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

COMPRESSED AIR BEST PRACTICES®

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December 2013

Air Compressor Controls

SUSTAINABLE MANUFACTURING FEATURES

COLUMNS

FROM THE EDITOR | Air Compressor Controls

We have a broad variety of articles this month. The first is about a plant owned by TIGG Corporation (yes, the custom tank people) down in Arkansas. Kevin Conley, from Arkansas Industrial Machinery, conducted a system assessment that took TIGG from a retrofitted 350 hp compressor to two new 75 hp rotary screws with one serving as back-up! The project received a utility incentive from Entergy and also led to other energy conservation projects getting done.

Ron Marshall provides us with a true "air compressor controls" article this month on behalf of the Compressed Air Challenge®. With the fun title, "Your Air Compressor May Be Smarter Than You Think", the article makes clear what many of us know. As with any technology, the main issue with controls is not whether it exists rather if it's actually used and applied appropriately.

I'm always looking for demand-side audit information and it's once again provided by Air Power USA. Don van Ormer provides us with examples of three demand-side projects they recently did at a glass plant. Speaking of the demand-side, Process Expo 2013 was held in November at McCormick Place in Chicago. As you know, food processing and packaging machines rely upon pneumatic circuits, vacuum circuits and chillers. I hope you enjoy my "roving reporter" article as I review the compressed air and pneumatic technology at the show.

We have two good articles on compressed air dryers in this issue. One article is supplied by Chris Ursillo from Ingersoll Rand and the other from the Compressed Air & Gas Institute (CAGI). When should a factory use a refrigerant or a desiccant dryer? What dew point requirements do our processes have? What are the associated energy costs? These are important questions each compressed air user should understand.

It's hard to believe this is the last issue of 2013. I'm looking forward to starting next year with a bang at the 2014 International Production & Processing Expo (www.ippexpo.org) scheduled for January 28-30 at the Atlanta Convention Center. We are proud to be a *Supporting Publication* and hope you can visit the show. Please stop by the Compressed Air Best Practices® Magazine booth (7662 B Hall) and say hello!

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COMPRESSED AIR, PNEUMATICS, VACUUM & BLOWER INDUSTRY NEWS

Atlas Copco Acquires U.S. Oil & Gas Service Company

Atlas Copco has purchased the operational assets of Archer Underbalanced Services, a leading service provider of down-the-hole hammers, drill bits and compressed air packages to U.S. land-based oil and gas drilling companies.

Archer Underbalanced, a part of Archer Well Services, based in Houston, Texas, had sales in 2012 of MUSD 34 (MSEK 230). The acquired assets include five service locations near major oil and gas reserves, and a drill bit manufacturing facility in Carlsbad, New Mexico. A total of 75 Archer Underbalanced employees is expected to transition to Atlas Copco.

"We are very pleased with this acquisition as it greatly enhances our distribution and support presence in the U.S. land-based oil and gas drilling industry," said Johan Halling, Business Area President, Atlas Copco Mining and Rock Excavation Technique. "This creates opportunities for adding several complementary Atlas Copco product lines in the future such as state-of-the-art compressed air solutions through this new distribution channel."

The acquired business will become part of Atlas Copco's business area Mining and Rock Excavation Technique.

Visit www.atlascopco.com

BOGE America Appoints New Service Manager

Boge Kompressoren, manufacturer of rotary and oil-free screw compressors, is pleased to announce that Michael Troyer has been appointed as Service Manager. Josh Chabot, current Service Manager for BOGE America, is moving into a new position as a Project Manager over seeing all current and future projects at BOGE America. Michael Troyer brings years of experience in the compressed air industry, customer service attitude, and a strong mechanical and electrical aptitude to BOGE. At BOGE, he will manage all warranty and technical support for the BOGE Distributor Network across North and South America. Michael's work ethic, interpersonal skills, and compressed air knowledge will be a great addition to the team at BOGE America. Scott Woodward, General Manager for BOGE America commented, "Having Michael Troyer join the already strong team at BOGE America will be a great addition in our effort to deliver superior Customer Service and Technical Support to our Distributor Network."

Visit www.boge.com/us

Dost Kompresör Becomes Part of Atlas Copco's Compressor Technique Service Division

Atlas Copco Internationaal B.V. has acquired Dost Kompresör ve Endüstri Makinalari Imal Bakim ve Ticaret A.S., a distributor and service provider of compressors and related equipment in Turkey.

Dost Kompresör, based in Istanbul, Turkey, has 16 employees and is active in industrial compressor sales and service. *"This acquisition will expand our presence in the increasingly important Turkish market,"* said Stephan Kuhn, President of Atlas Copco's Compressor Technique Business Area. *"It supports our strategy to focus on service relations with our customers".*

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"A total of 75 Archer Underbalanced employees are expected to transition to Atlas Copco."

THE COMPRESSED AIR SYSTEM ASSESSMENT

TIGG Corp. and Entergy Arkansas Reduce Energy Costs

By Kevin Conley, Arkansas Industrial Machinery

The Facility

TIGG Corporation, a manufacturer of activated carbon adsorption vessels, custom air receivers and other steel tanks and pressure vessels, substantially reduced its energy costs after implementing equipment, labor consolidation and procedural changes resulting from a compressed air energy audit. The audit was performed at TIGG's 155,000 square feet manufacturing facility in Heber Springs, Arkansas to determine the efficiency of the existing compressed air system and to set a baseline for TIGG's participation in Entergy Arkansas' Large C&I Custom Incentive Program.

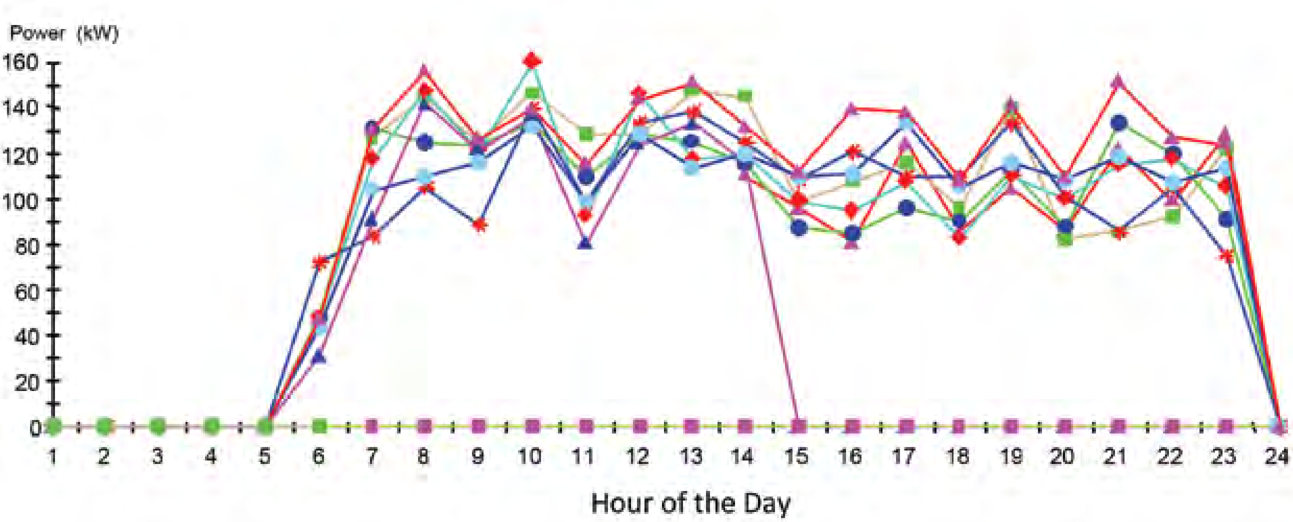
The C&I Custom Incentive Program is offered by the electricity provider to businesses whose facility utilizes a peak demand of 100 kW or greater and it delivers cost saving incentives for customers who reduce peak demand loads at their industrial facilities. The plant audit was administered by Clearesult, an energy management company that works with utility companies to implement and evaluate optimization programs. The compressed air audit was performed by Arkansas Industrial Machinery.

"As a builder of large tanks and custom air receivers we always knew our clients could see cost savings from a compressed air energy audit and the installation of bigger, more efficient air receiver tanks," said Doug Murray, TIGG's plant manager. "However, we were surprised to discover that adjusting our labor schedule, repairing air line leaks and installing new equipment would have such a major impact on our own operating costs."

The Current Compressed Air System

The majority of TIGG's compressed air usage occurs during the steel tank and pressure vessel painting and sand blasting processes. The rest of the air demand is from sporadic use throughout

Illustration 1



the facility for powering air tools. At the time of the audit, the plant was running two shifts with the majority of high air demand applications happening on second shift. TIGG was using a water-cooled 300 hp oil lubricated rotary screw compressor (motor was 350 hp) that used modulating controls without unloading. The steel tank and pressure vessel manufacturer had a water-cooled 1300 cfm cycling refrigerated air dryer and a 20 hp cooling water pump that only provided cooling for the compressed air system equipment.

"Our old equipment was a 300 hp water cooled compressor that would run 16 hours a day," Murray said. "It would run in full loading manner during that time. This machine would generate a peak demand charge because of all of the kW required to start the compressor each day. Also the compressor would remain loaded the entire time, which was 16 hours per day."

TABLE 1: BASELINE DATA

AIR SYSTEM COMPONENT	PEAK DEMAND (KW)	ANNUAL (KW)	ANNUAL COST
300 hp Compressor	134.6	682,528	$47,777
20 hp Cooling Pump	15	86,420	$6,050
Water Cooled 1300 cfm Dryer	Negligible	Negligible	Negligible
Total Compressed Air System	**149.6**	**768,948**	**$53,827**

The Baseline Audit

Data-loggers were deployed for two weeks monitoring the cooling water pump, the dryer and the compressor's kW usage and plant air pressure was also monitored. Caution was taken while planning the deployment of the data-loggers to ensure that a representative sample of TIGG's normal operations would be recorded. It is important to note that this facility does not perform the same task every

THE COMPRESSED AIR SYSTEM

day. Though TIGG manufactures standard steel tanks, a large portion of their business comes from making custom tanks and air receivers.

The process for manufacturing these custom tanks was scrutinized and the timing of the data logger deployment was such that a representative sample would occur. A direct correlation between air usage and finished product, which is needed to determine the amount of incentive money that TIGG would qualify for under Entergy's Incentive Program, was evaluated and no direct correlation was found. This is partly due to the amount of time it takes to manufacture some of the large tanks from start to finish.

The decision was made to keep strict records of work being performed throughout the plant and use this information with the baseline data to determine if TIGG would have enough energy savings potential to participate in Entergy's Incentive Program. Illustration 1 is a plot of the air compressor's kW readings broken down into hourly demand averages. Each line represents the hourly kW averages for each day of the logging period. The illustration shows that this facility does not have a stable compressed air demand throughout the day and that there are few clearly established day-types.

Representatives from Entergy and Clearesult presented TIGG with a check totaling $58,222 in incentive dollars garnered from equipment and labor adjustments made after a compressed air energy audit. (from left to right: Jeremy Dillon (Clearesult), Georgiana Riley (TIGG Corporation), Stoney Engle (TIGG) and Alice Leacher (Entergy).

ASSESSMENT | TIGG Corp. and Entergy Arkansas Reduce Energy Costs

TIGG's air compressor was running less than 25 percent capacity, but was using greater than 70 percent power due to the compressor using modulating controls. Take another look at the power readings in the above illustration knowing that the compressor is running less than 25 percent capacity. This is a remarkable opportunity for energy savings. Additionally, using the 350 hp motor on the 300 hp air compressor further reduced energy efficiency of the compressor and lowered the accuracy of predicting compressor flow by using the kW readings. The baseline data is in Table 1.

Based on the kW readings, TIGG used an hourly average of 277 cfm and there were periods of high consumption that exceeded well over 400 cfm for 15 to 20 minutes continuously. There were also many long periods of low demand that averaged less than 20 cfm per hour. It was obvious that a more energy efficient solution was needed, but the inconsistency in air demand made sizing a new compressor difficult. The application seemed not well suited for one air compressor. United States Department of Energy AIRMaster+ Software was used to determine the most energy efficient replacement options for this system.

The New Compressed Air System

A Variable Speed Drive (VSD) compressor is normally ideal for applications with such an irregular demand. In this application though, one VSD compressor was not the ideal solution because the compressor would run at very low capacities too often. Running VSD compressors consistently at low capacities causes the oil sump to fill up with the water that comes out of the air during the compression process.

TABLE 2: PROJECTED DATA

AIR SYSTEM COMPONENT	PEAK DEMAND (KW)	ANNUAL (KW)	ANNUAL COST
Two 75 hp Compressor's	61	337,624	$23,634
Refrigerated Dryer	4.3	23, 840	$1,669
Total Compressed Air System	**65.3**	**361,464**	**$25,302**

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> "In August of 2012 we used a total of 133,200 kW and August of 2013 we used only 52,800 kW."
>
> — Doug Murray, TIGG's Plant Manager

VSD's need to run at higher speeds to burn off the water as it enters the oil system. Water build-up in the sump will eventually destroy the air end of the compressor. Because of this, it was determined that a two compressor system was needed. After reviewing the most energy efficient options, TIGG chose to purchase two fixed speed air cooled 75 hp rotary screw compressors with load/no load controls and a shutdown timer. A 690 cfm air cooled cycling refrigerated air dryer was also purchased.

This selection seemed ideal in that one of the 75 hp compressors would handle the facility's operations over 75 percent of the time. The second compressor would start-up as needed based on their cascading control set points. Having two compressors in the facility also prevents the entire plant from shutting down in the event that an air compressor is down for preventative maintenance or is down due to a malfunction. This also gives the facility some excess capacity for possible future expansions.

Every operation that requires compressed air within the facility can operate with one 75 hp compressor, just not simultaneously. Additionally, the new air cooled equipment allows for the permanent shutdown of the cooling water pump, which was a constant 15 kW load during compressor operations.

The projected annual energy usage for the recommended compressors is in Table 2. The total annual energy usage for the entire system is expected to be less than half of their current system. Based on a calculated annual energy savings of 407,484 kW, Entergy offered to pay TIGG up to 75 percent of the cost of purchasing and installing the new more energy efficient equipment.

Due to the potential success of the compressed air project, TIGG evaluated their entire facility from an energy efficiency standpoint with the help of Clearesult's Representative Jeremy Dillon and started two new projects. The first

Sparks fly as Shawn Golliher applies welds to a custom air receiver at TIGG's Heber Springs, Ark. manufacturing facility. Thanks to a compressed air audit, TIGG was able to substantially reduce its energy costs.

project was installing more energy efficient lighting and the second project involved process improvement.

"The two new compressors run on a lead lag configuration, which means they will only run together when the demand for air is present", Murray said."The new compressors were installed in March, which was the same time we adjusted our man-hours."

In looking at their process, TIGG recognized that they could bring their second shift in to work with the first shift and maintain the same level of productivity. This change required better management and supervision of the flow of work throughout the plant. LEAN manufacturing principles were used to reduce waste within the process and training was given to promote a more energy conscious environment.

The combination of consolidating the shifts and increasing supervision on the floor considerably reduced runtime on the compressed air system. By smoothing out the flow of work, many of the processes requiring compressed air that used to happen simultaneously no longer do and peak air demand was lowered dramatically. The costs associated with lighting the facility were significantly lowered also by cutting the second shift.

The Verification Audit

After the new compressed air equipment was installed, data loggers were deployed for monitoring kW usage of the compressors and the dryer for verification purposes. Once again, caution was taken to ensure that a

Arkansas Industrial Machinery

The original company in the AIM Family, Arkansas Industrial Machinery Inc. was founded in 1971. The company was located at its present site in North Little Rock, Arkansas and has undergone several expansions over the past forty years. AIM Power and Fluids Division was established in Memphis, Tennessee in 1975 to cover the growing market in West Tennessee and North Mississippi. AIM of Louisiana in the Shreveport/Bossier City, Louisiana market was established in 1981 to cover the North Louisiana and North East Texas markets.. The newest member of the AIM Family, established in 1994, is AIM Power and Fluids Division. This Nashville, Tennessee branch covers the central Tennessee market. These 4 strategic locations meet industrial requirements for quality products and service on a local basis.

Andy Fowler, President, Arkansas Industrial Machinery

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TABLE 3: VERIFICATION DATA			
AIR SYSTEM COMPONENT	PEAK DEMAND (KW)	ANNUAL (KW)	ANNUAL COST
Compressor Operations	20.4	47,524	$3,327
Air Dryer	0.2	743	$52
Total Compressed Air System	**20.6**	**48,267**	**$3,379**

representative sample of normal workload would be provided during the logged period. Obstacles for Entergy's Audit Team were created when the facility combined second shift into first shift. The baseline data had two shifts of production and the verification data only had one. The initial plan by Entergy's auditors was to remove all second shift data from the baseline. This caused a problem because the majority of sand blasting occurred during the second shift and removing that from the baseline would not give credit to the air usage in that part of TIGG's process.

Eventually, it was proven that production in the facility had not gone down between baseline and verification. Production had actually increased. Due to this, the auditors compromised and allowed a portion of the

In order to save on energy costs associated with the compressed air system, TIGG upgraded its equipment by installing two new 75 hp compressors running on a lead/lag configuration and a new air dryer. The steel tank and pressure vessel manufacturer also adjusted man-hours to improve production and to further reduce energy consumption.

second shift data collected during of the baseline audit. Table 3 shows the results of the verification audit data. The energy usage for the compressed air system was even much lower than expected. The reduction in energy costs was over 90%. Thinking that an error must have occurred during the verification logging, data loggers were deployed by Clearesult's to ensure the data was accurate. The second round of data logging netted the same results as the first.

A plot of the results of the verification audit data is in illustration 2. It is important to note that due to the facility's improved processes, the demand on the compressed air system is much less than originally anticipated. During the verification logging period, one of the 75 hp compressors was able to carry the load of the entire plant and that compressor's highest flow was 63 percent capacity of the compressor.

Incentive and Savings

The equipment and installation costs of the project were $78,000. Based on the verification data and the adjustment of the baseline data by auditors, TIGG's total annual energy savings was calculated to be 443,748 kW. TIGG received an incentive check for $58,000 and they

saved over $50,000 annually in electrical costs associated with the compressed air system. TIGG's return on investment was five months.

Murray explained that TIGG's monthly utilities bills have been cut in half since May, which is showing direct results. "Our August utility bill shows our usage from last year to this year and in August of 2012 we used a total of 133,200 kW and August of 2013 we used only 52,800 kW," he said. "This shows a 60.3% reduction in kW from this year to last year." BP

For more information contact Kevin Conley, Arkansas Industrial Machinery, AIRMaster+ Certified, email: kconley@aimcompanies.com

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THE COMPRESSED AIR SYSTEM ASSESSMENT

Three Compressed Air Demand-Reduction Projects at a Glass Plant

By Don van Ormer, Air Power USA

This glass container plant is very large and very well laid out with a very apparent "culture of quality." They run (14) IS machines and inspection lines on four furnaces.

Currently the plant has three basic air systems: low-pressure air (52 psig); high pressure air (100 psig) and oil free instrument air (100 psig). The low-pressure air averages about 21,700 scfm with peaks to about 25,000 scfm. The high-pressure air system and the instrument air system average about 4,000 scfm at 100 psig with peaks to less than 4,800 scfm.

Annual plant electric costs for compressed air production, as operating today, are $3,050,625 per year. If the electric costs of $27,811 associated with operating ancillary equipment such as dryers are included the total electric costs for operating the air system are $3,078,436 per year.

These estimates are based upon a blended electric rate of $0.085 /kWh. The high and low-pressure air systems operate 8,760 hours per year. The load profile of this system is relatively stable during all shifts for both systems.

This was a complete supply and demand-side system assessment. The supply-side audit involved shutting off old air compressors and purchasing newer more efficient air compressors and dryers. The demand-side audit involved finding ways to improve the piping and reduce compressed air consumption.

Due to space limitations, this article will focus on some demand-side actions taken. Although the low-pressure leak audit yielded **287** cfm in demand reductions and the high-pressure leak audit yielded 22 cfm in demand reductions, this article will focus on other lesser-known project areas where a plant can reduce compressed air consumption.

The Existing Compressed Air System

Low Pressure: The low-pressure air supply is comprised of mostly old centrifugal air compressors. There are five TA18s with aftercoolers, four TA50's without aftercoolers, one small TA2000 150 hp centrifugal and a newer (2011) TA6000 1,250 hp centrifugal with an aftercooler.

Specific power ranges from 6.49 scfm/kW ($114.67 /scfm / year) on the TA2000 to 7.62 scfm/kW ($97.76 /scfm / year). This is a 14-15%

> "Both the high-pressure and low-pressure systems saw their air flows reduced. This was then leveraged into savings through modifications to the supply side of the system."
>
> — Don van Ormer, Air Power USA

variance in basic air production efficiency. Most units appear to be in relatively good working order and well maintained.

High Pressure: The high-pressure system is comprised of newer small centrifugals and single-stage rotary screws. There are two TA2020, 250 hp centrifugals, two older TA975 single-stage, lubricant cooled rotary screws, and four single-stage, lubricated rotary screws. All units are water-cooled and installed in a very hostile operating environment in the basement.

Specific power ranges from 4.66 scfm/kW ($146.66 /scfm / year) on the rotary screw compressor and 5.45 scfm/kW (136.50 /scfm / year) on one of the centrifugals. This is a 14-15% variance in basic air production efficiency. These units appear to be well maintained, but they are operating in a very harsh environment.

Instrument Air System: The "oil free" air for the instrument air system is supplied by three Joy WGOL-9 single-stage, double-acting reciprocating compressors. These units are very old and are applied at 100 psig discharge pressure which, even though it's within their rating, will cause excessive premature wear of rings, seal etc. Their optimum operating discharge pressure is really around 70-75 psig.

These units have a specific power of 4.09 scfm/kW ($182.10 /scfm / year). This is 25% less than the TA2020 centrifugals which are also "oil free", 100 psig class compressors.

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The high-pressure air and instrument air systems have refrigerated dryers. There are no dryers on the low-pressure system. The five TA18's have water-cooled aftercoolers as well as the newer TA6000 1,250 hp low-pressure unit. The older TA50's do not have aftercoolers. All units are water-cooled using tower water.

Project #1: Optimize Empire Sandblast Units

The sandblast units run in an Empire PC6060 automatic cabinet blaster at an inlet pressure of 100 psig. This air is coming from a header at 100 psig. There could be additional savings by running off the low pressure air supply. If a mechanical shot slinger blast system would be appropriate, all compressed air would be eliminated. Operating at a higher pressure will automatically use more air. This should be compared to time on the job and probably avoided.

All blasters should be set up with either manual or automatic shut-off valves so that the air can be turned off when not in use.

All the listed units have automatic shut-off valves working 18 hrs per day @ 50% utilization — includes mold blasting (8 min) and clean up (2 min). Six 1/4" nozzles @ 80 psig nozzle inlet pressure use 80 scfm each for 480 scfm @ 50% utilization = 240 scfm net air demand.

Replacing these six standard nozzles with six venturi suction nozzles at 20 scfm each @ 50% utilization will reduce the net flow of 60 scfm, a savings of 180 scfm. We recommend installation of flow meters on each blasting unit to determine "normal demand" or air flow and monitoring nozzles for wear and leaks that may trigger maintenance.

TABLE 25. LIST OF AIR VIBRATOR RETROFITS

LOCATION	QTY	USAGE (%)	AIR FLOW (CFM)	SAVINGS (CFM)
Scale 6 / Outlet #2	1	100	15	15
Scale 1 / Outlet #2	1	100	15	15
Scale 2 / Soda Ash	1	100	15	15
Scale 7 / Cullet	1	50	15	8
TOTAL	**4**		**60 cfm**	**53 cfm**

The plant should then set up regular maintenance to check and change nozzles when indicated by the flow meter. It is important to have regularly scheduled nozzle changes based on measured hours of wear. Changing out high performance nozzles (carbide) or boron nozzles at 10-20% wear will decrease blast time and increase blasting efficiency. This action results in faster material removal and will also reduce average air demand.

Total flow of current system	240 cfm
Total number of nozzles	6
Total cfm saved per nozzles	60 cfm
Total air reduction	360 cfm
Percent utilization	50%
Net avg savings in compressed air	180 cfm
Total annual savings	$25,081 /yr
Total cost of project	$4,000

*The annual recoverable energy cost is estimated at $139.34 per cfm saved.

Project #2: Replace Air Vibrators

Air vibrators are used to keep product or packaging moving or separated — e.g., keeping lids separated prior to sealing. If a plant employs air vibrators that use about 10 cfm each, they will require about 2.5 hp or more to produce the same as a similar electric vibrator, which might use about 0.25 hp input energy. Air vibrators can almost always be replaced with electric except in foundry sand mold operations.

Compressed air used currently	60 cfm
Reduction in compressed air usage	53 cfm
Total energy recovery project	$7,385 /year
Estimated power/energy to run electric vibrators	2 kW
17,524 kWh	
Electric energy cost at $0.085 /kWh	$1,489 /year
Net savings energy cost for project	$5,896 /year
Cost of project	$2,000

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TABLE 21. CURRENT APPLICATION VENTURI VACUUM GENERATORS IN USE

LOCATION	QTY	BRAND	MODEL SIZE	PSIG	CA SCFM FLOW	EVAC AIR FLOW	% UTILIZATION	AVG CA USE
Box Erector 11	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Box Erector 12	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Box Erector 13	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Box Erector 14	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Box Erector 21	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Box Erector 22	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Box Erector 23	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Box Erector 31	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Box Erector 32	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Box Erector 33	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Box Erector 41	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Box Erector 42	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Box Erector 42	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Box Erector 43	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Box Erector 44	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Emmeti Palletizer (5 shop)	1	PIAB	M200L	60	OFF			0
Tier Sheet robot (5 shop)	4	N/A	N/A	80	3 each	12	100	12
Tier Sheet robot (51 shop)	4	N/A	N/A	80	3 each	12	100	12
Reselect East Box Erector	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Reselect West Box Erector	2	Vaccon	JD 200	80	4.8 each	6 each	50	4.8
Tier Sheet robot (33 shop)	4	N/A	N/A	80	3 each	12	50	6
Emmeti Palletizer (33 shop)	1	PIAB	M200L	60	32	64	50	32
Tier Sheet robot (32 shop)	4	N/A	N/A	80	3 each	12	50	6
Tier Sheet robot (31 shop)	4	N/A	N/A	80	OFF			0
Tier Sheet robot (23 shop)	4	N/A	N/A	80	3 each	12	50	6
Emmeti Palletizer (23 shop)	1	PIAB	M200L	60	32	64	50	32
Tier Sheet robot (22 shop)	4	N/A	N/A	80	3 each	12	50	6
Emmeti Palletizer (22 shop)	1	PIAB	M200L	60	32	64	50	32
Tier Sheet robot (21 shop)	6	N/A	N/A	80	3 each	18	50	9
Tier Sheet robot (14 shop)	4	N/A	N/A	80	3 each	12	50	6
Tier Sheet robot (13 shop)	4	N/A	N/A	80	3 each	12	50	6
Tier Sheet robot (12 shop)	4	N/A	N/A	80	3 each	12	50	6
Tier Sheet robot (11 shop)	4	N/A	N/A	80	3 each	12	50	6
Total	**88**							**258.6**

Project #3: Optimize Vacuum Generators in Case Packers and Palletizers

The system assessment identified 88 vacuum generators using 259 scfm of compressed air. We estimate that 131 scfm of use can be eliminated if automatic compressed air shut-off controls are used when the generators are not functioning.

It would be advantageous to investigate the use of automatic shut-off vacuum Generators in the following two applications:

- Case or carrier erectors — when the line stops the vacuum air continues to run.
- Palletizers — most were holding about 15 to 20 seconds out of every 1.5 minutes, which is about 17% time on vacuum with air running. Vacuum generators with automatic shut off will eliminate all or most of this air use. The palletizer slip sheets appear to be an excellent application for this situation.

This project will add automatic air shut-off controls to Venturi vacuum generators to shut off the air to the vacuum generators when the proper vacuum is achieved. It will also replace less efficient single-stage vacuum generator with coaxial multi-stage. We believe most, if not all, of these can be reduced to a negligible level, in which case the savings would be significantly higher.

When the vacuum capacity to product lifted is appropriate, add venturi generator with built-in automatic on/off controls. A vacuum generator uses *60 scfm at 90 psig and can pull a 20" vacuum in 0.25 seconds.* If the vacuum generator is shut off at 20" of mercury vacuum pressure, total air demand will be about *0.25 scfm (1/16 hp) vs. 60 scfm (15 hp)*.

Estimated average flow of Venturi vacuum without auto shut off	258 cfm
Number of Venturi units	88
Air flow savings with auto shut-off & efficient vacuum generator	131 cfm
Recoverable energy savings	$139.34 /cfm yr
Annual estimated energy savings	$18,254 /year
Equipment and installation cost to add automatic controls	$15,000

Conclusion

The system assessment at this brewery realized significant demand-side reduction opportunities. Both the high-pressure and low-pressure systems saw their air flows reduced. This was then leveraged into savings through modifications to the supply side of the system. BP

For more information contact Don van Ormer, Air Power USA, tel: 740-862-4112, email: don@airpowerusainc.com, www.airpowerusainc.com

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

YOUR AIR COMPRESSOR MAY BE SMARTER THAN YOU THINK

By Ron Marshall for the Compressed Air Challenge®

➤ Not long ago most air compressors were controlled with mechanical pressures switches, relays and gauges. The setup of these units, especially when attempting to coordinate multiple compressors could be a frustrating and fruitless experience because often, no sooner than the controls were correctly adjusted, some sort of mechanical gremlin would throw something out of adjustment again.

Modern day controls are often made up of accurate cutting edge electronics controlled with sophisticated microprocessors that are programmed with clever algorithms to make the compressors run more efficiently and more reliably.

More and more features are being developed and implemented into the control algorithms. It is in the user's best interest to learn what your compressor control has to offer and to determine if you can benefit from the new innovations.

One such very useful algorithm is the automatic counting of starts per hour to reduce unloaded run time. This article discusses the use of this algorithm in controlling small air compressors for significant savings percentages and gives an example where this feature was used to gain a savings of 66% by simply adding a storage receiver, lowering the pressure and adjusting the compressor control.

Auto Start Feature

Quite a number of years ago the designers of compressor controls realized it was inefficient to leave a compressor to constantly run unloaded if it wasn't required to produce any air. In particular, many screw compressors consume significant power of 25% to 50% of full load (or higher in some cases) in the unloaded state which wastes power if left to run unnecessarily. To limit wasted energy the compressor controls were fitted with a timer circuit (auto start feature) that detected if a compressor had run unloaded for a period of time, and if it had, would turn off the compressor motor. The stopped compressor would remain active and be ready to start if the system pressure dropped to the load point. The trouble with this type of circuit is that if a user adjusts the timer to say one minute, and the system has limited storage capacity, the compressor might attempt to stop and start too many times per hour, exceeding the main driver motor's maximum number of starts per hour. The allowable starts per hour for a motor can vary greatly depending on the characteristics of the motor, the size, the starting method and the momentum of the shaft load, and other considerations. More information about motor starts can be found in NEMA standard MG-1. In general the larger the motor and higher the voltage the less times per hour a motor can start.

This is all very complicated, and in the old days, to simplify, a standard minimum timer setting, typically about 15 minutes was installed so that no compressor motor would stop and start more than 4 times per hour. It took a little while but some manufacturers soon realized the limitation of this setting, especially when it came to smaller compressors that could reliably start 10 to 15 times per hour. This 15 minute setting often was ineffective in reducing the unloaded power consumption of compressors that cycle more than 4 times per hour, but less than the maximum number of motor starts.

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Starts-per-hour Algorithm

Eventually some manufacturers figured out that it is safe to implement a way of operating that allows more starts per hour, but safely limits the number of starts should something happen that causes the compressor to rapidly cycle. For the purposes of this article these various control modes will be called "smart controls". Since this article is being written to be vendor neutral, the specific manufacturers with this feature will not be mentioned, it will be up to the user to request information about your particular control from your service provider. Some available "smart controls" work in these ways:

- One manufacturer allows a maximum of 4 starts per hour, but the starts can be any time within a moving one hour period. If the starts are exceeding then the compressor simply runs unloaded
- One manufacturer has a special pre-programmed mode if selected will sense the compressor cycle frequency and, if acceptable, will turn off the compressor immediately after a short unload period, this manufacturer also has a mode where the motor temperature is sensed by monitors, and if low enough additional stops/starts will be allowed
- Another manufacturer allows the user to program the desired maximum starts per hour or starts per day. Each compressor size comes with a maximum allowable number that the control setting will limit. The compressor will shut down immediately after a short unload period if the number of starts will not exceed this maximum number as the algorithm projects based on the current compressor cycles. If not satisfied the compressor will remain running unloaded
- Yet another manufacturer allows the timer to be reduced to as low as two minutes, with the motor allowed to turn off if the compressor has been running for 10 minutes (not recommended to be used to protect against excessive start)

Some of these ways to control the compressors are innovative in the way they protect the compressor motor from damage yet maintain enough flexibility to save unloaded run time. With many of these controls, if the compressor storage receiver is sized correctly, significant savings in hours of unloaded run time are gained, especially for lightly loaded compressors with the occasional high peaks, such as units located in repair shops.

Designing "Smart" Storage

The compressor control can't do it alone; in order to be effective the compressor cycles need to be within the range the control can handle. Chart 1 shows the effect of changing the volume and load/unload pressure band on the number of cycles per hour. For small compressors it is best to design enough storage for about 6 to 8 starts per hour at the maximum frequency, which occurs at the

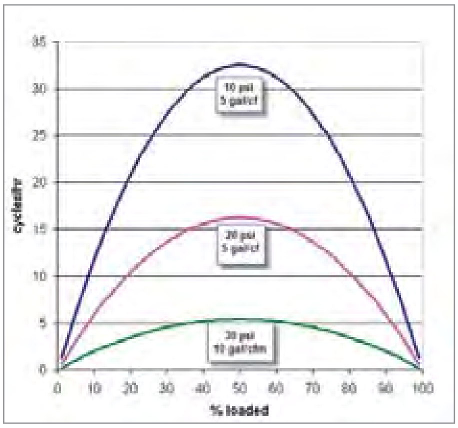

Chart 1: Effect of storage and pressure bands on cycle frequency

50% loaded point (check this limitation with the manufacturer). Experience has show that storage volume of 10 gallons per cfm and 30 psi pressure band ensures that the number of starts per hour at 50% load always remains under 6. In general, though, to be beneficial this strategy should be applied to systems with average loading well under 40%.

Things can happen in a system that could increase the cycle frequency, most likely filter differential. As the filters load with debris through the normal life cycle, if the filter is located between the compressor control sensing point and the storage receiver , then the effective capacity the compressor "sees" reduces and the cycles per hour increase. For

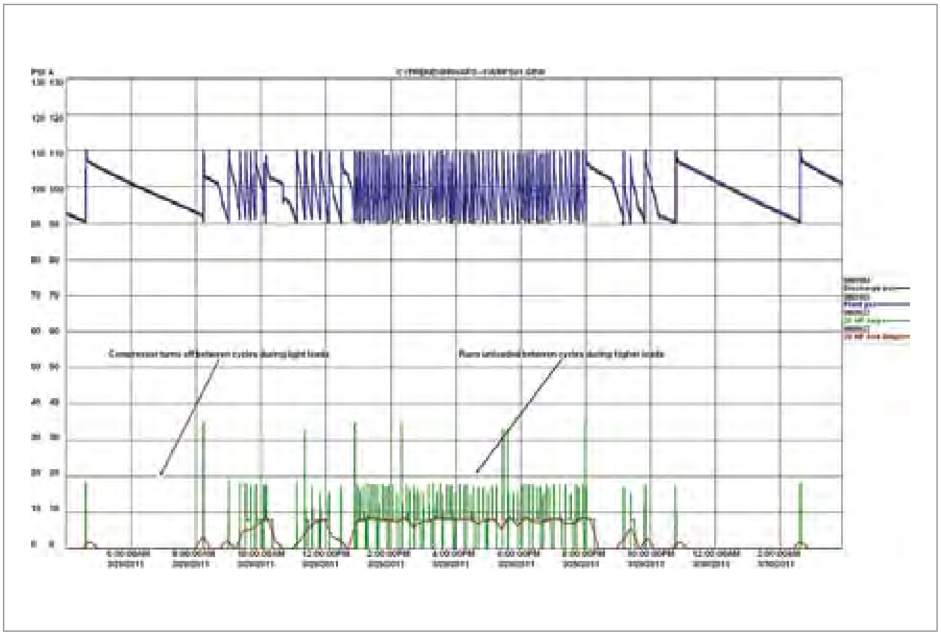

Chart 2: Typical production week profile showing significant time spent unloaded.

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this reason it is best to rely on a Smart control rather than simply turning a timer down to zero, which is possible in some cases.

Effect of Wider Pressure Band

The higher average pressure will make the compressor motor power consumption in the loaded state higher by about one percent for every two psi increase (usually less than this above 110 psi). Widening the pressure band from a 10 psi band to a 30 psi band increases the average pressure seen by the compressor by 10 psi and causes roughly 5% more energy consumption. However, if the compressor is running unloaded for significant hours, eliminating the unloaded run time can more than pay back this additional loaded power.

The higher pressure will also affect unregulated compressed air consumers and increase the flow if allowed into the plant. For this reason a pressure/flow control device is recommended to maintain a constant lower plant pressure of slightly less than the compressor load setting.

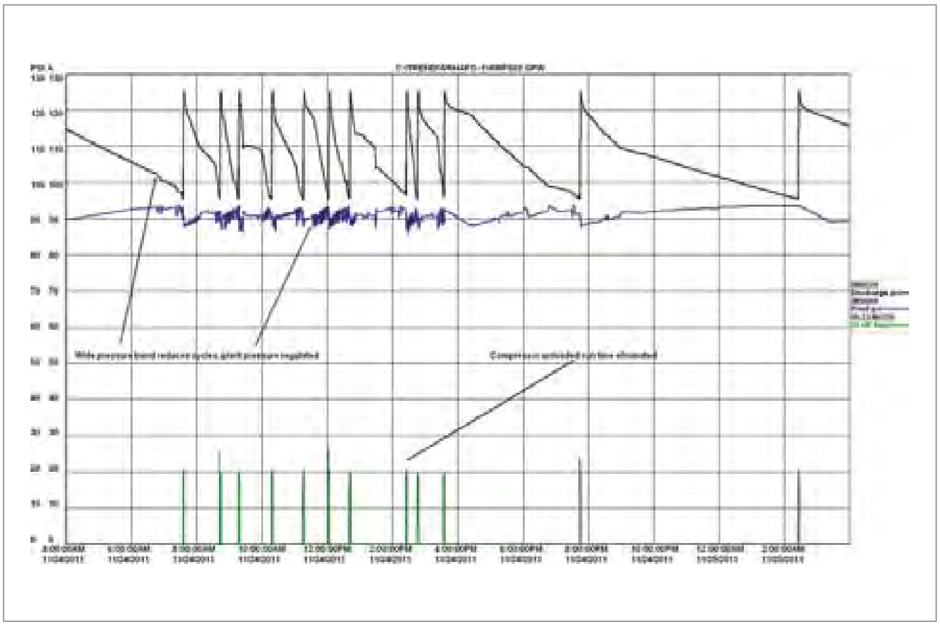

Chart 3: Compressor unloaded power eliminated after storage added.

Example Project

A central food services facility for area hospitals in a major Canadian city uses compressed air for pneumatic operations. An audit was done on the facility that showed the existing 20 hp compressor operating loaded 2% of the time while running unloaded 26% of the time. Because the load is light the compressor's internal starts per hour is active, shutting down the compressor between cycles during light loading between shifts, but not during main shifts due to the lack of storage. Nevertheless, the compressor's calculated specific power is 77 kW per 100 cfm produced because the compressor remains running unloaded for most of its operating time, still consuming about 35% of its full load power but producing no air. Chart 2 shows the original profile of 24 hours of system operation.

In order to reduce the compressor operating time a 660 gallon receiver was added to the system with a pressure/flow control valve set at 90 psi. The resulting compressor operation using a smart control virtually eliminated the unloaded run time and greatly reduced the number of compressor starts. The specific power of the system is now reduced to about 24 kW/100 cfm, a 60% reduction. With a flow reduction due to lower plant pressure, and small leakage reduction, the actual reduction in operating costs is 66%.

This example project is very small but illustrates the savings that can be gained if the "intelligence" of the control is coupled with good design and know how. Many similar projects have been implemented, one as high as 100 hp with very large storage, and have proven an excellent alternative to VSD's in locations with light average loading and high peaks, but with dusty environments. Should you wish to do similar projects the manufacturer of the compressor should be consulted to determine the allowable number of starts per hour for your particular unit and if the compressor control is set up for correct operation.

CAC Training Available

Projects like this can be yours for the taking; the secret is to apply some knowledge gained from a CAC training seminar and do some measuring. There are pre-qualified instructors available now to help you host your own seminar. More information on CAC's many instructors is at http://www.compressedairchallenge.org/training/instructors/ BP

For more information on ***Air Compressor Controls,*** visit www.airbestpractices.com/technology/compressor-controls

Energy Savings Result from Compressed Air Dryer Selection

Christopher Ursillo, Marketing Manager — Air Treatment, Ingersoll Rand

Every facility has differing application needs and usage demands, but selecting the right compressed air dryer for the situation will have a significant impact on energy savings and efficiencies.

Compressed air systems account for a significant portion of a facility's overall operating costs. Choosing the right type of compressed air dryer for the application, and making sure that dryer is using energy in proportion to the demand when possible, can yield major savings over the life of the system.

Two categories of air dryers — refrigerated dryers and desiccant dryers — are widely used in industrial applications, and both have a place in the market. There isn't a one-size-fits-all dryer solution for every facility. However, looking at the energy costs associated with the various options can help determine which solution will be most beneficial.

Refrigerated Dryers

Typically, refrigerated dryers are the most economical to purchase and maintain, and they work well for most general manufacturing applications. These dryers yield air with a pressure dew point between 38 and 50 ˚F.

Refrigerated dryers reduce the temperature of compressed air through contact with a cold medium. Since cold air cannot hold as much moisture as hot air, saturated air condenses out moisture as the air temperature decreases, drying the air. The resultant moisture is removed using a moisture separator within the dryer and eliminated from the dryer through the drain system.

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Refrigerated dryers generally fall into two categories: non-cycling and cycling, both of which use a refrigeration system to cool the compressed air. The two technologies differ in that once a non-cycling dryer is powered on, the refrigeration system runs continuously regardless of demand, while a cycling dryer can store cold energy within the unit until it is needed, which offers the ability to use energy in proportion to the demand. Most non-cycling dryers include a hot gas bypass valve to keep the dryer from freezing.

Because cycling dryers can store cold energy until it is needed, they help facilities conserve energy. Cycling dryers use the refrigeration system to cool a glycol-water mixture. This thermal mass exchanges heat with the warm air coming into the system, thereby cooling the air and warming the thermal mass. Once the thermal mass temperature rises above a set point, the refrigeration system is activated. The refrigeration system drives down the temperature of the thermal mass until it reaches the desired low temperature, at which point the refrigeration system turns off. This type of operation uses only the energy required to address the incoming air load on the dryer, another boost to energy efficiency.

Different air drying technologies yield different energy costs. The electrical costs for refrigerated dryers are essentially the refrigeration compressor, the controls and, in the case of an air-cooled unit, the condenser fans. Some units might have other components, such as a thermal mass pump, that make a minor contribution to the overall energy consumption.

Non-cycling refrigerated dryers are the least expensive models to purchase. However, cycling dryers provide the ability to use energy in proportion to demand, so they may ultimately be the least costly to own over the life of the dryer.

Desiccant Dryers

Instead of relying upon a refrigeration system that cools the air, desiccant dryers use porous desiccant beads to adsorb moisture from

ENERGY SAVINGS RESULT FROM COMPRESSED AIR DRYER SELECTION

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untreated air. Desiccant dryers, which provide air with a pressure dew point ranging from -40 to -100 ˚F, use two towers, each filled with desiccant material. While one tower adsorbs the moisture and dries the air, the second tower is regenerated. By alternating tower functions, desiccant dryers provide a constant stream of very dry air.

Desiccant dryers are good for applications where outdoor compressed air piping is subject to freezing. Critical applications, such as pharmaceutical and food applications, require the particularly dry air that is beyond what a refrigerated dryer is able to provide. There are three types of desiccant dryers used widely in the market: heatless, heated and blower purge. Energy costs vary by the type of desiccant dryer, with the energy use tied mostly to the manner of regeneration of the desiccant material.

Generating compressed air is an expensive process, and heatless dryers use about 15 percent of the compressed air emerging from the dryer to remove moisture from the desiccant beads, in order to regenerate it. This means that even though heatless desiccant dryers are less elaborate and often have no added electrical components other than the controls on the dryer, they can actually be higher consumers of energy compared to the other desiccant technologies because the cost of diverting 15 percent of the compressed air must be factored into overall energy costs.

Heated desiccant dryers incorporate a heater in the regeneration circuit of the dryer. This type uses a combination of heat and airflow to regenerate the desiccant adsorption beads in the regenerating tower. So while heated dryers consume additional energy with the supplementary heater, they use about half the compressed air for regeneration than that of heatless dryers. Therefore, heated dryers often are less costly to operate than heatless desiccant dryers.

The third type of desiccant dryer, blower purged units, do not use compressed air to regenerate the desiccant. Instead, this model has a dedicated blower to draw air from the surrounding environment. Because the airflow is generated by the blower, the total air capacity of the air compressor is available at the dryer outlet. This means the expense of compressed air for regeneration is not a factor, but there is the added energy use from the electric motor used to drive the blower.

The bottom line with desiccant dryers regarding energy consumption: Dryers that rely on large quantities of compressed air for regeneration probably will be more expensive to operate than dryers requiring less compressed air. Of the different desiccant designs, the blower purge type has the greatest up-front cost but is often the most efficient to operate because it does not use expensive compressed air for regeneration.

Many manufacturers do make desiccant dryers with technology that can regulate the switching and the compressed air consumption based on the demands on the dryer, which helps to make them more energy

Desiccant dryers, which provide air with a pressure dew point ranging from -40 to -100 ˚F, use two towers, each filled with desiccant material. While one tower adsorbs the moisture and dries the air, the second tower is regenerated. By alternating tower functions, desiccant dryers provide a constant stream of very dry air.

ENERGY SAVINGS RESULT FROM COMPRESSED AIR DRYER SELECTION

> "Compressed air system optimization is key for organizations looking to reduce energy costs."
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efficient. Such energy management systems typically either sense if the moisture front in the tower has reached a certain level, or they measure the actual output dew point of the dryer. This technology can prolong the switch-over of the towers, so the dryer's regeneration cycle is not starting on a fixed increment of time but instead being initiated based on demand. Alternatively, the energy management systems may hold the purge valves closed, preventing purge air from being used until it is needed for regeneration.

Reliability Issues

While energy use accounts for a significant portion of a compressed air system's operating costs, reliability also should be factored in when considering the total cost of ownership.

Refrigerated dryers use hermetic refrigeration systems, meaning the refrigerant is not exposed to the atmosphere, so they typically require low maintenance and service to keep the system running.

Desiccant dryers involve frequent valve-switching to direct air to either the drying or regeneration tower, and these models often operate in high-heat, high-demand applications. Therefore, this equipment requires more service and valve maintenance. Downtime for that maintenance should be factored into the overall life cycle cost of the product.

User Needs

First and foremost, user needs should dictate the choice of dryer technology. Refrigerated dryers have substantially lower up-front and energy operating costs than desiccant dryers, but they are not able to provide air that is as dry. For general manufacturing processes, the refrigerated dryer option probably will be sufficient. Desiccant dryers provide the driest air for critical applications, but have higher up-front and energy costs.

In making the selection, users should consider if the pipe work associated with the process is located in a conditioned or unconditioned space. Desiccant dryers are the best choice if the piping is exposed to harsh conditions, such as temperatures that are below 40 ˚F.

If a downstream process machine requires that the air be drier than what a typical refrigerated dryer can deliver, point-of-use equipment may be the right answer. Such a system may use refrigerated dryers for most of the applications and desiccant models only where they are needed for specific applications.

Consider System Optimization

While energy savings can be achieved by selecting the proper dryer for specific applications, system optimization should also be considered for all air systems to maximize efficiency and minimize operating costs.

Dryers are one part of a full compressed air system, and inefficiency of the system as a whole can have as much impact on energy costs as the dryers themselves. Fixing and repairing piping and valve leaks, maximizing air use within a facility and maintaining all compressed air equipment can help recoup the up-front dryer costs by ensuring the system as a whole is operating more efficiently.

The value of a compressed air audit and consideration of the system as a whole to determine true energy costs should not be overlooked. Compressed air system optimization is key for organizations looking to reduce energy costs. BP

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ABOUT THE AUTHOR

Christopher Ursillo is the product manager for air treatment products at Ingersoll Rand. He has a degree in mechanical engineering from Villanova University and diverse professional experience in engineered systems and product development. Ursillo has worked in the compressed air industry for 14 years with a focus on air treatment. His responsibilities have spanned from application engineering to managing air treatment marketing programs. He has authored several articles weighing compressed air treatment options and the practical application of each technology. For questions or comments for Ursillo. contact External Communications Leader Anne Wages at email: Ann_Wages@irco.com.

To read more ***Air Treatment Technology*** articles, visit www.airbestpractices.com/technology/air-treatment

SHOW REPORT: COMPRESSED AIR & PNEUMATICS AT PROCESS EXPO



By Rod Smith, Compressed Air Best Practices® Magazine

The 2013 edition of Process Expo was held November 3-6 at McCormick Place in Chicago. Produced by the Food Processing Suppliers Association (FPSA) the event is co-located and co-hosted with the International Dairy Show (produced by the International Dairy Foods Association). The North American Meat Association (NAMA) and the Meat Import Council of America (MICA) also co-located their fall conferences at Process Expo 2013.

The FPSA and the IDFA announced 829 exhibitors with more than 314,600 square feet of exhibit space. "The supplier community has wholeheartedly embraced this co-location with the International Dairy Show as it further strengthens the overall PROCESS EXPO event as an important destination for manufacturing solutions for the food and beverage industry," said David Seckman, President and CEO of FPSA. "The excitement of this co-location is also shared by our attendee base." The FPSA and the IDFA announced record attendance at the co-located PROCESS EXPO and International Dairy Show with total combined registration of 19,155.

"We are proud of the tremendous growth that we experienced at this year's show and how the food and beverage industry has enthusiastically embraced our co-location with the International Dairy Show," said David Seckman, President and CEO of FPSA. "We have grown our customer audience by 25%, quadrupled the number of VIP companies, and increased our international attendee audience by 40%."

"IDFA is thrilled with the continued support from our members, exhibitors and attendees from around the world," said Connie Tipton, President and CEO of IDFA. "The co-location has enhanced and

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>
> — Rod Smith, Compressed Air Best Practices® Magazine

expanded the Dairy Show without sacrificing the dairy focus that is so important to all of our stakeholders. We are delighted to report a 50% increase in our buyer attendance this year while increasing exhibit space by more than 20%."

Process Expo calls itself "The Global Food Equipment & Technology Show." It's an appropriate name. I found machines that make 2100 hamburger patties per hour and others packaging thousands of hot dogs per hour. Other machines fold cartons, grab yogurt containers, place them on the carton, and close the carton. This is what automation is all about and none of it can happen without compressed air.

A pneumatically automated machine that creates hamburger patties.

Delkor Packaging Systems Designed for Efficient Compressed Air Use

Normally one booth visit, per show I attend, stands out above all the rest. This time it was definitely at the Delkor booth thanks to Mitch Kelm — a Delkor Service Technician who took the time to explain the role compressed air plays in their packaging machines. "Delkor machines are normally designed for 80 psig inlet air pressure and we do use automatic shut-off valves, in front of pneumatic valves or venturi vacuum generators, so our machines don't use compressed air when idle."

Mitch Kelm, from Delkor, in front of the Trayfecta® S Series Former rated for 15 scfm at 80 psig.

I was impressed by his knowledge of compressed air use in their machines. Delkor's most famous product line is the Spot-Pak® Packaging system. It is a unique and patented concept that reduces the material content by 75% when compared to corrugated boxes. Glue guns, fired by compressed air, bond products to flat pads that are then wrapped with PE shrink film. The machine can use either mechanical grippers or suction cups (using venturi vacuum generators) to place the products on the pad.

We also looked at their Trayfecta® S Series Former used to form, load, and close a box — at a rate of 40-60 units per minute depending upon the application. Automation is so cool. This machine can be configured to use venturi vacuum generators or clients can request on-board vacuum pumps. The machine on display was rated for 15 scfm at 80 psig and Mr. Kelm assured me that all pneumatic valves have shut-off positions so there is no idle flow consumption. I thought it was a very efficient design offering customization opportunities for those wanting to use vacuum pumps to further reduce compressed air consumption (www.delkorsystems.com).

The patented Delkor Spot-Pak® Packaging System uses pneumatics to fire glue guns and compressed air driven vacuum generators.

SHOW REPORT: COMPRESSED AIR & PNEUMATICS AT PROCESS EXPO 2013

High-speed rotary leak detectors manufactured by Automation Ideas use 25 scfm at 80 psig of compressed air to do up to 240 automated container leak inspections.

Ryan Hettinger, Kristine Inserra, and Brad Schulz, from Festo Corporation, next to a product designed by their Custom Solutions Group for a food industry application (left to right).

Steve Dagovitz, Bill Mehall, Michael Camber, Wayne Brunner and Mike Houston, from Kaeser Compressors, presented blower and rotary screw compressor technologies (left to right).

Processing Equipment Using Compressed Air

Another interesting compressed air application was on-board the high-speed rotary leak detectors manufactured by Automation Ideas. These machines use around 25 scfm, at 80 psig, of compressed air to do up to 240 automated leak inspections per minute of all kinds of blow-molded plastic containers. The 8-head module on display was inspecting milk containers by creating a pressurized seal and gauging resistance. Lack of resistance means there is a leak in the bottle. These units are normally installed before the fill line (www.automationideas.com).

Compressed Air, Blowers & Pneumatics at Process Expo

Festo had a lot of technology on display including their IP69K wash-down manifolds — able to function in wet environments in a food plant. No electric-actuated manifolds allowed in these areas! I'm impressed by the MS Series compressed air preparation units. They offer users the ability to easily integrate flow, pressure and vacuum sensors into these modular units primarily designed for on-board machine compressed air inlet filtration and pressure regulation. These sensors can be used to establish a "best practices" flow for a case packer, for example, so when a deviation from flow occurs — it becomes clear that a leak has emerged. Festo is also building momentum with their "Energy Services" team, in the U.S., doing more and more demand-side audits of compressed air systems. This is something I'm watching very closely as their expertise on production machinery is important (www.festo.com/us).

Kaeser Compressors had a strong presence. They displayed the compact 7.5 hp Aircenter package that includes a rotary screw compressor, an air dryer, and a receiver. The Aircenter units use IE3 premium efficiency motors. Enjoyed speaking with Steve Dagovitz, who is a blower application expert. He reviewed many applications, in the food industry, where Kaeser Omega blowers are used (www.kaeser.com/cabp).

Parker has become a real authority on the food industry-accumulating knowledge from their different divisions. The pneumatics and automation side has food industry application experts with wash-down pneumatic solutions to any kind of production automation solution you can think of. The air treatment side has domnick hunter Oil-X Revolution coalescing filters and completely lab-tested and verified sterile air solutions. Most food processing machines require chillers and Parker displayed their Hyperchill process water chillers. This product line has models ranging from ½ to 54 tons. I learned something new speaking with Parker's Dan Rogowski reviewing their CO_2 Polisher. Used by almost every Coca Cola and Pepsi plant, Dan explained that this product ensures point-of-use CO_2 purity to deliver high-grade oxygen meeting international quality standards (www.parker.com).

Busch vacuum pumps had a significant booth and one could find their vacuum pumps on-board all kinds of meat processing equipment. They told me they have gone to IE3 premium efficient motors on their product lines and that they are seeing more and more VSD applications for their vacuum pumps (www.buschusa.com).

Spectroline, a division of Spectronics, is heavily engaged in all kinds of leak detection technologies. At their booth, they informed me of the launch of a new ultrasonic leak detector called the MDE2000NC Marksman II. It is designed to be a high-value model that every plant maintenance person can use and afford. It does not come with diagnostic software. It's simply designed, with internal noise control, to quickly detect compressed air leaks that a plant can then go fix (www.spectroline.com).

Process Expo is a biannual show. If you are interested in attending in 2015, it will be held September 15-18, 2015 again in Chicago's McCormick Place (www.myprocessexpo.com). BP

For more information contact Rod Smith, Compressed Air Best Practices Magazine, tel: 412-980-9901, email: rod@airbestpractices.com

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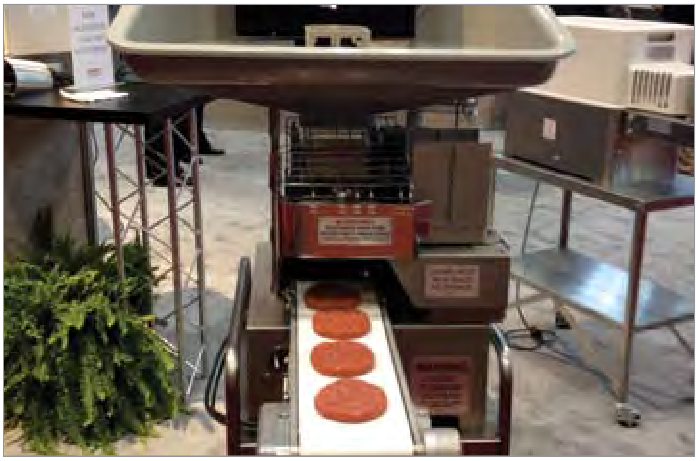


This "Super Patty Machine" uses pneumatics to create 1000 to 2100 hamburger patties per hour.

Jim McFadden and Dan Rogowski, from Parker, next to the CO_2 polisher commonly used in bottling plants.

The ConPro sausage production system, from Handtmann, uses pneumatic and vacuum systems.

TYPES OF COMPRESSED AIR DRYERS: REFRIGERANT AND REGENERATIVE DESICCANT

By the Compressed Air & Gas Institute

INTRODUCTION

The Compressed Air and Gas Institute is the united voice of the compressed air industry, serving as the unbiased authority on technical, educational, promotional, and other matters that affect the industry. Mention utilities and energy in a discussion about manufacturing and the Big Three — water, electricity and natural gas — immediately come to mind. But compressed air is commonly accepted as a manufacturing facility's fourth utility. A careful examination of a facility's compressed air system will likely reveal several opportunities to improve the performance of the compressed air system by effectively and efficiently removing moisture from the compressed air system. The Compressed Air and Gas Institute (CAGI) committed to issuing a series of articles discussing moisture in the compressed air system. The first article covered "Why Do Compressed Air Systems Need Drying?" This article will provide a brief overview of the two most popular compressed air drying technologies available — Refrigerant Type and Regenerative Desiccant Type.

COMPRESSED AIR DRYER SELECTION

Different methods can be used to remove the moisture content of compressed air. Current compressed air dryer types include the following products:

- **Refrigerant type:**
  - Cycling
  - Non-cycling
- **Regenerative desiccant type:**
  - Heatless (no internal or external heaters)
  - Heated (internal or external heaters)
  - Heat of Compression
- **Single Tower**
  - Deliquescent
  - Desiccant
- **Membrane**

Because of such a wide breadth of product offering, we will cover each of these dryer types in some detail. It is always recommended

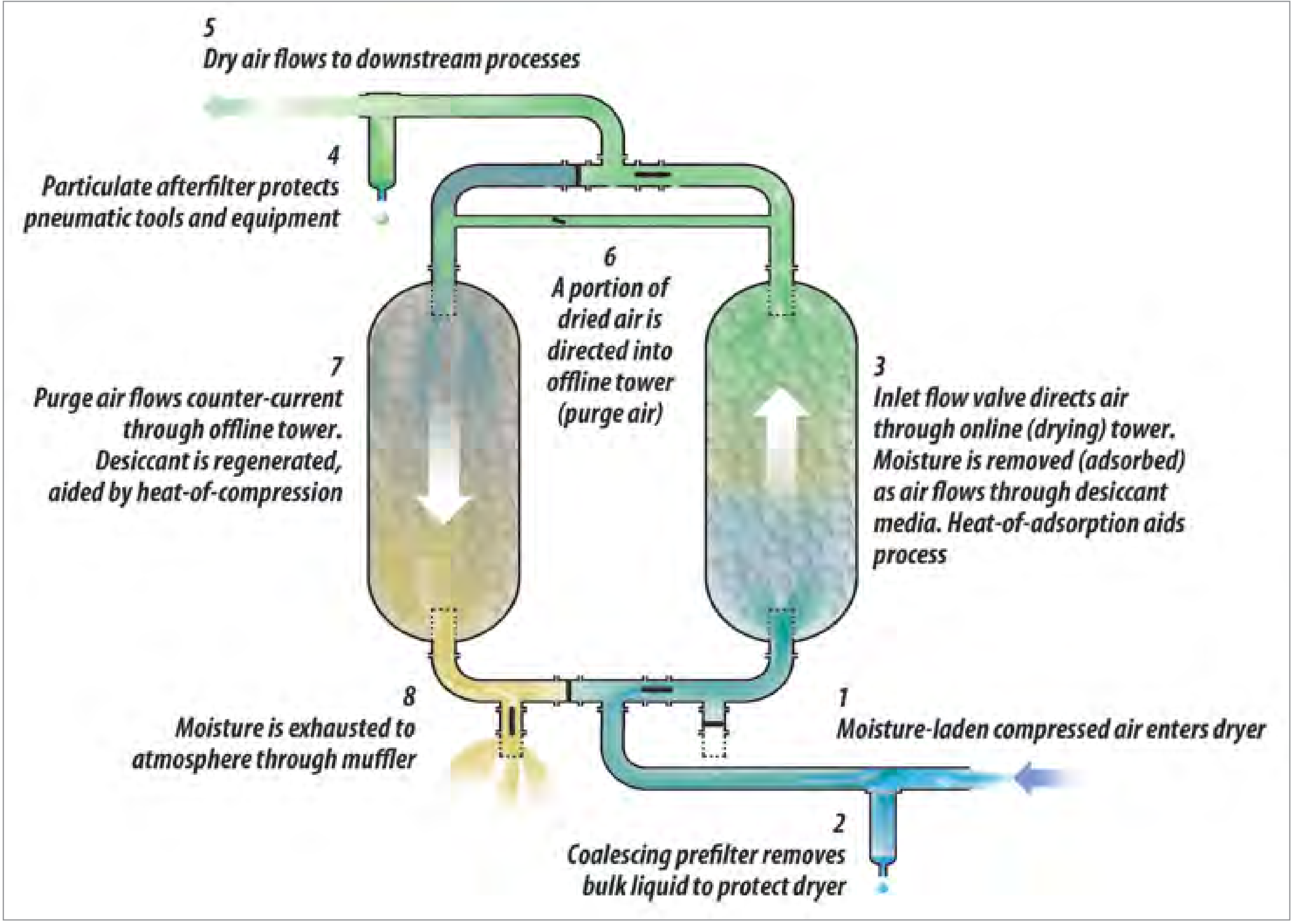
CAGI AIR DRYING & FILTRATION SECTION MEMBERS

Aircel	Donaldson Co., Inc.	Lectrodryer
Parker Hannifin Corp.	SMC Corporation of America	Walker Filtration, Inc.
Atlas Copco Compressors LLC	Ingersoll Rand Industrial Technologies	Mann+Hummel USA, Inc.
Pneumatech LLC	SPX Flow Technology	Zeks Compressed Air Solutions
Beko Technologies Corp.	Kaeser Compressors, Inc.	Mikropor America, Inc.
Pentair	Van Air Systems	

that the compressed air treatment products be discussed in concert with the entire compressed air system and the application of the products. You should consult a compressed air expert to assure that the compressed air dryer selected is correct for your application.

REFRIGERANT TYPE DRYERS

Although it does not offer as low a dew point as can be obtained with other types, the refrigerant type dryer has been the most popular, as the dew point obtained is acceptable in many general industrial plant



Desiccant Heatless Dryer Schematic

TYPES OF COMPRESSED AIR DRYERS: REFRIGERANT AND REGENERATIVE DESICCANT

air applications. The principle of operation is similar to a domestic refrigerator or home air conditioning system. The compressed air is cooled in an air-to-refrigerant heat exchanger to about 35 ˚F, at which point the condensed moisture is separated and drained off. The air is then reheated in an air-to-air heat exchanger by means of the incoming air, which also is pre-cooled before entering the air-to-refrigerant heat exchanger. This means that the compressed air leaving the dryer has a pressure dew point of 35 to 40 ˚F. A lower dew point is not feasible in this type of dryer as the condensate would freeze at 32 ˚F or lower.

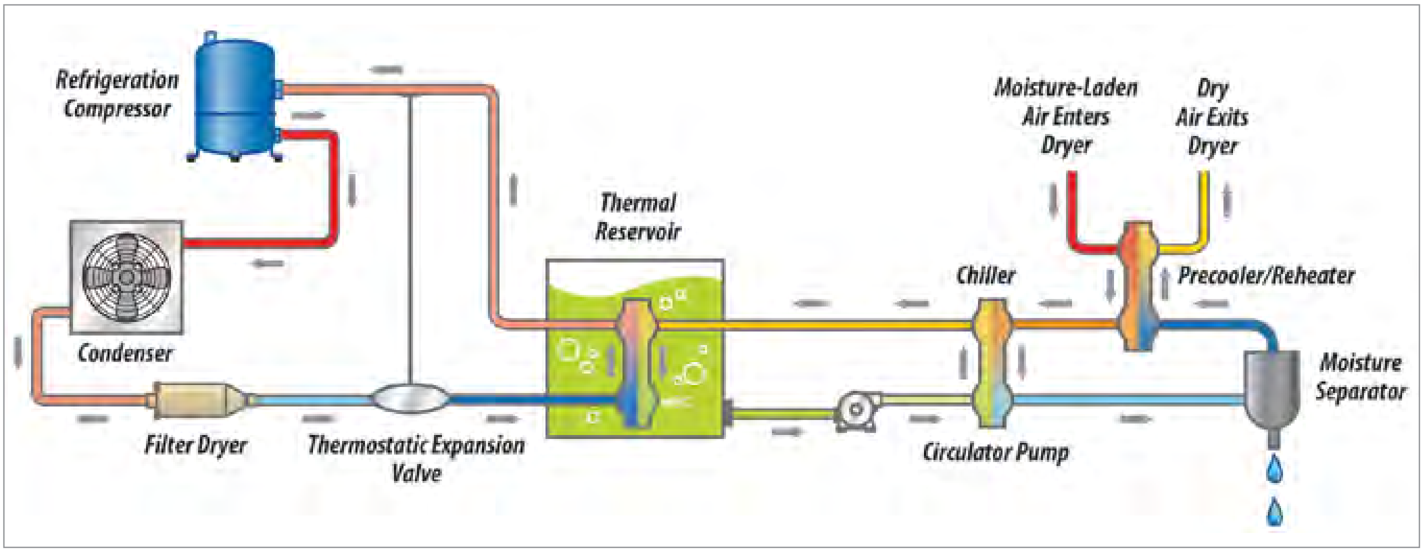
In a non-cycling refrigerant dryer (see Figure 1), the refrigerant circulates continuously through the system. This design provides rapid response to changes in operating loads. Since the flow of compressed air will vary and ambient temperatures also vary, a hot gas bypass valve or unloader valve often is used to regulate the flow of the refrigerant and maintain stable operating conditions within the refrigerant system. In most designs, the refrigerant evaporates within the air-to-refrigerant heat exchanger (evaporator) and is condensed after compression by an air-or water-to-refrigerant heat exchanger (condenser).

While older refrigerant type air dryers have used CFC refrigerants such as R12 and R22, newer designs are in compliance with the Montreal Protocol and use chlorine free refrigerants such as R134A and R407C or other environmentally friendly refrigerant blends. The properties of these newer refrigerants require careful attention to the refrigeration system design, due to differences in operating pressures and temperatures. Refrigerant type dryers should only be serviced by a licensed and trained technician to assure that the refrigerant material is properly handled.

Cycling type refrigerant dryers use refrigerant to chill a mass surrounding the air passage in the heat exchanger. This mass may be a liquid such as glycol or a metal such as aluminum block, beads or related substance, which act as a heat sink. The compressed air is cooled by the heat sink which has its temperature controlled by a thermostat and shuts off the refrigerant compressor during reduced loads, providing savings in operating costs but at higher initial capital cost.

Advantages of Refrigerant Type Air Dryers include:

- Low, initial capital cost
- Relatively low operating cost
- Low maintenance costs
- Not damaged by oil in the air stream (although, filtration normally is sometimes recommended)



Refrigerant Cycling Dryer Schematic

> "The typical regenerative desiccant dryer at 100 psig has a pressure dew point rating of -40 ˚F but dew points down to -100 ˚F can be obtained."
>
> — The Compressed Air & Gas Institute

Disadvantages of Refrigerant Type Air Dryers include:

- Limited dew point capability

Advantages of non-cycling designs include:

- Minimal dew point swings
- Refrigerant compressor operates continuously

A Refrigerant Type Compressed Air Dryer

Disadvantages of non-cycling designs include:

- No energy savings at partial and zero air flow

Advantages of cycling designs include:

- Energy savings at partial and zero air flow

Disadvantages of cycling designs include:

- Dew point swings
- Increased size and weight to accommodate the heat sink mass
- Increased capital cost

Regenerative Desiccant Type Dryers

These dryers use a desiccant, which adsorbs the water vapor in the air stream. A distinction needs to be made between adsorb and absorb. Adsorb means that the moisture adheres to the desiccant, collecting in the thousands of small pores within each desiccant bead. The composition of the desiccant is not changed, and the moisture can be driven off in a regeneration process by applying dry purge air, by the application of heat, or a combination of both. Absorb means the material that attracts the moisture is dissolved in and used up by the moisture. Absorption takes place in a deliquescent desiccant type dryer.

Regenerative desiccant dryers normally are of twin tower construction. One tower dries the air from the compressor while the desiccant in the other tower is being regenerated after the pressure in the tower has been reduced to atmospheric pressure. Regeneration can be accomplished using a time cycle or on demand by measuring the temperature or humidity in the desiccant towers or by measuring the dew point of the air leaving the on-line tower.

In the heatless regenerative desiccant type, no internal or external heaters are used. Purge air requirement can range up to 18% of the total air-flow. The typical regenerative desiccant dryer at 100 psig has a pressure dew point rating of -40 ˚F but dew points down to -100 ˚F can be obtained.

TYPES OF COMPRESSED AIR DRYERS: REFRIGERANT AND REGENERATIVE DESICCANT

> "It is always recommended that the compressed air treatment products be discussed in concert with the entire compressed air system and the application of the products."
>
> — The Compressed Air & Gas Institute

Heat reactivated regenerative desiccant dryers may have internal or external heat applied by heaters. In the internal type, steam or electricity may be used in heaters embedded in the desiccant bed. This reduces the amount of purge air required for regeneration to less than 10%. The purge air plus normal radiation is used to cool the desiccant bed after regeneration to prevent elevated air temperatures going downstream.

In externally heated regenerative desiccant dryers, the purge air is heated to an elevated temperature and then passes through the desiccant bed. The amount of purge air is approximately 5-10% of the air flow through the dryer. The purge air from the compressed air system can be eliminated if a blower is used for the circulation of heated atmospheric air through the desiccant bed. To protect the desiccant bed from oil contamination from the air compressor, a coalescing filter is required upstream of the dryer. To protect downstream equipment from desiccant dust or "fines", a particulate filter downstream of the dryer also is also recommended.

Advantages of Regenerative Desiccant Type Dryers include:

- Very low dew points can be achieved without potential freeze-up
- Moderate cost of operation for the dew points achieved
- Heatless type can be designed to operate pneumatically for remote, mobile or hazardous locations

Disadvantages of Regenerative Desiccant Type Dryers include:

- Relatively high initial capital cost
- Periodic replacement of the desiccant bed (typically 3-5 years)
- Oil aerosols can coat the desiccant material, rendering it useless if adequate pre-filtering is not maintained
- Purge air usually is required

The next article in the series will cover the other Regenerative Desiccant Dryer Type: Heat of Compression. It will also address Single Tower Types, as well as Membrane Dryers.

Compressed Air & Gas Institute Support

The CAGI website is an excellent source for more information on the application of compressed air dryers, compressed air dryer and filtration selection, and information on the Air Dryer & Filtration Section.

For more detailed information about CAGI, its members, compressed air applications or answers to any of your compressed air questions, please contact the Compressed Air and Gas Institute. CAGI educational resources include e-learning coursework on the *SmartSite,* selection guides, videos and as well as mentioned *Compressed Air & Gas Handbook.* BP

For more information, contact the Compressed Air & Gas Institute or visit our website, tel: 216-241-7333, email: cagi@cagi.org, www.cagi.org

To read more ***Air Treatment Technology*** articles, visit www.airbestpractices.com/technology/air-treatment

RESOURCES FOR ENERGY ENGINEERS

TECHNOLOGY PICKS

Ingersoll Rand Launches New C800 Centrifugal Compressor

Ingersoll Rand has launched the new Centac C800 centrifugal air compressor. The C800 is built on the latest generation, integrated and simplified centrifugal compressor platform, and is an extension of the Centac C1000 product line. Certified as ISO 8573-1Class 0, the C800 provides 100 percent clean, oil-free air, and is designed to minimize downtime and lower total cost of ownership.

The single largest contributor to life-cycle cost is loss of production. The Centac C800 is designed with features to maximize asset availability including tapered polygon attachments to create a precision fit and evenly distribute torque and a simplified oil piping system with an integrated oil filter to keep the system running at ideal conditions. The compressor's integrated AGMA rated gears, flex pad hydrodynamic bearings and components work to reduce vibration and error-proof alignment, minimizing downtime and lowering operational costs.

The optimized components and systems in the Centac C800 reduce energy use by up to 6 percent at full load. The backward-leaning impellers are designed with leading edge software and computational fluid dynamics that maximize peak efficiency and provide greater turndown. Furthermore, inlet guide vanes (IGVs) are standard on the new C800 delivering up to 10 percent additional energy savings at partial load.

Maintenance is easier on the C800 air compressor with a one-piece removable inducer, in-place roddable coolers, bull gear inspection ports, and open cooler casing which offer increased access to critical components. The fully configured compressor package also affords efficient installation — no special foundation or grouting required. The single inlet and outlet connections for cooling water also reduce installation time and cost. These features were specifically designed to optimize and enable system efficiency and reliability.

The Web-enabled Xe-Series controller enhances productivity and enables plant and operations managers to remotely access and adjust the system from virtually anywhere. It presents real-time monitoring and trending of critical components, making it easy to predict maintenance needs and correct operating parameters from Web-enabled smartphones, tablets and personal computers.

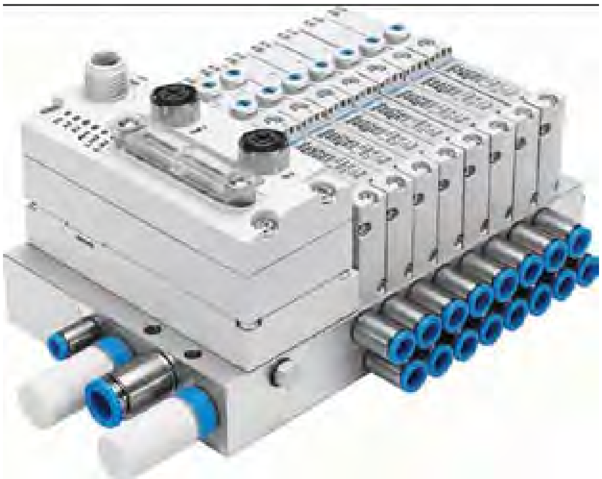
"Lost production caused by unscheduled downtime is the largest contributor to a compressor's life-cycle cost," said George Mankos, global category leader, centrifugal technology, Ingersoll Rand. "Ingersoll Rand manufactured the C800 with fewer parts, integrated components — and easily accessible critical components — to increase the compressor's reliability and efficiency."

For more information, visit ingersollrand.com or ingersollrandproducts.com

New Festo VTUG Pneumatic Valve Terminal

The new Festo VTUG compact, low-cost pneumatic valve terminal is designed for food, beverage, packaging, electronics, semiconductor, and light assembly industries where low cost and assured performance (high flow rate, small footprint, and long cycle life) is essential. Compact, lightweight VTUG aluminum manifold and valve housings can be mounted in cabinets, on machines, and on robotic end effectors. The VTUG valve terminal is also ideal for compact pilot valve applications when using an available dual 3/2-way function valve to accommodate from 4 to 48 solenoids.

TECHNOLOGY PICKS



The VTUG is ideal for the machine builder that wants to standardize on one valve terminal and offer customers control options from conventional multi-pin up to fieldbus. The original VUVG design, introduced in early 2010, has since taken off as Festo's premiere universal individual connection valve of choice. The success of this product helped influence the plug-in style VTUG. The VUVG design included the "E-Box" approach for electrical connectivity, allowing users to stock one valve body and choose from many designs to match application needs. Each E-Box uses a different electrical connector (such as Festo connectors, standard M8 connector, and other choices). Flexible design philosophy allows the user to select a desired communication preference for the VTUG valve terminal and modify it in the future.

The VTUG valve terminal can be controlled through a multi-pin connector, one cable IO-link interface to a master controller, or through Festo's new CTEU fieldbus module to DeviceNet, EtherCAT, CANopen, Profibus, and several other protocols. Multi-pin and I/O link modules are available as spare parts to easily convert existing valve terminal configurations, ensuring flexible communications.

For more information, please contact tel: 800-993-3786 and visit http://www.festo.com/us

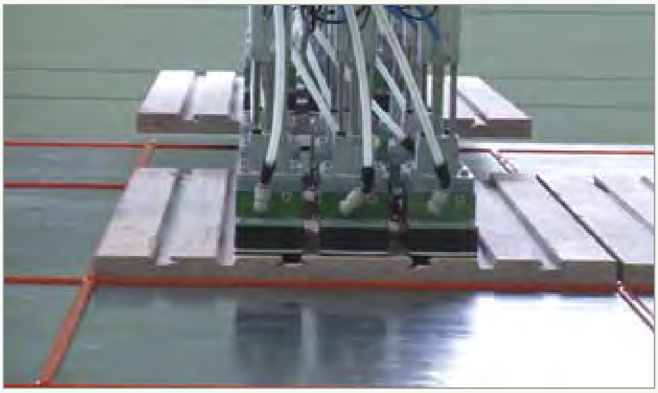
FIPA Custom Vacuum Grippers Handle Precast Concrete Units

FIPA partnered with a client to develop a customized gripper solution for the production of multi-layer concrete components. The solution was nominated for the 2013 BAUMA Innovation Award — an honor presented every 3 years to top companies which showcase groundbreaking developments in machinery and equipment for construction, building materials and mining.

A leader in conception, design and implementation of production plants for the precast concrete element industry, FIPA's client was looking for flexible vacuum grippers to handle wall cladding components in their production plant. The client chose FIPA as a project partner because of its flexibility and expertise in the vacuum gripper and end of arm tooling industry.

Multi-layer concrete components are often used in industrial and commercial buildings and in prefabricated houses to reduce construction time and building costs. Manufacturing concrete components with natural stone or plastic tile cladding involves extremely high staff costs. Manual tile application also causes the dimensional accuracy of the precast components to fluctuate.

Until now, no fully automated system on the market was capable of assembling these multi-layer concrete components with the required level of precision and flexibility. Our client was looking for flexible



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TECHNOLOGY PICKS

vacuum grippers to handle wall-cladding components in their production plant.

The specifications provided by our client required tiles/bricks between 40 x 80 mm and 700 x 1600 mm to be handled using multiple single-sized vacuum grippers without changing tools. The ability to securely grip partial segments as well as whole bricks was also essential. Due to the system dynamics, there were extremely high demands on the vacuum gripper's holding capacity: A Cartesian robot picked up the tiles horizontally from the material feed and carried them to the concrete component, where it deposited them with a high degree of precision. The robot axes moved at speeds of up to 4 m/s and acceleration could reach up to 3 m/s.

To match the clients unique requirements, FIPA developed a custom vacuum gripper within a very short period of time. Comprehensive testing determined the ideal vacuum gripper for the shape and weight of the bricks. It was important to ensure, that the vacuum duct holes did not line up with the tile grooves. The ability of the gripper to function reliably with a partial load was also successfully demonstrated. This is a standard feature in all FIPA vacuum grippers which included special ball valves seal off the intake ducts in the unused suction areas.

A special feature of the FIPA design prevented the intake ducts and ball valves from becoming blocked by dust, which is extremely pervasive in construction industry applications. The large diameter of the holes and balls allowed the dust to pass through the gripper unimpeded. Highly wear-resistant and age-resistant suction mats that were tailored exactly to the requirements of the construction industry were another feature of FIPA's custom vacuum gripper solution.

For more information visit www.FIPA.com

TECHNOLOGY PICKS

Unique Michell Portable Humidity Calibrator

Michell Instruments has upgraded its S503 Portable Humidity Calibrator to include an optional battery pack for customers who need to conduct calibrations at sites without electricity.

The battery pack provides 12 hours or more of continuous use from a single charge, allowing a full day of calibrations to be completed on-site. This is a unique feature not currently offered for any similar calibrator on the market. The S503 provides true portability, allowing the calibrator to be used where the job is, even if power is not available. The S503 portable humidity calibrator from Michell Instruments is a practical, affordable and flexible solution for calibrating RH sensors. It can be used by most service staff as no special training is necessary. Due to its ease of use, a 3-point calibration can be carried out in about an hour. The S503 in combination with a Michell Chilled Mirror Hygrometer, such as the Optidew Vision, offers a transportable and traceable, total humidity calibration system.

Visit www.michell.com

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Reach 13,000+ readers of Compressed Air Best Practices® Magazine with Marketplace Ads every month! Job Marketplace ads are also placed for one month on www.airbestpractices.com and promoted in our three monthly e-newsletters.

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