) in 1967, ULVAC has delivered many vacuum cooling systems to leading agricultural cooperatives in Japan.

These systems are highly acclaimed for their outstanding efficiency and reliability. In 1997, ULVAC transferred the technology to Hong Kong ULVAC to continue the manufacturing and promotion of vacuum cooling technology inside China. From 1998 to 2015, Hong Kong ULVAC has sold over 500 vacuum cooling systems in China, other southeastern Asian countries, and in North American countries.

When Hong Kong ULVAC started this project in 1998, farmers in Southern China Provinces were exporting their vegetables in chilled containers to Asian countries, such as Singapore, Malaysia and Thailand. Due to poor attention to detail at the postharvest stage of the cold chain, about 25 percent of the vegetables decayed before arriving at a client’s site. When ULVAC introduced vacuum cooling technology to those farmers, they applied it to their export vegetables, resulting in a reduction in waste from 25 percent to 3 percent.

Since then, Hong Kong ULVAC has also introduced this technology to farmers in

Northern China provinces. These farmers can also reduce the wastage rate when exporting vegetables to Japan and Europe.

### About ULVAC Technologies, Inc.

# ULVAC

ULVAC Technologies, Inc. is a leading supplier of production systems, instrumentation, vacuum pumps and components for the semiconductor, MEMS, solar, flat panel display, research automotive, medical, electrical, and refrigeration industries. ULVAC Technologies uses a class-10 process development laboratory and customer demonstration facility to meet the unique needs of different markets. ULVAC Technologies is a subsidiary of ULVAC, Inc., which is made up of over 50 companies engaged in most sectors of the vacuum industry.

ULVAC’s corporate philosophy aims to contribute to the evolution of industries and sciences by using vacuum technologies and other peripheral technologies. Since 1952, ULVAC has provided “ULVAC Solutions,” diversely incorporating equipment, materials, analysis, and services for flat panel displays, electronic components, semiconductors, and other general-industry equipment. **BP**

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#### References

1. Miller, J., & Harsh, B. (2015). 2015 Top Markets Report: Cold Chain (United States, International Trade Administration, Industry & Analysis). ITA. [http://trade.gov/topmarkets/pdf/Cold\\_Chain\\_Top\\_Markets\\_Report.pdf](http://trade.gov/topmarkets/pdf/Cold_Chain_Top_Markets_Report.pdf)

To read more about **Vacuum for the Food Industry**, please visit [www.blowervacuumbestpractices.com/industries/food](http://www.blowervacuumbestpractices.com/industries/food).



# Guzzler Discusses Dense Phase Offloading Systems

Blower & Vacuum Best Practices interviewed Ben Schmitt, Product Manager, Guzzler Manufacturing

► Industrial vacuum trucks, also known as industrial vacuum loaders, are used to recover, contain, and carry solids, dry bulk powders, liquids, slurries, and thick sludge from hard-to-reach areas. Guzzler Manufacturing, an industrial vacuum truck manufacturer based in Streator, Illinois, has long-standing expertise in pneumatic conveying—both dilute and dense phase—for all kinds of industrial applications.

Ben Schmitt, product manager at Guzzler Manufacturing, was kind enough to discuss pneumatic conveying with Blower & Vacuum Best Practices Magazine. Topics covered include: the differences between dilute phase and dense phase conveying, ideal applications for dense phase offloaders, and the common challenges involved in dense phase pneumatic conveying.

## Please explain the differences between dilute phase and dense phase conveying.

Dilute phase pneumatic conveying typically uses higher conveying velocities in order to keep the material suspended in the air stream and conveyed. When material is pneumatically conveyed through a hose via the dilute phase process, the hose typically has a higher ratio of air to material conveyed. Described as low-pressure/high-velocity systems, entry air pressure is typically under 15 psig at the beginning, and closer to atmospheric pressure at the end. Conveyance velocity ranges from about 2500 fpm at the beginning of the system to 6000 fpm toward the end.

Dense phase, on the other hand, uses lower conveying velocities, but the air stream in

the hose has a lower ratio of air to material conveyed. Therefore, a dense phase system conveys more material per amount of airflow, and is a more efficient system for conveying large bulk materials. Pressures for dense phase conveyance range from approximately 15 psig to 50 psig. Guzzler dense phase offloaders use 14.5 psig at up to 700 cfm.

## For what applications/materials are dense phase offloaders best suited?

Guzzler dense phase offloading systems are ideal for applications where the cleanup and recovery of valuable raw materials, such as powered cement, lime, carbon black, some types of sand, acetate flake and plastic pellets, are desired. A prime example is the cement industry, where cement powder often

accumulates below conveyors. This resource can be vacuumed into the body of the Guzzler truck and dense phase offloaded back into storage silos for reuse.

Dense phase systems can move most any product, including fly ash, dog food and sludge.

### How are these systems controlled? Can you describe a typical operation?

When using a dense phase system on a vacuum truck, the first step is to isolate the main collection hopper, where material is stored, from the vacuum system, and raise the debris body to allow the material to flow to the rear discharge cone. The CycloBlower system is then engaged, and pressurization of the debris body begins. Once the desired pressure level has been reached, control valves at the discharge cone are controlled by the operator to allow air and material to mix. The Guzzler dense phase system also features fluidizing valves which continually agitate the material to fluff it into the air stream. This agitates the material into the air stream prior to entering the main air stream.

The Guzzler system uses a positive displacement blower that is commonly found on bulk cement transport trucks. The CycloBlower is ideal for this application because of its efficiency and relatively high airflow and pressure capabilities.

### What are common challenges involved in dense phase offloading?

The biggest challenge is becoming familiar with the operation of the system and the fluidizer valves. The goal is to adjust the valves so that the material enters the air stream in a dense phase condition. Too much air from the fluidizer valves will put the material into a dilute phase, which compromises the dense phase conveyance efficiency. There is a visual sight glass that allows the operator to monitor the material conveying in the hose, providing

### Gardner Denver CycloBlower

Designed to clean and recover solids, dry bulk powders and liquids, industrial vacuum trucks are used for all kinds of applications. Using vacuum to load and positive displacement to unload, these trucks pneumatically convey a wide variety of materials, including sand, cement, liquids, slurries, and kinds of feeds—such as corn, rice, beans, and oats.



*The CycloBlower from Gardner Denver is ideal for providing pulsation-free and oil-free pressurized air.*

When designing a truck for pneumatically conveying valuable product, it is imperative to select the proper blower for the application. Brought to market in the 1960s, Gardner Denver's CycloBlower has a long-standing reputation for reliability, design versatility, and fast offloading times. In addition, it provides oil-free air to prevent product contamination.

### Addressing Varying Airflow Requirements for Different Materials

Pressure offloading typically requires 10 to 15 psi of air pressure. Airflow requirements change based on the material being conveyed. Powders, such as cement, flour, and fly ash, typically require between 220 to 350 cfm. Food products like corn, rice, and beans generally require 260 to 350 cfm.

Larger and denser materials, like pebbles, require additional airflow, ranging between 430 and 610 cfm.

The CycloBlower features a compact helical screw blower. Its two screw-type rotors mesh together to provide pulsation-free and oil-free pressurized air. Connected to the engine power by a PTO driveshaft, the CycloBlower provides 18 psi continuous, and 20 psi at intermittent duty. Up to 17" Hg of vacuum can be achieved, with airflows of up to 1060 cfm. The blower comes in two different sizes, one with a 9-inch rotor profile, and another with a 12-inch rotor profile. The 12-inch rotor model delivers more airflow, and can be leveraged on haulers dedicated to a certain kind of product.

### Benefits of Helical Screw Blowers

While bi-lobe blowers are commonly used for the tank and truck markets, the CycloBlower's helical screw design brings several unique benefits for designing an industrial vacuum truck. Importantly, CycloBlower models weigh an average of 50 pounds less than their bi-lobe blower counterparts. This, in conjunction with its compact design, makes the CycloBlower easier to integrate on mobile platforms.

In addition, the CycloBlower is driven by the gate-end rotor, so it requires less RPMs than bi-lobe products. The lower RPM consumption translates directly to less fuel consumption, and greater savings. Finally, the compression process of a helical screw blower delivers lower discharge temperatures than bi-lobe blowers—an important factor when conveying sensitive materials, such as food products or plastic pellets.

*For more information, contact Jason Costigan of Gardner Denver; tel: (217) 231-5870, email: Jason.Costigan@gardnerdenver.com, or visit www.gardnerdenver.com.*

## GUZZLER DISCUSSES DENSE PHASE OFFLOADING SYSTEMS

a visual indicator as to proper conveyance. Typically, the vacuum truck operator is also the person responsible for offloading the material back into the storage silo.

### How do changes in particle size, density and texture impact performance?

When conveying material, it's important to understand the makeup of the material. The lighter, or less dense, the material, the higher the material can be conveyed. More textured or jagged material has increased surface area, making it easier to be grabbed and carried

into the air stream. The larger the particle size of the material being conveyed, the more difficult it is to be conveyed. Irregularly shaped, larger material can become lodged in smaller hose systems. The key to preventing this from happening is to understand the application. The offload system works on a 4-inch discharge hose. Trying to convey material that may be near the 4-inch size can be problematic. Alternative offload options should be evaluated. Some contractors use guards on the end of their vacuum hose to prevent larger material from being recovered. This method would also be another solution to prevent clogging.

### How are Guzzler offloaders designed for reliability and economical maintenance?

At Guzzler Manufacturing, our primary design consideration is to ensure our equipment is durable, reliable and easily maintained. We make a point to provide access to the air path to ensure each Guzzler machine operates effectively and efficiently for the life of the equipment. Each air path has an access door to allow cleaning of the airways and paths.

We continually work with Guzzler customers to gather application and product feedback,



The Guzzler NX air mover, as seen here, features the advanced dense phase offloading system.

and we implement product improvements based on that feedback. All Guzzler products undergo a thorough testing process to ensure they exceed customer expectations. New product designs are first tested on our CAD system by using finite element analysis (FEA) to highlight potential high stress areas. We then use our dedicated technology center to perform various levels of testing, which may range from strain gauging of the potential high-stress areas, to filtration and airflow tests. Additionally, we use a local test facility to perform endurance and life-cycle testing.

We also use the test facility's test track to put our equipment through real-world endurance track testing. Once these tests are completed, select customers participate in real-life field application testing with our equipment. At that point, we move into the production stage. Once in production, each product goes through a multi-point inspection where equipment performance is tested and verified prior to delivery to our customer. Additionally, Guzzler uses high-quality components to ensure long-lasting reliability.

### Can you discuss some of the unique attributes of the Guzzler NX?

The Guzzler NX air mover features the advanced dense phase offloading system. This vacuum loader tackles the toughest applications, from solids and dry bulk powders—like fly ash—to liquids, slurries and thick, heavy sludge.

The dense phase offloading system allows the operator to quickly and easily reclaim, recycle and redistribute valuable material. The innovative system combines pressure offloading with vacuum recovery, providing a closed-loop system that eliminates spills. Additionally, the



Leveraging Gardner Devner's CycloBlower, the Guzzler NX air mover is ideal for dense phase offloading applications.

## GUZZLER DISCUSSES DENSE PHASE OFFLOADING SYSTEMS

dense phase offloading system allows conveyance of dry material up to 120 feet vertically. This system is ideal for cement or dry bulk powder applications. Material can easily be blown back into storage silos, rail cars or other appropriate containers. Vacuum recovery returns any carryover back to the tank, closing the loop in the loading and unloading process.

### Please describe the Guzzler CL as a dense phase offloading option.

A dense phase offloading option for the Guzzler® CL industrial vacuum loader was introduced by Guzzler Manufacturing in early 2015. Designed to increase value by recovering valuable resources for reuse, the optional batch offloading system is ideal for offloading powders, such as cement and lime, into large silos. The truck features a high-pressure (14.5 psi), direct-drive CycloBlower rotary pump with up to 750 cfm of free air displacement. The system pneumatically conveys material through a 4-inch (10.16 cm) hose up to 125 feet (7.62 m) vertically. In addition, the rear of the dense phase offloading configuration features a specially designed transfer cone with six fluidizing nozzles that fluff material into the air stream for improved material conveyance.

The powerful and efficient industrial vacuum system operates effectively in remote or inaccessible locations more than 1000 feet away. Simple to operate and easy to maintain, this Guzzler vacuum truck provides 100-percent accessibility to all internal chambers, and provides the lowest air-to-cloth ratio. Air-to-cloth ratio is the measurement of airflow in cfm to filter cloth area. The lower the number, the more filter air the unit has for the cfm of conveyance. This lower ratio allows the equipment to more easily move air through the system while vacuuming.

The Guzzler CL is also available with a vane pump pressure offload system (high-pressure, low airflow), which is ideal for the vacuum loading of liquids, sludges and thicker materials. **BP**

For more information about Guzzler, contact Annette Adams, tel: (847) 741-5370, email: aadams@federalisignal.com, or visit [www.guzzler.com](http://www.guzzler.com).

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# Sewage Treatment Plant Retrofits Diffusers to Cut ENERGY CONSUMPTION 50%

By Doreen Tresca, Stamford Scientific International

*The Ilmajoki sewage treatment plant experienced challenges due to industrial effluent coming from both an alcohol production facility and a biogas facility.*

► The Ilmajoki sewage treatment plant (STP) located in southern Finland was built in the mid-1970s during a boom of infrastructure construction. Over time, industrial presence in the Ilmajoki area grew, and the plant saw an increase in flow of industrial effluent—or liquid waste and sewage. As the amount of influent increased, the plant was no longer able to meet required performance criteria suffered from a severe lack of oxygen—particularly during peak loading times.

## Food Plant and Industrial Effluent Sources Cause Spikes

The main treatment challenges were coming from an alcohol production facility and a biogas/waste handling unit located a short distance away from the plant. The liquor facility pre-treats their effluent and generally does not contribute much to the waste at the Ilmajoki STP, however, during maintenance operations, a peak load will occasionally be sent to the wastewater treatment plant.

The biogas facility, on the other hand, did not have a proper pre-treatment facility, and it would flow peak loads into the wastewater treatment plant for 19 hours on a daily basis. The effluent brought in from the biogas facility was nearly 10 times more concentrated than typical municipal flow. The constant and concentrated flows were affecting Ilmajoki's current processes, and the plant could not keep up. Realizing the plant could not reach government-mandated standards, the staff realized they had to do something, and quick.

## Retrofitting Diffusers for Increased Aeration Capacity

The Ilmajoki STP partnered with Jani Savolainen, Technical Director of Solid Water OY, to design an upgrade to meet the plant's needs in late 2013. The plant features two aeration tanks, which are able to run in parallel or in series. Each of the two tanks is outfitted with dissolved oxygen (DO) probes for controlling the airflow valves of the downpipes

## SEWAGE TREATMENT PLANT RETROFITS DIFFUSERS TO CUT ENERGY CONSUMPTION 50%

of the tank. Originally when planning the upgrades, it was decided and confirmed that they needed to increase their aeration capacity by 30 percent. To achieve this goal, Mr. Savolainen designed a new system for the plant, which included replacing the 9-year-old discs with 240 pieces of Stamford Scientific International's (SSI) Snappy Saddle tube diffusers. Paired with the new diffusers were three blowers controlled by a supervisory system for monitoring frequency and constant pressure.

Stamford Scientific's Snappy Saddle tube diffusers took the place of the aging disc diffusers along the bottom of the aeration basin. The Snappy Saddle tube diffusers were an ideal choice for the Ilmajoki plant, as each set offers the performance equivalent of five 9-inch disc diffusers. The Snappy Saddle diffusers use one orifice to connect to the air supply, and thus are less likely to leak than standard tube diffusers, which come equipped with two seals. Each Snappy Saddle tube diffuser goes through rigorous quality

control at Stamford Scientific's factory before being sent out to the client. Each membrane is checked for even perforation depth to ensure uniform air release. Through extensive research and development, Stamford Scientific has formulated membranes that contain the right amount of plasticizer—featuring just enough to reduce shrinkage and hardening, while also preventing creep. The Snappy Saddle diffuser is easily installed and mounted by one person, who can use a simple band and wedge system to secure the diffuser on the piping.



*The plant's two aeration tanks are able to run in parallel or in series.*



The upgrades to the plant were completed in April 2014, and the plant has been running flawlessly since. Since upgrading the diffusers, the plant has seen a vast improvement in influent and effluent quality running through the tanks. At the return activated sludge recirculating aquaculture system (RAS) inlet, the color of the influent—which was initially very dark—has drastically changed for the better. Improvements in effluent color at Ilmajoki were also seen at the channel weir of the clarifier tank (a barrier across a moving body of water) channel.

During the design of the DO control system and consideration of the diffusers, the main goal was to increase the capacity of the plant to handle the peak flows that had troubled them before. Generally, as most people would assume, an increase in capacity would also mean a spike in energy consumption and operating costs of the plant. In the case of Ilmajoki, because of the smart improvements they had made, operators discovered after a few weeks they were actually saving power.

### Quantifying Energy Savings

In 2012 when the plant was struggling to keep up with regulatory requirements, the Ilmajoki STP was using 4000 kWh per day. Once the new diffusers and control systems were implemented, the plant was able to reduce their consumption and averages to under 2000 kWh per day. With the current cost of power in Finland around .11 Euro per kWh, these savings cumulate up to over 80,000 euro per year. The Stamford Scientific Aeration tube diffusers offered the plant a high-efficiency option for the aeration basins, allowing them to treat substantially more waste than the 9-year-old disc diffuser system. This, paired with a control system customized by Jani Savolainen and the



*The Snappy Saddle from Stamford Scientific offers the performance equivalent of five 9-inch disc diffusers.*



*Roberto Amboldi from Stamford Scientific (left) and Jani Savolainen of Solid Water Oy (right) work to address the challenges at the Ilmajoki sewage treatment plant.*

# SEWAGE TREATMENT PLANT RETROFITS DIFFUSERS TO CUT ENERGY CONSUMPTION 50%

plant operator, allowed the plant to efficiently run their system both at peak loads and during normal flow.

By making a few simple switches and upgrading their aeration basins to Stamford Scientific Aeration's tube diffusers, the plant was able to make great strides in improving the plant output—in addition to saving money along the way. While upgrading older equipment may

seem expensive upfront, over time these improvements for developing a more energy-efficient system will pay for themselves.

## About Stamford Scientific International

Stamford Scientific International, Inc., headquartered in Poughkeepsie, New York, has developed and patented multiple advanced membrane technologies, including our PTFE (Polytetrafluoroethylene) coated membranes, POD's factory mounted diffusers, and wireless pipe monitoring systems. PTFE membranes from Stamford Scientific International (SSI) have been installed worldwide in various applications—both municipal and industrial. These membranes have become increasingly popular, as the focus on energy conservation and life-cycle costs has grown worldwide. SSI POD's diffusers have become a favorite of contractors around the globe, allowing them to reduce installation time by over half. SSI's wireless pipe monitoring systems allow operators to keep an eye on their plant 24/7 from anywhere in the world and flag any potential issues before they happen. **BP**

For more information, contact Doreen Tresca, tel: (845) 454-8171, email: [Doreen@stamfordscientific.com](mailto:Doreen@stamfordscientific.com), or visit [www.stamfordscientific.com](http://www.stamfordscientific.com).

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Tel: 412-980-9902

**A Publication of:** **Smith Onandia Communications LLC**  
37 McMurray Rd. Suite 106  
Pittsburgh, PA 15241

Blower & Vacuum Best Practices is published quarterly and mailed together with Compressed Air Best Practices®. Compressed Air Best Practices® (USPS# 17130) is published monthly except January-February combined by Smith Onandia Communications LLC, 37 McMurray Rd., Suite 106, Pittsburgh, PA 15241. Periodicals postage paid at Pittsburgh, PA and additional mailing offices. POSTMASTER: Send address changes to: Compressed Air Best Practices®, 37 McMurray Rd, Suite 106, Pittsburgh, PA 15241.

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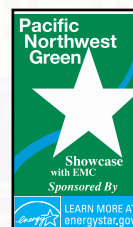
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