Pneumatic Conveying | Sandblasting | Chillers | Heat Recovery

January 2011

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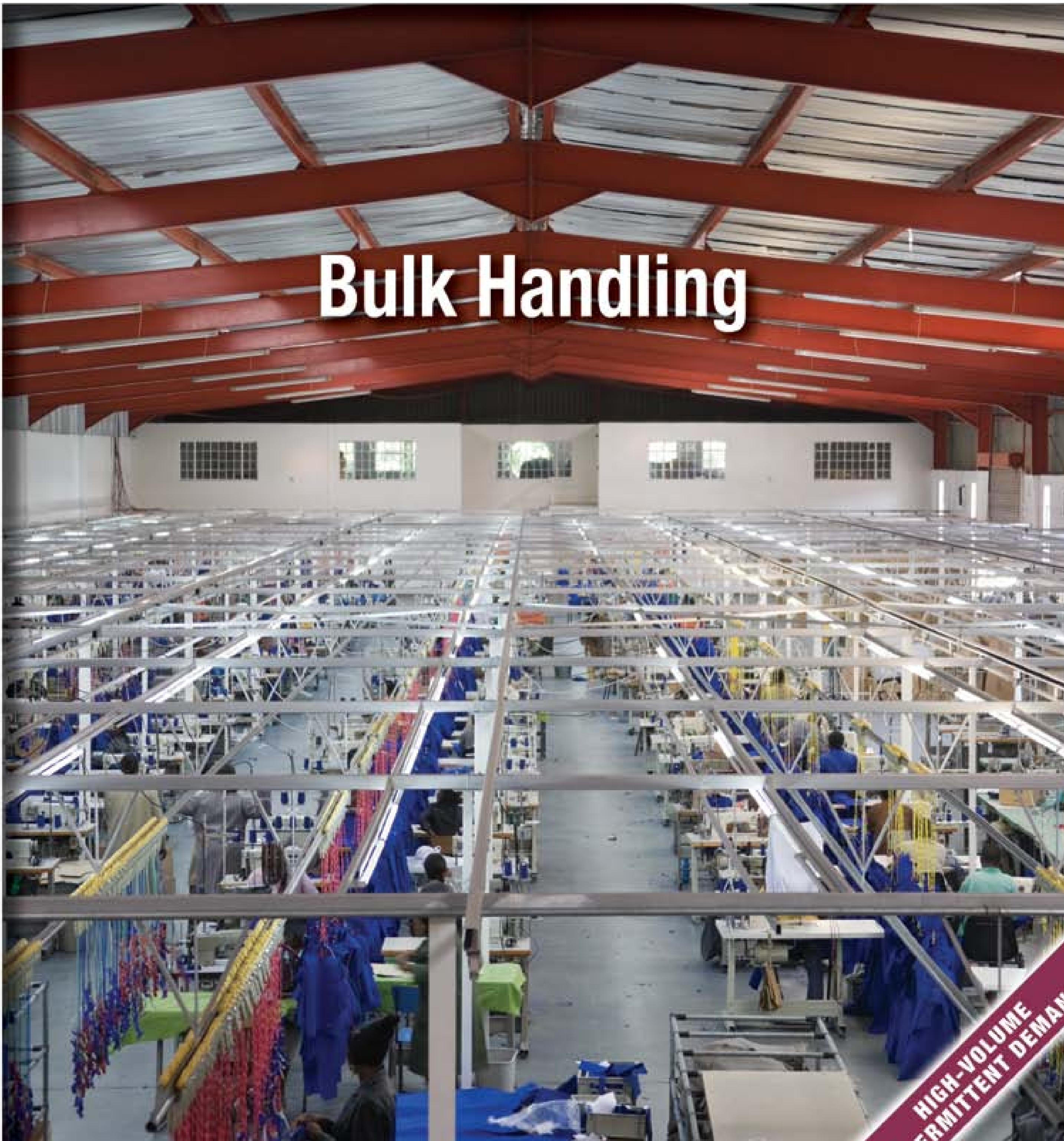

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HITACHI
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SUSTAINABLE MANUFACTURING FEATURES


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FROM THE EDITOR

Bulk Handling

We are pleased to publish an article this month titled, "Pneumatic Conveying of Bulk Materials", written by G.D. Nigudkar from TATA Consulting Engineers. Mr. Nigudkar has extensive experience designing conveying systems for different types of bulk materials including:

- Coal and coal ash in thermal power plants
- PET and nylon chips in industrial plants
- Sugar, flour, and food powders in food processing plants
- Zircon and zirconium hydro-oxide in nuclear power plants

Sending us this article from India, Mr. Nigudkar describes vacuum-type and pressure-type pneumatic conveying systems used for these materials. Pressure-type systems are broken down into lean-phase and dense-phase pneumatic conveying systems.

The Compressed Air Challenge® kicks-off 2011 with an article titled, "Dealing with High-Volume Intermittent Demands." Managing these situations efficiently is one of the toughest challenges presented by compressed air systems. The authors explain how dense-phase transport systems can cause dynamic pressure fluctuations affecting quality of the end product in a plant. They detail how the correct sizing and location of a secondary air receiver can relieve this challenge.

I highly recommend the article written by Gary Wamsley, called "Compressed Air Systems Improvements". It's a straight-forward example of work he's done with two extremely common opportunities with compressed air systems:

1. Heat recovery to reduce HVAC energy costs
2. Distribution systems (piping, receivers, valves)

This edition has a variety of different applications — much like compressed air systems themselves. Air Power USA provides us with an interesting article on industrial sandblasting applications. John Medeiros, from MTA USA, provides us with an interesting story on how chillers provide temperature regulation to ensure the production of high quality wines. Orion Industries shares their experiences with us on how their special coatings have helped airends improve efficiencies.

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

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AIR BEST PRACTICES™

"Sending us this article from India, Mr. Nigudkar describes vacuum-type and pressure-type pneumatic conveying systems used for these materials."

SUSTAINABLE MANUFACTURING NEWS

Lafarge, DOE Superior Energy Performance, CalPortland, CEMEX

SOURCED FROM THE WEB

First Companies Earn Industrial Energy Efficiency Certification

DOE announced the first industrial plants in the country to be certified under the Superior Energy Performance program, a new market-based industrial energy efficiency program. The energy management certification program is accredited by the American National Standards Institute (ANSI), and it will serve as a road map for industrial facilities to help continually improve their efficiency and maintain market competitiveness.

The industrial and manufacturing sectors, which account for roughly one-third of energy use in the United States, include significant opportunities to improve the overall efficiency of their operations. By reducing the energy consumption for their industrial processes, companies can save money, save energy, and help create new clean energy jobs.

Companies receiving the awards were:

- Cook Composites and Polymers Co. (Houston, Texas)
- Freescale Semiconductor Inc. (Austin, Texas)
- Owens Corning (Waxahachie, Texas)

All three were certified in the Superior Energy Performance program's pilot, which began in May 2008 as a partnership between DOE and Texas Industries of the Future, located at the University of Texas at Austin.

A series of additional energy management demonstration projects are now underway in other regions around the country to further test the Superior Energy Performance program, which is aimed at helping to make it possible for companies to conform to the upcoming International Organization for Standardization (ISO) 50001 energy management system standard. ISO, the world's largest developer and publisher of international standards, identified energy management as a priority for its significant potential to save energy and reduce greenhouse gas emissions worldwide. Based on broad applicability across national economic sectors, the ISO 50001 standard could eventually influence up to 60% of the world's energy demand.

The Superior Energy Performance program, which is led by the U.S. Council for Energy Efficient Manufacturing with support from DOE, is already serving as the basis for the Global Superior Energy Performance initiative, a multi-country effort to create and harmonize nationally accredited energy performance certification programs.

Source: www.energy.gov/news

Lafarge Exceeds Its Target to Reduce Global CO_2 Emissions

Lafarge has made a significant breakthrough in reducing its carbon footprint by exceeding its CO_2 emissions reduction target one year in advance. Lafarge is following a voluntary approach on a global scale. For ten years, the Group has been publicly committed to reducing its global net emissions per ton of cement by 20% between 1990 and 2010, within the framework of a partnership with WWF International. At the end of 2009, the Group had reduced its emissions by 20.7%*, thanks to the mobilization of operating units in three areas:

- The improvement of energy efficiency through mastered production processes
- The substitution of fossil fuels by alternative energy sources, such as biomass or industrial waste
- The development of new ranges of products meeting market requirements, using additives and recovering by-products from other industries

Lafarge intends to continue its efforts to reduce its CO_2 emissions; this is the major reason that led to the renewal of the strategic partnership with WWF International.

LAFARGE

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Source: www.lafarge.com

*Figure verified by Ernst and Young

SUSTAINABLE MANUFACTURING NEWS

Lafarge, DOE Superior Energy Performance, CalPortland, CEMEX

New EPA Rules Threaten Domestic Cement Plants

The Environmental Protection Agency's stringent new emission and performance standards present a significant challenge to the nation's cement plants, including CalPortland's plants in Mojave, Colton and Rillito.

The EPA final NESHAP rule, published Sept. 9, 2010 in the Federal Register, requires Portland cement facilities to meet lower emission standards for mercury, total hydrocarbons, hydrochloric acid and particulate matter, in all four categories. The compliance date for the cement industry is Sept. 9, 2013.

Portland Cement Association Fears Closures, Leakage

The Portland Cement Association filed two petitions in federal court on Nov. 5 asking that the EPA reconsider and hold off implementation until certain issues are resolved.

"The Portland Cement Association supports the rising demand for Portland cement through environmentally and socially responsible business practices," Brian McCarthy, the association's CEO and president, said in a press release. "The national emission standard for hazardous air pollutants emission limits are very low and will not be achievable by a number of facilities. We are concerned that the rule presents a significant threat to the continued viability of many cement companies, high paying jobs at cement facilities and their local communities."

The new EPA rule will lead to several plant closures, according to both the trade association and the EPA. Imported cement, not subject to the same level of regulation, will fill the resulting unmet demand. Replacing the domestic cement production with imported cement will result in additional global emissions from the unregulated plants as well as from the transport of cement over long distances, a phenomenon known as leakage. According to the Portland Cement Association, "Compliance with current and proposed EPA regulations for the cement industry could add a minimum of $26 per ton to domestic cement production costs by 2020."

The new EPA rule will lead to several plant closures, according to both the trade association and the EPA. Imported cement, not subject to the same level of regulation, will fill the resulting unmet demand.

No Plant This Low Anywhere

The EPA has fashioned a sort of a dream team of standards. CalPortland Plant Manager Bruce Shafer said the EPA looked across the country and found the plant with the lowest reading of pollutant "A" and "set that level for everybody in the country." They did the same for pollutants "B," "C" and "D. The result is that no cement plant in the country, including newly constructed plants, can meet all four lower limits without modifications." It is unknown what will be required for the three CalPortland plants to comply with the rule. "The allowable levels are so low," Shafer said.

"What is particularly frustrating about the hydrochloric acid standard is that there is no adverse health effect from this pollutant, even at the current unregulated levels. EPA agrees with this finding but continues to push the low standard anyway," remarked Jay Grady, Senior Environmental Manager at CalPortland.

Rick Jacobs, CalPortland's Chief Process Engineer, said "The emissions levels are set so low that instruments to accurately measure these compounds continuously in the stack don't exist."

Portland Cement Association Asks EPA to Rework Rule

The petition asks for reconsideration of new standards for particulate matter, saying that in its final rule, the EPA "dramatically deviated from the range of possible limits that it had proposed for particulate matter…" and "rather than collecting a broad swath of representative data from across the industry, EPA 'cherry picked' the data." The petition also asserts that some of the standards in the final rule never were addressed in public prior to adoption by the EPA or were significantly changed from the original proposal without public input. Those issues include outside clinker storage requirements, classification of cement facilities in the solid waste category, startup and shutdown standards and particulate standards.

Source: www.calportland.com/news

CALPORTLAND™

SUSTAINABLE MANUFACTURING NEWS

Lafarge, DOE Superior Energy Performance, CalPortland, CEMEX

CEMEX's successful energy management program can be attributed to senior management support, best practice sharing, adoption of new technologies, and utilizing external resources and tools from ENERGY STAR®.

CEMEX USA Wins 2010 ENERGY STAR® Awards

CEMEX USA announced that the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE) have awarded three of its U.S. cement manufacturing plants the 2010 ENERGY STAR® for their superior energy performance. CEMEX's plants in Clinchfield, GA; Louisville, KY and Demopolis, AL received the 2010 ENERGY STAR®.

"CEMEX is leading the industry for energy efficiency and our work to protect the environment," said Gilberto Perez, President of CEMEX USA. "We're honored to again have three plants receive this award by the U.S. government. CEMEX's commitment to sustainable manufacturing is clear, our local men and women at the plants are focused and we're achieving results while producing the highest quality products to build the nation's communities and infrastructure."

It is not the buildings that are recognized, but the actual efficient cement manufacturing processes and performance at each of these CEMEX cement plants that is labeled with the ENERGY STAR®. So far, the EPA and DOE have only awarded five ENERGY STAR® awards for individual cement plants in the U.S. for 2010, and CEMEX's plants have received three of them. CEMEX USA was also recently awarded the EPA's ENERGY STAR® 2010 Partner of the Year Award for its work in managing its energy and cutting greenhouse gases company-wide. This is the second consecutive year it has achieved this Partner of the Year honor and received the award at a ceremony in March in Washington, D.C.

CEMEX's Clinchfield, Louisville, Demopolis and Wampum, PA plants received the 2009 ENERGY STAR®. In 2008, its Clinchfield, Louisville, Wampum, Davenport, CA and Knoxville, TN cement facilities received the award – this was the most cement plants selected for any one company in the U.S. In addition, CEMEX's Clinchfield, Davenport and Louisville plants were awarded the ENERGY STAR® in 2007.

Over the last year, the plants conducted compressed air system surveys to identify leaks, installed more efficient motors, completed staff energy training programs, upgraded lighting systems with motion sensors, increased the use of permitted and authorized alternative fuels, reduced equipment idle times, performed process inspections, and conducted audits to reduce unnecessary power usage. All three plants implemented measures to improve their energy use performance.

CEMEX's successful energy management program can be attributed to senior management support, best practice sharing, adoption of new technologies, and utilizing external resources and tools from ENERGY STAR®. CEMEX USA is a corporate partner of the ENERGY STAR® program, has been one of ENERGY STAR's biggest advocates and has worked relentlessly in promoting energy efficiency within CEMEX and throughout the industry. CEMEX has also worked with customers, suppliers and local communities to raise awareness of energy efficiency and the ENERGY STAR® message.

The ENERGY STAR® program is a joint initiative by the EPA and DOE that focuses on strategic energy management and emphasizes the importance of demonstrating environmental leadership for future generations.

CEMEX is a global building materials company that provides high quality products and reliable service to customers and communities in more than 50 countries throughout the world. The company has a rich history of improving the well-being of those it serves through its efforts to pursue innovative industry solutions and efficiency advancements and to promote a sustainable future. BP

Source: www.cemexusa.com

CEMEX

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A VIEW FROM INDIA

Pneumatic Conveying of Bulk Materials

BY G.D. NIGUDKAR, TATA CONSULTING ENGINEERS

The need for having an efficient and reliable fly ash handling system is well recognized. This is more significant here as Indian coal may contain 40% ash.

Introduction

In thermal power stations, nuclear plants, and chemical and industrial plants, different types of bulk materials are used. The materials exist in different forms including lump, powder, granules, chips and pallets. These bulk materials, in their different forms, require efficient and reliable material handling systems.

Here is a list of some commonly found bulk materials.

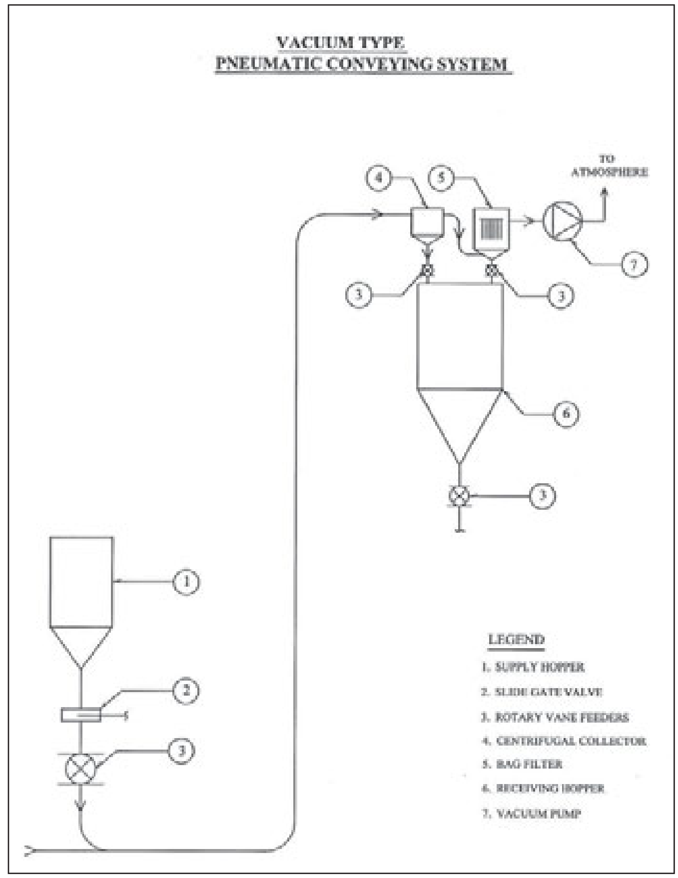
- Coal and coal ash are the materials found in thermal power plants
- PET chips and nylon chips are commonly found in industrial plants
- Sugar, flour and chocolate powder are commonly found in food processing plants like chocolate plants
- Zircon, zirconium hydro-oxide are found in nuclear power plants

Belt conveyors, screw conveyors and bucket elevators, are some of the conventional modes of transporting and conveying these materials. Specific materials, however, may require conveying in an enclosed form. Also, with layout constraints, it is preferred to convey materials in pipes using pneumatic systems.

This article describes Vacuum-type and Pressure-type pneumatic conveying systems. The pressure-type systems are broken down into Lean-phase and Dense-phase pneumatic conveying systems.

Vacuum Type Conveying System

In this type of system, the material to be conveyed is mixed with air under atmospheric conditions i.e., the material is metered into the air stream generally by a rotary vane feeder and thence conveyed to a receiving hopper via centrifugal collector by means of a vacuum pump (mechanical exhauster). At the centrifugal collector, the solids and the air get separated from each other. Air is then exhausted to the atmosphere and material is discharged into the receiving hopper by means of another rotary vane feeder. In addition to the centrifugal collector, a bag filter also may be added to ensure dust concentration in exhaust air is less than 100 ppm or within permissible limits per regulations.



Vacuum type conveying systems are used typically in the applications listed below. Variation of parameters given in (a), (b), (c) is possible and acceptable.

However, combinations shall be such that the maximum vacuum requirement for the system is around 600 mm Hg.

- **a.** For material with bulk density less than 1,000 Kg/M^3
- **b.** For low conveying rates up to 75 TPH
- **c.** For short distances up to 100 meters
- **d.** Maximum vacuum of 600 mm of Hg

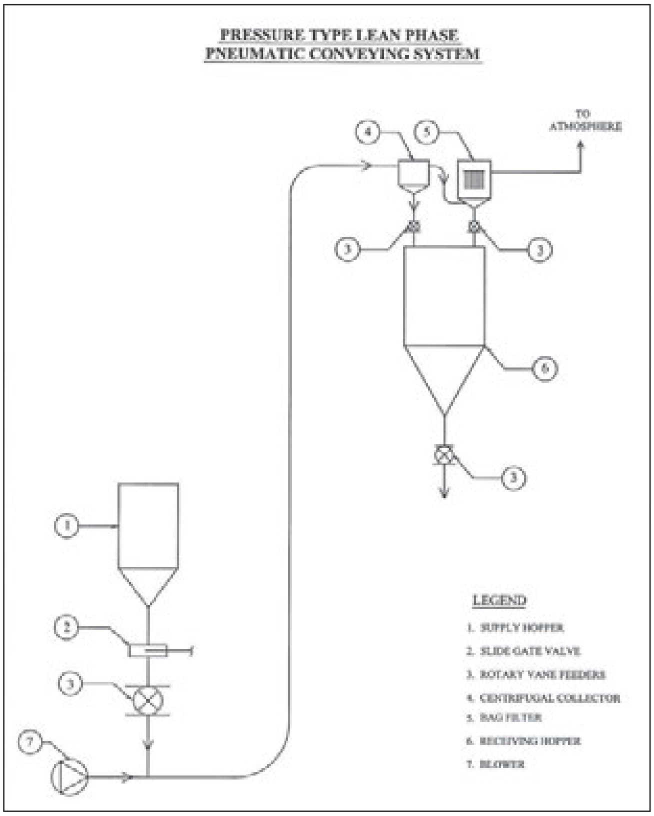
Pressure Type Lean Phase System

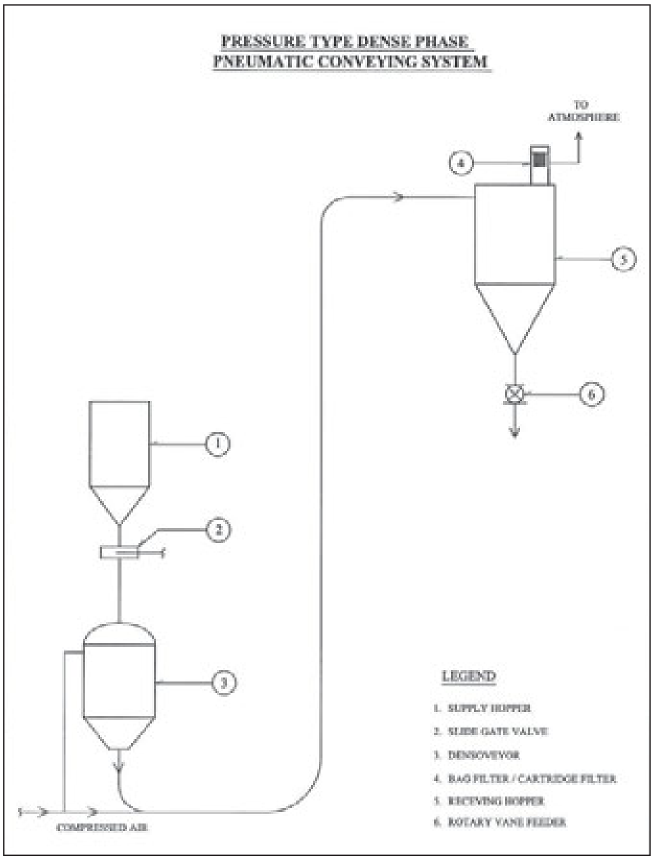
In this type of system the material to be conveyed is fed into the pipeline through a rotary vane feeder. During the conveying operation the pipeline is under positive pressure. Downstream from the rotary vane feeder the mixing of the material and the compressed air takes place.

The conveying air is supplied by a blower, which transports the material to the receiving hopper via a centrifugal collector. At the centrifugal collector, the solids and the air are separated from each other. Air is exhausted to the atmosphere and material is discharged into the receiving hopper by means of another rotary vane feeder. In addition to the centrifugal collector, a bag filter also may be added to ensure dust concentration in exhaust air is less than 100 ppm or within permissible limits per regulations.

A VIEW FROM INDIA:

Pneumatic Conveying of Bulk Materials





Lean phase type conveying systems are used typically in the applications listed below. Variation of parameters given in (a), (b), (c) is possible and acceptable.

However, combinations shall be such that the maximum pressure requirement for the system is 1 Kg/cm^{2}g.

- **a.** For material with bulk density of less than 1,000 Kg/M^3
- **b.** For low conveying rates up to 100 TPH For short distances up to 100 meters
- **c.** Maximum operating pressure of 1 Kg/cm^{2}g

Pressure Type Dense Phase System

In this type of system the material to be conveyed is fed intermittently to a densoveyor (a pressure vessel of cylindrical shape with a conical bottom) from the supply hopper. The filling and discharge of the densoveyor is automatic and is achieved by means of relays or a PLC.

Generally, a PLC-based system is preferred. Material is discharged from the densoveyor in a cyclic manner. Material is conveyed in plug form. Individual plugs of material are conveyed by means of compressed air. Material is discharged into the receiving hopper and air is exhausted generally through a cartridge filter.

Dense phase type conveying systems are used typically in the applications listed below. Variation of parameters given in (a), (b), (c) is possible and acceptable.

However, combinations shall be such that the maximum pressure requirement for the system is 6 Kg/cm^{2}g.

- **a.** For heavier material with bulk density more than 1,000 Kg/M^3 and up to around 2,500 Kg/M^3
- **b.** For high conveying rates up to 300 TPH
- **c.** For longer distances of 100 metres and more
- **d.** Maximum operating pressure of 6 Kg/cm^{2}g

IS 8647 "Design Criteria for Pneumatic Conveying Systems" may also be referred to while selecting the type of conveying system to be used.

Compressed Air Systems for Dense Phase Conveying

Compressed air is required to convey the material in the Dense phase system. The conveying pressure is around 6 bar g. The exact pressure depends upon the rate of conveying and distance.

Generally, non-lubricated, two-stage air compressors are employed to generate 6 bar g pressure air. Generally dust free, oil free and dry air is preferred for pneumatic conveying systems. The system consists of air compressors, inter-coolers, after-coolers, air receivers, air dryers, air filters and plant associated piping, valves and instrumentation.

The compressed air system may be designed exclusively for a pneumatic conveying system. It may also be a compressed air line taken from the compressed air system of the main plant.

Air quality specifications, like pressure dew point, are dependant upon the properties of the material to be conveyed and site operating conditions. Properties of material to be reviewed include lump size, bulk density, and the hygroscopic nature of the material. Site conditions play an important role in deciding the quality requirements of compressed air. Factors include minimum and maximum site temperatures and relative humidity (RH) in order to decide which type of air dryers to use and the resulting pressure dew point of conveying air.

Compressed air piping consists of pipes, fittings, bends, valves, flanges etc. Piping material specifications are to be compatible with the material to be conveyed e.g. SS-304 pipes are used for PET chips conveying etc.

Dense Phase Pneumatic Conveying in Power Plants

1. **Coal Handling Systems**
   The Dense phase system has revolutionized coal conveying in power plants. Coal is fed to the boilers using compressed air. The densoveyor pumps coal through totally enclosed piping ensuring all conveying takes place in a completely dust and spillage-free manner. The system is simple and has no moving parts, drives or bearings. It is suitable for all grades of coal and conveys it as it comes in wet, dry, lumpy or powder forms. There are more than seven thousand successfully working installations throughout the world.

2. **Fly Ash Handling Systems**
   The need for having an efficient and reliable fly ash handling system is well recognized. This is more significant here as Indian coal may contain as high as 40% of ash in it. The total ash produced from a 500 MW Unit amounts to about 2000 tons per day. Hence a reliable system which can handle such large quantities of ash is required.

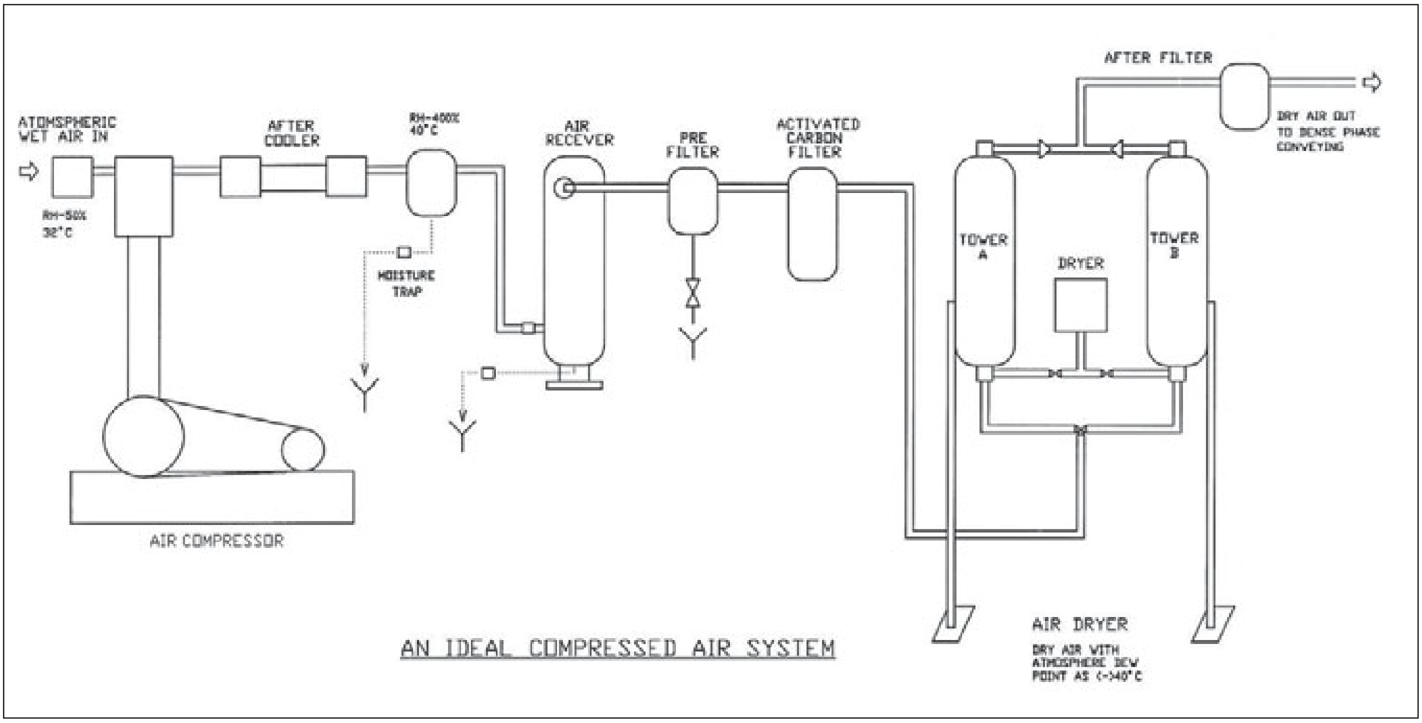
   There are two principal methods of ash handling, hydraulic and pneumatic.

Coal utilization is associated with the production of two types of ash, namely bottom ash and fly ash. Out of the total ash produced, the amount of bottom ash is about 10–20 % and that of fly ash is 80–90%. Fly ash being a pollution hazard, restrictions are imposed on its disposal. Hence a system is necessary for its collection and disposal.

In India, fly ash is mostly handled using hydraulic methods or pneumatic systems.

A VIEW FROM INDIA:

Pneumatic Conveying of Bulk Materials



In a hydraulic system, ash is conveyed/transported to the disposal area by means of high-pressure water. This requires a pump house, pumps and piping for the system. Ash may be conveyed through open trenches also. This requires large quantities of water. However, with new pollution norms, wherein there are restrictions on wet ash dumping to ash pond, hydraulic systems are not much in use.

A typical thermal power plant generates 500 MW. The thermal unit can run wholly on coal, although it can take other fuels also. The maximum amount of coal that can be used is 4,200 tons per day. With coal of 20% ash content, about 800 tons of ash is generated per day. The Ash handling plant at a thermal power station consists of specially designed bottom ash and fly ash systems.

A typical Dense Phase Conveying System

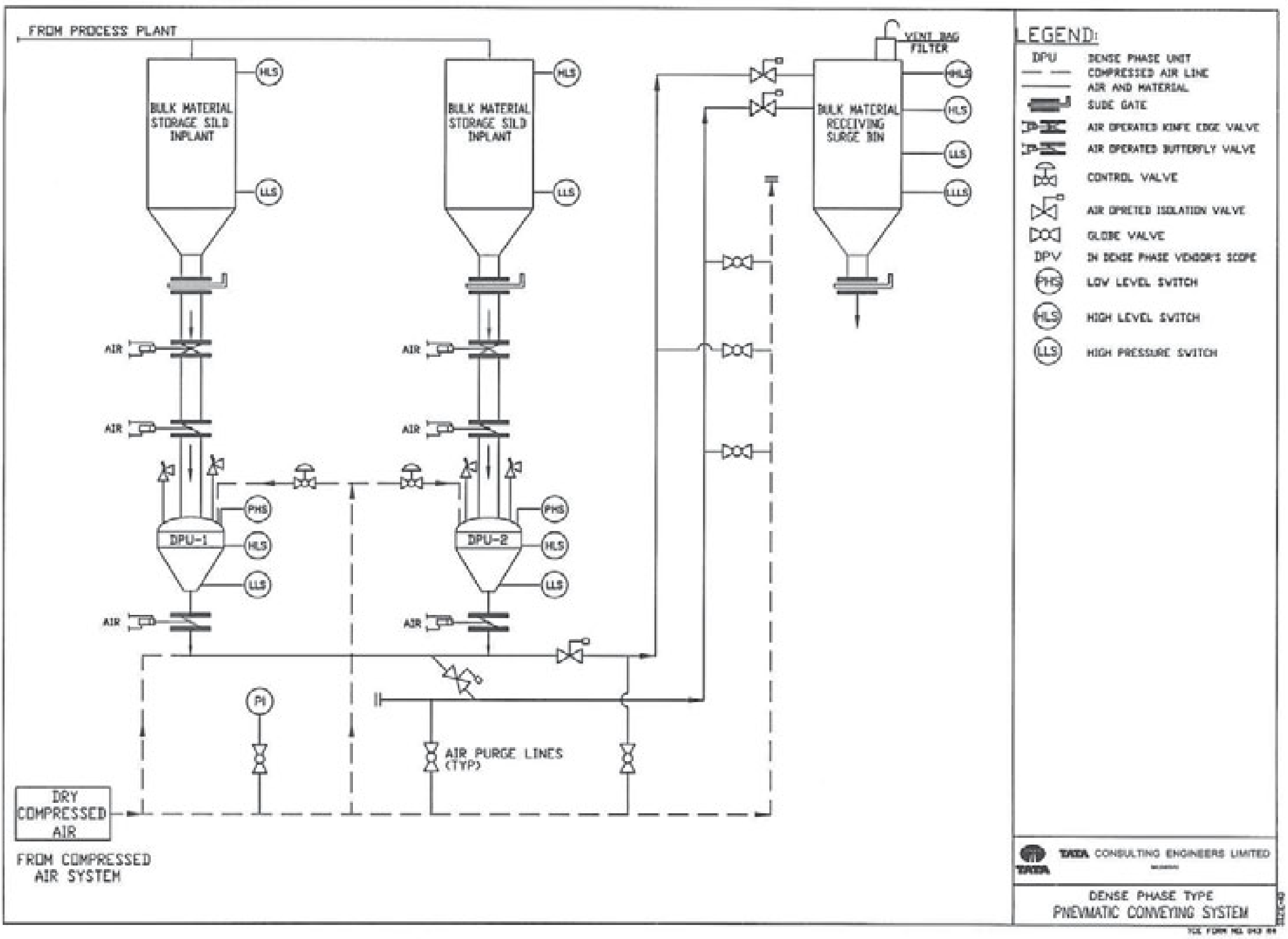
Fly ash as discharged from various ESP hoppers etc. is collected and conveyed to a silo located in the plant area by means of a vacuum conveying system in dry form. It is then conveyed to another silo located at fly ash aggregate plan area. Densoveyors are used to convey it to the fly ash aggregate plant, with a dense phase type pneumatic system.

The densoveyor totally eliminates ash fluidization and its high conveying velocity. Fluidization of fly ash at high velocities produces rapid pipe wear and tear and also results in excessive air consumption. The densoveyor pumps small batches of ash in compact slug form at controlled and low velocity. Thus, it ensures both long pipeline life and low air consumption.

The densoveyor pumps small batches of ash in compact slug form at controlled and low velocity. Thus, it ensures both long pipeline life and low air consumption.

A VIEW FROM INDIA:

Pneumatic Conveying of Bulk Materials



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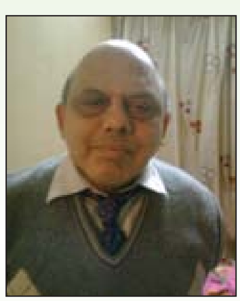

G.D. NIGUDKAR is a graduate from Jiwaji University Gwalior and Post graduate from University of Roorkee-Roorkee. He is Deputy General Manager, TATA Consulting Engineers Ltd.-India. He has 32 years of experience working on handling systems for various thermal power plants, chemical and industrial plants, and nuclear power plants.

He has published various articles on conveying systems and compressed air systems in national and international magazines and seminars.

System parameters:

Type of Compressors: Reciprocating, two stage, non-lubricated type

Discharge Pressure: 7 Kg/cm^{2}g

Flow rate: 1,200 m^3/hr.: (FAD)

Conveying rate: 12.5 TPH

Distance – Length of conveying: 500 metres with 14 metres vertical conveying

Type: Dense Phase BP

Fore more information please contact G.D. Nigudkar, TATA Consulting Engineers, Mumbai, India, email: gdnigudkar@tce.co.in, Tel: 91-22-6647-2111.

DEALING WITH HIGH-VOLUME INTERMITTENT DEMANDS

BY RON MARSHALL AND BILL SCALES
FOR THE COMPRESSED AIR CHALLENGE®

The following is adapted from information obtained from CAC's Fundamentals and Advanced Compressed Air Systems seminars and the Compressed Air Best Practices Manual.

In many industrial plants there are one or more applications with intermittent demands of relatively high volume. One example is the use of dense phase transport systems to convey the cement. Dense phase systems can cause severe dynamic pressure fluctuations affecting quality of the end product in a plant. Usually, the correct sizing and location of a secondary air receiver close to the point of high intermittent demand can relieve this. Such demand is often of short duration, and the time between demand events is such that there is ample time to replenish the secondary receiver pressure without adding compressor capacity.

Fundamentals of Compressed Air Systems WE (web-edition)

Join us for the next session of *Fundamentals of Compressed Air Systems WE* (web-edition) coming February 28th. 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**.

DEALING WITH HIGH-VOLUME INTERMITTENT DEMANDS

Dense phase systems can cause severe dynamic pressure fluctuations affecting quality of the end product in a plant. Usually, the correct sizing and location of a secondary air receiver close to the point of high intermittent demand can relieve this.

An intermittent load such as dust-collector bag house can also be affected by its own pulse demand if the distribution piping to the operation is undersized. This can cause poor cleaning pulse force, leading to poorly performing bag cleaning operations. To compensate for these failures it is not uncommon to see system pressure raised, pulse frequencies increased and blow durations extended in an attempt to make the system work correctly. This can cause huge increases in air consumption and increased energy costs.

"I've seen wide variations in air pressure due to excess air demand in bag house cleaning operations that cause the air pressure to drop below acceptable levels," says Joe Ghislain, Manager, Lean Supplier Optimization with the Powertrain Division at Ford, and a CAC® Level II instructor, "In one particular case the problem was so extreme the site was running twice the compressor capacity they needed, and at higher than normal pressure.. The CAC® Fundamentals seminar shows an example of how to apply the localized metered storage method to optimize high-volume intermittent uses, like bag houses, and turn off compressors."

High-Volume, Intermittent Needs

Applications that consume relatively high-volumes of air for short durations of time (sometimes called "demand events") often cause poor system performance. A common solution to the problem is properly placed compressed air storage.

Storage can be used in numerous ways to control demand events in the system by reducing both the amount of pressure drop and the rate of decay. Receivers are used to provide compressed air storage capacity to meet peak demand events and help control system pressure. Receivers are especially effective for systems with widely varying compressed air demand. Where peaks are intermittent, a large air receiver may allow a smaller air compressor to be used, and allow the compressor capacity control system to operate more effectively.

Pressure Band Necessary in Primary Storage

A receiver must have a working pressure band if it is to be effective. If production requires the system to maintain a constant 100 psig and the compressor controls are set at exactly 100 psig, there is no effective storage. If an event makes the pressure drop below the 100 psig requirement the compressor controls will respond by increasing the volume compressed, but the pressure will drop below the minimum pressure required, causing low pressure.

If the compressors, however, are set to operate at 110 psig, then the difference between 110 and 100 psig accounts for air stored in the receiver. If an event suddenly occurs, the pressure can drop 10 psi before the minimum requirement is reached, with the air stored in the system receiver being used to help support the demand. Pressure/flow controllers located downstream of the storage may provide additional benefit by lowering average downstream pressure and stabilizing the pressure during demand peaks.

Secondary Storage

Secondary storage refers to using air receivers in the distribution system in addition to the primary air receivers in the supply side. Sometimes this storage is dedicated to a certain end-use application, while other times it is located to provide additional general storage at the end of a distribution line or loop. Secondary storage can help:

- Maintain more stable pressures at points of use
- Improve the speed, thrust or torque of an application
- Reduce the rate of pressure drop in the system during demand events
- Control demand events (peak demand periods) in the system by reducing both the amount of pressure drop and the rate of decay.

For some systems, it is important to control the rate of compressed air flowing to refill a secondary receiver (the control is called metered recovery). If the rate is not controlled, filling the receiver will become a demand event that may cause system problems due to a high rate of flow.

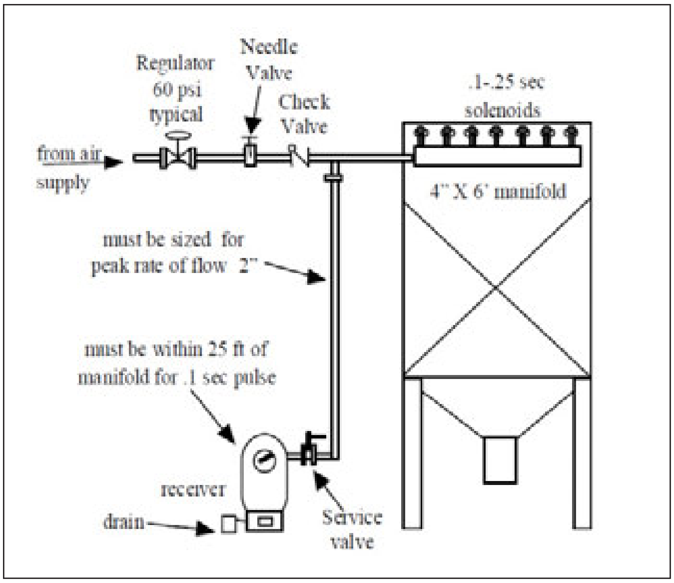

Diagram 1

DEALING WITH HIGH-VOLUME INTERMITTENT DEMANDS

"I've seen wide variations in air pressure due to excess air demand in bag house cleaning operations that cause the air pressure to drop below acceptable levels."

— Joe Ghislain, Manager, Lean Supplier Optimization with the Powertrain Division at Ford and a CAC Level II instructor

The following formula is typically used to size storage receivers to act as secondary storage:

$$V = \frac{T \times (C - S) \times Pa}{P1 - P2}$$

Where:

V = Receiver volume, ft^3

T = Time allowed for pressure drop, minutes

C = Intermittent demand, cfm

S = Rate of flow through the needle valve, cfm

Pa = Absolute atmospheric pressure, psia

P1 = Initial receiver pressure, psig

P2 = final receiver pressure, psig

This formula will be used to illustrate three separate solutions to the challenges caused by high flow intermittent demands.

Example Use of Storage — Three Solutions

High-volume intermittent events can create the appearance of inadequate supply because they can cause the pressure to fall in the system before the compressors can react. In facilities where powdered material is transported there are often high-volume applications called dense-phase conveying, which can cause these problems.

Consider an example plant where a conveyor is installed that consumes a flow of 1,000 standard cubic feet (scfm) for two minutes totaling 2,000 standard cubic feet (scf) of air per event. The event occurs no more than once per hour, but impacts the system so much that the pressure drops to as low as 70 psig in the header supporting this area of the plant.

Because of this situation, the production in the packaging area of the plant has historically stopped when the transport occurs. The critical pressure in the compressed air system is at a bagging machine, which requires 20 cfm at a minimum of 75 psig for machine operations. Because the pressure drops to 70 psig at the inlet to the machine it malfunctions during the event, resulting in interruption of production and loss of finished product.

Before applying a solution, a good way to improve the situation might be to minimize the total event by reducing the flow rate or duration of flow by proper adjustment of the system, and then after that provide adequate storage to support the requirement. If the total transport time was reduced to 1.5 minutes by eliminating a period of time where the transport pipes are empty, but the transporter is still passing air, the average flow could be reduced to 900 cfm. The total compressed air requirement would now be only 1,350 scf in total volume. These savings figures are conservative. It is very important to realize that with the pipes empty, the air consumption will increase significantly. The cfm flow rate will be well above the normal consumption when the pipes are filled with the product. Controls should shut off the air supply once the material conveying process is completed.

Some possible solutions that would prevent the packaging machine from being negatively affected are as follows:

Use Dedicated Metered Storage

Metered storage provides isolation of short duration, high rate of flow end uses from local critical pressure operations, and is used to eliminate pressure fluctuations that might affect this sensitive equipment. Providing a dedicated receiver, and isolating it from the system with a needle valve and check valve, will protect the whole system from the high flow event by averaging the flow.

Adjusting the needle valve for a slow refill rate allows the system to re-pressurize the receiver over a longer time and prevents the system pressure from being affected by excessively high flow that might overwhelm the system air compressors, cause excessive pressure differential across system components or start another compressor.

This metered recovery system enhances bag house pulses.

Initially, the valve might be adjusted to recover in approximately 20 minutes, which will average the demand to 45 scfm for the transport event of 900 cfm. The receiver would be sized based on the differential from the minimum system pressure of 100 psig to the minimum pressure the conveyor can use during the transport, which has been determined to be 70 psig.

The following is an example of sizing calculations for a secondary receiver with metered recovery for an intermittent demand event:

$$V = \frac{T \text{ x } (C - S) \text{ x } Pa}{P1 - P2}$$

$$V = \frac{1.5 \text{ x } (900 - 45) \text{ x } 14.7}{100 - 70}$$

V = 628 scf x 7.48 (gallons per cf) = 4,700 gallons. Select the next larger standard-size air receiver.

Application of this solution would provide enough stored air for the high flow event, eliminating the major two-minute 1,000 scfm air demand from the main system, replacing it instead with a flow of only 45 cfm for a ten-minute duration.

High-Pressure Off-Line Storage

High-pressure off-line storage can be used if a high-pressure system is available or if makes economic sense to install. Off-line storage is served by a dedicated compressor, usually at a higher pressure than the rest of the system. Because the useful differential can be much higher, the receiver volume required to support the high volume will be smaller. For example for the previous example consider using a 10 hp 35 cfm compressor discharging to a storage volume charged to 200 psig. The pressure in the tank would be initially at 200 psi and fall to 70 psi, the minimum pressure for the transport, at the end of the event:

$$V = \frac{1.5 \text{ x } (450 - 35) \text{ x } 14.7}{200 - 70} = 70.4 \text{ cf x } 7.48 = 526 \text{ gallons}$$

CAC® Qualified Instructor Profile

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Joe is currently the Manager, Lean Supplier Optimization with the Powertrain division at Ford in Dearborn, Michigan and has over 30 years experience with Energy, Compressed Air Systems and Powerhouse operations. Joe has served on the Compressed Air Challenge® Project Development Committee since its inception and is an instructor for both Fundamentals and Advanced Compressed Air System Training.

DEALING WITH HIGH-VOLUME INTERMITTENT DEMANDS

Local storage receivers support pressure caused by intermittent demands.

In this case the same 1,350 scf event can be supplied by stored air, but this time a much smaller storage receiver is required. The compressor would run for less than 18 minutes* to refill the receiver tank and then the system would be ready to supply the next event.

*Using the above equation and solving for Time (T)

$$T = \frac{V \times (P2 - P1)}{C \times Pa}$$

$$T = \frac{70.4 \times (200 - 70)}{35 \times 14.7} = 17.8 \text{ minutes}$$

Dedicated Storage — At the Critical End Use

Dedicated storage is accomplished by isolating a pressure sensitive critical use with a check valve and providing adequately sized dedicated storage to protect it from neighboring short duration high flow events that cause momentary pressure swings and subsequent problems. The idea is that the dedicated storage would be sized so that the critical use can ride out the longest event and still maintain pressure above the lowest required for adequate operation.

The aforementioned packaging machine consuming 20 cfm) can only operate at a minimum pressure of 75 psig. The air volume required by the machine to operate during a one and one-half minute event would be (20 scfm x 1.5 minutes) = 30 scf.

The required storage size would be as follows:

$$V = \frac{1.5 \times (20) \times 14.7}{100 \text{ psig} - 75} = 17.6 \text{ cf} \times 7.48 = 132 \text{ gallons}$$

This volume of storage would be enough to allow the packaging machine to run for one and one-half minutes even if the system pressure at the inlet to the check valve fell below 75 psi for the full event duration.

Baghouse Example — End Use Improvement

Students of CAC's Fundamentals of Compressed Air Systems seminar learn about applying the method in Diagram 1 to improve the effectiveness of a bag house reverse pulse cleaning system using a metered recovery system. This solution increases the force of the cleaning pulse, allowing lower pressure to be used, and often allowing less frequent cleaning pulses. The distribution piping of this system sees much lower peak flows due to the averaging effect of the metered recovery.

Applications that consume relatively high volumes of air for short durations of time (sometimes called "demand events") often cause poor system performance. A common solution to the problem is properly placed compressed air storage.

COMPRESSED AIR SYSTEM IMPROVEMENTS

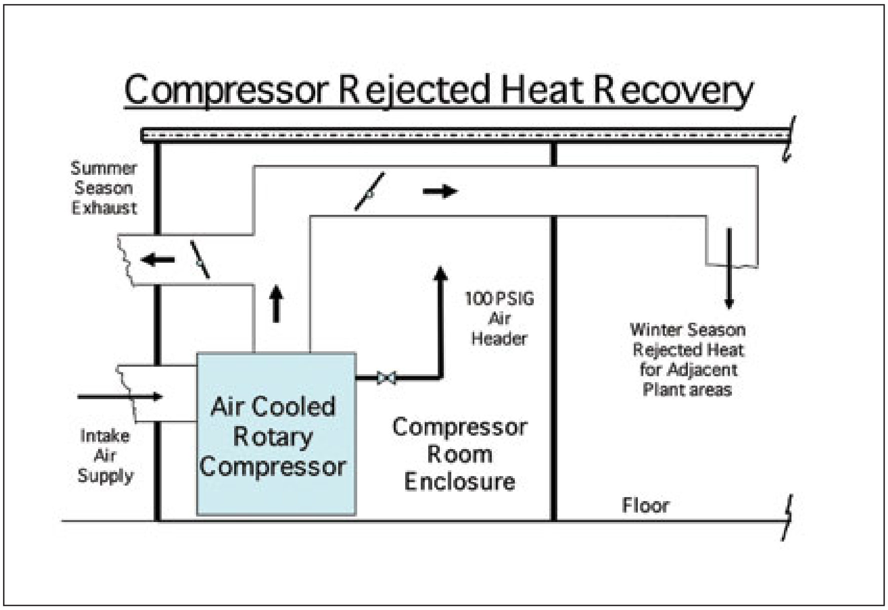
BY GARY WAMSLEY,
JOGAR ENERGY SERVICES

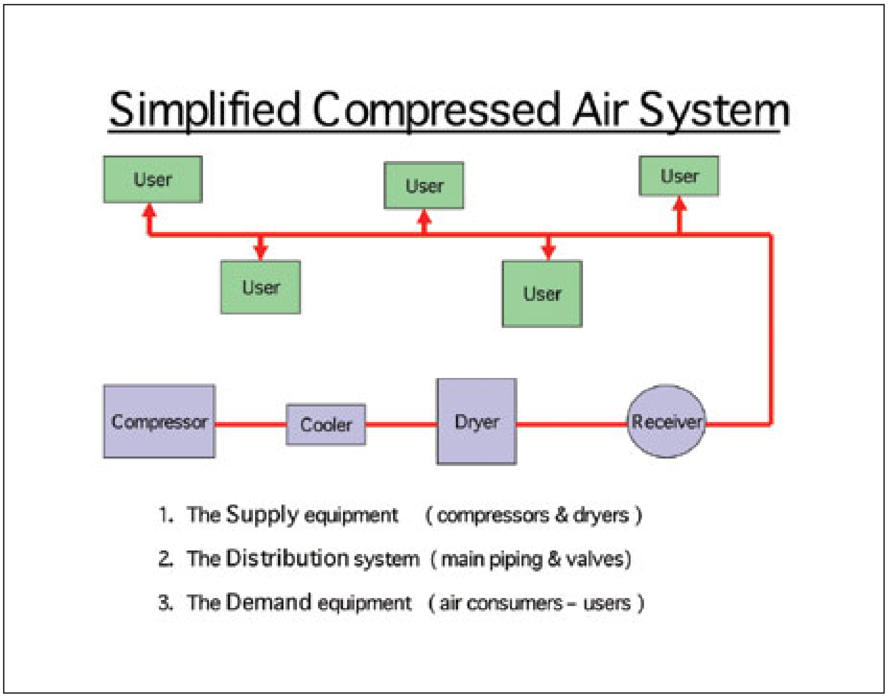
An industrial manufacturing plant (producing commercial water meters and valves) had engaged us to conduct an 'on-site' Energy & Utilities Assessment of their facility. The annual 'spend' for electricity, natural gas, fuels and water was about $2.0 million.

During a five-day visit, several opportunities were identified and delineated in lighting, HVAC, process ventilation, the water systems and energy supply contracts. However, the most significant savings were in their compressed air system.

Normal production operations (12 and 18 hours per day and 5 to 6 days per week) required three of four 300 hp air-cooled rotary compressors to be running (generally fully loaded) at 110 to 115 psig. The foundry operations building (with a 200,000 cfm exhaust air ventilation dust collection system) was costing about $250,000 per winter season for heating using several roof mounted natural gas-fired air make-up units. Temperatures were being controlled at 550 to 600 ˚F to conserve costs. Cold air was being pulled in through most doors and wall openings. Comfort was not the 'norm'.

COMPRESSED AIR SYSTEM IMPROVEMENTS





We noted that both under-roof air compressor mechanical rooms were conveniently located outside adjacent to this High-Bay Foundry building. Thus, we recommended a heat recovery project. The compressors already had sound enclosures and exhaust ducts through the roof cover. Each compressor was producing about 700,000 Btuh of parasitic heat at 1,400 to 1,600 ˚F. Their HVAC maintenance technician (who had to go on the High-Bay roof in mid-winter to service the gas-fired AMUs) was excited about this new scheme to say the least.

They installed insulated air ducts (with diversion dampers for the Summer season) into the sides of the Foundry building over the next few months. When winter arrived building heating savings was on the order of $12,000 per month. Moreover, ambient temperatures inside the building were much improved. Employees were able to 'shed' their heavy jackets.

Further investigation identified that the 110 to 115 psig compressor discharge pressure was needed to maintain process cycle efficiency on the huge metal casting conveyor line that utilized four large 8" diameter x 30" long air cylinders. These cylinders required 90 psig minimum to the control valves. Due to undersized air supply piping and a small local surge tank, a 15–20 psig pressure drop was occurring in the line to the cylinders. The production superintendent was strongly opposed to lowering system pressure due to numerous process line problems over the years. It took some serious salesmanship to convince them that air system supply piping improvements could be made to work.

Piping changes and an additional local surge tank (that they happened to have in excess) were installed. The surge tank was located as close to the cylinders as possible. This change not only resulted in reducing the compressors to 100 psig, but also allowed shut-down one of the 300 hp units. Talk about an 'artificial demand' issue success!

The specific savings for that energy project was estimated at $29,000 per year and compressor maintenance cost savings were also expected at 15 psig lower operating pressure. Compressor after coolers, Air Dryers and condensate trap preventive maintenance improvements accounted for an additional $12,000 per year of savings.

Equipment modifications and routine maintenance activity changes were also developed and implemented to ensure that the savings (as outlined above) would continue. Several months after implementation, the maintenance crew continued to be quite pleased with the new operating conditions and the employees in the Foundry have improved their productivity.

Summary and Comment:

Do your compressors have heat recovery? Have you considered this option? What compressor discharge pressure does your facility really need? Piping system design is crucial to operating the compressors at lower pressures. Piping configuration frictional line losses can be significant. Short duration high 'surge-flow' conditions also can affect system pressure.

If your plant operates air compressors above 95–100 psig, you should know why and have a sound technical reason for that condition. Not only energy cost savings, but also long term reliability of the compressors would result when operating at 90–100 psig versus units operating continually at 115–125 psig. Most process equipment should operate reliably with 80 psig air supply to the machine manifold (with some specific exceptions such as large air cylinders, Pulse-Jet baghouses and sandblast units). BP

For more information, please contact Gary Wamsley, PE, CEM, JoGar Energy Services, Tel: 678-977-1508, www.jogarenergy.com.

Compressed Air Systems — ASV 1st Steps

1. Develop a one-line "diagram" of your System
2. Determine mcf unit cost and annual costs
3. Extrapolate a percent of air leakage
4. Identify "lower efficient" compressors
5. Is equipment maintenance an issue
6. Evaluate system "pressure drop"
7. Take steps to reduce system pressure
8. Determine if "Heat Recovery" is possible
9. Evaluate the need for new controls

The specific savings for that energy project was estimated at $29,000 per year and compressor maintenance cost savings were also expected at 15 psig lower operating pressure. Compressor after coolers, Air Dryers and condensate trap preventive maintenance improvements accounted for an additional $12,000 per year of savings.

SUSTAINABILITY PROJECTS FOR INDUSTRIAL ENERGY SAVINGS

Chillers Provide Temperature Regulation For Fine Wine

BY JOHN MEDEIROS, MTA USA

Excellent Wine Depends on Excellent Process Temperature Control

Certainly, the production of wine is a complicated mixture of art and science. Color, flavor and aroma — characteristics that define a quality wine — rely as much on the technical expertise and experience of the winemaker as on the grapes themselves. Precise process temperature control is one of the most critical technical requirements of modern winemaking. It allows high volume production while insuring that the unique character of the final product is consistently attained. Temperature control is also an important factor in the preservation of wine to insure the consistent quality required to allow worldwide distribution in today's global market.

CHILLERS PROVIDE TEMPERATURE REGULATION FOR FINE WINE

MTA — The Food Refrigeration Specialist

A leading manufacturer of equipment for the industrial refrigeration and air conditioning markets, MTA specializes in providing products designed to meet the unique requirements of the food processing and storage market segments. This application experience, coupled with MTA's technically superior, highly efficient products and worldwide customer service network, translates to consistent, high quality food products benefiting both processors and consumers. MTA offers process chillers in over 100 different models and configurations in capacities ranging from 1/2 ton to over 350 tons. The MTA TAEevo (0.50–53 tons), the Hercules (46–98 tons) and the Phoenix (91–356 tons), with a wide range of options and accessories, can easily be applied to either processing applications (with liquid cooling capacities down to 14 ˚F) or for facility air conditioning.

Pre-Fermentation Process Cooling

During a process called crio-maceration the grape musts (freshly pressed grapes still containing solids — pulp, skins, stems and seeds) are cooled to a temperature of 40 ˚F in stainless steel tube-in-tube heat exchangers. The time and the temperature at which this process takes place greatly determine the characteristics of the finished product.

Cooling is also required for the clarification process. This pre-fermentation process involves static separation of the musts at a temperature of 50 ˚F–58 ˚F to remove suspended impurities.

Cooling Required During the Fermentation Process

Temperature control of the musts during the fermentation process is required for the production of high quality wines. Alcoholic fermentation is the chemical reaction in which yeast is used to transform the natural sugars of the fruit into alcohol. The heat generated by this exothermic reaction has to be managed. If must temperatures are allowed to reach the 85 ˚F–105 ˚F range the reaction will be stopped. This results in high sugar content and an unstable product that requires the addition of sulphur dioxide (SO_2) to allow it to be stored without spoiling. In general, optimal fermentation temperatures are 65 ˚F–68 ˚F for white wines and 77 ˚F for red wines.

Although fermentation tanks are generally cooled, certain system features may require heating as well. In these cases MTA's HAEevo — the heat pump version of the TAEevo chiller — is available to meet this requirement. The HAEevo is available with stainless steel casing panels making them more hygienic and increasing overall durability.

For example, in Australia (just one of the countries where MTA is a leading wine market supplier) a winery with an annual production of 500 tons uses a MTA Model TAEevo301 to manage the 18 tons of cooling associated with the fermenting process. The chiller's on-board storage tank maintains a 90 gallon supply of chilled water at 41 ˚F from which it is pumped through heat exchangers immersed in the fermentation tanks (or in some cases, through tank jackets). The large volume of the chiller's storage tank provides a thermal mass which compensates for sudden changes in cooling load to provide constant chilled water temperatures regardless of external conditions. A unique feature of the TAEevo chiller is the extended surface evaporator located inside the storage tank which provides high cooling efficiency and low resistance to water flow. This minimizes the electric energy costs associated both with the refrigeration compressor and the chilled water circulating pump.

The wine is taken down to a temperature much lower than it would ever be exposed to thereby preventing the formation of crystals after bottling.

Malolactic Fermentation

Malic acid occurs naturally in wine and provides a tart, apple taste. For the wine to have a more delicate taste, malolactic fermentation is employed by adding lactic acid bacteria to the wine to convert the malic acid to the softer-tasting lactic acid. This is often used for barrel-aged (oaked) wines. Sometimes malolactic fermentation can occur unintentionally after bottling resulting in a slightly carbonated, bad tasting wine. This can be avoided by raising the wine temperature to about 77 ˚F. Either a HAEevo heat pump or a TAEevo chiller that is equipped with condenser heat recovery can provide the heat required for this process.

Cold Stabilization

At low temperatures, potassium bitartrate, a natural component of the wine will appear as sediment in the bottle. To avoid this situation the wine is chilled to about 27 ˚F for a period of up to 24 hours prior to bottling. This process, called cold stabilization, causes the potassium bitartrate to precipitate out of the wine where it can be filtered out. For the example of the Australian winery, cold stabilization is achieved with (4) TAEevo121 chillers that chill brine to about 19°F. This brine is then circulated to the wine tanks to maintain the proper temperature.

Precise Temperature Control and Accessibility

Wine making is delicate business. Each phase of the process requires controlled conditions to achieve optimum quality. The winemaker must have complete control of process temperatures and be informed of any problems. Each model of the MTA TAEevo line of process chillers includes a user friendly electronic controller that provides digital temperature indication, easy parameter adjustment and enunciates over twenty individual alarms to provide instant troubleshooting. Remote monitoring and control is also available with a RS485-based supervisor system or the TAEevo can be equipped with a technologically advanced server card that can communicate with any PC-client anywhere in the world. This web-based server transmits performance data and allows remote operation via a web browser interface.

Conclusion

TAEevo provides the winemaker with an efficient tool to optimize the temperature control portion of the winemaking process. And with many years of experience and long-tested reliability, this industry is just one of the many food and beverage applications where MTA offers the right refrigeration products to insure the quality of the finished product. So, the next time that you carefully select the perfect wine for your evening, maybe it is worth asking the waiter which chiller was used in its creation. BP

For more information please contact John Medeiros, MTA-USA, Tel: 716-693-8651, email: jmedeiros@mta-usa.com, www.mta-usa.com.

THE SYSTEM ASSESSMENT

Industrial Sandblasting — Where Does All the Air Go?

BY DON VAN ORMER & SCOTT VAN ORMER, AIR POWER USA

Figure 1. Typical large "Sand Pot" most often used for larger material treatment, particularly outside.

Figure 2. Typical Industrial Cabinet type sandblast unit.

"Sandblasting" is one of the oldest and most used methods of metal treatment. Various abrasive materials may be loaded manually or by a vacuum system pulling the "grit" from a storage tank. A control valve then operates with the compressed air (bypassing the vacuum pump), being forced into the tank pressurizing the receiver. When the high-pressure compressed air goes out the discharge line, it pulls the appropriate amount of grit with it to effectively impinge against the targeted metal surface.

Larger contractors and manufacturing processors such as shown in Figure 1 are usually driven by productivity the air use and pressure, is often very critical and to the applications are usually monitored and controlled.

"Industrial Sandblasting" particularly when it is not directly a part of the production process is often not that well controlled or monitored. Since it often "only uses compressed air" and therefore perceived to be "inexpensive to operate.

The main concern is producing acceptable quality and quantity. The primary question is, "Is it running?"

In many plants we audit sometimes a "very small" sandblasting operation becomes a significant air savings opportunity with very quick payback. Many industrial plants use single operator hand held hose nozzle assemblies, but also use many types of "cabinet blasters."

A full cabinet type stationary sandblaster unit (Figure 2) can be equipped with many types of nozzles, controls and configurations and alignments.

Some cabinets are designed for just one process and all the nozzles are in a standard configuration and used continuously.

Next to "air left on", over-run nozzles are the second biggest waste of compressed air.

Figure 3 shows a set of nozzles in a high production cabinet unit that processes several parts of similar design and thus run the same nozzles in the same configuration and alignment. Properly set up the air should only run when there is product to be processed.

Figure 3.

Figure 4 shows a multiuse cabinet blaster with several different sizes and types of nozzles, all set up with a fully adjustable configuration and alignment. These types often are used for many different parts and the blast lines often have separate shut off valves on each line.

Figure 4.

We have found a great many times that no one has determined the optimum number of nozzles / lines for each part. **They all run wide open all the time.**

Often we find:

- All nozzles blasting air when not all are used
- Nozzles left on with no parts to blast. Operator off site waiting for next job — working on something else
- Automatic blasting cabinets exacerbate this situation
- Old nozzles well worn continue in use….“they still work”
- **WHAT IS THE MAGNITUDE OF THESE OPPORTUNITIES?**

The controlling part here is the nozzle and how much compressed air it uses to do the job. The most common size nozzle we see in plants is 5/16" diameter. In the “full pressure type” nozzles each 5/16" nozzle **(WHEN NEW AND NOT WORN OUT)** uses 113 scfm each at 80 psig inlet pressure. If we have a five nozzle cabinet operating at 80 psig, the air use would be 565 scfm to 627 scfm, or about 140 to 150 input horsepower. If you could run some times with only 3 nozzles, the savings would be 226 scfm (250 acfm) or about 55 to 60 input horse power. At $0.10/kWh, one hp cost about $700 per year. Full time savings could run from $3800 to $4200 per year with no investment or implementation costs. Figure 5 shows a typical full pressure blast nozzle and system.

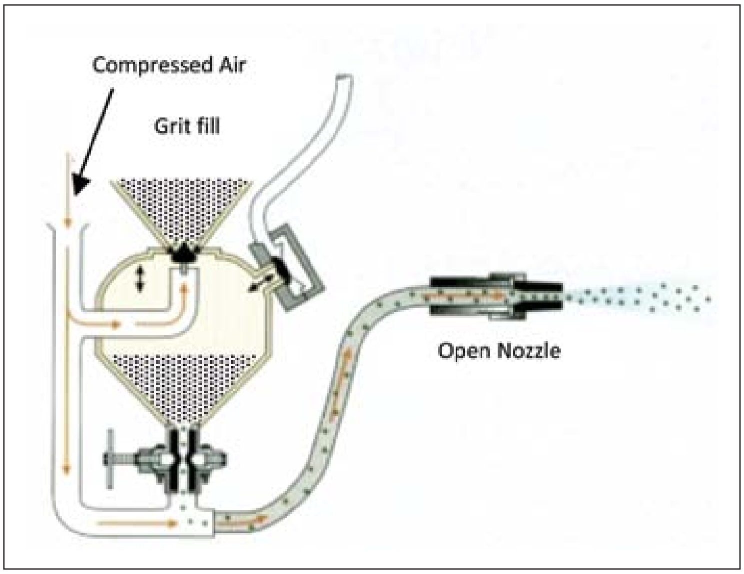


Figure 5. Compressed Air

THE SYSTEM ASSESSMENT

Industrial Sandblasting — Where Does All the Air Go?

The following chart shows the basic air demand of a new unworn nozzle by size at various inlet pressures.

Standard Nozzles

PRESSURE — BLAST AIR REQUIREMENTS (SCFM)								
Pressure (psi)	20	30	40	50	60	70	80	90
1/8" nozzle	6	8	10	13	14	17	20	25
3/16" nozzle #4	15	18	22	26	30	38	45	55
1/4" nozzle #4	27	32	41	49	55	68	81	97
5/16" nozzle #5	42	50	64	76	88	113	137	152
3/8" nozzle #6	55	73	91	109	126	161	196	220

Larger Nozzles

PRESSURE — BLAST AIR REQUIREMENTS (SCFM)								
Pressure (psi)	20	30	40	50	60	70	80	90
7/16" nozzle #7					170	193	215	240
1/2" nozzle #8					230	260	290	320
5/8" nozzle #10					360	406	454	500
3/4" nozzle #12					518	585	652	720

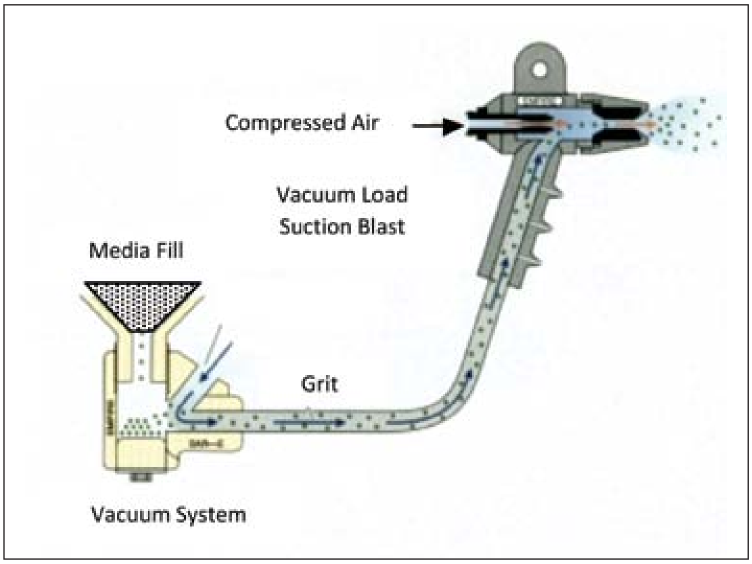
Efficient operation and testing will identify and implement the proper blast media, nozzle size and alignment for each operation.

Reviewing these charts shows several things:

- The higher the pressure the greater the flow. It is important to note that for every application there is probably an optimum inlet pressure that will provide the most effective coverage pattern and media impact to deliver proper production levels and quality surface treatment
- Running the nozzles with a good pattern and impact, may well allow running fewer nozzles with each at lower blast time
- Efficient operation and testing will identify and implement the proper blast media, nozzle size and alignment for each operation
- Shutting the air off when not in use is important

THE SYSTEM ASSESSMENT

Industrial Sandblasting — Where Does All the Air Go?



Nozzles Which Use Less Compressed Air

Suction Blast Nozzles or Venturi amplification Blast nozzles

The suction blast nozzle utilizes a Venturi driven vacuum inside the nozzle to pull up the blast media and to also carry it into and join the compressed air stream to impact the work piece. In effect the air used to deliver the media to the blast stream becomes part of the blast stream thus limiting the amount of compressed air used. Unlike Venturi vacuum generators often use in packaging where the compressed air used to generate the vacuum is "lost", this system loses no air and amplifies the air stream with Venturi generated ambient air. This uses less air to do a similar job.

SUCTION — BLAST AIR REQUIREMENTS (SCFM)

Pressure (psi)	30	40	50	60	70	80	90	100
1/4" nozzle, 3/32" air jet	6	7	8	10	11	12	13	14
1/4" nozzle, 1/8" air jet	10	12	15	17	19	21	23	26
5/16" nozzle, 5/32" air jet	15	19	23	27	31	37	38	42
7/16" nozzle, 7/32" air jet	31	38	45	52	59	66	73	80

You can see form this list of nozzles that these Venturi type do not cover as great a range as the pressure type, however, in the world of small to medium sized blast cabinets they cover the usage area very well.

Looking at our example 5/16" nozzle class, the 5/16" nozzle with a 5/32" air jet uses only 37 scfm of compressed air versus 113 scfm of compressed air with the pressure blast nozzle. This is over a 30% reduction in compressed air usage.

On a recent audit in a glass bottling plant there were three blast cabinets in the mold shop. They were used to clean up the molds as required, all equipped with five standard pressure nozzles each.

At the operating pressure they used 88 scfm at 60 psig inlet pressure and run an average of 45% utilization.

Estimated operating costs:

(15 nozzles) x (88 scfm) = 1320 average scfm

Estimated input kW cost:

246 kW X .10 X 8760 X .45 = $96,973 per year

Investigation revealed we could run almost all the work just using three nozzles each with "tested" Venturi amplified nozzles (27 scfm each at 60 psig).

Estimate new operating costs:

(3 nozzles) x (3 units) = (9 nozzles) x 27 scfm = 243 scfm average

Estimated input kW costs:

45.3 kW x .10 X 8760 X .45 = $17.857 per year

Estimated annual electrical operating savings = $79,115 per year

Some Pertinent Comments:

- The Venturi amplified nozzles is a great tool and where it can be used they offer very good performance. In most industrial applications we have reviewed the results are very comparable to pressure systems. Sometimes with less productivity (i.e. slower). The air and the blast media re applied at lower velocities which account for this. In some cases the required media impact areas exceed this technology. The potential savings makes it worth a close look and trial.
- Next to "air left on", over-run nozzles are the second biggest waste of compressed air. When you next ask the operator "How are your nozzles?", and he says "Great!", you might inquire "Define Great?"
- If he says "I've run these over 10 years and they still keep going, I've not had to change them yet" you have stumbled upon an opportunity.

There are many more types of nozzles then described and many different materials used.

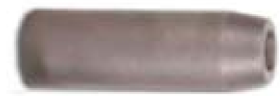
Ceramic nozzles are the least expensive with the shortest life. Various harder materials are used (Carbides, Boron, etc.) to offer longer life. NO NOZZLE SHOULD BE RUN BEYOND 20% WEAR (INCREASE IN DIAMETER).

Beyond 20% wear the nozzle is not only using much more air, but also is most likely not delivering an effective pattern. Changing nozzles effectively will decrease blast time and increase blaster efficiency and material removal.

The point of this article **is not** how to select and use a sandblaster but to make the reader aware of the opportunities beyond the obvious leaks that abound in every industrial application. BP

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

Pressure Blast Ceramic



Pressure Blast Carbide

Suction Blast Venturi

Changing nozzles effectively will decrease blast time and increase blaster efficiency and material removal.

THE TECHNOLOGY PROVIDER

Coatings Designed to Increase Airend Efficiencies

BY BRUCE NESBITT, ORION INDUSTRIES

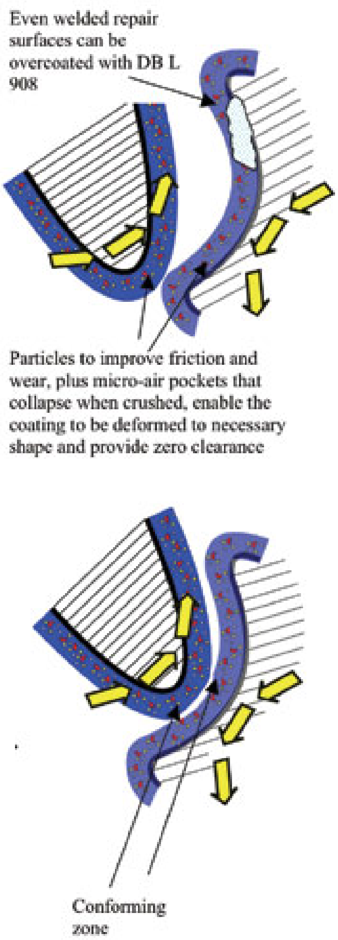


Figure 1 — Coating on surface of male and female rotors conforms to achieve zero-leak clearance between rotating members and housing. Even if the case is warped or repaired, the DB L- 908 conforms to the rotor and vice-versa.

Oil-free rotary screw compressors are ideal for hospitals, biomedical OEMs, electronic manufacturers, food and beverage plants, textile facilities and similar applications where clean and oil-free compressed air is vital. For the volume of air that they move, they are compact, run reliably, and relatively vibration free. However, efficiency can now be improved.

But oil-free blowers don't have the luxury of an oil film to seal the air gaps between the two rotors and between the rotors and housing. Gaps are like a door that won't completely close and leaks cold air, and in compressors, leaks limit maximum discharge pressure and reduce efficiency and generate hot air. To minimize losses, OEMs carefully machine and grind rotors and housings so that gaps are small; but even with CNC machining precision, the ideal — zero clearance — is impractical because of the possibility of metal-to-metal contact and the resulting galling and scuffing that can lead to seizure. For small compressors, the industry standard static air gap clearance is 0.002". This is difficult and time consuming to achieve; common practice is to custom match male and female rotors for optimum fit. This extensive and exacting added machining slows production and drives up manufacturing costs, so the resulting compressor is a compromise between small gaps/high efficiency and potential surface collisions and contact wear. Worse is if the gap is a bit too small. The galling and seizure of rotors need to be scrapped in many cases. The cost of "when is close enough" can, however, be improved with modern coating technology.

Conformable Surface That Seals...A True Dynamic Gasket

OEMs have tried a number of surface treatments to both close the gap and minimize wear, including hard anodizing, hard chrome and other plating, and PTFE coatings, but these only put off the inevitable scuffing for a short time. None allow a true conformable or custom fit for each pair of rotors. What has been lacking is some form of dynamic seal on mating surfaces that can adapt itself to the slight variations in the air gap and live for the life of the unit...a sort of bonded gasket.

Not only do energy-efficient compressors save money at the power meter, they can save money on the initial purchase. In most parts of the country, energy companies offer incentives for buyers of equipment that represents an efficiency upgrade over existing equipment.

This is the concept behind a new conformable coating matrix developed by Orion Industries of Chicago. The coating, known as DB L-908, is a unique marriage of tribological materials that is tenaciously bonded, yet gives it a structure that is slick, but deformable so that it conforms and minimizes air-gaps between high speed mating surfaces, Figures 1 and 2.

Film thicknesses can be built up from .002" to .008", with a tolerance of ±0.001" The coating is applied thick enough on rotors so that there is a slight, purposeful, initial interference fit between rotors. During assembly, an initial, single revolution of the rotors causes the opposing mating surfaces to permanently compress the coating to form a zero-leak seal between them, Figure 3. Once compressed, the film stays compressed as it has zero-compression recovery. Particles of PTFE give the contact area low friction and reduce inter-surface friction as the rotors warm up in the initial use or run-in. The air gap remains at zero and widens slightly as the rotors get warmer in operation. The net effect is a substantial increase, repeatedly documented at a minimum of 5%, in compressor efficiency, along with a reduction in noise and a reduced output temperature of the air.

First trials of this new sealing concept were on superchargers for environmental-friendly four-cycle marine engines, to make them perform with the gusto of the two-cycle designs that they replaced. Blower efficiency increased by an average of 5%, which has been verified by more than a dozen tests with several manufacturers over the past two years.

In addition to greater efficiency, OEMs find another benefit from the coating. They are able to open up machining tolerances slightly and eliminate much of the final precision work and rely on the coating to compensate the increase in tolerances. One manufacturer estimates that this has enabled him to trim 18% off the cost of machining compressors. Rough milling rather than final grinding is now being tested as the final surface to which an 0.004" thick layer of DB L-908 is bonded on both rotors.

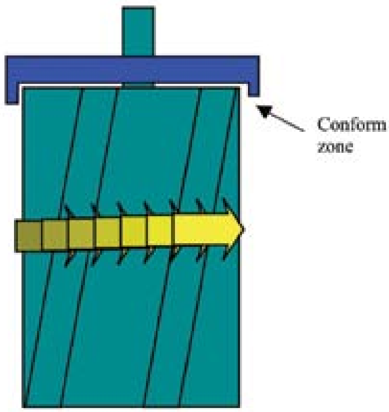


Figure 2 — On end plates, the rotor presses into the coating to provide a zero-leak fit.

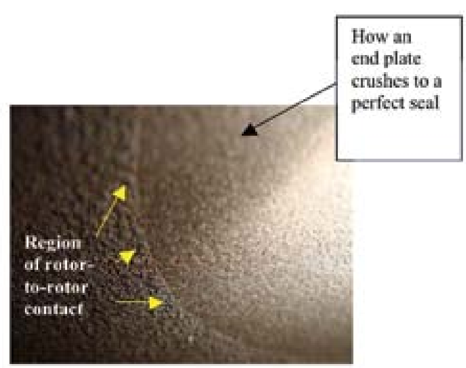
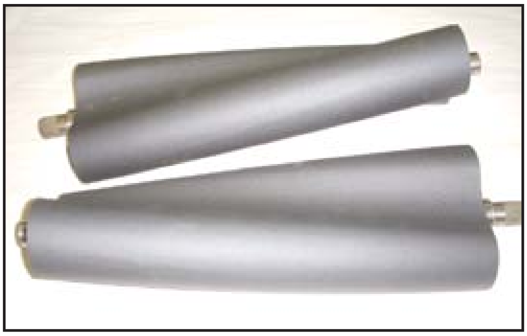


Figure 3 — After mating surfaces of rotors sweep over each other, contact region is compressed permanently and burnished.

THE TECHNOLOGY PROVIDER

Coatings Designed to Increase Airend Efficiencies

Oil-free compressors for industrial and commercial processors show improvement in efficiency when rotors and housings are coated with the dynamic sealing coating.



Unusual twisted rotor design in Hampton supercharger combines some of the characteristics of older Rootes-type blower and screw type.

Larger Compressors

Screw-type and Roots-type compressors and vacuum pumps for industrial, commercial and construction applications benefit from the dynamic seal coating, too. In these cases, improvements in efficiency are felt as measurable energy saving by users.

Oil-free screw-type compressors can operate under conditions of extreme cleanliness and thermal stability because the air that they supply is for medical or semiconductor manufacturing where "clean room" standards prevail. Typically they are two-stage units, with rotors machined from steel, often not much larger than automotive superchargers. Their duty cycle is almost endless, in steady state conditions under load.

Because of high operating hours — 4,000 to 8,000+ per year is not unusual — efficiency is of prime interest to users, with small improvements bringing large benefits to energy bills. The application of DB L-908 to these rotors has raised the efficiency a minimum of 5%.

This is an economic step change. For example, a 214 cfm compressor operating at 125 psig, driven by a 50 hp motor, draws 26,845.2 kWh per year (assuming 24/7 operation at full load). Based on the national average cost of energy for industry ($0.0712/KWH), the operating expense of the compressor is $22,936.20/year. The user will save 5% ($1146.83 in this example) in energy costs — about 11% of the price of the entire compressor and drive!

Improving ROI

Not only do energy-efficient compressors save money at the power meter, they can save money on the initial purchase. In most parts of the country, energy companies offer incentives for buyers of equipment that represents an efficiency upgrade over existing equipment. While high-efficiency compressors may not be specifically on the list of equipment qualifying for these incentives, energy companies usually allow for "customized incentives." In the South for instance, Duke Energy has a program known as *Smart Saver Incentives* in which prospective buyers of energy-efficient equipment can apply for incentives. According to the company, "Programs include energy assessments and incentive rebates that make your adoption of energy-saving products easy and affordable." Each application is evaluated on a case by case basis; the application process is described on their website: http://www.duke-energy.com/north-carolina-large-business/energy-efficiency/nclb-smart-saver-incentives.asp. Utilities throughout the country have similar programs.

"The coated rotors in the supercharger were better than new. We gained a two-pound boost by switching to them."

— Marty Wolfe, Wolfe Racing Engines

Photo courtesy of Doug Ostrowski

Quickest in the Quarter Mile, on the Water

First use of the dynamic sealing coating was in superchargers for marine engines, which from a design standpoint are similar to oil-free screw compressors. Surprisingly, it was OEM engineers — with the help of a company called Whipple Supercharger — who tried it first. Later, when racing engine tuners discovered it, the spectacular difference the coating makes in compressors became apparent.

Don Hampton of Pomona, California, is a legend among drag racing fans, having built and supplied Roots-type superchargers for high performance engines for over 50 years. Dragsters fitted with Hampton superchargers have racked up numerous NHRA championships. More recently, his superchargers have found their way into the boat racing world.

At a typical operating speed of 11,000 rpm, the lobes of Roots blowers have scuffing and wear problems similar to screw type compressors, even though they are machined with a clearance of 0.008" between the rotors and 0.002" between the rotors and housing. Hampton first tried hard anodizing on the 6061 T6 lobes, but scuffing persisted. That's when he discovered that outboard makers were using a special coating on the inside of screw-type blowers on their new four-cycle engines. The coating was Orion Industries' DB L-908.

Hampton was quick to try it and one of his first customers was Marty Wolfe of Wolfe Engines, Steger, IL. The application was in an offshore racing boat. During its initial season, Wolfe's boat **never lost a race**. "The coated rotors in the supercharger were better than new," explained Wolfe. "We gained a two pound boost by switching to them. The dyno doesn't lie." BP

For more information please contact Bruce Nesbitt, Orion Industries, Tel: 773-282-9100, email: bruce@orioncoat.com, www.orioncoat.com.

RESOURCES FOR ENERGY ENGINEERS

TRAINING CALENDAR

TITLE	SPONSOR(S)	LOCATION	DATE	INFORMATION
Compressed Air Challenge® Fundamentals of Compressed Air Systems	SoCal Gas California Energy Commission	Downey, CA	1/12/11	Larry Bennett Tel: 562-803-7570 lbennett@semprautilities.com
Compressed Air Challenge® Advanced Management of Compressed Air Systems	SoCal Gas California Energy Commission	Downey, CA	2/16/11–2/17/11	Larry Bennett Tel: 562-803-7570 lbennett@semprautilities.com
Compressed Air Challenge® Fundamentals of Compressed Air Systems	Online Training	web-edition	2/28/11	www.compressedairchallenge.org info@compressedairchallenge.org
Compressed Air Challenge® Fundamentals of Compressed Air Systems	ProtoGen Group	Kettering, OH	4/15/11	Ray Lepore Tel: 937-216-9452 ray.lepore@fastmail.fm
Compressed Air Challenge® Fundamentals of Compressed Air Systems	Hughes Machinery Atlas Copco Omaha Public Power	Omaha, NE	4/26/11	Dennis Tribbie Tel: 402-571-5004 dtribbie@hughesmachinery.com
Compressed Air Challenge® Advanced Management of Compressed Air Systems	Hughes Machinery Atlas Copco Omaha Public Power	Omaha, NE	4/26/11	Dennis Tribbie Tel: 402-571-5004 dtribbie@hughesmachinery.com

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

PRODUCTS

Kaeser Introduces Omega Control Basic™ On Additional Blower Models

Kaeser — a leader in packaged blower systems for over a decade — revolutionized the industrial blower in 2008 with the introduction of Omega Control Basic. First offered on the Com-paK Plus™ DB series, Omega Control entered the market as the first factory integrated control for ready-to-run blower packages.

Monitoring a number of on-board sensors and switches such as the enclosure thermostat and oil level, the Omega Control indicates when maintenance is needed and will shutdown the unit automatically to prevent damage. Further, it can be remotely monitored and integrated into plant controls. Operating, monitoring and protecting the right blower system for your application has never been easier!

The innovative Omega Control is now available on the CB, DB and EB Com-paK Plus model series with flows from 335 to 1419. Kaeser Com-paK Plus blowers set the standard in the industry for reliability, durability and efficiency — and now the Omega Control Basic further extends equipment life and optimizes the air system.

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

PRODUCTS

Hitachi Expands Oil-free Scroll Compressor Range

Hitachi America announced the introduction of the SRL Series Oil-free Multiplex Scroll Air Compressor. As the originators of Scroll Technology for air compression, Hitachi's Air Technology Group continues to make advancements for the discriminating air user. The SRL Oil-free Multiplex Scroll Air Compressor provides an expanded range of operation based on the industry proven Simplex SRL design.

"The expansion of the SRL Series (1.5–16.5 kW) to compliment our DSP Series Oil-Less Screw units (15–240 kW) empowers the customer to consider oil-free from small to large…it is this versatility of system design that enables oil-free to be a reality for Pharmaceutical, Chemical, Electronic, Food, Beverage and other markets," noted Larry Cooke, Senior Product Specialist of the Hitachi Air Technology Group. "The SRL Multiplex Series is one of our most exciting portfolio enhancements as we look to enter 2011."

With growing concerns for natural resource conservation, expansion of oil-free air technologies is a critical contributor…Hitachi is committed to this and more through our advanced environmental technologies," noted Nitin G. Shanbhag, Senior Manager of the Hitachi Air Technology Group.

Features of the SRL Series Oil-free Multiplex Scroll portfolio include:

- 7.5 kW, 11 kW, and 16.5 kW units with pressure optimization at 116 psi or 145 psi
- Microprocessors Controls with Energy Saving Variable Drive Mode
- Quiet Enclosure
- 100% oil-less design
- Patented Scroll Wrap with Alumite™ surface treatment and labyrinth seal

Hitachi America
Tel: 704-494-3008 x28.
Email: airtechinfo@hal.hitachi.com
www.hitachi-america.us/airtech

Quincy Expands Range of Screw Compressors

Quincy Compressor has expanded its QGS line of rotary screw air compressors, now ranging from 5 hp through 30 hp. The new additions of 20 hp, 25 hp & 30 hp are available with integrated dryer and tank-mount options. **All QGS compressors come standard with Quincy's 8,000 hour synthetic fluid and a 5 year warranty on all major components.** Noise levels are as low as 63 dB(A).

Quincy Compressor
www.quincycompressor.com

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 December 27, 2010.

DECEMBER 27, 2010 PRICE PERFORMANCE	SYMBOL	OPEN PRICE	1 MONTH	6 MONTHS	12 MONTHS	DIVIDEND (ANNUAL YIELD) 12 MONTHS
Parker-Hannifin	PH	$85.81	$81.00	$58.31	$55.23	1.36%
Ingersoll Rand	IR	$47.15	$40.52	$37.97	$36.35	0.60%
Gardner Denver	GDI	$69.70	$64.67	$48.65	$43.50	0.29%
Atlas Copco ADR	ATLCY	$22.42	$19.58	$13.97	$13.14	1.77%
United Technologies	UTX	$79.27	$74.72	$67.91	$70.30	2.14%
Donaldson	DCI	$58.97	$54.18	$43.70	$43.58	0.88%
SPX Corp	SPW	$71.58	$65.80	$56.18	$56.68	1.41%

Ingersoll Rand Reports Third Quarter 2010 Earnings

Ingersoll Rand announced that total reported revenues increased by 8% for the third quarter of 2010 compared with the 2009 third quarter; orders increased by approximately 10% excluding currency; and diluted earnings per share (EPS) from continuing operations were at the top of the prior guidance range.

The company reported net earnings of $232.2 million, or EPS of $0.68, for the third quarter of 2010. Third-quarter net income included $271.7 million, or EPS of $0.80 from continuing operations, as well as $39.5 million of after-tax costs, equal to EPS of $(0.12), from discontinued operations. This compares with net earnings for the 2009 third quarter of $216.6 million, or EPS of $0.65, which included EPS of $0.69 from continuing operations and $(0.04) from discontinued operations. Third-quarter 2009 EPS from continuing operations included approximately $12 million of pre-tax restructuring/productivity costs, or EPS $(0.02).

"Our third-quarter 2010 operating income was up 26% year-over-year and our earnings per share were at the top of our forecast range," said Michael W. Lamach, chairman, president and chief executive officer. "We are seeing improvement in several of our key markets including global demand for refrigerated transport and industrial and commercial HVAC in Asia. Our innovation and productivity initiatives are driving results as Ingersoll Rand employees continue to find new opportunities to serve customer needs, enhance operations and improve financial performance."

Additional Highlights for the 2010 Third Quarter Revenues: The company's reported revenues increased 8% to $3,730.3 million, compared with revenues of $3,458.9 million for the 2009 third quarter. Total revenues excluding currency were up 9%, compared with 2009. Reported U.S. revenues were up 5%, and revenues from international operations increased by approximately 13% (up 16% excluding currency).

WALL STREET WATCH

> "Our innovation and productivity initiatives are driving results as Ingersoll Rand employees continue to find new opportunities to serve customer needs, enhance operations and improve financial performance."
>
> — Michael W. Lamach, Chairman, President and CEO of Ingersoll Rand

Operating Income and Margin: Operating income for the third quarter was $408.2 million, an increase of 26% compared with $324.6 million for the third quarter of 2009. The third-quarter operating margin was 10.9%, an increase of 1.5 percentage points compared to an operating margin of 9.4% for the same period of 2009. Higher volumes and continued strong productivity drove the increase in operating profits and margins. These improvements were partially offset by inflation.

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

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 third quarter of $624.3 million increased approximately 22% (up 24% excluding currency) compared with the third quarter of 2009. Air and Productivity revenues increased 24%, with volume increases in all major geographic regions. Revenues in the Americas increased 31% compared with last year as industrial and commercial markets for both air compressors and tools continued to improve. Air and Productivity Solutions revenues outside the Americas increased by approximately 17% (up 21% excluding currency) compared with 2009, from improved activity in Asia. Bookings increased 31% year-over-year with substantial gains in all geographic regions.

Club Car revenues increased 18% compared with the third quarter of 2009, from increased sales for both golf cars and utility vehicles. Bookings declined due to slowing demand in the domestic golf market and more difficult year-over-year comparisons.

Third-quarter operating margin for Industrial Technologies of 12.7%, including $10 million of restructuring/productivity investments, increased by 3.9 percentage points compared with 8.8% last year due to productivity, higher volumes from recovering industrial markets and new product introductions, and improved pricing, partially offset by inflation.

Atlas Copco Announces Third Quarter 2010 Results

Organic orders received increased 35% to MSEK 19 316 (14 309) and revenues increased 18% organically to MSEK 17 743. Sequentially, sales of mining and industrial equipment improved while the order intake for construction equipment weakened somewhat. Operating profit increased to a new record of MSEK 3 782 (2 402), corresponding to an operating margin of 21.3% including restructuring costs.

"Better market penetration, new innovative products and a fantastic development for our aftermarket business, combined with a further enhanced customer focus has paid off," says Ronnie Leten, President and CEO of the Atlas Copco Group. "I am particularly pleased to see that our energy efficient solutions and our service offering has gained solid ground at customers in the emerging markets."

All business areas launched new products and solutions offering higher productivity, better ergonomics, increased safety and improved energy efficiency. "We received some very large orders for mining and tunneling equipment from Kazakhstan and India and a major compressor order for the pipeline industry in Russia. These orders show a strong confidence in Atlas Copco's products and services".

In the quarter Atlas Copco acquired an Austrian mobile crushing operation, a Dutch biogas treatment company and a British drilling equipment company. These companies add complementary products to the Atlas Copco ranges. A new customer center was inaugurated in Panama and on the Group's two largest markets — United States and China — new efficient distribution centers are established. Atlas Copco also acquired a tool distributor in the United States to further penetrate the market.

"Better market penetration, new innovative products and a fantastic development for our aftermarket business, combined with a further enhanced customer focus has paid off."

— Ronnie Leten,
President and CEO
of the Atlas Copco Group

UTC Third Quarter 2010 Report

United Technologies Corp. (NYSE:UTX) reported third quarter 2010 earnings per share of $1.30 and net income attributable to common shareowners of $1.2 billion, up 14% and 13%, respectively, over the year ago third quarter. Results for the current and prior year quarters included net charges for restructuring and one-time items of $0.09 and $0.13 per share, respectively. Before these charges, earnings per share increased 9% year over year. Currency hedges at Pratt & Whitney Canada, net of foreign exchange translation, contributed $0.02 to the earnings per share increase.

Revenues of $13.5 billion for the quarter were 1% above prior year with 3 points of organic growth and 1 point of adverse foreign currency translation. Segment operating margin at 16.1% was 160 basis points higher than prior year. Adjusted for restructuring and one-time items, segment-operating margin of 16.3% was 90 basis points higher than prior year. Cash flow from operations was $1.7 billion and, after capital expenditures of $177 million, substantially exceeded net income attributable to common shareowners.

"UTC's results this quarter reflect solid operating leverage with strong conversion on organic revenue growth," said Louis Chênevert, UTC Chairman & Chief Executive Officer. "Sustained and structural cost reduction actions drove record segment operating margin, while we increased our investment in new game changing technologies. Cash generation continued to be exceptional, and we made additional contributions of $350 million to our domestic pension plans.

"Based on the strong year to date performance, we are raising 2010 earnings per share guidance to $4.70, the high end of our prior range of $4.60 to $4.70, while increasing restructuring, net of one time items, by $100 million," Chênevert added. "As expected, commercial aerospace aftermarket orders have rebounded nicely but the commercial construction markets remain weak. Additional restructuring will further position us for solid earnings growth in the years ahead."

New equipment orders at Otis were down 1% over the year ago third quarter. Commercial HVAC new equipment orders at Carrier grew 3% including unfavorable foreign exchange of 1 point. Commercial spares orders at Pratt & Whitney's large engine business grew 35% and at Hamilton Sundstrand were up 13% over the year ago third quarter.

WALL STREET WATCH

"We are particularly pleased with our ability to leverage improved top line performance into record level operating margins and earnings."

— Don Washkewicz, Chairman, CEO and President of Parker Hannifin Corporation

"We expect 2010 earnings per share will grow 14% over 2009 on revenues of $54 billion, up 2%," Chênevert continued. "We now expect full year cash flow from operations less capital expenditures to exceed 100% of net income attributable to common shareowners. UTC's leadership team remains focused on maximizing the potential of our world class franchises and achieving industry leading margins in all of our operating segments." Share repurchase was $494 million in the quarter and $1.6 billion year to date. Acquisition spend was $183 million in the quarter and $2.6 billion year to date. For the year, UTC expects that share repurchase and acquisition spend will be at least $2 billion and around $3 billion, respectively.

Parker Announces Fiscal First Quarter 2011 Results

Parker Hannifin Corporation (NYSE:PH) reported results for the fiscal 2011 first quarter ending September 30, 2010.

Fiscal 2011 first quarter sales were $2.8 billion, an increase of 26.5% from $2.2 billion in the same quarter a year ago. Net income was $249.0 million compared with $74.0 million in the first quarter of fiscal 2010. Earnings per diluted share for the quarter were $1.51, which is a quarterly record and compares with $0.45 in last year's first quarter. Cash flow from operations for the first quarter of fiscal 2011 was $122.9 million, or 4.3% of sales, compared with cash flow from operations of $260.1 million, or 11.6% of sales in the prior year period.

"Demand levels continued to improve across many markets as reflected in a significant increase in sales for the first quarter," said Chairman, CEO and President Don Washkewicz. "Sales improved in every segment, with total sales increasing 27% organically, while foreign currency translation negatively impacted sales by 1%. Order rates also increased in all segments.

"We are particularly pleased with our ability to leverage improved top line performance into record level operating margins and earnings. Our total segment operating margin performance was at an all-time record level of 15.5%, led by record Industrial North America segment margins of 17.8% and record Industrial International segment margins of 16.8%. We also continued to deliver strong operating cash flow, which gave us the flexibility to make a discretionary contribution to our pension plan."

Segment Results

In the Industrial North America segment, first-quarter sales increased 36.0% to $1.1 billion, and operating income was $189.4 million compared with $76.2 million in the same period a year ago.

In the Industrial International segment, first-quarter sales increased 28.5% to $1.1 billion, and operating income was $183.8 million compared with $61.8 million in the same period a year ago.

In the Aerospace segment, first-quarter sales increased 4.8% to $436.7 million, and operating income was $43.8 million compared with $53.1 million in the same period a year ago.

In the Climate and Industrial Controls segment, first-quarter sales increased 25.5% to $234.7 million, and operating income was $21.6 million compared with $10.5 million in the same period a year ago.

Orders

Parker reported an increase of 29% in total orders for the quarter ending September 30, 2010, compared with the same quarter a year ago. The company reported the following orders by operating segment:

- Orders increased 31% in the Industrial North America segment, compared with the same quarter a year ago
- Orders increased 34% in the Industrial International segment, compared with the same quarter a year ago
- Orders increased 16% in the Aerospace segment on a rolling 12 month average basis
- Orders increased 23% in the Climate and Industrial Controls segment, compared with the same quarter a year ago

Outlook

For fiscal 2011, the company has increased guidance for earnings from continuing operations to the range of $5.20 to $5.80 per diluted share.

Washkewicz added, "First quarter performance has clearly demonstrated the company's ability to generate strong operating cash flow and strong incremental returns on increased revenues. This gives us confidence in our ability to deliver earnings per share in a higher range for fiscal year 2011. The focus of our employees will continue to be on executing the Win Strategy and our cash flow position affords us the flexibility to drive growth through investments in innovation, international expansion, acquisitions, as well as expansion of our global distribution and industrial retail channels. Thanks to the efforts of Parker's employees in all regions who are pursuing a consistent strategy, we are building momentum from a position of great strength."

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MARCH 30-31, 2011
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For 2011, the ***Association of Energy Engineers (AEE)*** has teamed up the host, PGW, along with a powerful cross-section of cosponsors to present this industry conference and expo which addresses innovative energy management programs, distributed generation strategies, HVAC and building systems success stories, green buildings, the role of renewables, energy procurement updates, power quality solutions, and more. The conference and expo is held on March 30-31, 2011 at the PA Convention Center located in Philadelphia, PA.

GLOBALCON 2011 offers more training flexibility than ever before with a multi-track conference program, intensive seminars, and an energy, power, and facility management expo. Visit the **GLOBALCON 2011** exposition and discover the latest strategies to reduce costs, upgrade equipment, and improve operational efficiency. Access to this valuable expo is included with full conference registration. The expo offers the chance to network with various equipment and service providers. We have also added a series of FREE exhibit hall workshops to help get you up to speed on the latest technologies and success stories. For full details on any of the events during the **GLOBALCON** conference and expo, visit the show website for full details on all the programs: www.globalconevent.com.

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GLOBALCON'S Northeast Green showcase, co-presented by the U.S. EPA's ENERGY STAR®, will also be a prominent part of the event 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; the latest developments in renewable energy; reducing carbon emissions; transportation solutions for the future; and green/sustainable project success stories.

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