The Magazine for ENERGY EFFICIENCY in Compressed Air, Pneumatics, Blower and Vacuum Systems

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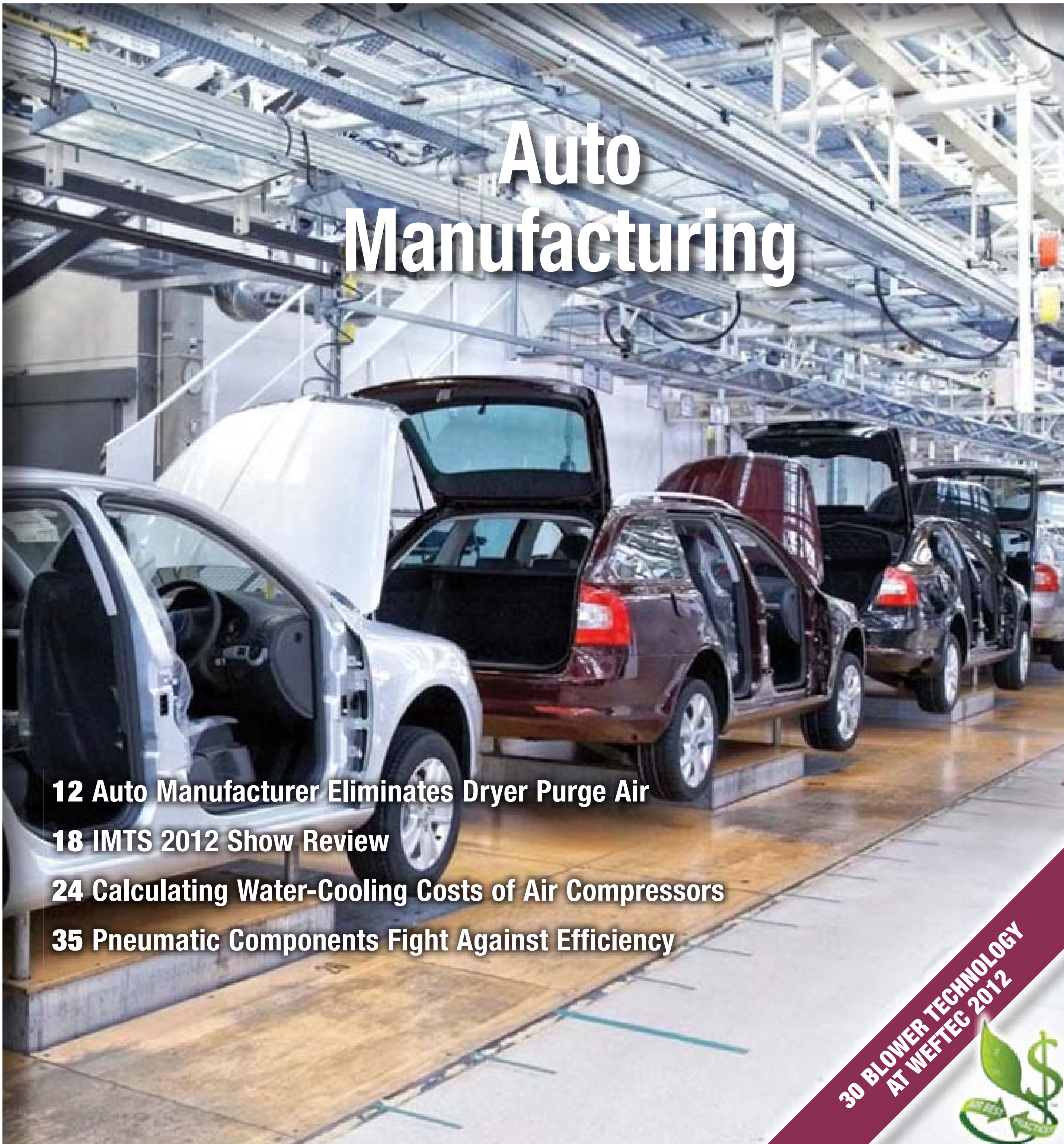
November 2012



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FROM THE EDITOR | Automotive Manufacturing

It's election time of year. My only comment is I wish some of our Energy Manager subscribers, who are also experts in lean manufacturing, would each be assigned the responsibility to run different governmental bureaucracies more efficiently. That would be something!

My "pet peeve" (outside of politics) is what's known as "The Dirty 30" in a compressed air system — the last thirty feet of a compressed air line as it enters a machine. Here one fines a multitude of pneumatic components vigorously working to prevent efficiencies in the compressed air system. Aside from hissing leaks, these regulators, actuators, lubricators, quick-disconnects, and tubes create significant pressure drops — sometimes up to 40 psig! Peter Stern, from Quality Maintenance Services, provides us with a detailed example of the flow constrictions created inside these pneumatic components. When are the machine builders going to wake up to this — instead of just specifying 100 psig compressed air?

Veteran system assessment expert, Hank van Ormer, supplies us with a job his team did at a major automotive manufacturing plant. One of the demand reduction opportunities involved replacing 46 (yes forty-six) heatless desiccant dryers generating 3,000 cfm in purge air. By pure coincidence, this same issue came up this month from a Member of our LinkedIn Group called "Compressed Air Best Practices."

Calculating the costs of cooling water required for water-cooled air compressors is the topic of an article supplied to us by Nitin Shanbhag from Hitachi America. As factories try to pay more attention to Sustainability, water consumption is a metric of growing importance along with kW consumption at a corporate level.

A solid review of compressed air dryers is provided to us by Ron Marshall for the Compressed Air Challenge®. I personally had my travelling shoes on and hope you enjoy my "Roving Reporter" stories from my visits to trade shows over the past month. The IMTS 2012 Manufacturing Show focuses on the machining industry and the WEFTEC 2012 Show is for the wastewater industry — a huge event for the blower industry. I enjoyed meeting a lot of people and learned a lot. I hope you can pick up something interesting from the reports.

We thank the authors above for sharing their knowledge and thank you for your support and for investing in ***Compressed Air Best Practices®***. BP

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COMPRESSED AIR, PNEUMATICS, VACUUM & BLOWER INDUSTRY NEWS

Atlas Copco Provides On-site Biogas Production

Based in Rhede, Germany, the Wenning family has run a successful agricultural business and distillery since 1752. Thirty years ago, they took the first pioneering steps towards on-site biogas production. Together with the help of Atlas Copco, they now have evolved into an award winning energy producer, using 50% less power than other, comparable plants.

By 2020, 20% of all energy and 10% of all transport fuel should come from renewable sources. To reach these European targets, countries are rethinking their energy mix. Germany is extensively promoting biogas as an alternative source of energy. "In comparison with other sources of energy, like electricity for example, the biggest advantage is storability. We can store up to two months' worth of energy", says Bernd-Josef Wenning. As biogas is stored in the existing gas network, it doesn't have to be consumed immediately and no additional investments in the gas grid is required.

In Germany, over 6000 anaerobic digesters convert biomass into raw biogas. This number will more than double over the next ten years. "The energy cycle is simple: the distillery contributes with residues that feed the bulls", Wenning explains. "The bulls give manure in return, a raw material for the biogas plant. The plant delivers gas, which is used to generate electricity and steam. This is a closed loop that really makes sense."

There are two possibilities to use your biogas: cogeneration and as substitute to natural gas (upgraded biogas). As cogeneration is only effective as a local source of electricity and heat, and is less efficient when the heat is only used at certain times of the year, upgrading the biogas to biomethane offers better opportunities. By 2020, biomethane is expected to provide 10% of Germany's overall gas demand.

"Biomethane offers a twin benefit: first, we gain energy. Secondly, we avoid energy costs. On the one hand, we obtain gas, energy we can use for all sorts of things. On the other hand, the output of a biogas plant can be used as fertilizer, reducing the burden on the environment."

Atlas Copco acquired the know-how that pioneered biogas technology, offering proven high-quality solutions. Installations have already been built in Germany, throughout Europe and there are many more to come. By being a single partner for integrated solutions, Atlas Copco selected together with Wenning the most suitable technology, ensuring optimal energy efficiency and minimal operating costs.

Watch the Youtube movie at http://www.youtube.com/watch?v=021mvxMxUfA

Or visit: www.atlascopco/biogas

VP Instruments Holds 4th Distributor Days Conference

VP Instruments, a manufacturer of compressed air flow and system management products, held their 4th Annual Distributor Days Conference September 26-27 in their beautiful hometown of Delft, Holland. Instrumentation and compressed air specialists came from all around the world including Sweden, Spain, Italy, Slovenia, Turkey, Singapore, and the U.S.

Hosted by VP Instruments Managing Director, Pascal van Puten, the theme of the meeting was, "If you can measure it, you can improve it." The company unveiled a new web site and a new 40-page catalog organizing their products and services into the three segments of "Measure", "Monitor", and "Manage". These support the company mission to provide energy management solutions for compressed air and industrial gases.

Training was conducted on where to install flow meters on the supply and demand side of the compressed air system. As plant operators waken to the energy costs of their compressed air system, demand for flow measurement going into different sections of the plant and also individual machines is growing.

VP Vision 2.0 was unveiled as the new complete monitoring solution for compressed air systems. Extremely intuitive using the latest web technology, the training was done on an iPad

COMPRESSED AIR, PNEUMATICS, VACUUM & BLOWER INDUSTRY NEWS

Pascal van Puten and Sander de Knegt (left to right) from VP Instruments.

and enables users to view system data anywhere and at any time. Key performance indicators can be entered into the system and then measured and monitored so that they can be managed.

The attendees were provided classroom and hands-on installation training on the core product, the VP FlowScope. Able to measure mass flow, temperature and pressure, the visitors were shown how to perform "hot tapping" so that the flow meter can be installed even when the piping system is pressurized.

More information is available at www.vpinstruments.com

Atlas Copco Acquires Manufacturer of Nitrogen and Oxygen Generators

Atlas Copco AB has acquired Gazcon A/S, located in Denmark. The acquisition extends Atlas Copco's offering of nitrogen generators and adds oxygen generators to the range. Gazcon is based in Lynge, northwest of Copenhagen, where it designs and manufactures generators using technology known as pressure swing adsorption (PSA). The company had revenues in 2011 of around MDKK 25 (MSEK 30) and employs 21 people. See www.gazcon.com.

"With Gazcon we get an extensive range of on-site nitrogen and oxygen generator technology. This is an interesting growth opportunity which broadens our offering to several customer segments," says Stephan Kuhn, Business Area President, Atlas Copco Compressor Technique.

Nitrogen and oxygen gases are traditionally transported to customers through pipelines, bulk containers and cylinders. The PSA technology, combined with air compressors and dryers, allows small and medium gas consumers to economically generate gases on site, reducing costs and decreasing emissions. Nitrogen is typically needed in the marine, electronics, food and beverage industries, whereas oxygen is used for instance in medical, waste water treatment and metal applications.

Gazcon A/S will be part of the Quality Air division within the Compressor Technique business area.

For information about Atlas Copco's nitrogen generators, see www.atlascopco.com/nitrogen.

Pneu-Logic Allows Qualified Plants to Pay for Controls with Energy Savings

Pneu-Logic Corporation, a leading supplier of industrial compressed air monitoring and control systems, announces a novel plan to help plants across the U.S optimize their compressed air systems and realize immediate energy savings, all without the typical budgeting delays faced by many. The company's new energy payback plan, called the "Nothing-To-Lose Plan," lets qualified customers pay for their systems via energy savings.

"Up to 10% of plant energy used in the US is to power air compressors, and active control of compressed air systems can save up to 40% of that energy," said Tom Orton, Pneu-Logic CEO.

With Pneu-Logic's new Nothing-To-Lose Plan, qualified plants who are currently running 4-12 compressors can apply to have a Pneu-Logic system installed at zero up-front product cost (third party costs may apply depending on installation). Pneu-Logic and the customer will agree upon estimated energy cost savings at the start of the program, and a share of those savings will be used to pay for the system over an agreed period.

"This is an innovative way of enabling plants to immediately start saving money and energy at a time when capital budgets are tight and sustainability targets seem unreachable," says Orton. "Besides energy savings paying for the system over time, customers should immediately benefit from a reduction in operating costs."

Customers that are saving money with Pneu-Logic controllers span a wide range of industries including food processing, manufacturing, mining and materials handling. For example, a Pneu-Logic system at the Gatorade Plant in Tolleson, Arizona, the leading producer of Gatorade and Propel in the world, has helped decrease the plant's compressed air system energy usage by 21%, resulting in an annual savings of more than 1 million kWh of electricity.

More information is available by calling (866) 348-5669 or by visiting: www.pneulogic.com

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THE SYSTEM ASSESSMENT

Auto Manufacturer Eliminates Dryer Purge Air

By Hank van Ormer, Air Power USA

The System Assessment Objective

This northeastern U.S. automotive manufacturing facility spends $269,046 annually on energy to operate their compressed air system. This figure will increase as electric rates are raised from their current average of .019 cents per kWh. The set of projects, in this system assessment, reduce these energy costs by $110,166 or forty percent. Reliability of compressed air quality, however, is the main concern in this plant and the primary focus of this system assessment.

Due to space limitations, this article will focus on the air quality and demand-side projects recommended to ensure a -40 ˚F pressure dewpoint in the compressed air system — while reducing over-all demand by almost 4,000 scfm.

The Baseline: Supply-Side System Overview

The full load operating range is 345 days a year, 24 hours a day, 8280 hours a year. There are two flow meters in the system and the modicom central system monitors the percent load of each unit continuously.

The load profile or demand of this system is not relatively stable during all shifts. The total plant compressed air requirement observed was 13,500 to 15,000 cfm peak flow, a 8500-9,500 cfm minimum flow and an average flow of 10,500 cfm. These numbers were established through interviews with plant personnel, reviewing historical flow recordings and observing the loads on the modicom system. The central modicom control system appears to control and monitor all seven compressors very well.

During the system assessment, we were informed of plans to increase compressed air demand by 1200 cfm due to the installation of an additional four (4) molding machines.

COMPRESSED AIR FLOW SCENARIO	FLOW (CFM)
Current maximum possible peak demand (rarely seen) (including current expansion mold and bead blast)	19,000 – 20,000 cfm
Current peak demand usually observed	13,500 – 15,000 cfm
Average production flow (with 4 new mold units)	10,500 – 11,700 cfm
Low production demand	8,500 - 9,500 cfm

This plant has two separate air compressor rooms. Compressor Room #1 has five (5) double-acting reciprocating air compressors able to provide a total nominal 15,000 cfm. The air is sent to one glycol chiller refrigerated air dryer (reported to be rated for 9000 cfm flow). Compressor room #2 has two (2) double-acting reciprocating air compressors able to provide a total nominal flow of 6,000 cfm and one (1) "chiller air dryer" rated for 15,000 cfm).

Each compressor room has a 12" compressed air line header. Basically, there are two compressed air distribution systems. There is one 8" interconnecting line between the two systems.

The plant has condensate problems in the system and many (46) heatless desiccant dryers have been installed throughout the system at point of use. **It is estimated that the purge air, required to regenerate the towers, is creating a demand for 3,000 scfm of compressed air.**

All existing compressors are positive displacement, two stage reciprocating and 3000 scfm class capacity each. From a total of seven (7) compressors, five (5) can be in operation at any time. One compressor is stand-by and one is usually off line.

The primary compressors are efficient air compressors that are capable of delivering 90 psig full load pressure. The primary compressors are very well maintained, very well installed and very power efficient units at both full and part load. They are lubricated type. Most important, they are **very old** — particularly the three units in Compressor Room #1. These are late 1940's units, well over 50 years old and have been out of production for over 35 years. It is difficult and expensive to obtain any major parts when and if needed. There may still be some used parts in the gas fields but certainly not any left on the used equipment lots.

The reciprocating compressors are double-acting, water-cooled units with five-step unloading. This is an efficient compressed air unloading system. Reciprocating five-step unloading will efficiently translate the percentage reduction in air usage of "less air used" into nearly the same proportional reduction in energy cost. The older three "late 1940's units", however, overheat if run at 25% of load.

The other four units are not quite 25 years old and are no longer manufactured in the United States. There is limited production overseas and critical parts are available — some at long lead times. There are 10" stroke models with many parts available in the used equipment lots now but as time goes by they will end up in the same situation as the older units. The plant is spending significant resources on periodic overhauls, maintenance, and water-cooling for these air compressors.

Cooling water, for the air compressors, is supplied from three sources; **mill water** (a settling pond of recycled water), **process water** (treated and filtered water) and **cooling tower water.** The older three air compressors in Compressor Room #1 use process water for inlet and head cooling and mill water for the inter and aftercoolers. The other four air compressors and aftercoolers are on cooling tower water.

This article does not have space to review the supply-side recommendations. We did recommend replacing the older three recips with three new oil-free centrifugal air compressors piped to heat-of-compression dryers in Compressor Room #1. The energy savings were not significant — the benefits were improved air quality and reduced maintenance and water-cooling costs. The project also recommended replacing the refrigerated dryer in Compressor Room #2 with a blower purge desiccant air dryer the company could transfer in from another facility.

Demand-Side Projects to Reduce Compressed Air Consumption

The overall strategy for improving the air system centers on repairing purge controls on compressed air dryers and reducing overall demand. The recommended projects include:

AIR FLOW REDUCTION PROJECTS	AIR FLOW SAVINGS
Eliminate purge air from 46 heatless desiccant dryers	3000 cfm
Repair compressed air leaks	200 cfm
Replace timer drains with demand drains	47 cfm
Replace ten air operated diaphragm pumps with electric	320 cfm
Total Compressed Air Flow Reduction	3,567 acfm

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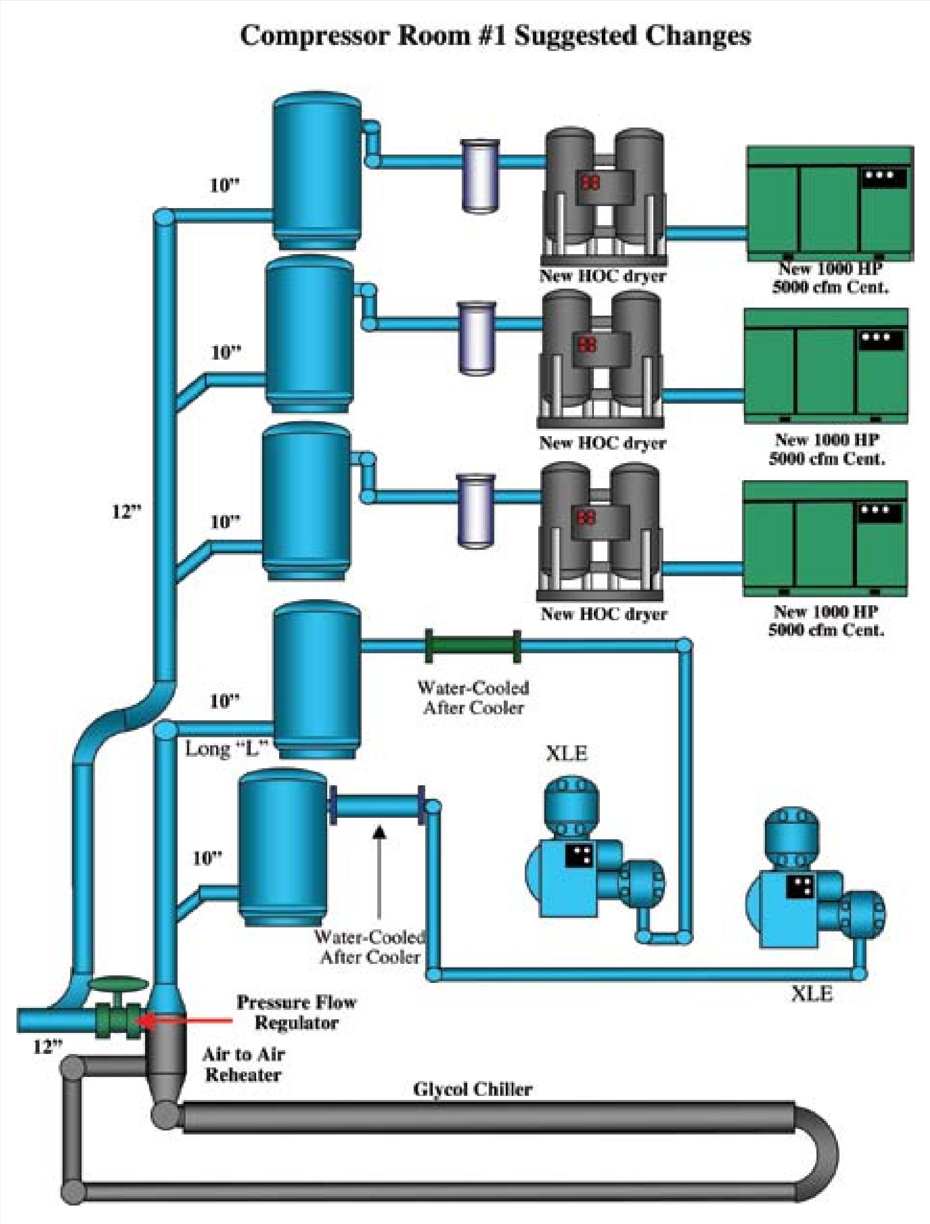
Auto Manufacturer Eliminates Dryer Purge Air



Project #1: Air Dryers and Dewpoint Monitors

One of the higher air users in the plant and the largest air user in molding is the X line, which is still growing. Plant personnel have done a great deal of investigation in modeling the air flows to this system and have collected some very significant data. This acquired data allows for effective analysis and developing solutions to continue to improve quality and productivity.

Reviewing this data and showing the changes already implemented and to be implemented, leads us to believe that this process is being very well handled and will continue to evolve to its optimum performance level. The 8" header appears to be supplying air appropriately and the larger planned feeds should eliminate any pressure loss problems, particularly when the point of use dryers are out of the circuit.

The large supply receivers already installed should effectively isolate the system even without pressure flow regulation.

Molding uses both "wet air" and "dry air"— systems that can be combined into one when an effective central compressed air drying system is in place. It is important to note that when we reviewed the molding operations, we saw the heatless point of use dryers in many operating modes:

TABLE 1. THE BASELINE: CURRENT SYSTEM KEY CHARACTERISTICS

MEASURE	1ST SHIFT	2ND SHIFT	3RD SHIFT	WEEKEND HOLIDAYS	TOTAL
Average System Flow	10,500 cfm	10,500 cfm	8,500 cfm	8,500 cfm	N/A
Average Compressor Discharge Pressure	89 psig	89 psig	89 psig	89 psig	psig
Average System Pressure	85 psig	85 psig	85 psig	85 psig	
Input Electric Demand	1672 kW	1672 kW	1513.6 kW	1513.6 kW	N/A
Operating Hours of Air System	2080 hrs	2080 hrs	2080 hrs	2040 hrs	8280 hrs
Specific Power	6.28 cfm/kW	6.28 cfm/kW	5.62 cfm/kW	5.62 cfm/kW	N/A
Electric Cost for Air – per unit of flow	$6.29 cfm/yr	$6.29 cfm/yr	$7.37 cfm/yr	$6.90 cfm/yr	$26.85 cfm/yr
Electric Cost for Air**– per unit of pressure	$330.39 psig/yr	$330.39 psig/yr	$299.09 psig/yr	$293.34 psig/yr	$1,253.21 psig/yr
Annual Electric Cost for Compressed Air	$66,077/yr	$66,077/yr	$59,817/yr	$ 58,667/yr	$ 250,638/yr

- Dryers at full capacity with purge air
- Dryer turned off but still in the flow — still using purge air
- Dryer turned on but valved out of the flow
- Dryer turned off and valved out of the flow

Bead blast is another high consumer of compressed air. Most of these units are blast cabinets with robots handling the pieces that are blasted with precisely controlled compressed air. Control air is critical and apparently higher pressure (80-90 psig) and the blast air pressure indicated on the machines ranged from 35 to 50 psig. Often with a 50 psig setting, the actual feed pressure at work runs at 40 psig.

We believe that since this is such a high use item and requires high quality dry air for a sensitive process, that the plant should review and analyze the relative dynamics. A closely monitored and precisely measured program similar to what you have and are implementing at the "X Line" will generate excellent opportunities for improvement and savings.

After the (2) new 400 scfm heatless desiccant dryers are installed in front of the new molding machines, there will be at least 48 heatless type desiccant dryers installed throughout the system. We observed several dryers valved out of the system (in bypass) while the production machines were running. The dryers **were not** drying the air to the system **— but many were still purging air.** These dryers (some have "dewpoint demand control") collectively use about 3000 scfm of purge air. This costs the plant about **$75,750/yr** in electric power to produce this 3000 scfm of compressed air.

These desiccant dryers are required, throughout the plant, because the supply-side refrigerated dryers cannot provide the required dewpoints. The chiller dryer (in Compressor Room #2) was rated to handle 15,000 scfm of air at 100 °F/100 psig and deliver a +40 °F pressure dewpoint. However, in reality, this technology is basically limited to a + 50 °F pressure dewpoint consistently at 89 psig.

The glycol cooler/reheater arrangement in Compressor Room #1 has delivered a measured +39 °F pressure dewpoint in the past. It's performance is very dependent on what cooling water temperature it receives and the performance of the water-cooled after-cooler on the compressors. Plant

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personnel are not sure of the full rating on this dryer but feel it may be limited to handling 9000 scfm effectively.

By modifying the supply-side air treatment to include heat-of-compression dryers in Compressor Room #1 and a blower purge desiccant air dryer in Compressor Room #2, the plant will ensure air quality throughout their processes. This will allow the plant to remove and/or bypass all the decentralized heatless desiccant air dryers and can reduce their compressed air consumption by 3000 cfm.

Project #2: Air Leak Identification and Repair

Leak levels, in most plants, represent 20% of total compressed air demand. Fifty leaks were identified in this plant. We estimate 4 cfm of wasted compressed air per leak for a total air flow reduction opportunity of 200 cfm.

Estimated number of leaks	50 leaks
Estimated average leak size	4 cfm/leak
Estimated reduction of air flow with proposed project	200 cfm
Current air flow cost	$22.98/cfm year
Annual electric cost savings with proposed project	$4,596/year
Unit cost of leak repairs	$2,500

Project #3: Replace Timer and Manual Condensate Drains with Level-Operated Drains

This project focuses on replacing all timer and manual condensate drains with level-activated electric or pneumatic-actuated automatic condensate drains. Dual timer electronic drains use an electronic timer to control the number of times per hour it opens and the duration of the opening. The theory is that you should adjust the timers to be sure that the condensate drains fully and the open time without water is minimized, because it wastes compressed air. The reality is that the cycles either don't get reset from the original factory settings (which causes condensate build-up in the summer) or they get set wide open and not closed down later in cooler weather, thus wasting more air. When they fail "stuck open", they blow at a full flow rate of about 100 cfm.

Consider, for example, that the usual "factory setting" is 10 minutes with a 20-second duration. 1500 scfm of compressed air will generate about 63 gallons of condensate a day in average weather or 2.63 gallons per hour. Each 10-minute cycle will have 0.44 gallons to discharge. This will blow through a ¼-inch valve at 100 psig in approximately 1.37 seconds. Compressed air will then blow for 18.63 seconds each cycle, 6 cycles a minute will equal 111.78 seconds per hour of flow or 1.86 minutes per hour of flow. A 1/8-inch valve will pass about 100 cfm. The total flow will be 100 x 1.86 = 186 cubic feet per hour, or 186 * 60 minutes = 3.1 cu ft/min on average. This 3.1 cfm would translate into an energy cost of $300 per year based on a typical air flow cost of $100 per cfm year. In reality they are often set much longer generating higher values.

Level operated electronic drains come in a number of varieties, including ones that receive the signal to open from a condensate high level and the signal to close from a condensate low level. These waste no air and from a power cost standpoint, are the best selection.

The system assessment identified fifteen drains that should be replaced.

Total of number of drains	15
Air flow (cfm) savings per drain	3.1 cfm
Total compressed air saved	46.5 cfm
Current air flow cost	$22.98/cfm year
Estimated energy savings per drain	$71.24/year each
Total annual savings	$1,069/year

Project #4: Air-Operated Diaphragm Pumps

Although air-operated diaphragm pumps are not very energy efficient, they tolerate aggressive conditions relatively well and run without catastrophic damage even if the pump is dry. There are several questions to ask and areas to investigate that may yield significant air savings:

- Is an air-operated diaphragm pump the right answer? An electric pump is significantly more energy efficient. Electric motor driven diaphragm pumps are readily available. An electric motor drive progressive cavity pump may also work well.
- Consider installing electronic or ultrasonic controls to shut the pumps off automatically when they are not needed. Remember

"The new supply configuration also allowed the factory to eliminate the small army of heatless desiccant air dryers that were purging 3,000 scfm of compressed air."

— By Hank van Ormer, Air Power USA

that pumps waste the most air when they are pumping nothing.

- Is the pump running most of the time at the lowest possible pressure? The higher the pressure is, the more air is used. For example, filter packing operations often do not need high pressure except during the final stages of the filter packing cycle. Controls can be arranged to generate lower pressures (and cycles) in the early stages and higher pressures later on — which may generate significant savings.

The system assessment replaces (10) air-operated 1¼" diaphragm pump in coating with electric-driven unit on units running light fluid and continuous run.

Air flow associated with air-operated pump (80% utilization)	32 cfm avg
Current air flow cost	$22.93/cfm
Annual electric cost to operate air-operated pump	$735/year/each
Electric demand of new electric pump	.75 kW (average)
Annual electric cost to operate electric pump	$118/year
Annual electric savings	$617/year/each
Annual savings for replacing (10) pumps	$6,170 / yr

Conclusion

The primary results of this system assessment were to modernize a portion of the air compressors into oil-free centrifugal technology able to use heat-of-compression dryers. This allowed the factory to reduce the significant maintenance and water cooling costs involved with the long-lasting and efficient double-acting reciprocating air compressors. The new supply configuration also allowed the factory to eliminate the small army of heatless desiccant air dryers that were purging 3,000 scfm of compressed air. BP

For more information contact Hank van Ormer; tel: 740-862-4112, email: hank@airpowerusainc.com, www.airpowerusainc.com

To read more ***System Assessment*** articles, visit www.airbestpractices.com/system-assessments

SHOW REPORT:

Industrial Automation NORTH AMERICA

at

IMTS 2012

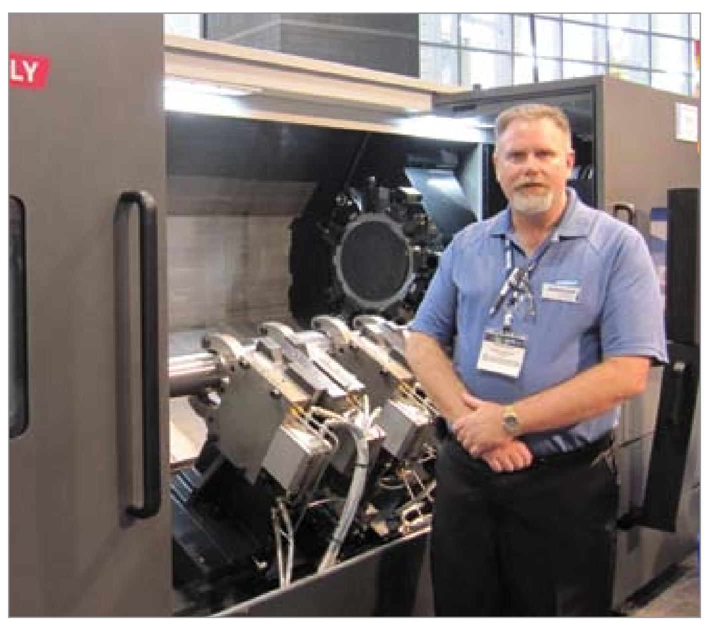
By Rod Smith, Compressed Air Best Practices® Magazine

The IMTS 2012 International Manufacturing Technology Show was held at the McCormick Convention Center in Chicago, Illinois, September 10-15. More than 1,909 companies exhibited — including Compressed Air Best Practices® Magazine, as a part of the Industrial Automation North America Pavillion — organized by Deutsche Messe, the owners of the Hannover Fair. Over 1.24 million square feet of exhibition space was contracted and total registration for the six-day event was for 100,200 people, a 22% increase over 2010.

The primary focus of this show is the metal machining industry. This includes turning centers, machining centers, horizontal boring mills, double-column machining centers, swiss-type turning centers, and a universe of accessory equipment. The compressed air industry was well represented at the show displaying all types of air compressors, dryers, controls, and piping systems. Here are the highlights.

Machining and Turning Centers

I was very fortunate to meet Ron Majewski, a Mechanical Engineer on the Systems Team at Doosan Infracore Machine Tools. He patiently walked me through how compressed air is used in their sophisticated vertical lathes, machining centers and turning centers. The lathe uses "shop air" to open and close doors, power air actuated chucks, air actuated grippers on the chucks and to blow-off the parts. The estimate was 20% of demand goes to pneumatic actuation and 80% goes to blow-off air.



Ron Majewski, from Doosan Infracore Machine Tools, in front of a PUMA 3100 XLY Turning Center.

Over 1.24 million square feet of exhibition space was contracted and total registration for the six-day event was for 100,200 people, a 22% increase over 2010.

The Doosan Infracore Training Coordinator, Doug Rizzo, further explained that clean dry compressed air is important for the turning center using air at 20 psig to support the hydraulic steady rest. A 90 psig application is the air-over-hydraulic chuck. Compressed air provides the speed while hydraulic power provides the grip. Automated tool change-outs also use positive pressure for the block that holds the tool holder. Milling machines use a blast of air through the spindle to clean out debris. Fluids are not wanted in the spindle so compressed air is a clean way to do this. A final application is the pre-cleaning of parts.

After visiting a good number of booths featuring machining and turning centers, I was amazed by the automation, control and sophistication of the machines. The drilling and automotive industries are two markets driving demand right now. I wondered, however, if these machinery manufacturers will follow manufacturers in the printing press and blow molding industries that have created separate pressure sub-systems within the machines in order to save their customers energy. (www.doosan.com/doosaninfracoremachinetool)

Chris Koehn shows the Air Reduction Valve configuration on Stotz Air Gauges.

SHOW REPORT: INDUSTRIAL AUTOMATION NORTH AMERICA AT IMTS 2012

Air Gauges

Air gauges are heavily used in the quality control processes of parts used in the automotive industry. Parts are normally measured after milling as a standard part of the quality control process. They can measure machining accuracy down to one millionth of an inch (0.249096 inches to be precise). Air gauges are a popular time-saving option over coordinate measurement machines (CMM).

Chris Koehn, the AME Business Unit Manager for Stotz Products (a leading air gauge manufacturer), spent some time with me and explained that air gauges are only used 10% of the time — but are usually left on 100% of the time — all the while consuming compressed air. My ears perked up at this "inappropriate use" example. Mr. Koehn explained that air gauges blow 45 psig compressed air (usually between 1-3 cfm per gauge) on a part and then measure backpressure to calculate the diameter of a part. Air gauging requires a steady and consistent air flow, across the surface of the part being measured, to maintain the proper protocol and accuracy in measuring procedures.

Mr. Koehn explained that, until now, air gauges have not provided the option to turn off compressed air use when the air gauge isn't at work. The reasons for this are that (1) most sensors need a 15 minute warm-up time so plants just leave them running and (2) they keep dirt out of the tooling and (3) compressed air cools some parts and keep them from expanding. This means that air consumption continued on 24/7 unless the plant made some kind of shut-off valve arrangement.

Stotz has now introduced the Air Reduction Valve featuring a digital I/O regulator switch connected to the air column that can turn off the air flow when not in use. Koehn commented, "To be optimally beneficial, this type of technology must have the proper interface between the air column and the power supply to function effectively. In one configuration, a proximity switch is positioned in the gauge holder, and the air flow can be triggered when the gauge is removed from the holder."

Mr. Koehn told a story of an automotive parts plant, located in the southeast, running one dedicated air compressor just for air gauging. For all of you focused on demand-side compressed air reduction opportunities, I suggest you take a look at the new Stotz air gauges (www.ame.com) with the Air Reduction Valve feature.

Air Compressor Technology

Sullair Senergy 1800 rpm motor, VSD, gear-to-gear, air-cooled units were on display at the Sullair booth. Standard Rotary Products Product Manager, Brit Thielemann, also showed me the 1109E encapsulated 15 hp, VSD, gear-to-gear, rotary screw compressor along with the ShopTek 10 hp rotary screw compressor that comes tank-mounted with a refrigerated dryer. The Sullair sales & marketing staff I met at the booth, led by Roger Perlstein, seemed excited by their future growth prospects under the compressor-focused ownership of the private-equity firms The Carlyle Group and BC Partners.

I ran into the President of Atlas Copco Compressors USA, John Brookshire, in the Atlas Copco booth. Recently returned to the good

Brit Thielemann and Michael O'Hanlon, from Sullair Compressors, in front of the Senergy variable speed drive rotary screw air compressor.

Ryan Norsworthy, Dale Garthus, Tim McDonald, and Drew Hoffman, from Gardner Denver, displayed the APEX 5-15 hp Total System Packages and the EnviroAire water-injected, oil-free air compressor (left to right).

‘ol USA after many years of expatriate assignments abroad, John told me amazing stories about their explosive growth in Asia over the past ten years. John reviewed the recently launched next generation of the GA range of oil-injected screw air compressors from 40 to 124 hp. Sold in three options, variable speed drive, premium fixed speed, and fixed speed. The company claims industry-leading efficiency and FAD (free air delivery) with the premium-efficiency fixed-speed variant. An improved layout inside the “cool canopy”, including new IE3/NEMA premium efficiency motors, has led to an average temperature decrease of 18 °F at the screw element. Units come with optional integrated R410A environmentally-friendly refrigerated dryers, reducing dryer energy consumption by up to 50%, and with improvements to the oil-treatment system resulting in up to 50% less oil use. Booth visitors had fun “designing” their own GA Compressors on a computer monitor by adding graphics to the cabinet!

Kaeser Compressors had a very busy booth staffed by Mark Olson and Bob Maurer. They were reviewing the Air Tower system featuring integrated dryers, the SM10 Air Center providing a space-saving tank mounted package with optional refrigerated dryers, and the direct-drive rotary screw air compressor packages. Booth visitors were also interested in the Sigma Air Manager master controls as well as the convenient piping system.

Gardner Denver is turning heads with the oil-free centrifugal Quantima air compressor. With 320-400 hp units, the Quantima has caught the attention of some major food processors and was on display

John Brookshire, from Atlas Copco Compressors, in front of the new generation GA Range variable speed drive rotary screw air compressor.

SHOW REPORT: INDUSTRIAL AUTOMATION NORTH AMERICA AT IMTS 2012

at the IMTS Show. Drew Hoffman is the Gardner Denver Product Specialist and he said the product line is being successfully introduced into the U.S. market. We also reviewed the EnviroAire 50 hp, water-injected, oil-free air compressor using a reverse osmosis system with a filter to treat the water. This reliability feature eliminates water quality as a variable to be managed. Also in the booth was the APEX 5-15 hp, belt-driven, total air system package offering tank-mounted compressors with optional refrigerated dryers.

Mark Olson (foreground) and Bob Maurer (background), from Kaeser Compressors, reviewing the Kaeser technology with booth visitors.

Renner Kompressoren, from Germany, had a booth where I met their Sales Director, Stefan Gloser. A world traveler building the export business, Mr. Gloser told me they were looking to grow their business in North America. Some of the product strengths he mentioned was a full range of belt-driven rotary screws, oil-free scroll compressors with sound attenuation to 57 dba, and a range of oil-lubricated direct-drive rotary screw air compressors.

Compressed Air System Products

It's a small world and one meeting I found very interesting was with EWO, a German manufacturer of heavy-duty pneumatic products and blow guns. Their Director of International Sales, Oliver Reinl, explained that EWO has been manufacturing private labeled products, since 1914, for many international pneumatic companies. The product that caught my eye was their "Battery Regulator" used by KRONES in their sophisticated CONTIFORM blow molding machines I wrote about earlier this year at the NPE Show. Another interesting product was their brass material FRL designed for 40-60 bar applications.

Hydraulics play a big role, in machining centers, and Thermasys had a nice booth where they launched their new Cool Loop Series offline fluid conditioning system. The two main enemies of the hydraulic systems in machining centers are contamination and overheating. Tim McDonald, from ThermaSys, reviewed the benefits of pumping,

Jan Hagener and Stefan Gloser, from Renner Kompressoren, displayed their 25 hp, oil-flooded, belt-drive, rotary screw air compressor.

Oliver Reinl and Dean Bachemiller, from EWO, displayed their heavy-duty brass material FRL designed for 40-60 bar applications.

filtering, and cooling the oil — independent of the machining operation. This allows maintenance to be done without any downtime at the machining center. The new Cool Loop Series was getting a lot of interest at the show.

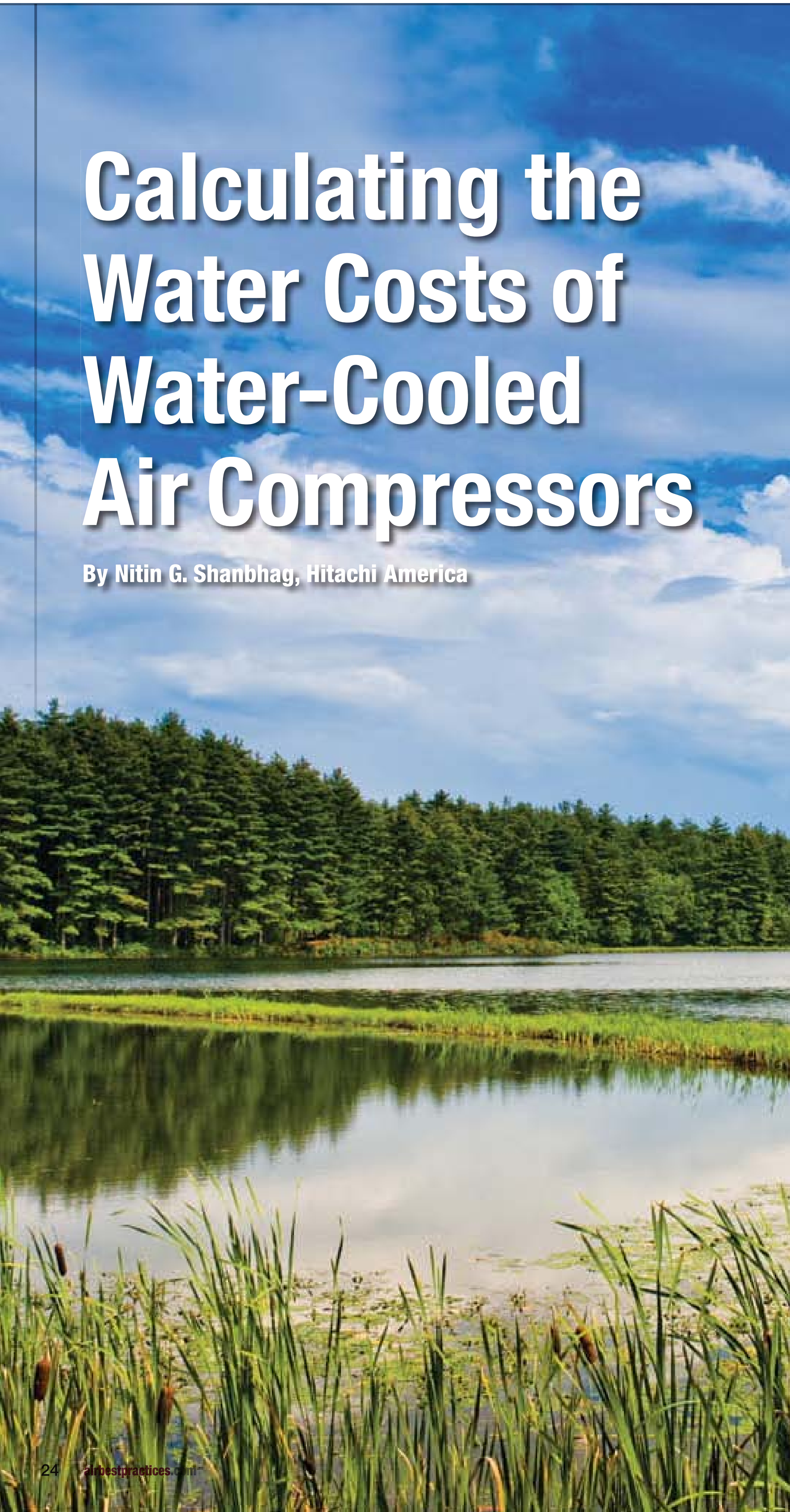
Spectronics Corporation had a booth featuring their Spectroline ultrasonic leak detector. A leader in fluid and gas leak detection out of Westbury, New York, the Marksman™ diagnostic tool is the product they recommend for compressed air systems.

CKD Pneumatics was also present, with space at the booth of their important distributor — All World Machinery Supply. Troy Manley is the National Sales Manager for CKD USA and we had a nice discussion on their product lines. They have a 92-page product catalog of actuators, valves, and other pneumatic components. CKD is also a major manufacturer of compressed air dryers — sold mainly in Asia. BP

For more information contact Rod Smith, Compressed Air Best Practices® Magazine, rod@airbestpractices.com, www.airbestpractices.com

Tim McDonald and Marty Christianson, from ThermaSys, launched the new Cool Loop Series offline fluid conditioning system.

To read more ***Industry News*** articles, visit www.airbestpractices.com



Calculating the Water Costs of Water-Cooled Air Compressors

By Nitin G. Shanbhag, Hitachi America

Compressed air systems are sometimes called the "4th Utility" due to their presence in almost all industrial processes and facilities. The objective of this paper is to focus on the opportunity to reduce the water consumption of compressed air systems. Water consumption has leveled off in the U.S. as reductions in the power, irrigation, and industrial segments have offset increases in the public-supply segment driven by population growth. Energy managers should understand how much cooling water is required for the inventory of air compressors in their factories along with the related costs. An evaluation can then be made, of the different types of cooling systems, to ascertain water and cost reduction strategies.

Compressed air systems are present in almost all industrial processes and facilities. They have been correctly identified as an area of opportunity to reduce electrical (kW) energy costs through measures like reducing compressed air leaks and identifying artificial demand and inappropriate uses. Water-cooled air compressors can also be significant consumers of water and reducing these costs can represent a second area of opportunity.

A very "typical" industrial plant running two 125 horsepower, water-cooled, single-stage, rotary screw, air compressors can consume 11.4 million gallons of water per year. A larger installation, with a 350 horsepower rotary screw under similar circumstances, can consume 17 million gallons per year[1].

Many older facilities continue to use two-stage, water-cooled, reciprocating air compressors. Pulp and paper mills and steel mills are perfect examples. Facilities, like these, can require 550 million gallons per year of cooling water for the air compressors.

1 Figures taken from a data sheet of a single stage, lubricant cooled, rotary screw air compressors at 100 psig pressure, 8600 working hours, and 70 °F water temperature.

TABLE 1: COOLING WATER REQUIREMENTS FOR SINGLE-STAGE ROTARY SCREW AIR COMPRESSORS						
TYPICAL LUBRICANT-COOLED ROTARY SCREW COOLING ESTIMATED HEAT REJECTION TO COOLING WATER (BTU/HR)*				TYPICAL VALUES FOR AIR-COOLED OIL-COOLERS ESTIMATED HEAT REJECTION TO COOLING AIR (BTU/HR)*		
AIR COMPRESSOR CAPACITY CFM/HP**	WATER-COOLED OIL-COOLER AND AFTER-COOLER BTU/HR	APPROX. GPM AT 70 ˚F	APPROX. GPM AT 85 ˚F	AIR COMPRESSOR CAPACITY CFM/HP*	AIR-COOLED OIL-COOLER AND AFTER-COOLER BTU/HR	APPROX. CFM COOLING AIR
250/62	150,900	6	10	250/62	156,300	8400
350/83	200,300	7	12	350/83	208,500	8400
500/120	276,700	11	18	500/120	287,700	12000
800/215	445,500	16	27	800/215	463,100	17500
1000/250	550,400	23	39	1000/250	572,400	28700
1200/300	668,200	33	56	1200/300	694,700	28700
1500/350	889,709	33	56	1500/350	920,000	36000
2500/500	1,543,000	49	79	2500/500	1,543,000	45000

* This data is general in nature and should not be used to select equipment. It is necessary to look at the specific engineering data for all equipment being used.
**System at 100 psig

CALCULATING THE WATER COSTS OF WATER-COOLED AIR COMPRESSORS

"Rule of Thumb" Formula to Calculate Water-Cooling Costs of Air Compressors

(a or b) + c

Formulas:

a. Untreated Cooling Water Cost = (Gallons per year/1000) x $3.00

b. Treated Cooling Water Cost = (Gallons per year/1000) x $4.20

c. Compressor Enclosure Vent Fan Electric Cost = (Input kW x hours x ($/kWh)

Example:

A water-cooled, two-stage, rotary screw, lubricant-cooled, 100 horsepower air compressor. Assumptions:

- 8600 working hours per year (to take into account down-time)
- Cooling water use volume of 11 GPM at 70 °F
- Untreated Cooling Water Cost of $3.00 per thousand gallons
- Compressor Enclosure Vent Fan Input Power of 1.1 kW
- Electrical energy cost of $0.06 per kWh

Solution:

- Step 1 to Calculate **a**: 8600 hours x (11 GPM x 60) = 5,676,000 gallons of water per year
- Step 2 to Calculate **a**: (5,676,000/1000) x $3.00 = $17,028.00 untreated cooling water cost per year
- Step 3 to Calculate **b**: 1.1 kW x 8600 hours x $0.06 kWh = $567.60 vent fan electric cost per year
- Step 4: $567.60 + $17,028.00 = $17,596.60 total annual cooling costs

Both air compressors and compressed air dryers can be water-cooled. We highly recommend that energy managers, at multi-factory corporations, take an inventory of the water-consumption of all the installed air compressors and of how the water-cooling systems function. An evaluation should be made, in each facility, of the feasibility and benefits of switching to an air-cooled air compressor or switching to a different water-cooling system.

How Much Cooling Water is Required by Air Compressors?

The standard rating, for air compressor cooling water requirements, is how many gallons of water per 1,000 btu/hr is rejected into the cooling water flow. Air compressors generate a high rejection load due to their very basic inefficiency — i.e. it takes 7 to 8 input horsepower to supply 1 hp of work in compressed air. This creates a heat-of-compression generated during the process reflecting this inefficiency. Energy input not converted to work shows up as heat. This heat has to be removed for the equipment to run and for the plant to be able to use the air. Particularly today, where dry compressed air is often critical, it must be reliably and effectively after-cooled and dried to a specified pressure dew point using compressed air dryers.

Calculating the required gallons-per-minute (gpm) is dependent upon several critical variables:

- Intake cooling water temperature to the air compressor or dryer.
- The allowable compressor discharge temperature — i.e. reciprocating, oil-free rotary screw and centrifugals easily handle 350 to 400 ˚F discharge. Lubricant-cooled units are limited by the cooling lubricant fluid but are usually a maximum of about 200 ˚F.
- Other critical data is needed such as OEM rated air flow (acfm at full load pressure), compressor shaft power

TABLE 2: COOLING WATER REQUIREMENTS FOR TWO-STAGE RECIPROCATING AIR COMPRESSORS

TWO-STAGE RECIPROCATING AIR COMPRESSOR COOLING WATER*						
			INLET AIR 60 ˚F, WATER 75 ˚F		INLET AIR 100 ˚F, WATER 95 ˚F	
BHP CLASS	DISCHARGE PRESSURE PSIG	CAP ACFM	AIR DISCHARGE ˚F	GPM WATER REQUIRED	AIR DISCHARGE ˚F	GPM WATER REQUIRED
150	125	772	335	16	370	16
200	125	1050	335	21	370	21
250	125	1300	335	26	370	26
300	125	1560	335	32	370	32
350	125	1840	335	37	370	37
400	125	2035	335	41	370	41
450	125	2340	335	52	370	52

*This data is general in nature and should not be used to select equipment. It is necessary to look at the specific engineering data for all equipment being used.

(BHP), and motor input HP/KW inclusive of motor/drive losses.

- GPM is typically provided, relative to cooling water requirements, by the manufacturers of air compressors.

Three Primary Sources of Industrial Cooling Water

Public Supply Water

Discussed in the U.S. Geological Survey as the category that continues to grow in water use. Over the last 40 years these costs have escalated rapidly reflecting the scarcity of water and the cost of water treatment. It is becoming the exception to the rule today to see a compressed air system's cooling-water supply coming from the municipal utility. True costs are not always evident. Additional costs, like sewer chargers, can't be ignored. Often, city water will still require water treatment for effective performance in industrial cooling. These costs must also be considered.

Self-Supplied Well-Water

Well-water has varying site-specific characteristics but it is generally not "Free". After the well is drilled, in most parts of the world the good news is that the water is usually cool. The bad news is that it usually requires significant intake filtration and water treatment for industrial use. Electric energy is required to pump it out of the ground and through the equipment.

Today, the cost of disposing of the heated cooling water has escalated as various agencies may limit the dumping of the heated water into streams, rivers and lakes due to potential thermal pollution. This is what has driven the thermoelectric power plants to alternative cooling systems. In many areas well-water supply is diminishing as the water tables are lowering and as the well gets older, the total flow in gallons-per-minute (gpm) falls off.

River Water/Lake Water

River and lake water have the same limitations as well-water with regards to intake filtration and water treatment. In many, if not most, areas today it is no longer "free" and there often is a charge for the discharge-heated water to the local body of water. There are also EPA Clean Water Act regulations to be met and monitored with any water being discharged to this type of water supply.

Calculating the Basic Water Costs for Compressed Air Systems

Regardless of what "rule of thumb" number is used for water cost (not including energy

A modern air-cooled, oil-free, rotary screw air compressor

CALCULATING THE WATER COSTS OF WATER-COOLED AIR COMPRESSORS

TABLE 3: COMPARING COSTS OF WATER- AND AIR-COOLED SYSTEMS: TWO-STAGE, LUBRICANT COOLED, 100 HP, ROTARY SCREW AIR COMPRESSOR

COMPARING COOLING REQUIREMENTS LUBRICANT-COOLED, TWO-STAGE, ROTARY SCREW COMPRESSOR	TWO-STAGE LUBRICANT-COOLED 100 HP CLASS 547 ACFM /111 BHP AT 100 PSIG DISCHARGE 180–200 ˚F	
	WATER	AIR
GPM AT 50 ˚F ELECTRIC $.06 KWH AT 8,600 HOURS/YR.	8	5.5 fan hp/ 5kW/$2,580 yr.
GPM AT 70 ˚F	11	N/A
GPM AT 80 ˚F	18	N/A
TOTAL H_2O PRESSURE LOSS (PSID)	21	N/A
VENT FAN INPUT POWER	1.1 kW	N/A
COOLING COST AT 70 ˚F H_2O (H_2O COSTS AT 3.00 PER 1,000 GALLONS)	$17,028 per year	—
VENT FAN COST	$568 per year	N/A
WATER & ELECTRICAL ENERGY COST AT $.06 KWH/8600 HRS/YR.	$17,596 per year	$2,580 per year
TOTAL HEAT REMAINING	303,000 btu/hr	

TABLE 4: COMPARING COSTS OF WATER- AND AIR-COOLED SYSTEMS: TWO-STAGE, OIL-FREE, 200 HP, ROTARY SCREW AIR COMPRESSOR

COMPARING COOLING REQUIREMENT OIL-FREE, TWO-STAGE ROTARY SCREW COMPRESSOR	TWO-STAGE OIL-FREE 200 HP CLASS 856 ACFM/193 BHP AT 100 PSIG DISCHARGE 350–400 ˚F	
	WATER	AIR
GPM AT 50 ˚F ELECTRIC $.06 KWH AT 8,600 HOURS/YR.	22	11 fan hp/10 kW/ $5,160 yr.
GPM AT 70 ˚F	29	N/A
GPM AT 80 ˚F	48	N/A
TOTAL H_2O PRESSURE LOSS (PSID)		N/A
VENT FAN HP	1/.75 kW/ 3,500 cfm	
COOLING COST AT 70 ˚F H_2O/$/YR. ($H_2O$ COSTS AT 3.00 PER 1,000 GALLONS)	$44,892	
VENT FAN COST	$387	N/A
WATER & ELECTRICAL ENERGY COST AT $.06 KWH/8600 HRS/YR.	$45,279	$5,160
TOTAL HEAT REMAINING	599,000 btu/hr	

use) it will probably not be right for each particular location. This cost is very site specific and should be the first factor identified when embarking on a water cost, energy-control program. All of these escalating costs, along with the man hours required to measure and manage the process, have created a great incentive for industrial plants to supply or replace all their own plant water utility.

The net result of these cost factors for cooling water have resulted with most design engineers using a "default cost" of **$3.00 (USD) per 1,000 gallons** of cooling water — when the actual site situation is unknown. The accompanying water treatment cost is about specific situations and can be much higher depending on site conditions and maintenance diligence — $1.20 per 1,000 gallons based on 40 grains of hardness, alkalinity 10, and biocide treatment included.

Switching to Air-Cooled Air Compressors

In light of escalating water costs and regulations, plants have sought to decrease their cooling water requirements. Compressed air systems have become prime targets for continuous duty air-cooled air compressors. Some air-cooled rotary screw compressors have seen design improvements and can accept higher ambient temperatures than in the past.

The benefits of switching are readily apparent in terms of reduced water consumption and costs. Using the prior example, an air-cooled, two-stage, rotary screw, lubricant-cooled, 100 horsepower air compressor will have 85% lower water and electrical energy costs — compared to a similar water-cooled unit. The air-cooled unit will simply deploy a 5 kW fan creating an energy cost of $2,850.00 per year. Assuming 8600 working hours per year to take into account down-time, the water-cooled unit, with cooling water at 70 °F, will use 5,676,000

> "An air-cooled, 200 horsepower oil-free, air compressor will see 89% lower water and electrical energy costs — compared to a similar water-cooled unit."
>
> — Nitin G. Shanbhag, Hitachi America

gallons per year at a cost of $17,028.00 per year. Add the small compressor enclosure vent fan and the total annual cost is $17,597.00.

Using a similar example, an air-cooled, 200 horsepower oil-free, air compressor will see 89% lower water and electrical energy costs — compared to a similar water-cooled unit. The air-cooled unit will simply deploy a 10 kW fan creating an energy cost of $5,160.00 per year. Assuming 8600 working hours per year to take into account down-time, the water-cooled unit, with cooling water at 70 °F, will use 7,236,600 gallons of water per year at a cost of $44,892.00 per year. Add a small compressor enclosure vent fan and the total annual cost is $45,279.00.

Both of these examples used conservative water temperatures of 70 °F, did not add the potential cost of $1.20 per thousand gallons for water treatment, and did not add pumping circulation costs.

When evaluating a switch to an air-cooled air compressor, however, particularly on units larger than 100 horsepower, it is important to seriously evaluate all the application variables like room ventilation, ambient temperatures, after-cooler and dryer performance capabilities, maintenance personnel and processes.

All this considered, looking at the differences, it is obvious why plants are looking for air-cooled units whenever possible and/or looking at how to minimize water cooling costs when air is not viable. BP

A modern air-cooled, oil-free, rotary screw air compressor

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To read more ***Technology*** articles, visit www.airbestpractices.com/technology

weftec 2012 the water quality event™

SHOW REPORT: AIR BLOWER TECHNOLOGY AT WEFTEC 2012

By Rod Smith, Compressed Air Best Practices® Magazine

A total of 17,452 water professionals and 980 exhibiting companies from around the world attended WEFTEC 2012 — the Water Environment Federation's (WEF) 85th Annual Technical Exhibition and Conference — September 29 to October 3 in New Orleans, La.

"The amazing energy level at WEFTEC this year emphasizes the transformation that is occurring within our industry," said WEF Executive Director Jeff Eger, "We couldn't be more pleased that so many water professionals continually look to WEF for leadership and the best in water science and technology during this time of evolution."

To that end, last week's conference offered attendees their choice of more than 1,000 presentations in 148 technical sessions, 24 workshops, seven local facility tours, as well as several high profile events. Key sessions and workshops featured in-depth topics such as boosting biogas to energy, utility funding and financing strategies, trenchless rehabilitation technology, water reuse planning, wet weather treatment, and green infrastructure.

The blower aeration industry was well represented at the show displaying all types of blowers; rotary lobes, rotary screw, and centrifugals. Different control and drive technologies are rapidly being adopted as well to help better match blower kW with dissolved oxygen (DO) concentrations in the activated sludge treatment process. Here are the highlights.

Aeration Air Optimization Technology

BioChem Technology impressed me with their specialization in maintaining dissolved oxygen (DO) concentrations at their setpoints

Brandon Quinton and Andrew Balberg (left to right), from HSI/Atlas Copco, displayed multistage centrifugal, high-speed turbo and screw blowers.

Ralph Wilton, from Aerzen, next to the Generation 5 Turbo Blower.

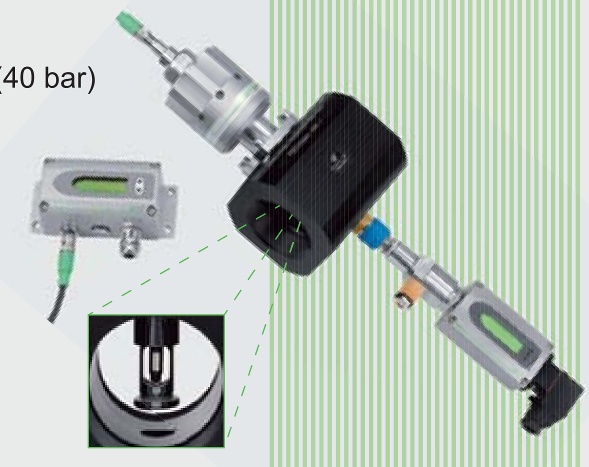
independent of influent BOD and ammonia loading. They combine an advanced control algorithm (derived from the activated sludge model) with airflow valve control technology. Called the Bioprocess Aeration Control System (BACS), it uses airflow and DO measurements to calculate changes in oxygen uptake rate (OUR) in each control zone over a specified time increment and calculates the airflow required to maintain the desired set-point. The system then sends a total airflow set-point to the blower control and modulates the air valves to distribute the air accurately to each aeration zone. (www.biochemtech.com)

The subject of an article last month, O2 Automation/Pulsed Hydraulics Inc., reported very positive tests back from their third-party test site in Korea. Their unique bubble mixing technology introduces a small air compressor into the installation while reducing kW requirements on the blower side. The testing is verifying the hypothesis of reduced system kW requirements while improving wastewater biochemical demand (BOD) metrics like total suspended solid uniformity (TSS), and mixed liquor suspended solids (MLSS). (www.phiwater.com)

Many industrial and municipal wastewater treatment plants are upgrading their aeration systems — realizing the significant kW savings when reducing loads on blowers due to more effective air distribution systems. The OTT Group displayed their new HE® System high-performance membrane diffusers featuring industry-leading oxygen transfer rates with very low air flow. OTT personnel described retrofit projects where energy savings up to 30% where realized compared to conventional systems. (www.ott-group.com)

Air Blower Technology

Kaeser Compressors, with their Omega Rotary Lobe Blower technology, had a nice display of a low pressure air system using a combination of a fixed speed and a variable speed blower. Stephen Horne, Product Manager for Omega Blowers, demonstrated how their adaptive system controller can manage the two blowers for optimal energy efficiency — based upon a PID loop driven by DO measurements coming from the wastewater treatment basin. Interesting to me is the Kaeser philosophy of "system splitting" — designing a system with fixed-speed blowers and then a VFD



SHOW REPORT: AIR BLOWER TECHNOLOGY AT WEFTEC 2012

Stephen Horne, from Kaeser Compressors, demonstrated "system splitting" with fixed-speed and VFD Omega blowers.

Shawn Boynton, from Gardner Denver, demonstrating the cut-away of the HeliFlow helical tri-lobe rotary blower.

blower for trim — as opposed to plants using two or more identically sized units with variable frequency drives. It's hard to beat the efficiency of a fixed-speed machine at full load. (www.kaeser.com/omega)

Atlas Copco's January 2012 acquisition of Houston Service Industries (HSI) to further enter the municipal wastewater market was on display. HSI's multistage centrifugal and high-speed turbo technologies complement Atlas Copco's line-up of ZS screw and ZB centrifugal blowers. HSI sales reps will serve as the primary channel to market for the sales of all HSI and Atlas Copco low pressure products into the municipal wastewater market segment. "Taking advantage of the combined technologies from both companies allows us to provide the municipal wastewater market with low pressure solutions that give customers maximum reliability with proven levels of energy efficiency," said Conrad Latham, Vice President Marketing, for the Atlas Copco oil-free air division. (www.hsiblowers.com)

Vic Miolee, from United Blower, was kind enough to provide an in-booth tutorial on high-speed turbo blowers. Looking at a cut-away of their new "Made in the U.S.A." turbo blower that runs at 20 to 30,000 rpm with a VFD control, Mr. Miolee pointed out the magnetic bearings. Magnetic bearing, in his opinion, are more durable than air foil bearings commonly seen on turbo blowers. There is no oil in this direct-driven turbo blower for lubrication or cooling. This new system also uses a closed loop refrigeration system to cool the permanent-magnet motor as opposed to the remote water-glycol heat exchanger systems other designs use to cool their AC motors. The airend itself uses a variable diffuser vane to increase the operating range of the blower. Mr. Miolee is a real encyclopedia of blower knowledge and by the end of the session, I was the definition of "knowing enough to be dangerous!" (www.unitedblower.com)

Sulzer Pumps announced the global launch, at WEFTEC, of their new ABS Turbocompressor HST 20. Sulzer Pumps was the first with direct-driven high-speed turbocompressors for wastewater aeration processes, introducing their first design nearly twenty years ago. The Turbocompressor HST 20 represents their third generation of fully air-cooled technology. The company has been working with magnetic bearing technology since 1995 and this package focuses on "wireto-air" energy management. Incorporating into one package what for other brands are called "accessories", this product integrates inlet and outlet silencers, the blow-off valve, and motor cooling air silencers. All inside one <70 dba sound attenuated canopy. The modern 7" HMI Control is a state of the art instrument allowing for full diagnostics, metric management, and external inputs for DO requirements. I was impressed by the statement there is no maintenance aside from the process air inlet filters. (www.sulzer.com)

I immediately saw the personification of "Made-in-the USA" rugged durability when Shawn Boynton, from Gardner Denver, showed me the airend cutaway of their HeliFlow helical tri-lobe blower. Described as a low-pulse design from inlet to outlet, this package lowers vibration levels resulting in longer bearing and downstream gauge life. This also lowers sound levels by 4-7 dba. The robust shaft and spherical roller bearings also allows packagers greater shiv selection options due to the fact it can withstand greater belt pull. Also on display was the IQ Blower Package with a canopy, controller, and optional VFD. (www.GardnerDenverProducts.com/blowers/heliflow)

The "Revolution" is continuing with Hoffman's release of the RO2 Model to fill out the range of this new centrifugal blower line. The model flows approximately 850 to 3500 cfm at 3 to 15 psig. This "Made in the USA" package offers a single enclosure housing, a direct-drive, high speed motor/blower unit, a self-contained cooling system, air filtration elements, and magnetic smart bearings. The modern control panel allows for external DO driven control of the variable frequency drive. (www.hoffmanandlamson.com)

Aerzen continues to grow in the municipal wastewater treatment segment with the Generation 5 turbo blower line they launched one year ago. With volume flow intakes from 4,000 to 13,200 m^3/h, these frequency-controlled and oil-free turbo feature very low maintenance costs over the lifecycle of the product. This air-cooled turbo blower features a stainless steel impeller. An oil-free design because the turbo impeller is mounted directly onto the motor shaft, aero-dynamic air-foil bearings guarantee friction and vibration-free operation, without the need for lubrication. (www.aerzenusa.com)

Wiekert Miolee and Vic Miolee (left to right), from United Blower, displayed their new high-speed turbo blowers.

Jason Morse, from Hoffman & Lamson, displayed the newly released RO2 model of the Hoffman Revolution™ high-speed centrifugal blower line.

SHOW REPORT: AIR BLOWER TECHNOLOGY AT WEFTEC 2012

Dave Parsons, John Paiva and Tom Albrecht (left to right), from Sulzer Pumps, displayed their new ABS Turbocompressor HST 20.

Omar Hammoud, from APG-Neuros, displayed their turbo blower.

APG-Neuros had a big booth showing their "plug and play" line of turbo blower offered in a compact package — claiming footprint reductions of 25 to 50% compared to conventional blowers. The product line can attain flow rates up to 8,500 cfm and a discharge pressure up to 15 psig with motor horsepower range from 30 to 300 hp. APG-Neuros also offers the "Dual Core" models that combine two cores within the same enclosure achieving a flow range between 3,000 and 20,000 cfm — in a small footprint! (www.apg-neuros.com)

We don't have room to do justice to all the brands on display at the WEFTEC Show. Christopher Harper, from Robuschi (www.robuschi.com), showed me the ROBOX Screw blower that is extremely quiet (<70 dba) due to their special silencers and engineered noise enclosure. Erik Ellevog, from GE Energy, walked me through the comprehensive control solutions (based on DO levels) they offer wastewater clients using their ROOTS EasyAir X2 blower package system. A bi- or tri-lobe splash lubricated blower, the package features TEFC motor enclosures, automatic belt and v-belt drive tensioning systems in a small footprint enclosure (www.ge.com/energy).

Howden Water Technologies displayed their high-speed drive (HSD Series) turbo blower combining their blower technology with permanent magnet motors able to provide new levels of turn-down capability and lower power consumption. I was impressed by their Bioactive Response System (BARS™) able to provide an automatic DOL set point control in case of nitrification via NH_4/NO_3 monitoring amongst many other features (www.howden.com). Other exhibitors included Piller and their turbo blower line (www.piller-tsc.com), FPZ regenerative blowers (www.fpz.com), Swam rotary tri-lobe and centrifugal blowers (www.swamatics.com), and Eurus bi-lobe positive displacement blower and vacuum pumps (www.eurusblower.com). BP

For more information contact Rod Smith, Compressed Air Best Practices® Magazine, rod@airbestpractices.com, www.airbestpractices.com

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Pneumatic Components Fight Automotive Plant Efficiency

By Peter Stern, Quality Maintenance Services

The fundamental question this paper poses is, "Are factories happy with vendors of manufacturing equipment (using pneumatic components) dictating their energy footprint requirements?" Compressed air is a significant energy consumer in every plant and to fully understand the ramifications of the imbedded misconceptions with respect to compressed air supply, one must take into consideration the actual point of use needs for compressed air.

One of the largest categories of compressed air uses, in automotive manufacturing plants, is the actuation of pneumatic cylinders. These cylinders are found throughout plants in the form of rotary valve actuators, slide gate actuators, and in the internal operating components for production and packaging machinery, material handling services, and a myriad of other devices. Supporting these actuators are a "rogues gallery" of pneumatic components creating unnecessarily high energy costs in the compressed air system. Remember the rule of thumb that for every 2 psig increase in system pressure, air compressors are forced into a 1% increase in energy consumption. Consistently restricting air flow, these pneumatic components force compressed air system pressures to be significantly higher than necessary.

Pneumatic Components Restrict Air Flow and Force

It has long been the habit of industry to perceive cylinder actuation timing adjustment to be a function of pressure, thereby requiring the installation of the ubiquitous pressure regulator in the supply line.

It should be recognized that, with the exception of those cylinder applications and services where small and incremental changes in down/up-force for nip rolls, press rolls, lift applications where down/up thrust or tensioning must be carefully controlled, and on some valve operators for positioning I/P devices, **most pressure regulators are misused and misapplied as de facto flow controllers.** The vast majority of the balance of the cylinder applications are not, in fact, pressure dependent.

The thrust of this portion of the report is to focus factory staff on the reality that cylinder actuation is a function of the **time rate of change (recharge)** initiated by adding the specific volume of air needed to properly actuate the device as the air is gated into the internal volume of the cylinder. Stated in another and more simplistic fashion, cylinder actuation time is a function of mass flow and time of the rate of recharge, not pressure.

PNEUMATIC COMPONENTS FIGHT AUTOMOTIVE PLANT EFFICIENCY

It is the restriction created by the pressure regulator, along with the other parallel restrictions in tubing, fittings, filters, oilers, solenoid valves and other components controlling the flow of the volume of air into the cylinder over a chosen period of time. Unfortunately, at the same time, this type of assembly creates the perception of the need to artificially raise pressure (add energy) in the plant to overcome the restriction these devices create.

The Improper Use of Pressure Regulators as a Faux Flow Control Device

Plant staff should seriously consider an incremental project to first educate all concerned personnel on this issue. Subsequent to the education effort, steps should be taken to identify point of use applications involving cylinders which are amenable to change and begin removing filters, lubricators, and regulators, along with concurrent undersized tubing and fittings, upsizing of feed tubing, and **installing common bar stock needle flow control valves. The net result will be more accurate control of stroke times and a commensurate reduction in the pressure needed to do the job.** *The reader should note that care should be taken to ensure the elastomers in the cylinder do nor require lubrication and consider a retrofit to new elastomers if they do.*

This in turn will result in allowing staff to lower the pressure in the overhead transmission piping of the compressed air system.

Remember, the force applied on a cylinder is directly proportional to the cross sectional area of the cylinder ram times the net article pressure of air in psig applied to that ram. The hidden factor that is generally overlooked is the time domain of the stroke. If one is desirous of sizing the approach pipe/tubing to adequately feed a sufficient volume (NOT PRESSURE) of air to do the task in the time allotted, one must realize that the time frame of one minute is the common denominator in calculating flow in cubic feet per MINUTE.

Image 1: The Components of a ¼" Regulator.

Image 2: The Diaphragm and Follower Plate.

If a cylinder is designed to stroke in a two second time domain, one must take into account that there are 30 two-second increments in every minute. If you know the cylinder diameter and stroke length, you have a volume. In this example, in order to delineate the exact flow, you must multiply the volume times 30. That number is the actual cubic feet per minute equivalent but taken in two seconds. This scenario is described as a "Sudden Event Demand" and must be properly dealt with.

Please understand that this is not a full essay on all the specific factors surrounding compressed air supply to cylinders. **The intent is to alert the reader to the specific issue of the improper use of pressure regulators as a faux flow control device.** This is the preeminent issue that must be understood fully in order to create an open pathway for beneficial change.

Flow Restrictions in a ¼" NPT Regulator

Image 1 shows a disassembled standard ¼" NPT industrial air pressure regulator. The left portion is the main body. The next item to the right is the diaphragm and the follower plate with an integral flow port. The next item to the right is the compression spring and follower cup. The final item to the right is the bonnet with an integral threaded compression rod.

A close view of the body of the pressure regulator shows a small raised rod in the center as the spring-loaded pilot poppet assembly. The hole above the poppet contains a .060" drilled hole to allow air from the input from the adjacent pipe nipple to flow up into the visible cavity area.

Image 2 shows the diaphragm and follower plate with a center orifice port through which the air is supposed to flow on overpressure. The hole in the orifice centers directly on the spring-loaded pilot rod in the main body. When a worker tightens down the thread compression rod into the follower cup, it compresses the spring against the diaphragm. This in turn presses the pilot hole in the diaphragm more tightly against the spring-loaded poppet.

For the sake of comparison, this photograph superimposes the point of a .7 mm lead pencil immediately adjacent to the pilot hole. In this way the viewer can easily see the very small diameter of the pilot hole in relation to the pencil point. Taken in a common sense view, the tighter one compresses the spring against the diaphragm follower plate, the tighter the compressive pressure pushes the orifice against the pilot rod. This in turn creates an inordinately high restriction which prevents mass flow of air from passing rapidly through the orifice, a higher bleed off pressure.

Naturally the adjacent pressure gauge reflects a higher pressure. The physical laws of air dictate that with reduced flow, pressure must rise until it mirrors the highest supply pressure. Given the linear characteristics of this standard compression spring, the more the rod is turned down into the bonnet, that tighter the orifice plate is pushed against the pilot rod.

Image 3 shows the regulator housing with the pin (actually a poppet) removed from the .060" hole. The air comes in from the nipple at top and rises through the .060" hole in the larger hole to the left of the hole the poppet came out of. Note the poppet has a tapered shoulder which seats in the cavity below the hole as shown in next view.

The housing has a seat where the tapered poppet sits in the center hole, pin up through the hole in the center. The cavity to the right is the air exit out of the regulator through the elbow. The post protruding from the bottom is the stop for the poppet bottom which has a small spring for purported flow control and to keep the poppet from being blown out of its hole. This view shows the poppet on its spring and follower cup to keep things centered.

All being said, the air in must flow through the .060" inlet hole, through the cavity area, and around the shaft of the poppet, a passage considerable smaller than the .060" hole, into the lower cavity, and out through the elbow. It is easily understood that this mechanism creates extremely high levels of restriction against the flow of air while at the same time establishing a barrier that allows the adjacent pressure gauge to read a higher pressure.

Image 3: Inside the Regulator Housing.

Image 4: A ¼" NPT "Mini-Regulator."

Image 5: A 1 ½" NPT Pressure Regulator.

PNEUMATIC COMPONENTS FIGHT AUTOMOTIVE PLANT EFFICIENCY

"The perception that higher pressure settings in a regulator allow for more air flow are totally erroneous and flies in the face of common sense and reason, not to mention the laws of physics."

— Peter Stern, Quality Maintenance Services

Image 6: A poppet orifice measuring .060" in a 1½" NPT Regulator.

Image 7: The 1½" NPT Housing.

It would be nice if someone could logically explain how an orifice this small can pass a sufficient volume of air through it to successfully actuate a large cylinder in an acceptable short time frame while using a minimum of energy to do so. Unfortunately, the laws of Physics militate against the possibility.

Image 4 shows the so-called mini ¼" NPT regulator found in great abundance throughout industry. The assembly is very similar to the larger standard unit. For the sake of comparison, however, a common sewing needle has been inserted through the pilot hole in the diaphragm, the same size as the internal flow port under the white seat area in the lower body, to substantiate the .035 inch hole through which the air must pass.

Image 5 shows the configuration of a 1½" NPT Regulator is essentially the same as the others shown in the article. The hole in the center of the body is 1/8". The poppet is .220 inches in diameter. The air cross over port seen in the poppet stem leads to a hole in the bottom of the poppet seat that is slightly less than .080" in diameter. However, please take notice of the poppet.

Image 6 shows the passage in the poppet stem is the path through which the exit air flows out of the regulator, to the left past the 0 ring seal which separates the top chamber from the bottom one, through the center of the stem. Image 7 reveals the determinant port through which the air finally passes to exit the regulator. It measures .060" which actually limits flow to 11.5 cfm at 90 psig.

In Image 7 we can see how compressed air exits through the small tube seen on the side of the housing, NOT a 1½" port, but the reduced passage from which the flow through the poppet exits the regulator. The folly of installing this type of regulator is immediately obvious.

The perception that higher pressure settings in a regulator allow for more air flow are totally erroneous and flies in the face of common sense and reason, not to mention the laws of physics. With this firmly in mind, it now becomes abundantly clear that any facility wishing to improve the actuation of pneumatic cylinders and the equipment on which they work, should seek an alternative to the standard practice of using regulators. It is far more reasonable to utilize a common bar stock precision linear needle flow control valve to control the rate of recharge of the cylinder volume.

Image 8: A Common Manifold Mounted Solenoid.

PNEUMATIC COMPONENTS FIGHT AUTOMOTIVE PLANT EFFICIENCY

Image 9: A Common ¼" Solenoid Valve With Small Flow Ports.

Solenoid Valves

Efforts must also be made to increase the diameter of pneumatic approach tubing, solenoid valves and their internal porting, and other component issues. This will reduce restrictions to flow in the most expedient and cost-effective manner. If pressure must, by nature of a service requirement be regulated, the use of a low differential, high flow, piloted regulator should be a point of focus.

Along with the pressure versus flow issue we must simultaneously consider the supply control issue. The usual means of supply control is a solenoid valve which opens when demand is calling for supply. Research on this subject demonstrates that the same restriction issue is found to be prevalent in most solenoid valve applications. Image 8 depicts a common manifold mounted solenoid found on a myriad of production and packaging machinery.

Image 10: Quick Disconnect Hose Fittings.

The orifice, in Image 8, was gauged with the help of the small nail which was then measured at .060 inches with the calipers. Banks of these types of valves are found throughout American industry where overhead transmission pipe compressed air pressures are typically 85 psig or greater.

We can further follow this logic and common sense train of thought by observing, in Image 9, a common ¼" NPT solenoid valve found on all too many point of use applications throughout industry. Please take careful note of the fact that while the pipe connections are ¼" NPT, internal to that connection the actual flow ports are less than one half that size. This demonstrates the forcing factor requiring application of larger amounts of energy at the compressor to attempt, albeit all too often unsuccessfully, to overcome restriction through higher compressed air pressures at unnecessarily higher energy costs.

Quick Disconnect Hose Fittings

The last in our rogue's gallery is the ubiquitous quick disconnect hose fittings (Image 10) found everywhere in industry. If an interested person were to look carefully inside these devices, they would quickly see the very small air passages which are the reason these devices typically have a minimum of 7 psig differentials across them. Some are even higher going to as much as 12 psig differential.

Conclusion

When you look at these pneumatic components closely, it is easy to see why pressure differentials in the range of 40 psig are not uncommon. The higher pressures are obviously governed by the inability of the small diameter openings in these types of valves, taken in combination with restrictions in FRL sets, to pass sufficient volumes of air at lower pressures to accomplish the task assigned the mechanism at a faster rate and lower energy applied in the compressor room.

The consequence is an overall higher cost of operation, quality excursions, and reduced rates of product throughputs. It is long past time for industry to wake up and take a look at how they specify and purchase pneumatic equipment. BP

For more information please contact Peter Stern, Quality Maintenance Services, tel: 828-349-3007, email: pkstern@dnet.net

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HOW'S THE WEATHER IN YOUR PIPES?

By Ron Marshall for the Compressed Air Challenge®

What are the conditions inside your pipes, is it cloudy and hot with showers or cool and dry? Could there be snow and blowing snow and excessive icing conditions? Are there smog and dust storm conditions or is the air as fresh as a mountain breeze. All these conditions are commonly experienced inside compressed air systems. What you get is determined by your selection of system equipment, ambient conditions and how well your system is maintained. Compressed Air Challenge's Fundamentals and Advanced Seminar material, and our Best Practices Manual contain a wealth of background material about air quality and dryers that could make you a good weather maker for the air inside your pipes. The following is a sample of the information provided.

Why Does Compressed Air Need Drying?

All atmospheric air contains some water vapor which will begin to condense into liquid water when the air in a compressed air system cools to the saturation point, i.e., the point where it can hold no more water vapor. The temperature at which this happens is known as the dew point. This dew point is a key factor in determining how much drying is needed.

Condensation in the compressed air system would occur at the intake air saturation temperature (the dew point of the ambient air) if the temperature remained constant as air was compressed. However, since there is a rise in temperature during actual compression, condensation generally does not occur within the compression elements. But later, as compressed air is discharged and cooled in an after cooler, condensation begins to occur as the temperature drops. The condensed moisture must be removed by an efficient separator and trap.

The air leaving the after cooler is normally is normally 100% saturated at the after cooler discharge temperature. Thus the dew point

Fundamentals of Compressed Air Systems WE (web-edition)

Learn about Dryer Types

Join Compressed Air Challenge for the next session of *Fundamentals of Compressed Air Systems WE* (web-edition) coming November 6th. 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 student 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.**

HOW'S THE WEATHER IN YOUR PIPES?

of the air within the pipes is about the same as the cooling air temperature plus the cold temperature differential of the after cooler. As the hotter air cools to ambient some moisture drops out of the air.

For many years, problems from moisture in air lines were tolerated. To prevent freezing, alcohol was injected into the lines and electric heaters were used during cold periods. Filters were used to separate moisture and other contaminants, but did not completely solve the problem. The increased use of compressed air and the development of many new and more sophisticated devices and controls have accelerated the need for clean dry air. Hence drying technologies have advanced, and dryers have come into general use. Dryers are used for the following reasons:

- Moisture in compressed air used in manufacturing plants causes problems in the operation of pneumatic air systems, solenoid valves, and air motors by leading to rust and increased wear of moving parts as it washes away lubrication. Moisture also adversely affects the color, adherence, and finish of paint applied by compressed air.
- Moisture causes problems in process industries, where many operations are dependent upon the proper functioning of pneumatic controls. The malfunctioning of these controls due to rust, scale, and clogged orifices can result in damage to product and costly shutdowns. Additionally, the freezing of moisture in control lines in cold weather commonly causes faulty operation of controls.
- Corrosion of air or gas operated instruments from moisture can give false readings, interrupting or shutting down plant processes.

Measuring Moisture Content

Obviously there are times when it is desirable to know, with varying degrees of accuracy, the moisture content of the compressed air. Methods are available which will give you readings, which vary from approximations to precise measurements:

- Moisture Indicating Desiccants
- Dew Point Cup
- Refrigerant Evaporation
- Fog Chamber
- Infrared Analyzer
- Capacitance
- Hygroscopic Cells
- Frequency Oscillator

By far the most common method these days is the Capacitance Cell method. A good accurate instrument that can be used to constantly monitor dew points and ensure you are getting top quality compressed air and to guard against unexpected failure of drying equipment. These cells are also used with dryer controls to cut back the purge flow of compressed air dryers.

Moisture Carrying Capacity of Air

The maximum water vapor the air can hold depends upon the temperature and pressure. The amount of vapor the air actually does contain — relative to the most it can contain is relative humidity (the ratio of the quantity of water vapor present to the quantity present at saturation at the same temperature).

Dew Point

The temperature at which water vapor in the air starts to condense or change from vapor to a liquid or a solid state. (Dew points may be expressed at an operating pressure or at atmospheric pressure. Operating pressure should be specified when using pressure dew point. The relationship between pressure and atmosphere dew point is shown on Chart No. 3 in the appendix.

Specifying a Compressed Air Dryer

The air dryer with certain auxiliary equipment becomes a system, which is an important component of the whole plant compressed air system. Various components comprising the dryer subsystem should be selected on the basis of the overall requirements and the relationship of the components to each other. The selection of the drying equipment can significantly affect the cost of compressed air in your facility. Good management of the costs means that you dry your air only to the level required by your plant production equipment or ambient conditions.

There are just three main factors to analyze in selecting the appropriate dryer (including size) to provide your required performance — dew point, operating pressure and inlet temperature.

Dew point — Refrigerant dryers provide a pressure dew point of 35 °F or 50 °F at operating pressure based on saturated inlet air temperature of 100 °F. Regenerative desiccant dryers generally provide a pressure dew point

"Air which may be considered dry for one application may not be dry enough for another. Dryness is relative. Even the desert has moisture."

— Ron Marshall

of minus 40 °F or lower, at operating pressure and 100 °F saturated inlet air temperature.

Deliquescent dryers are more sensitive to the saturated inlet temperature and, based upon a saturated inlet air temperature of 100 °F, provide a dew point from 64 °F to 80 °F at operating pressure.

Operating Pressure — At higher pressures, saturated air contains less moisture per standard cubic foot than lower pressure saturated air. Drying air at the highest pressure consistent with the plant design will result in the most economical dryer operation. Chart 1 shows the relationship between operating pressure and water content. Taking air at 100 psig as the normal pressure, a subsequent decrease in pressure results in a substantial increase in the water to be removed. At higher pressures the water content curve tends to increase at a slower rate.

Inlet Temperature — The temperature of air entering the dryer is usually close to the temperature at which it leaves the aftercooler. Saturated air at 100 °F saturated contains almost twice the amount of moisture of saturated air at 80 °F. For every 20 °F increase in the temperature of saturated air, there is an approximate doubling of the moisture content. Thus it is desirable to operate the dryer at the lowest feasible inlet temperature.

Selecting The Right Dryer

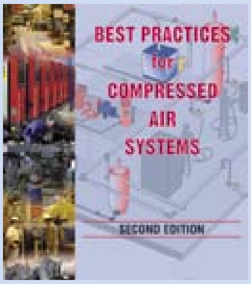
Before looking at the several types of dryers available, we need to look at what to consider in deciding which dryer is best for the specific requirements.

Know the Specific Uses of the Compressed Air — The selection of an air dryer is done best by the professional who knows or learns the particular end-uses, the amount of moisture which each use can tolerate, and the amount of moisture which needs to be removed to achieve this level. Air which may be considered dry for one application may not be dry enough for another. Dryness is relative. Even the desert has moisture. There is always some moisture present in a compressed air system regardless of the degree of drying. Different types of dryers, therefore, are available with varying degrees of pressure dew point ability. To specify a dew point lower than required for an application is not good engineering practice. (Naming a pressure dew point is how to state the degree of dryness wanted.) It may result in more costly equipment and greater operating expense.

Know the Temperatures

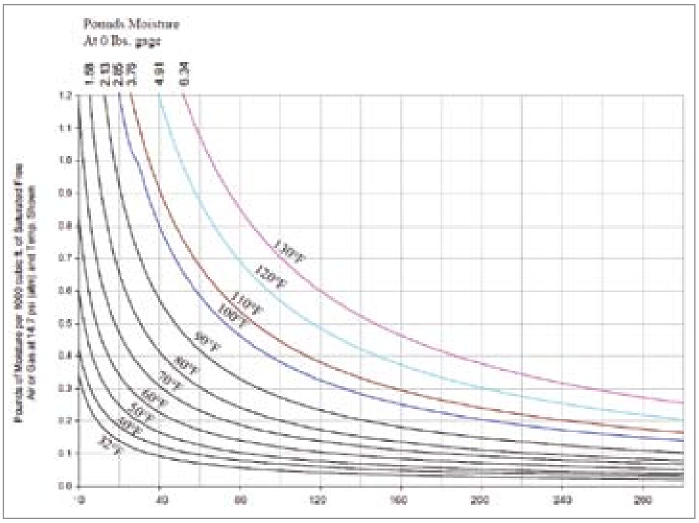
To determine whether or not the compressed air will remain sufficiently dry, we must know the end-use of the air and the temperature at which it must work. In an industrial plant where the ambient temperature is in the range of 70 °F or higher, a dryer capable of delivering a pressure dew point 20 °F lower than ambient, or 50 °F, may be quite satisfactory. Summer temperatures do not require a very low dew point whereas winter temperatures may dictate a much lower dew point. In winter, the cooling water temperature usually is lower than in summer, resulting in a variation of the air temperature to the dryer. This will affect the size of the dryer needed, since the same

Best Practices for Compressed Air Systems Second Edition



This 325 page manual begins with the considerations for analyzing existing systems or designing new ones, and continues through the compressor supply to the auxiliary equipment and distribution system to the end uses. Learn more about air quality, air dryers and the maintenance aspects of compressed air systems. Learn how to use measurements to audit your own system, calculate the cost of compressed air and even how to interpret utility electric bills. Best practice recommendations for selection, installation, maintenance and operation of all the equipment and components within the compressed air system are in bold font and are easily selected from each section.

HOW'S THE WEATHER IN YOUR PIPES?



Moisture content in saturated air with varying pressure (PSI).

dryer must work in both summer and winter temperatures and relative humidities. For example, many chemical processing plants, refineries, and power plants distribute instrument and plant air throughout the facility with lines and equipment located outside the buildings. In such plants two different temperature conditions exist at the same time in the same system. Also, a dryer, which may be satisfactory for high daytime temperatures may not be satisfactory for lower nighttime temperatures. In areas where freezing temperatures are encountered, a lower pressure dew point may be required. In general, the dew point should be specified 20 °F lower than the lowest ambient temperature encountered in order to avoid potential condensation and freezing. To specify a winter dew point when only summer temperatures will be encountered, can result in over-sizing the equipment and increased initial and operating costs. For plant air and instrument air, primary considerations in specifying a dryer are condensation and freezing. In a system where a lot of internal pipe corrosion could occur, high humidity in the air stream should be avoided.

Know the Actual Performance — While many dryers have a standard rating of 100 °F saturated inlet air temperature and 100 psig operating pressure, it is important to check on the actual performance of the units obtained in actual plant operating conditions.

Know Each Use — In addition to plant and instrument air applications, there are many other uses requiring moisture removal to a low dew point. For example, railroad tank cars which carry liquid chlorine are often padded (charged) with compressed air to enable pneumatic unloading. Chlorine will combine with water vapor to form hydrochloric acid; therefore, the compressed air must have a minimum moisture content to prevent severe corrosion. Another example are droplets of moisture in wind tunnel air at high-testing velocities; these droplets may have the effect of machine gun bullets, tearing up the test models. Another example is where compressed air used for low temperature processing (for example, liquefaction of nitrogen or oxygen) can form ice on cooling coils, thus requiring defrosting. The lower the moisture content of the air, the longer the periods between defrosting shutdowns.

For these and similar temperature applications, compressed air must not only be free of liquid phase water but must also have a minimum content of vapor phase water. Usually specified for these requirements are dew points in the range of -80 °F to -100 °F at pressure.

Mind the Inlet Temperatures

Because, as mentioned earlier, the amount of water in the compressed air being processed by the dryer significantly increases as the temperature increases, high compressor discharge temperatures due to extreme ambient conditions or a problem with the compressor cooling system. When this happens the design capacity of the dryer will be exceeded allowing water to pass unprocessed into the downstream system causing contamination problems. To avoid these problems the dryer inlet temperatures should be continuously monitored. If problems exist some remedial measures may be required like compressor cooling system redesign, adding a wet storage receiver to help cool the air, or a secondary aftercooler with a separator.

Maintain Your Equipment

Often poor maintenance of condensate drains, cooling radiators, and filter elements can affect air dryer operation, even if the equipment requiring maintenance is not associated with the air dryer. Maintenance staff must ensure the condensate that is supposed to be drained before it gets to the dryer is removed. Cooling surfaces that are coated with dust or oil cannot remove the heat from the air before it gets to the dryer. Filters that are clogged or have failed inside and are passing water through due to element failure can significantly affect dryer performance. BP

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TECHNOLOGY PICKS

Sullair Announces Industry's First 900 CFM Electric Portable Air Compressor

Sullair Corporation introduced its revolutionary new E900H Electric Portable Air Compressor, the only 900 cfm electric portable in the domestic and 460/60 markets. Designed to combine the clean, quiet efficiency of electric drive technology with the Sullair legacy of rugged air ends and portable compressor designs, the E900H offers an amazing 67% lower operating cost than equivalent diesel-driven compressors. The Sullair E900H Electric Portable Air Compressor delivers 900 acfm at operating pressures up to 150 psig. Distinguished by a unique combination of features, the Sullair E900H is the first 900 cfm portable electric compressor to offer such diversity. Foremost among these features is the Sullair AF System that allows the compressor to deliver convenient and cost-effective instrument quality air for instrumentation, process equipment and other sophisticated industrial applications. Available with a built-in high capacity, low-approach after-cooler and highly efficient down-line filtration, the Sullair E900H provides an ideal source of supplemental, replacement or emergency instrument quality plant. The mobile Sullair E900 Electric Portable Compressor features standard 460volt/3 phase/60 Hz cam-lock electrical connections for quick connect installation using standard electrical power or portable generators for either indoor or outdoor applications. The Sullair E900H Electric Portable Compressor is designed to provide many of the same features as its diesel driven counterpart, but without the time and expense required for re-fueling and diesel sourcing. The system is powered by a 214 HP premium efficiency TEFC electric drive motor with Wye-Delta starter and provides 100% emission-free operation. The unit has a user-friendly deluxe instrument panel that includes easy-to-read gauges and visual alerts to compressor operating conditions and service prompts. The enclosure has large lockable service doors that provide ample access to motor and compressor for service and maintenance. The E900H Electric Portable Compressor also features a highway towable tandem axle design that supports a full fluid containment frame; and includes electric brakes, restraining tow chains and tail lights. For optimum hot and cold weather lubrication, the compressor system is charged with Sullair AWF Compressor Fluid that offers longer fluid life and an extended 5-year air end warranty.

Contact Sullair Corporation
www.sullair.com

New Kaeser Mobilair M350 Portable Air Compressor

Delivering 1200 cfm at 125 psig, the new versatile, fuel-efficient Mobilair M350 takes its place as the most powerful model in Kaeser Compressor's portable compressor line. The unit includes many of the same features as Kaeser's other Mobilair models — a large fuel tank, easy access to maintenance points, and an anti-frost valve —

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as well as a low carbon particulate production diesel engine, an SCR catalytic converter, and more.

The powerful combination of an efficient Kaeser rotary screw airend and a Mercedes Benz engine provides impressive compressed air delivery with minimal emissions and fuel consumption. Additional innovations help boost savings even further. For example, a viscous fan clutch controlled via Kaeser's Sigma Control Mobile™ cuts fuel consumption by up to 5%. Options on the M350 include various pressures, skid-mount, and air treatment for cool, dry air.

Contact Kaeser Compressors
tel: 877-682-6482
www.KaeserNews.com/M350

New BOGE K8 Booster generates oil-free 580 psi compressed air

The new BOGE K8 BOOSTER compresses compressed air from 150 psi to a maximum pressure of 580 psi — completely oil-free. Especially sensitive areas, such as the food, plastic, health or chemical technology industry profit from this procedure. But also for users attaching special importance to permanent compressed air generation or having no possibility to carry out an oil change — the new K8 BOOSTER is the ideal solution.

The K8 BOOSTER completes the oil-free piston compressors of the BOGE K-series and is unique in the category up to 5.5 kW of oil-free pistons. The compact construction of the K8 BOOSTER provides the conditions for a smooth decentralised installation. It is driven by Premium Efficiency Class IE 3 motor and generates — depending on the inlet pressure — a delivery volume of maximally 41 cfm at a pressure of 580 psi. Models with and without pressure receivers are available.

Contact BOGE Compressors
tel: 770-874-1570
www.boge.com/us

Upgrade Ejector Vacuum Pump with piSAVE Optimize

Piab, a leading supplier of industrial vacuum technology, introduced piSAVE optimize, a vacuum controlled proportional pressure regulator. A fully pneumatic device, easy to use and easy to install — actually the perfect pressure regulator for air-driven pumps/ejectors! Why adjust the feed pressure when the desired vacuum level can be adjusted instead, piSAVE optimize will take care of the rest. It is designed especially to simple to connect for any air driven pump

piSAVE optimize senses the vacuum level in the system. The feed pressure of the compressed air to the vacuum pump/ejector is automatically regulated and controlled to maintain the set vacuum level. The vacuum level

RESOURCES FOR ENERGY ENGINEERS

TECHNOLOGY PICKS

is kept constant in this manner and the air/energy usage is kept to a minimum for the application (optimized).

piSAVE optimize provides maximum feed pressure/vacuum flow to the vacuum pump until the vacuum level starts to build up. This means no reduction on the initial amount of flow or pick up speed in handling applications. The unit reacts quickly to changes in compressed air pressure or to changes in the degree of leakage into the vacuum system in order to maintain the set vacuum level.

Available in two versions, as a stand-alone unit with a simple connection for any air-driven vacuum pump as well as a click-on version to Piab's piCLASSIC & Classic lines of vacuum pumps, the desired vacuum level is easily set by an adjustment knob on the unit.

Contact PIAB
tel: 800-321-7422
www.piab.com

Michell Easy Re-calibration for Moisture Transmitters

Following the success of its Easidew Service Exchange program, Michell Instruments has extended the service to its Pura trace moisture transmitters. Users subscribing to the Pura Service Exchange Program can relax about their periodical calibration needs because, at an agreed time, Michell will provide them with a freshly calibrated, reconditioned transmitter. It takes just minutes for the user to install the new sensor in the process in place of the old sensor, which is returned to Michell.

By subscribing to the Pura Service Exchange Program, the user's process will always be monitored by freshly calibrated instruments, utilizing the latest firmware and hardware updates. "The beauty of this system is its simplicity," says Peter Shepherd, product manager for sensors at Michell Instruments. "The user has the assurance not only of keeping their process operational throughout, but also of having a fully calibrated dew-point transmitter at all times. This increases the reliability of the process for everyone." Shepherd went on to explain, "This exchange program is perfect for industries such as semiconductor manufacturing where shutting down a process will involve loss of production time."

Service Exchange is not the only option offered by Michell to help its customers maintain the reliability of their processes. The company has a fully UKAS and NIST accredited moisture calibration laboratory at their international headquarters in Ely, UK, and many customers opt to return their sensors here for recalibration. "When users need to maintain full calibration traceability of their sensors, then recalibration is the best option," explains Peter Shepherd. "At Michell we offer a fast and reliable re-calibration service for our own sensors and instruments, as well as for other brands."

The Pura Transmitter is a rugged, self-contained hygrometer, designed for the measurement of trace moisture content in ultra high-purity gases and is widely used in applications such as semi-conductor manufacture, fiber optic production as well as industrial gas production and distribution. Measuring dew points down to -120 °C, or 1ppbV, the Pura provides one of the most economical, yet reliable, methods of measuring trace moisture.

Contact Michell Instruments
tel: 978-484-0005
www.michell.com/us

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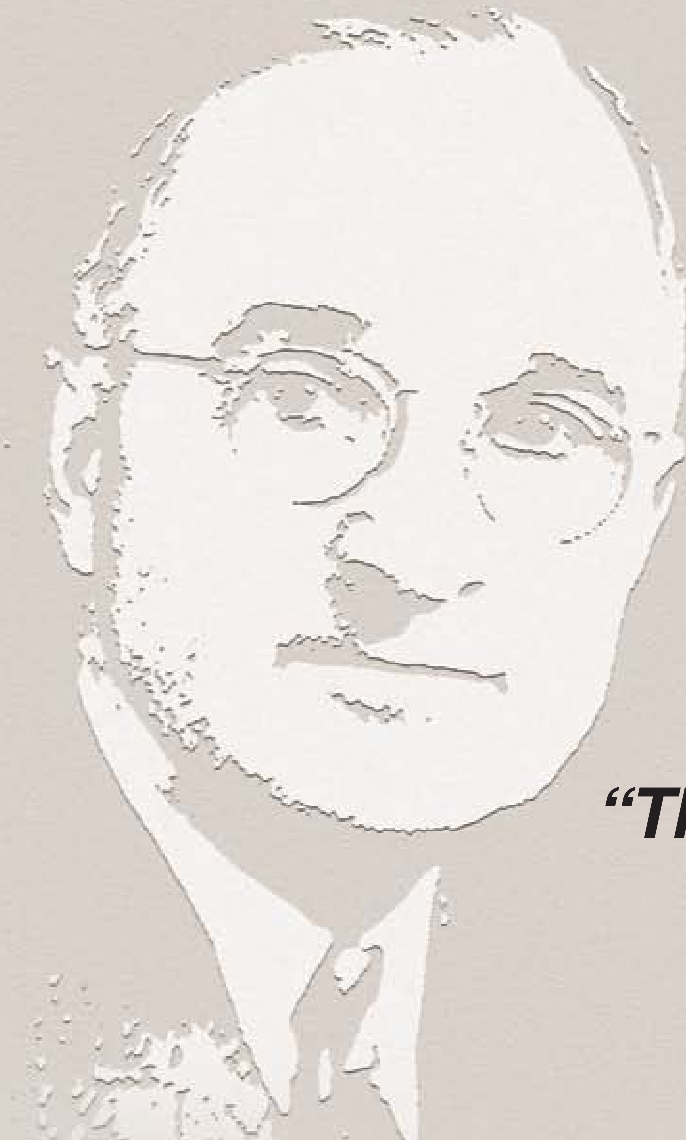

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— Harry S. Truman

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