The Magazine for QUALITY & RELIABILITY in ENERGY-EFFICIENT Compressed Air Systems

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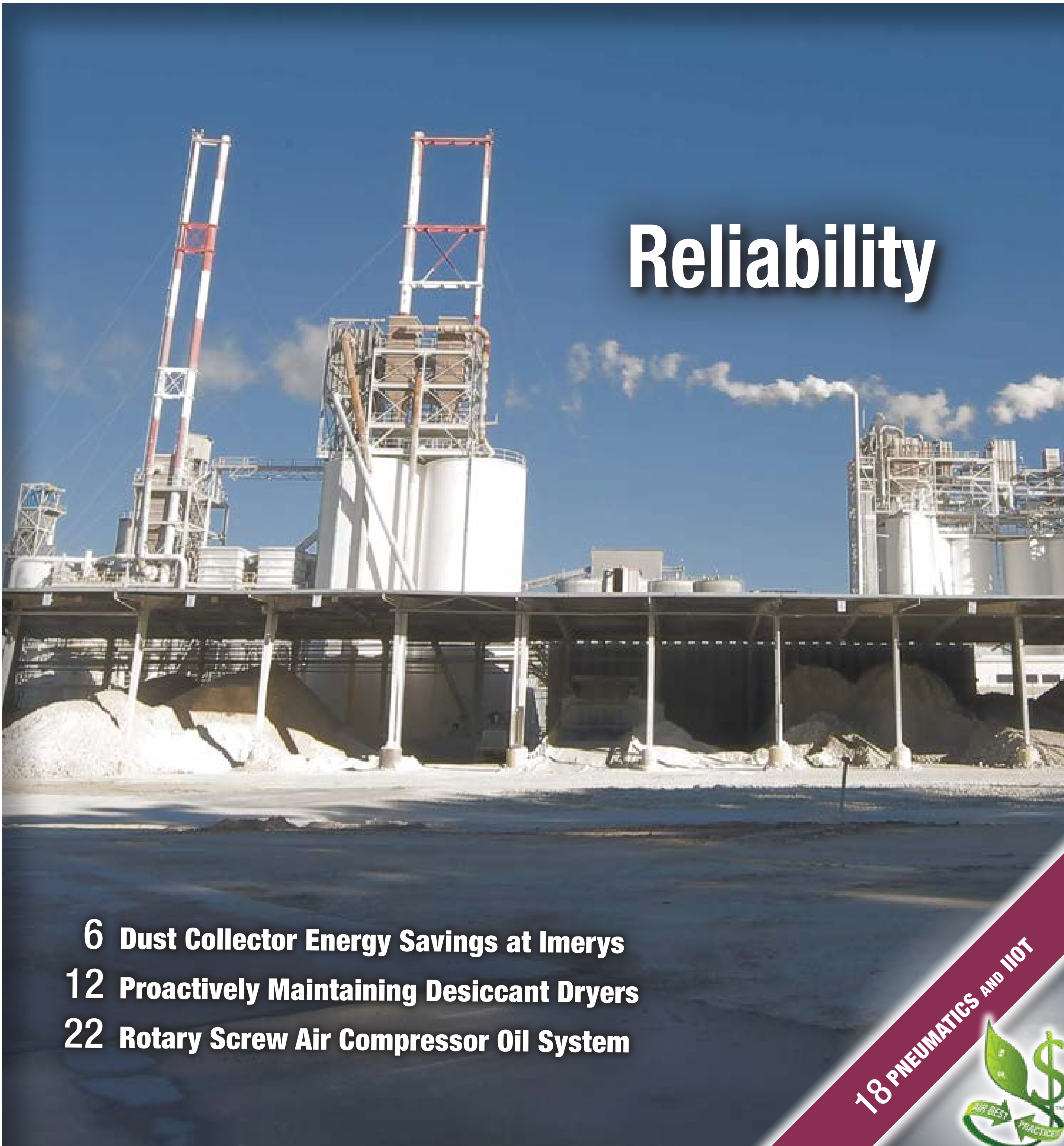

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EVERY ISSUE

COVER PHOTO. This month's cover features the Imerys S.A. calcine plant in Sandersville, Georgia.

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FROM THE EDITOR

How reliable are the compressed air systems at your plant? Are they reliable *and* optimized for efficiency?

Quality, Safety and Reliability

Desiccant compressed air dryers are a critical component in many compressed air systems. Russ Jones, from BEKO Technologies, has sent us a practical article on how to maintain them. Pre- and post-filters, valves, desiccant material, purge exhaust mufflers and dew point sensors are covered.

Understanding the basics of the lubrication system in an oil-flooded rotary screw air compressor is the focus of an article sent to us by lubricant manufacturer, Isel.

Chris Beals has spent many years optimizing compressed air systems in large chemical and oil refining plants. His experience troubleshooting heatless desiccant dryers is vast and I'm sure you'll enjoy his article on the topic.

Productivity, Sustainability & Energy Conservation

The Imerys calcine plant, in Georgia, is on our magazine cover as they were willing to share with us the results of their work optimizing dust collectors. The actions are being rolled out to all their plants with a projected energy savings of 16 GWh of electricity!

Optimizing the pneumatics on production equipment can improve worker safety, reliability and efficiency. Enrico De Carolis, from Emerson, has sent an article sharing three real-world applications using IIoT-enabled pneumatics. These systems are enabling a data-driven new frontier of compressed air system **and** production-machine optimization.

Thank you for investing your time and efforts into ***Compressed Air Best Practices®***.

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PRODUCTIVITY, SUSTAINABILITY & ENERGY CONSERVATION

Dust Collector Pilot Program Points to 16 GWh of Energy Savings at Imerys Minerals Processing Facilities

By Mike Grennier, Compressed Air Best Practices® Magazine

The Imerys S.A. calcine plant in Sandersville, Georgia, implemented a pilot program demonstrating how optimization of dust collectors can save up to 16 GWh of electricity across its plants in North America and reduce CO_2 emissions by more than 7,500 metric tons.

For Imerys S.A. there's little question about the importance of managing dust collection systems it uses to control and reduce harmful particulates in its worldwide minerals processing facilities. And now there's zero doubt about the tremendous energy savings it stands to save by reducing the amount of compressed air needed for these same dust collectors.

Thanks to a best practices pilot program at the company's calcine plant in Sandersville, Georgia, the company stands to save upwards of 16 GWh of electricity across North America – and reduce CO_2 emissions in the process by more than 7,500 metric tons by optimizing its dust collectors.

Robin Davis of Imerys Performance Mineral Americas and the engineer who led the pilot said it didn't take long for dust collector best practices to catch on at other plants after seeing the possibilities at the Sandersville operation.

"I was initially looking at this from the perspective of one plant, but I can't even keep up with how fast this is rolling out and how everybody is taking to it," Davis said. "Now we're all thinking, 'this is a no brainer.' It's easy to do and it's cost-effective."

Sustainability a Big Priority

The dust collector pilot program at the Sandersville plant is one example of Imerys' promise to take action on climate change and protect the environment.

Based in Paris, France, the multinational company launched its SustainAgility program in 2018 to meet its commitment to Science Based Targets – committed to reducing Scope 1 and 2 greenhouse gas emissions by 36% relative to revenue by 2030 from its 2018 base-year. Imerys, which specializes in the production and processing of industrial minerals for use in diverse manufacturing and construction industries, operates 230 industrial facilities across 50 countries. The company, which employs 19,000 people, operates 40 plants in North America.

The sustainability program at Imerys includes "I-Nergize" teams dedicated to finding and implementing initiatives aimed at energy and $C0_2$ reduction. The teams, which are divided between The Americas, Europe, Middle East and Africa (EMEA) and Asia, work with various processing plants to conduct regular energy assessments and identify energy-savings opportunities. Each plant subsequently implements any number of projects based on the roadmap established, along with continued help from the corporate team when needed.

The goal, said I-Nergize team member Davis, is to identify energy savings that can be achieved with little to no cost, or with projects that have an attractive ROI.

Imerys Performance Minerals North America

Imerys Performance Minerals North America extracts different types of minerals at its mines, which are then processed for use in a wide range of industries and applications including construction, hygiene products, paper, paint, plastic ceramics, telecommunications and beverage filtration.

At its processing facilities, Imerys relies on compressed air for conveying materials, as well as powering a host of pneumatic systems and devices. By far the biggest user of compressed air are the plants' baghouse dust collectors, which filter, separate, and capture dust and particulate matter in various processes and then release clean air. The dust collectors play a critical role in the company's ability to maintain environmental compliance, while helping it maintain product quality.

A typical compressed air system at an Imerys processing facility includes any number of rotary screw air compressors and the occasional centrifugal unit, combined with wet receiver tanks, and dryers. The configuration of each

Dust Collector Pilot Program Points to 16 GWh of Energy Savings at Imerys Minerals Processing Facilities

compressed air system is dependent upon the size of the operation and the minerals processed. Additionally, the setup for each system differs from plant to plant.

Less Pressure is Better for Dust Collectors

World-class is the aim of the Sandersville operation, which uses a calcination process to produce kaolin clay. The clay is used in numerous products such as paper, rubber, and paint. When the plant experienced problems with the reliability of several pulse jet dust collectors, Davis and plant decision-makers dove in and formulated plans for a pilot program aimed at optimizing the dust collector systems.

The team closely examined how compressed air is used with the plant's 72 dust collectors 24 hours per day, seven days a week and explored strategies for improvement. One particular area of interest was the level of pressure used to pulse dust collectors. The team found the plant's compressed air system was delivering pressure to the dust collectors at 100 psi, which was unnecessary and problematic. Supplying more pressure than needed was simply due to antiquated methods, Davis said.

"It's how the plant did it for 20 years," he said. "It's the old adage of, 'If you've got pressure at 80 psi, 90 psi is better, and if you have 90 psi, 100 psi is better.' Of course, that might be able to help with leaks, but it really just helps cover them up. And after we talked with some of our vendors, we realized too much pressure can cause problems in terms of reliability and the life of the dust collector bags."

The team discussed whether to reduce the level of compressed air pressure at length but couldn't agree on whether to lower it. Ultimately, the plant manager opted to experiment with the concept of lower pressure as part of the pilot program. The experiment meant shutting off one of the plant's seven air compressors, which in turn, lowered the pressure supplied to the plant from 100 psig to 85 psig. It also meant gauging the reaction of those on the team against lowering pressure.

"We hit the off button on one of the air compressors and waited for the alarms and complaints from people," Davis said. "We didn't hear anything right away so we went the rest of the day and still didn't hear anything."

One day of shutting down one of the plant's air compressors led to several more days of having the machine offline and operating at lower pressure – all without any complaints. Afterwards, Davis shared the results of the experiment with the full team at the plant, some of whom were not aware that pressure had been lowered.

"Once the group saw the data and the technical information about how we shouldn't be pulsing the bags at 100 psi anyway, things started to click," he said.

New Control Method and Pulse Valves Prove Worthwhile

As part of the pilot at Sandersville, Davis and the team also explored various methods of pulsing compressed air to clear the bags, as well as technologies used to do it more efficiently.

Research led to the installation of differential pressure monitors in place of manual gauges and the implementation of a pulse-on-demand approach for managing various dust collectors. The approach includes the use of electronic timers installed on each dust collector system and tied to a Programmable Logic Controller (PLC), which in turn, initiates pulsing and stops it when it's not needed based on differential pressure settings.

"In a lot of cases, for example, we have dust collectors that are primarily used for environmental compliance and they don't see a lot of material, which means we might be able to reduce the pulsing by as

Imerys Performance Minerals North America extracts a wide range of minerals at its mines and processes them for use in a host of industries and applications.

Dust Collector Pilot Program Points to 16 GWh of Energy Savings at Imerys Minerals Processing Facilities

much as 70%," Davis said. "That's a 70% reduction in energy consumed for that dust collector and we've extended the bag life. It's a no brainer."

The use of differential pressure monitors also allows the plant to measure the performance of dust collectors and make ongoing improvements for the purposes of environmental compliance, in addition to providing troubleshooting capabilities to help bolster plant uptime.

"If we find we didn't get a good number on one of the dust collectors for a given week we just pull the history on it," he said. "The plant can also make the necessary adjustments to achieve efficiencies and strengthen system reliability."

The pilot program also considered efficiency of pulse valves used on the dust collectors. More research led to the installation of a newer valve design that uses spool technology rather than diaphragm-style technology for pulsing several bags. The technology showed promise for better performance and reduced compressed air consumption.

Robin Davis of Imerys Performance Mineral Americas installs a technically advanced pulse valve that has proven to improve dust collector performance and reduce compressed air consumption.

"The diaphragm on a traditional valve is generally a rubber-type material and it can basically have microfractures that allow air through, which requires a lot more work since less air is getting through. Instead of having that rubber constantly flexing, a valve with a mechanical spool goes back and forth to allow the transfer of air. You get a cleaner, crisper pulse and less air consumption," Davis said, noting that one collector with the newer valve technology has proven its ability to lower compressed air use by as much as 40% while maintaining bag life.

Standardization Saves Energy and Improves Reliability

Davis said the dust collector pilot program at Sandersville is in addition to a corporate-wide initiative to standardize on technologies and systems as a way to increase efficiencies, enhance plant reliability, and maintain environmental compliance.

"I can easily say 90% of our industrial plants have dust collectors in them, but we have varying levels of standardization for reliability for the equipment," Davis said. "Additionally, we know we need to be in environmental compliance, so we thought, let's start with standardization of dust collectors in North America."

Part of standardization for Imerys means documenting best practices and technologies used to improve energy and plant reliability and making the information easily available and accessible to all Imerys operations.

"You might go to one dust collector system that's been in service for 30 years and it will have five different pulse valves," Davis said. "With all of these little design differences you don't get as reliable of a system as you could have."

Davis said another example of standardization to enhance plant efficiencies and reliability is related to the quality of air delivered by any given plant's compressed air system.

"Introducing water into a dust collector either makes mud or concrete, depending on the mineral. It's very bad for quality, and plant uptime if we get water in our compressed air," he said. "So we're working to address it by doing things like adding water separators to compressed air systems and developing recommendations for target pressure dew points for specific dryers and filters. This is the next big focus area for us."

Dust Collector Optimization Best Practices Put to Work

The dust collector pilot program has been deemed a tremendous success, which is proven by the results – and the decision to continue implementing dust collector best practices at the Sandersville plant and other facilities.

Results of the program are seen in the ability of the plant to save $68,000 per year in annual energy savings. In addition, the project earned Imerys a 2020 Better Practice Award from the Department of Energy (DOE) Better Plants® program.

Today, the Sandersville facility typically uses only five of its seven air compressors to supply the plant and its dust collectors with compressed air at 85 psig. It's also working to implement a capital project to replace all traditional diaphragm-style pulse valves on its pulse jet collectors with the new, spool-style valves. Additionally, it's moving forward with its pulse-on-demand control system for all of its dust collector systems.

Davis said he's especially excited about the longer term impact of the dust collector pilot for Imerys and its ability to protect the environment. Toward that end, Imerys has the realistic opportunity to reduce its annual electric use by 16 GWh and eliminate over 7,500 metric tons of $C0_2$ emissions by following the same best practices of those in play at the Sandersville pilot and optimizing nearly 600 dust collectors across North America.

"As we implement more and more of these best practices and we start seeing the true numbers, I think our efforts will have a big impact on our sustainability goals. We just have to start applying this across our different sites," Davis said. BP

All photos courtesy of Imerys.

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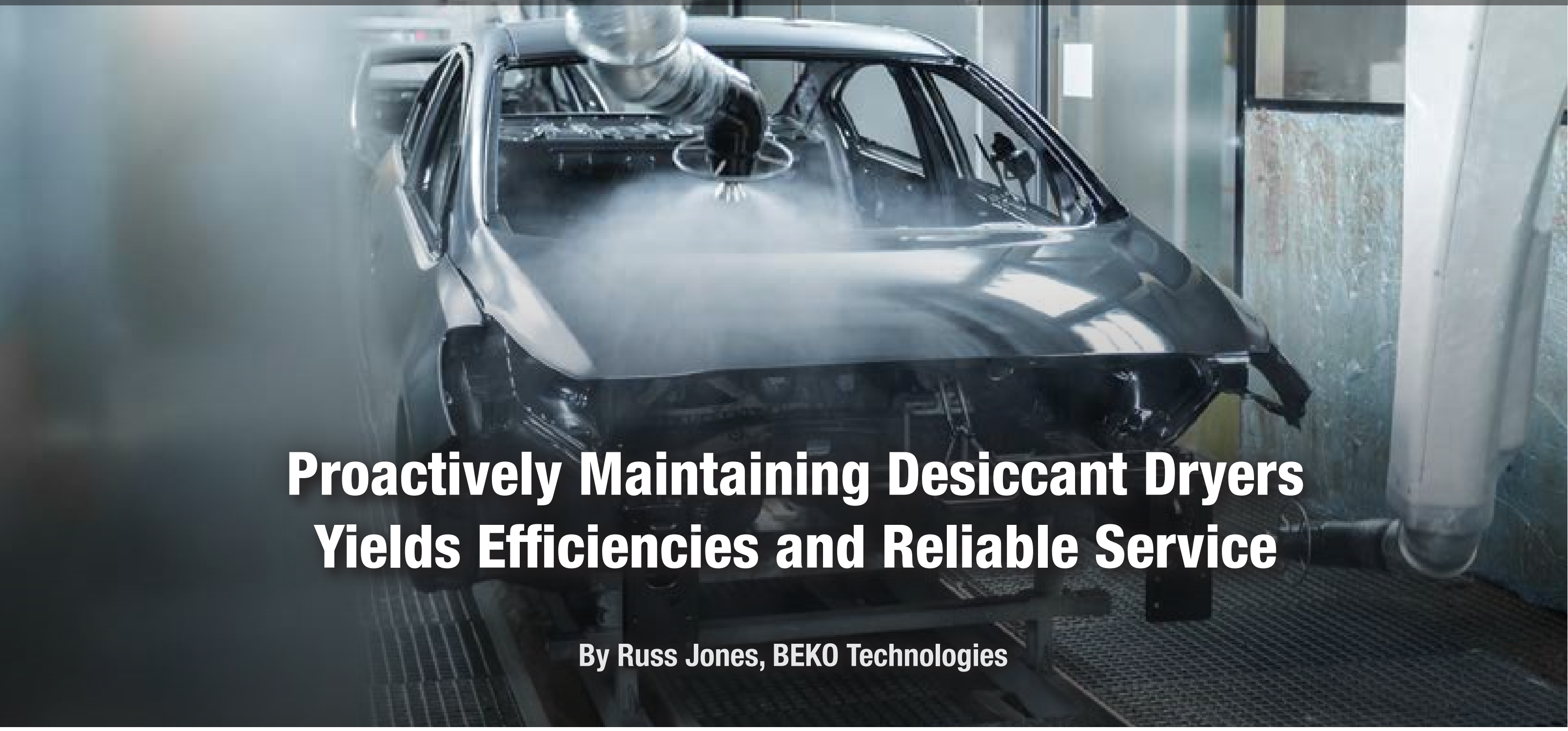


Proactively Maintaining Desiccant Dryers Yields Efficiencies and Reliable Service

By Russ Jones, BEKO Technologies

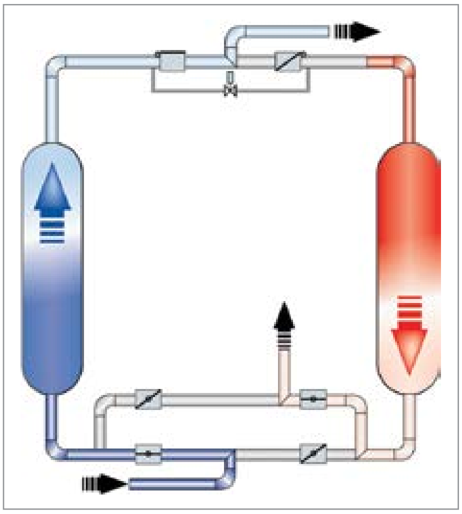
Moisture in compressed air is almost never a good thing. It can damage a compressed air system by causing corrosion, rust and scale buildup. It can damage downstream equipment with these moisture byproducts or with the moisture itself. It can negatively affect processes and products that require dry compressed air.

There are many ways of reducing moisture in compressed air but if you need to do more than just eliminate liquid water at normal indoor temperatures, it's probably a desiccant dryer you will be using. What follows is advice on care and maintenance of these dryers with close attention paid to twin-tower desiccant dyers.

Moisture Spells Trouble

Problems related to moisture in compressed air can range from someone slipping on a puddle of water leaking from compressed air piping to a flawed paint job to damaging a piece of multimillion-dollar equipment or contaminating a batch of product. This is well known to users and suppliers of compressed air equipment, many of whom have learned these lessons the hard way.

Desiccant dryers reduce moisture via the process of adsorption and are also known as adsorption or regenerative dryers. One of the primary instances when desiccant dryers are employed is when the compressed air will be exposed to below freezing temperatures, either due to outdoor conditions or while passing through refrigerated areas. But there are also certain materials, processes and equipment that require very dry air. Here, we are defining "very dry" as air with a pressure dewpoint of -40˚F (-40˚C) or less which is ISO 8573.1 Class 2 or better.



Valves used to direct air on desiccant dryers must be maintained to ensure reliability and proper performance.

If only a small portion of the compressed air supply needs to be very dry, this can sometimes be handled with point-of-use dryers to suppress the dew point to the required levels after the air is pre-dried with a refrigeration type dryer. These are often membrane dryers or small desiccant dryers. If the majority of the compressed air needs to be very dry, a twin tower desiccant dryer is by far the most common solution.

Pre- and Post-filters for Twin Tower Desiccant Dryers

The three most common types of twin tower desiccant dryers are heatless, heated purge and heated blower purge. All use some type of adsorption media or desiccant in bead form which fills the towers to remove moisture as air passes through it. They operate with one tower drying while the other regenerates (desorbs/removes the captured moisture from the desiccant).

Another thing these dryers have in common is that they all require maintenance to provide consistent and reliable operation. Specific and detailed information on maintenance intervals and procedures should be available in the operator's manual for the dryer. The manual should be made readily and easily available to everyone involved in the dryer's operation and maintenance. Most twin tower desiccant dryers require both pre- and post-filtration.

The pre-filter protects the dryer, particularly the desiccant itself, from contamination in the airstream like dirt ingested by the air compressor or air compressor lubricant which bypasses the air compressor's lubricant separation system. The pre-filter can also protect the dryer from ingesting bulk moisture, especially if a "wet" air receiver is not installed. Since this protection is so crucial, the pre-filter is generally rated at .01 mg/m^3 ISO 8573.1 Class 1. With this fine of a filter, it is often advisable to add a more coarse (larger micron rated) filter upstream of this filter to reduce maintenance intervals.

The post filter keeps any dust or residue from the desiccant from traveling downstream. This dust is produced by the desiccant beads rubbing against each other as the air passed through the desiccant bed.

Filter Maintenance

Though the engineering that goes into filter design is very sophisticated, their operation and maintenance is fairly straightforward. The element within the filter housing captures contamination in the air and will need to be replaced when the contamination begins to impede the airflow causing pressure drop across the filter to rise.

Some filters are equipped with differential pressure gauges which can be a useful, but they're not a foolproof way of determining element change intervals. Overall, the contaminant load in the air stream will determine how often the elements need to be changed. As mentioned earlier, dual pre-filters, from coarser into finer, will divide the contaminant load and extend the change interval. A good rule of thumb is that filter elements should be changed no less frequently than every 8,000 hours of operation.

It is also crucially important to maintain the auto drains on the pre-filter(s). Any liquid contamination captured by the pre-filter(s) will drop to the bottom of the filter housing and need to be drained. Drain failure in a pre-filter can lead to liquid contamination entering the

Russ Jones, Northeastern Regional Sales Manager, BEKO Technologies.

Proactively Maintaining Desiccant Dryers Yields Efficiencies and Reliable Service

dryer and damaging the desiccant media. On smaller systems, the pre-filter drains tend to be the internal float-type units, while larger systems usually use some type of external drain: mechanical, pneumatic or electronic. Drains on post filters are usually manual since if the dryer is operating properly, there will be no liquid in the post filter.

Valve Maintenance

Also common among these three desiccant dryer types (heatless, heated purge, and heated blower purge) is the use of valves to direct air flow within the dryer. These valves allow the incoming wet compressed air to "switch" from one tower to the other as the towers cycle between drying and regenerating so they are often referred to as "switching valves." These valves also direct the purge air from the regenerating tower to the purge mufflers for exhaust to atmosphere.

There are numerous types of switching valves based on the size and style of dryer but they are all critically important to the operation of the dryer. These valves are usually air-operated so there are also solenoid valves on the dryer package that direct the control air to the valves so each switching valve has three maintenance points for the user to be aware of: the mechanical valve itself, the pneumatic actuator for the valve and the solenoid that directs the control air.

All three of these components should be regularly inspected and maintained as should the control air filter/regulator which uses dry air from the downstream side of the towers and prevents control line contamination from desiccant dust.

A switching valve failure can lead to desiccant over-saturation, poor dew point performance and even dryer failure. Many dryers can be equipped with "failure to switch" alarms which are usually pressure transducers that monitor the tower pressure to confirm that each tower is being pressurized for the drying cycle and de-pressurized for the regeneration cycle. There are also check valves at the compressed air discharge of each tower to prevent back-flow and safety relief valves (one per tower or a shared valve) that also require regular inspection and maintenance. Always refer to the operator's manual as well as local codes (particularly for the pressure relief valves) for specific information regarding maintenance and inspection intervals.

Desiccant Material Maintenance

Another important maintenance item for desiccant dryers of all types is the desiccant material itself. Various types of desiccant are used in compressed air dryers, sometimes multiple types in a single dryer. The three most common desiccant types in compressed air dryers are activated alumina (aluminum oxide), silica gel (sodium silicate), and molecular sieve (zeolite).

BEKO Technologies' DRYPOINT XCp desiccant dryer offers efficient low dew point heatless desiccant drying.

All three types mention have a service life and will require replacement at some point. Desiccant is degraded through bead-to-bead abrasion from movement caused by the passage of air through the bed and also by repeated adsorption (drying) and desorption (regeneration) cycles. It can also be damaged by contamination, most commonly air compressor lubricant and/or liquid water. When a significant contamination even has occurred, like an air compressor separator element failure or an upstream drain failure, the evidence of damage is often obvious: lubricant in exhaust mufflers and/or post filters or lubricant and moisture downstream. In these cases, complete desiccant replacement is necessary.

The gradual breakdown of desiccant due to normal "wear and tear" is more difficult to ascertain. It can be determined by the degradation of dryer performance but since this performance degradation can happen fairly quickly leading to damage to the dryer or even then entire system before service can be performed, desiccant is often changed proactively based on operating hours or elapsed time (two to three years for heated and heated blower purge dryers and three to five years for heatless dryers).

With larger dryers where a desiccant change can be an expensive and time-consuming procedure, desiccant sample testing can be used to determine change intervals. Desiccant sample testing can include measuring heat of adsorption (adsorption is an exo-thermic or heat producing reaction), moisture adsorption by weight, and measurement of surface area to determine the level of bead abrasion. This information can be used to estimate the remaining life of desiccant material to avoid unnecessary maintenance expense.

Purge Exhaust Mufflers

Other components requiring maintenance in desiccant dryers are the purge exhaust mufflers. These mufflers, as their name suggests, reduce the noise caused by the release of air passing through the off-line tower during the tower de-pressurization and regeneration/purge cycles. As this air flows directly through the desiccant bed and into the muffler, it carries desiccant dust along with the moisture it is removing from the tower. This dust can clog the mufflers over time which can cause back-pressure and reduce the effectiveness of the regeneration.

Upon initial start-up, there can be a fair amount of desiccant dust released due to vibrations and movement during the shipment of the dryer to the job site and/or the initial loading of the desiccant into the dryer towers. Most dryer manufacturers recommend running the dryer without the exhaust mufflers for a period to allow any excess dust to exhaust without clogging the mufflers. Most mufflers have internal elements that can be changed out when necessary but there are some, particularly on smaller dryers, where the entire muffler assembly is replaced. Maintenance intervals can vary based on the duty cycle of the dryer among other factors but the mufflers should be inspected regularly and most manufacturers recommend annual replacement.

Heated purge and heated blower purge dryers are more complex devices than heatless desiccant dryers and so require additional maintenance. Important is the need to regularly inspect electrical connections and the overall condition of the heating elements as directed by the manufacturer and in compliance with all applicable safety codes and regulations. The blowers on heated blower purge dryers also require regular inspection. The inlet filters for these blowers are a maintenance item. The filters prevent the ingestion of ambient contaminants that could damage the blower as well as the desiccant. Like all filters, the maintenance interval for blower inlet filters is dependent on ambient conditions so should be inspected regularly and changed as needed.

Dew Point Quality Monitoring

Most desiccant dryers use at least some sensors and the use trend is definitely upwards as more users want more data available to them through the dryer controller. These sensors measure values including pressures, temperatures, humidity and pressure dew point. The sensors provide data to help govern the operation of the dryer but also provide reference information for the user. Luckily, most of these sensors do not require calibration but dew point sensors generally do, usually on an annual basis, or after 8,000 operating hours. In addition to measuring outlet dew point to confirm dryer performance, dew point sensors can be used as energy saving devices as part of a purge control system on a desiccant dryer.

Monitoring the outlet dew point can allow the dryer to extend its drying cycle beyond the time needed to regenerate the off-line tower thus providing purge-free operation which saves compressed air and, of course, energy and money. In short, the dryer can continue to operate on the on-line tower until the outlet dew point begins to degrade. At that point, the towers can switch.

A best practice is to monitor both outlet dew point and mid-tower humidity in the drying

Proactively Maintaining Desiccant Dryers Yields Efficiencies and Reliable Service

tower and use both data points to define the length of the drying cycle with outlet dew point being more accurate as you are directly measuring what you want to achieve in terms of dryer performance and mid-tower humidity being faster reacting as it gives the dryer more time to react before performance degrades.

While dew point sensors on a dryer package do provide valuable data, that data does not tell you if you are getting the required pressure dew point downstream at point of use. Even the best compressed air systems will experience some dew point degradation as the air travels downstream due to moisture re-entrainment.

Whenever there is very dry air on one side of a pipe and relatively moist atmospheric air on the other side, the universe will be trying to equalize those moisture levels through every pipe fitting, drop, and leak in the piping system. If you have a critical air use downstream that requires a specific dew point, it makes sense to monitor the dew point in that area of the system to make sure you are getting the air quality that you need.

After spending the time and money to install and properly maintain a desiccant dryer, it would be a shame to experience an issue caused by downstream piping. The most basic solution would be a stand-alone dew point monitor (sensor and display) that shows the local dew point visually and has a programmable alarm to trigger action if a certain threshold is reached.

A more elaborate solution, and one that might make sense in an environment where air quality needs to be monitored for regulatory compliance, would be a system that allows the dew point data to be downloaded, stored and trended as needed, either as a separate system or integrated into a larger central monitoring system.

Take a Comprehensive and Proactive Approach

A comprehensive, proactive maintenance program guided by both manufacturers recommendations and site-specific historical data will go a long way towards making sure that twin tower desiccant dryers provide many years of reliable service supplying the dry air that many compressed air systems require. Downstream dew point monitoring

Stand-alone, programmable dew point monitors help ensure desiccant dryers deliver the air quality needed at critical use points.

can confirm both dryer and air system performance and give users the visibility required to keep things running smoothly. BP

Russ Jones is Northeastern Regional Sales Manager with BEKO Technologies. Jones has been working in the compressed air industry at both distributor and manufacturing levels for over 30 years and has been with BEKO Technologies since 2015, email: russjones@bekousa.com.

BEKO Technologies develops, manufactures, and distributes components and systems for the treatment and management of compressed air and compressed gas. The independent family-owned company with headquarters in Neuss, Germany was founded in 1982 and is now internationally positioned with over 500 employees and 14 sales offices and production facilities in the USA, India, and China. BEKO Technologies advises manufacturing companies in all industries to find the optimum solution for their compressed air treatment and to ensure that the required quality and energy efficiency in the process are maintained. For more information, visit www.beko-technologies.us. All photos courtesy of BEKO Technologies.

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PRODUCTIVITY, SUSTAINABILITY & ENERGY CONSERVATION

Three Real-World Applications for Pneumatics and IIoT

By Enrico De Carolis, Emerson

The integration of data-driven predictive maintenance with preventive maintenance is one example of how IIoT-enabled pneumatics can solve ongoing challenges.

Industrial operations and manufacturers using pneumatics have access to more Industrial Internet of Things (IIoT) technology than ever before, from position sensors on cylinders to system flow sensors and edge gateways that operate independently from the machine controller with globally accepted communication protocols.

However, the rich data these tools produce also presents a challenge for machine builders and OEMs: How do we put the Industrial Internet of Things (IIoT) to work in a way that makes the most of opportunities in a digitized, highly connected world?

Let's explore real-world applications that leverage IIoT-enabled pneumatics to solve fundamental challenges faced on an ongoing basis.

Improving Safety to Protect People and Equipment

Pneumatics have long provided efficient and cost-effective motion and actuation with reliable technology and a proven record of equipment safety. Now, IIoT technology, along with related European trends like Industry 4.0, creates new opportunities for pneumatics to further improve safety. Additional functional insights also allow users to monitor a machine's safety characteristics to better protect people and equipment from harm.

Consider a machine using a safety light curtain to disable a pneumatics valve system when an operator is loading or unloading a part to be processed into the machine. Historically, safety applications have relied on statistical calculations to define a safety component's mission time replacement cycle.

Mission time defines the number of cycles when a safety component requires replacement regardless of whether it is functioning or not, in order to keep the calculated statistical safety function valid. While the valve may seem to be okay according to its rated mission time, there are other measurable factors that may not be considered (for example, changes in valve response time). A response time that changes from 30 to 70 milliseconds could create a serious safety hazard by allowing an operator to move further into the machine's dangerous motion area before a safety response event is triggered.

A system using new IIoT technology would proactively capture, analyze and report the decline in the valve's response time, as well as the corresponding alert response time before the safety function is compromised. This type of actionable safety information creates a safer workplace.

Improving Predictive and Preventative Maintenance

Dealing with wear and tear is a daily challenge in any manufacturing setting. Predictive and preventive maintenance programs are critical to effectively managing machine lifecycles and maximize Overall Equipment Effectiveness (OEE).

For example, maintenance technicians can analyze appropriate data from IIoT sensors. They can then use that information to predict that a shock absorber at the end of an actuator is deteriorating by sensing a millisecond's increase in its stroke speed. This can trigger predictive maintenance protocols to replace the worn shock absorber. As a result, there are shorter or fewer machine stoppages and a reduction in unplanned downtime, or complete or unrecognized failures.

In addition, IIoT-enabled pneumatics can monitor functionality at a valve's location. A valve's state of wear can be hard to determine from the outside of a machine. If additional internal sensors are not an option, an IIoT gateway can evaluate valve life by tracking the valve's cycle counts. The user can then enable a cycle counter algorithm to determine how much of the valve's life cycle has been used and to predict how many operating days and hours it has left. This allows machine operators or end-users to plan downtime.

Data-driven insights for predictive maintenance can also help to improve

Three Real-World Applications for Pneumatics and IIoT

the scheduling of preventive tasks for pneumatics components. The data can be analyzed and used as information to guide plant management teams as they predict and address issues before they cause injury, damage, failure or production losses.

The integration of data-driven predictive maintenance with preventive maintenance also allows just-in-time part replacements, decreasing the need to purchase and warehouse a full inventory of system-critical, "just-in-case" parts. When pneumatics work together with IIoT, it creates a system that facilitates early detection and prediction of potential issues. Maintenance technicians can place orders to ensure parts are delivered when they are needed. In the future, this, too, could become an automatic step where the IIoT system itself autonomously sends the order to parts suppliers.

Improving Machine Efficiency

The real-world value of a certain technology ultimately equates to how well that technology boosts the bottom line and creates a return on investment. IIoT offers significant opportunities to improve pneumatics operations in several ways, including:

Regulating upstream/downstream flow: Combining the traditional strengths of a pneumatics system with IIoT-based technology can maximize process control and monitoring, particularly for upstream/downstream flow. The result is enhanced OEE and lower Total Cost of Ownership (TCO).

The Emerson RXi2, an edge gateway, allows analysis independent of the controller via local data collection and pre-installed analysis modules.

An intelligent, IIoT-based closed-loop system, including sensors on IIoT-enabled pneumatics components, allows for more flexibility in machine operation positioning.

Consider a plant using a system that allows only fully open or fully closed positions on pneumatically actuated gates on a hopper or silo that dispenses bulk material for packaging. Uneven product flow and traffic jams can inundate or starve downstream processing stations. The inability to vary the dispensing gates' position based on downstream demand creates inefficiencies and bottlenecks throughout the plant. The results range from damages to the bulk material to overtime costs for personnel to make up production quotas.

A retrofit solution, without disturbing the existing controller or its program, can address the issue at a fraction of the cost required for new controller equipment or work process modifications. An intelligent, IIoT-based, closed-loop system, with appropriate sensors on IIoT-enabled pneumatics components, allows each gate's position to vary from zero to 100% of the opening – not just the two positions of opened or closed. The flexibility results in much better flow control for bulk material, without the need to change the controller program.

By adding additional components, such as an extremely precise pneumatic positioning system for control and IIoT gateway to analyze functionality, the system enables more efficient control of the bulk material, preventing starvation of the packaging system downstream as well as optimizing OEE. In addition, data from the IIoT system can be leveraged for additional system improvements. It could, for example, measure valve life so the operator understands whether a valve is performing to specification and, if necessary, change the component during scheduled maintenance while alleviating any unplanned downtime.

Boosting energy efficiency: Smart energy usage is a key consideration for machine manufacturers and end-users alike. Data generated by IIoT-connected sensors can be converted into actionable information, allowing manufacturers to more fully understand and better manage energy usage.

For example, smart sensors can monitor pressure losses within the system and an IIoT gateway can analyze this data and send alerts when leakage becomes the predominant contributor to energy consumption. Users could then identify excessive leaks caused by a worn seal, for example, and mitigate them before they become a major concern. This functionality can also be achieved without changing the machine controller's program or process.

Additionally, smart technology can minimize air consumption, not only to save money but also to reduce wear on components. For instance, by monitoring and analyzing compressed air pressure with respect to cycle time, the end-user can reduce the preset system pressure at the point of use to the work side of a cylinder and determine the optimal operating point where the cycle time can be maintained with the least energy consumption. This also decreases component wear by optimizing generated forces and reducing vibrations.

Enabling manufacturing flexibility: From product customization to packaging variations, manufacturers increasingly require the flexibility to change equipment without sacrificing quality. Connected components can be engineered to easily and seamlessly supply different pressures for different tooling positions and sequences. A directional control valve system, for example, can support simple, on-the-fly changes and tooling positions for quick product variations and changeovers.

Build a Path Forward

Data is only as useful as its ability to provide insights, guide decisions and help justify investment. And while OEMs and end-users understand the potential to capture, aggregate and use sensor data, it's time to turn that potential into reality.

From creating a safer workplace to predicting failure before it happens and building flexible production lines, IIoT-enabled technology can generate real-world results in pneumatics operations. BP

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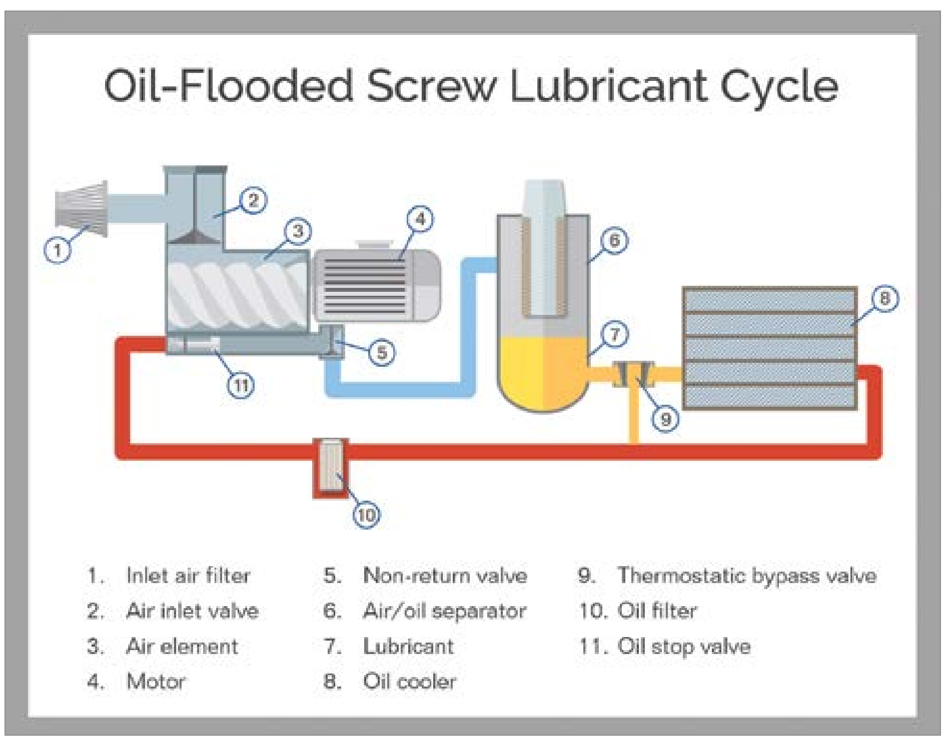
QUALITY, SAFETY & RELIABILITY

Rotary Screw Air Compressor Oil System Components

By Dave Brockett, Isel Inc.

There are many critical components involved in rotary screw air compressors, and the lubricant we use is of vital importance in the process. Screw machines rely heavily on these fluids for bearing lubrication, system cleanliness, water removal, sealing, as well as heat transfer. These fluids work in a very unforgiving environment and must function well in circumstances that would normally be deemed torturous in other lubricant applications. We run it at high velocities, through scorching temperatures, while we blast it with water. Over the years the airends have continued to shrink in size, and turn faster, and oil sumps grow ever smaller, pushing up internal temperatures and increasing the loads these lubricants must endure.

Understanding the basics of the oil system can help us to understand the importance of the lubricant and offer some hints when



Shown are the major components of an oil system in an oil-flooded rotary screw air compressor. Image courtesy of Isel Inc.

there are signs of trouble. In this article, we will go through the major components in the oil system, and some common problems associated with them. The major components can all be found in oil-injected screw machines, but depending on the manufacturer, there may be differences in their order of operation in the loop.

The Sump

We will start our trip through the loop at the same place we will finish: The oil sump. This reservoir is where oil is stored for use in the system. It is usually located in the lower section of a tank-like cylinder, that also houses components used in the air/oil separation process.

This is normally a trouble-free component on the sump side, though certain conditions can cause premature failure, and contamination. Most problems related to the sump are borne from water. If an access amount of water accumulates in the sump due to low oil temperatures, or the separation process fails to vaporize the water from heat of compression, it can continue to adversely affect the lubricant over a long period of time.

This buildup of water can not only damage the machine by replacing oil in critical lubricated areas, but it can cause corrosion in the sump, leading to particle contamination and unwanted metals. The sump is normally our low spot in the system, so there is also risk of airborne contaminants or particulate picked up through the inlet, separating and accumulating in the bottom of the sump. When this occurs, the lubricant can show high particulate counts, or unwanted metals on an oil analysis – and it can mislead technicians even after fresh lubricant changes. Since these particulates have time to settle in the sump, oil changes do not remove them very effectively. We can care for the oil sump by watching oil analysis for water content, making sure to minimize the entrainment of too much moisture, and periodically cleaning and inspecting the reservoir area where possible.

Oil Filter

Our first component outside of the sump is usually an oil filter. In most cases we have a spin-on automotive style centrifugal oil filter, which is designed for high flow and excellent particulate filtration.

Oil from the sump flows through small entry passages around the outside of the filter base and is forced through an opening near the closed side of the filter casing, where it passes through a filter median, then out the threaded center port, and downstream of the filter. These filters are very effective at removing particulate which may be ingested

Rotary Screw Air Compressor Oil System Components

An internal thermostatic valve component. Photo courtesy of Ozen Air Technology.

from the outside air as it is pulled in through the inlet. Other contaminants can also get caught in the media, preventing damage to the air compressor. Examples include solids that may have formed from a lubricant in the process of breaking down, wear materials like metals from wetted parts that are starting to degrade and failing sealing materials.

Many of these filters contain a spring-loaded valve internally at the media entrance, which will open and bypass the media when the oil is too thick to effectively pass through the filter media. This type of filter has the added benefit of protecting the machine from oil starvation while the lubricant is cold and at a higher viscosity. As the oil works its way up to operating temperature, the valve seals, sending the fluid through the media.

These filters are a key maintenance item and must be changed regularly to ensure a particulate-free oil sump. If these filters become completely clogged, they will starve the system of lubricant, and can cause catastrophic damage. They also represent a common leak point if the O-ring seal around the flange fails, or the filter fails to seat properly.

Thermostatic Valve

This is our first stop in our trip through the system. This valve will direct our lubricant towards its next component based on temperature.

Just like the engine oil in a car, air compressor lubricant works best within a certain temperature range. Air compressor lubricants at room temperature have a viscosity or thickness much higher than desired at operating temperature. As we are going to operate this machine at a constant duty cycle, the fluid is manufactured to be at optimal performance once it reaches its operating temperature.

When the air compressor is first started, and the oil is cold, this valve will direct our oil straight into the airend and bypass the oil cooler. This will ensure the lubricant heats up quickly and can effectively perform all the tasks we demand of it. Once the lubricant reaches an acceptable operating temperature, this valve will direct the oil flow out to the oil cooler to maintain that operating temperature and ensure the oil does not overheat.

These valves are normally rather robust, and typically offer years of reliable service, though they do present some leak points. There are occasions where this valve may become clogged with foreign material which may be present in the lubricant. This is rare, as this component is typically downstream of the oil filter, but the accumulation of small particles on the wetted parts of this valve can cause it to clog or jam. Fortunately, modern rotary screw air compressors have controls that will shut the machine down if a loss of lubricant or high temperatures are detected, preventing catastrophic damage to the airend.

Another possible but uncommon failure could be related to a valve unable to cycle or move to its alternate position. This type of failure could be related to the valve's actuator, communication issues with the controller, or caused by debris preventing the valves movement. This can cause the lubricant to remain bypassed away from the cooler, causing high temperature of the lubricant fairly quickly, or the valve may continually send the fluid to the cooler regardless of temperature, causing access accumulation of water in the sump, by preventing the lubricant from preheating properly.

Oil Cooler

Our next stop, assuming our lubricant has reached its operating temperature will be to the oil cooler. As our lubricant has been subjected to extreme friction and bears the brunt of temperature gain from heat of compression, the lubricant will be very hot.

Temperature will have many negative affects on the lubricant. It shortens the life of key additives that are designed to increase shear strength, modify viscosities, prevent excessive foaming, and countless other additives could be present.

High temperatures affect almost all these additives. Another challenge lies in the base stocks themselves, which will turn acidic if overheated. Acid leads to varnish which can clog components, decrease efficiency, and cause severe damage. All these circumstances can be avoided by an effective oil cooler.

Air-cooled Air Compressors

This component, like the radiator in your car, passes the fluid through tubing encased in a block of baffles, designed to optimize heat transfer.

Rotary Screw Air Compressor Oil System Components

Most air-cooled air compressors have a high capacity fan which will force air through the baffles, and out of the cabinet, removing large amounts of heat from the lubricant. These fans have the added benefit of removing heat from all the components inside the cabinet, and a good bit of engineering is typically involved in the design of the cooler, its fan, and the cabinet itself, to ensure the airflow is optimized to remove heat.

These coolers must be cleaned and maintained to ensure proper heat transfer is achieved. When the external surfaces of these coolers collect an excessive amount of dust or other debris from the air being forced through them, the heat transfer can be disrupted, causing high oil temperatures. Simply blowing clean air through a cooler – and removing this buildup – can have a drastic effect on an air compressor's operating temperature.

The thermostatic bypass valve on this unit is built into the oil filter housing. Photo courtesy of Ozen Air Technology.

Internally, the coolers can collect varnish or sludge, which can build up on the cooler walls, and insulate the lubricant from the much cooler inner wall of the tubing. This can often be removed with a cleaner solvent additive, or the cooler can be removed and cleaned with a chemical bath.

Water-cooled Air Compressors

These machines use a liquid heat exchanger instead of an air/oil cooler. The lubricant passes through a series of tubes that run horizontally through a cylinder which is filled with a cooling medium. The cooling medium works on a pressurized loop, so that the cooling liquid is constantly flowing through exchanger.

As the cold fluid passes over the tubes of hot oil, the heat is transferred to the cooling liquid, and is removed from the lubricant. This is a less-common method of oil cooling as it requires a great deal of ancillary equipment in most applications and is typically only used in environments where air cooling the lubricant may not be feasible, or the cooling water system is used for other applications, making water cooling a practical option.

Common issues with water cooling may include corrosion from cooling water that is not properly treated. This can lead to failure of barrier between the lubricant and the cooling water, causing a mixture in the air compressor. Another concern is cooling water temperature. It can be too cold, causing accumulation of water from heat of compression, or not cold enough, causing high oil temperatures.

Oil Stop Valve

Our oil system is under pressure during normal operation, and flows through the oil stop valve, typically on its way into the airend. This is normally an in-line pilot valve that

A centrifugal oil/water separator element. Photo courtesy of Ozen Air Technology.

closes upon shutdown and helps to maintain some oil pressure in the airend. Without this valve, we could run very low or completely out of lubricant in the airend as we wind down, or the oil could flow backwards as pressure is lost.

Airend

All our components thus far have fulfilled their purpose, so now our lubricant is going to do its job.

The lubricant is going to bathe our rotating element bearings in warm, clean oil, forming a film between the rolling elements within the bearing and the bearings race, preventing direct metal to metal contact. The entirety of the rotating assembles will ride on top of this film, drastically reducing friction and optimizing efficiency.

As the oil is injected into the casing, it will form a thin film over the rotor tips and will become the primary sealing method to ensure that air is compressed between the rotors, as our now compressed air exits the airend. At this point the lubricant is emulsified with water, which has been squeezed from the moisture in the outside air during compression, and the compressed air itself. At this point in the process the primary concerns of our lubricant are temperature and water.

The lubricant is going to pick up extremely high temperatures through this process, and it will relieve the rotors and bearings of this extreme heat by carrying the temperature out, and away from the airend. The lubricant needs to be very close to its design viscosity or thickness for this to take place effectively. If the oil is to thick, it may not transfer the heat fast enough. This can lead to high temperatures in the airend which may be difficult to troubleshoot.

Lubricants that have become acidic may form solids in the gaps of the rotors, which can be extremely detrimental to performance and efficiency. Another less-common failure that can be catastrophic is starvation of the lubricant from entering the inlet. In this rare occurrence, the element functions without the presents of the lubricant at all. The bearings will only function for a short time without lubricant separating the moving pieces, and with no heat transfer taking place. In most cases, well under a minute, the extreme heat will cause the rotors to swell and contact the inner casing. This usually results in destruction of the airend itself.

Air/Oil Separator

The airend has discharged an emulsion of extremely hot air, oil, and water, and it's time to separate out our finished product of compressed air, get our lubricant back to the sump, and remove the water we picked up in the airend.

All these tasks will be performed by the separator. We are going to inject this mixture into the same cylinder-shaped tank that our oil is stored in. Our cylinder contains a large separator/filter element at the top, near the inlet port where our mixture will enter, under pressure. This is a coalescing-type filter that will prevent the lubricant from leaving the system, help trap impurities and provide a barrier to give our lubricant no other alternative but to return to sump.

The mixture will spin around the outside of our separator creating a centrifugal effect, causing most of our lubricant to separate and drip down the interior of the cylinder and back to the bottom. Our separator element in the middle of this spinning mixture will only allow our compressed air to squeeze through the final filter median, creating a coalescing effect, and prevent oil and water from escaping downstream.

This process also vaporizes water from heat of compression and allows it to pass back to atmosphere. The medium is much too dense to allow the lubricant to pass, and it will form larger droplets as it gathers in the base of the element, and will fall downward back to lower area of the tank, where it will begin the cycle again. Some of the lubricant will be piped from the center of our separator, back to the air

Rotary Screw Air Compressor Oil System Components

end via a scavenger line. This scavenger line is connected via tubing to the airend and is under vacuum and will collect any lubricant which passes through our separator and return it directly to the air end.

Newer air compressors, especially the smaller machines, utilize a spin-on-type unit, like the oil filter, instead of a large separator element. These spin-on separators have significant maintenance advantages as they are much easier to change. These separators function in much the same way, but are typically mounted inverted, and the scavenge line still pulls access lubricant from a port at the bottom of the filter housings casing.

Larger machines, usually over 100 horsepower (HP), typically use the traditional large separator element, and this arrangement can process a much higher volume of mixture. Some manufacturers still use this arrangement throughout their entire offering, though spin-on separators have become extremely popular for their cost savings and ease of maintenance.

At this point our lubricant is back in the sump and ready to make another loop through the system. Many of the components present in an oil-flooded screw air compressor are related to the oil, as it has so many roles to fill as it is manipulated by these components to provide compressed air. Some of these components are in combined units, where up to three of these jobs are performed by a single assembly, and others are separated completely.

Know your Oil-side Systems

This guide should serve as a roadmap to the oil-side components of your air compressor and can be used to develop an understanding of the oil side systems. As an operator, familiarizing yourself with these components in your machine can be very helpful. The principles and importance of clean, warm lubricating oil are the same for all flooded rotary screw-type air compressors, so though there may be a variance on the operational order in your air compressor, the principles and required components remain the same. BP

Dave Brockett of Isel Inc. is an Air Compressor Product Manager with over 20 years in the air compressor business, starting as an air compressor technician following military service. His experience includes project management, product development, maintenance management, and industrial equipment sales. The author extends special thanks for technical and media assistance from Steve George of Ozen Air Technology and Clint Staples of Katy Equipment.

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QUALITY, SAFETY & RELIABILITY

Troubleshooting Heatless Desiccant Dryer Proves Challenging Yet Successful

By Chris E. Beals, Air System Management, Inc.

➤ One of the most satisfying parts of being a compressed air system auditor is resolving compressed air system reliability issues. This article exposes a seldom, if ever, mentioned problem that can occur when air dryers are dedicated to air compressors. It examines a real-world application and discusses the action taken to remedy the situation.

Dryer Not Maintaining Pressure Dew Point

A portion of the general contractor's project was to purchase and install a lubricated rotary screw air compressor along with a heatless desiccant dryer, a 1,060-gallon wet air receiver, and "no-air loss" auto drains. The air compressor was rated for 518 acfm at 110 psig, while its dedicated dryer was rated for 500 scfm at inlet conditions of 100˚F (38˚C) and 100 psig.

The equipment was installed indoors at sea level and the no-air loss auto drains were installed on the air receiver and the dryer pre- and after-filters. *The reader would be*

> "The specified 500 scfm dryer was undersized; however, after the distributor increased the size of the dryer to 600 scfm by installing additional desiccant, it was sized properly."
>
> — Chris E. Beals, Air System Management, Inc.

correct to question the dryer sizing along with specifying an auto drain for the dryer's after-filter. The project specifications required the dryer to deliver air at -40˚F (-40˚C) pressure dew point (PDP). The equipment was commissioned by a local distributor owned by the air compressor manufacturer. Three weeks after the commissioning the dryer wasn't maintaining -40˚F (-40˚C) PDP, which was a problem for the contractor because they wouldn't receive their final payment until it met the specification.

The distributor responded quickly and found the mufflers plugged along with an eight-psig drop across the pre-filter. The service person cleaned the mufflers, removed the balance line on the pre-filter's no-air loss drain because it was connected downstream of the pre-filter, and adjusted the purge pressure. The pre-filter element was clean so it was assumed that the differential indicator was bad.

Return Visits Yield Few Results

The PDP never recovered so the service person returned two weeks later. He reinstalled the balance line on the pre-filter no-air loss auto drain, moved the control air for both drains from the dry side of the dryer to its wet side and decided to order a new pre-filter and differential gauge. When he left the site the PDP was improving while the dryer was cycling with its upstream air compressor turned off, but it never reached -40˚F (-40˚C) PDP.

The service person returned nine days later and replaced the pre-filter and differential gauge. The service person also replaced the pre-filter's no-air loss drain with an electronic drain, but he left the float drain in the pre-filter housing. *Float drains should be removed whenever an auto drain is installed.* A factory engineer thought the dryer inlet temperature may be too low for the dryer to function properly.

In addition, the service person noticed that while the dryer was delivering air at -23˚F (-31˚C) PDP the system PDP was only at -7˚F (-22˚C). Therefore, the service person theorized the downstream PDP may be affecting the dryer's PDP reading.

The service person returned again nine days later and replaced the pre- and after-filters with larger ones and verified that the purge orifice was correct. *It appears the original filters were undersized because the new ones have the same model number as shown in the dryer's parts manual.* He also disconnected the new equipment from the system and vented its air to the atmosphere but the PDP didn't improve so he decided the desiccant should be replaced.

The service person returned once again 18 days later to change the dryer desiccant. He installed enough desiccants to increase the dryer's rated capacity to 600 scfm. He didn't find any sign of oil or water in the dryer's towers. He also found the oil level in the air compressor to be okay. After the dryer was put back online the PDP read -54˚F (-48˚C), but three days later it was worse than the required -40˚F (-40˚C).

Dew Point Problem Persists

A week later the service person brought the air compressor manufacturer's system engineer along to review the system. The service person changed the purge mufflers, increased the dryer purge pressure, and installed an air coupon at the inlet to the air compressor

Troubleshooting Heatless Desiccant Dryer Proves Challenging Yet Successful

to test the quality of the air flowing into the air compressor. The system engineer discussed several options with the contractor but they didn't want to proceed with any of them until receiving the results from the air coupon.

The service personnel returned three weeks later to change out the dryer purge mufflers and download the air compressor's SD card. The data on the SD card showed that, at times, the air compressor's discharge pressure dropped to 90 psig. A month and a half after the air coupon was installed it showed airborne contaminants so the manufacturer and the distributor said all warranty claims would be denied. *Studies have shown that approximately 80% of airborne contaminants are washed out of the air by the air compressor lubricant. While the airborne contaminants shorten the life of the lubricant; thereby, requiring more frequent*

Oil also found on the after-filter element meant the plant didn't shut off the dryer when it shut off the air compressor. This strongly suggested it was the reason the dryer wasn't maintaining the proper PDP.

oil changes, if they even affect the dryer performance, they aren't going to affect it that quickly.

In addition, the manufacturer's system engineer said the engineering firm had undersized the air compressor and dryer. *The specified 500 scfm dryer was undersized; however, after the distributor increased the size of the dryer to 600 scfm by installing additional desiccant, it was sized properly. They said the air compressor was undersized because it couldn't maintain a discharge pressure of 100 psi, but the low discharge pressure was actually due to the setpoints of the other air compressors.* So six months after commissioning the air compressor and dryer, the dew point issue remained unresolved and the contractor could not get any more support from the distributor.

Oil in the compressed air piping downstream of the dryer pointed to the potential problem with the desiccant dryer's inability to maintain the proper PDP.

Remote System Assessment Only Goes So Far

Approximately two months later the contractor called and asked for my help. Due to the COVID-19 pandemic it was decided to attempt to resolve the issue remotely, even though most compressed air system issues can't be resolved remotely. After reviewing the communications between the engineering firm, the equipment supplier, and the contractor the following facts were gathered:

- There was a no-air loss auto drain installed on the air receiver, but the others had been removed.
- The system contained four air compressors each having a dedicated dryer.
- All the air compressors were air-cooled lubricated rotary screw air compressors that exhausted their hot air into the air compressor room.
- The new air compressor's discharge temperature sometimes reached 110˚F (43˚C).
- The new air receiver and dryer, located approximately 50 feet downstream of the new air compressor were installed in a separate room where the ambient temperature was 87˚F (30˚C).
- The plant only operated four days a week.

Troubleshooting Heatless Desiccant Dryer Proves Challenging Yet Successful

- The plant operated the new air compressor along with one other air compressor.
- On the weekends the plant shut off the new air compressor but they didn't shut off the new dryer.
- Over the weekends the plant continued to operate the larger air compressor in order to support their nitrogen generator.

Our initial thoughts were:

- The dryer may be operating in energy savings mode, which reduces the PDP the dryer is capable of producing.
- The dryer's purge exhaust mufflers may be plugged.
- The dryer may be undersized.
- One or more of the drains aren't working.

Shown is the test setup used to help validate the cause of the dryer problem.

- Condensation may be causing moisture and oil to reach the desiccant. Condensate can reach the desiccant if it slugs the pre-filter, or if it condenses between the pre-filter and the dryer inlet.

- The purge pressure may be set too low.

The contractor investigated these possibilities and found:

- The dryer was working in fixed mode and there wasn't any backpressure on the offline towers.

- The dryer inlet temperature varied between 95˚F (35˚C) and 100˚F (38˚C), which meant the 600 scfm dryer was large enough for the existing dryer inlet conditions.

- The wet air receiver was found nearly full of condensate because the no-air loss drain wasn't working. This suggested that condensate may be slugging the pre-filter.

After removing the air receiver's auto drain and draining the water out it was decided to try and regenerate the desiccant once again. The contractor shut off the air compressor over the weekend and increased the purge airflow to help with the regeneration. The PDP improved to -42˚F (-41˚C) by the end of the weekend, but shortly after the air compressor was put back online it worsened.

Site Visit Reveals Potential Problem

We decided a site visit was required and the following would need to be done in preparation for the visit:

- We couldn't risk having anyone questioning our PDP readings so we had our two dew point monitors calibrated and shipped to the site along with a flow meter and large exhaust muffler.

- The contractor would order new desiccant and filter elements, replace the float drains with ¼-turn ball valves, and insulate the piping between the pre-filter and the dryer inlet.

In order to get familiar with the compressed air system I arrived a day prior to the plant shutting down. I found:

- The setpoints of the other air compressors were set too low for the system to maintain a dryer inlet pressure of 100 psi so the plant increased their setpoints.

- Oil in the main header that was installed near the floor below the dryer discharges.

Troubleshooting Heatless Desiccant Dryer Proves Challenging Yet Successful

A second calibrated dew point monitor verified the accuracy of the PDP reading and showed the oil had damaged the dryer's dew point monitor.

One of our calibrated dew point monitors was installed downstream of the dryer and it read between -25 (-31.6˚C) and -35˚F (-37.2˚C) PDP, which appeared to agree with the dryer's dew point monitor.

The next day the contractor removed the desiccant from the towers and no moisture or oil was found in the towers. The old desiccant appeared to be slightly grayer than the new pure white desiccant. Then sections of the piping upstream of the pre-filter and downstream of the after-filter were removed so the flow meter and exhaust muffler could be installed. At the same time the pre- and after-filter housings were removed so the filter elements could be replaced.

It was at this time we noticed oil on the after-filter element and we began to suspect the cause of the dryer problem. There wasn't any oil in the piping upstream of the dryer, but we did find oil in the downstream piping. At this point we were pretty sure the reason dryer couldn't maintain -40˚F (-40˚C) PDP was because the plant didn't shut off the dryer when they shut off the air compressor.

With the upstream air compressor shut off the dryer's purge air had to come from the main header that contained oil. Hence, the purge air from the main header flowed backwards through the after-filter leaving oil residue on the after-filter element and then into the offline tower contaminating the desiccant before it was exhausted out through the mufflers. However, we still had to prove our theory.

Theoretical Solution Met with Success

In order to prove our theory we completed the test setup after installing the new desiccant and then opened the valve upstream of the exhaust muffler, until the flow meter upstream of the dryer read 500 scfm, and the new air compressor stopped cycling. To our disappointment the dew point monitor on the dryer only read -41˚F (-41˚C) PDP. We installed our dew point monitor downstream of the dryer, but upstream of the ¼-turn ball valve used to exhaust the air to the atmosphere.

To our surprise the PDP read -80˚F (-62˚C). The PDP of compressed air improves when it's expanded to a lower pressure so we weren't sure the -80˚F (-62˚C) PDP reading was accurate. In order to verify the PDP reading our second calibrated dew point monitor was installed just upstream of the dryer's dew point monitor. Our second monitor also read -80˚F (-62˚C) PDP so we knew the dryer's dew point monitor had failed. The dryer maintained -80˚F (-62˚C) PDP throughout the three-day test and when the dryer's new dew point monitor arrived and was installed it also read -80˚F (-62˚C) PDP.

After the site visit the plant installed a check valve, downstream of the after-filter and started shutting down the dryer whenever they shut down the new air compressor. It's been a few months since the test was conducted and the dryer is still maintaining -80˚F (-62˚C) PDP. BP

Chris Beals is President of Air System Management, Inc. He is also a founding member of the Compressed Air Challenge and has been solving compressed air system problems for 22 years. Chris can be reached at email: cbeals@earthlink.net, tel: 303-881-8870. All photos courtesy of Air System Management, Inc.

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COMPRESSED AIR INDUSTRY & TECHNOLOGY NEWS

Kaeser Expands US Headquarters

Kaeser Compressors, Inc. broke ground on a new 30,000 sq. ft. facility expansion. The virtual ceremony was led by Frank Mueller, president of Kaeser Compressors, and included representatives of Lifecycle Construction Services, McKinney Architects, and the Spotsylvania County Economic Development Department. “At this critical time, we are increasing capacity to serve our customers’ needs in the many essential industries throughout the country,” said Mueller. “This new and exciting project will allow us to better support our national distribution network and our ever-expanding business in the US. And like our original building which we opened 25 years ago, this new addition is dedicated to our employees, Kaeser’s most valuable resource.” The new space will accommodate an additional 100 people and provide enhanced amenities for all employees. Construction should be complete by November 2021.

Kaeser Compressors, us.kaeser.com

Portable Air Compressor

The all-new Sullivan-Palatek D185PKR Kohler powered portable air compressor is a 185 CFM/100 psi unit featuring a durable but light-weight composite clam shell canopy design for access to all routine serviceable components, such as the spin on oil filter and separator. Easy to tow and compact in design, the unit is equipped with a foldable drawbar to minimize overall footprint in shipping and storage. It is powered by a 48.8 hp Tier 4 Final Kohler engine and a Sullivan-Palatek factory-made 108 mm rotary screw air end. Features side by side coolers for the compressor and engine, a large curbside toolbox for storage, a 12-hour full shift 30-gallon composite fuel tank with fuel level visibility, and a state-of-the-art controller.

Sullivan-Palatek, www.sullivan-palatek.com

ELGi North America Opens New Headquarters

ELGi North America a subsidiary of ELGi Equipments Limited, a global supplier of compressed air solutions, announced it recently held a grand opening and ribbon cutting ceremony for the company’s new, expanded North American headquarters, located in Charlotte, NC. The ribbon cutting event was attended by ELGi employees and included speeches by David Puck, President, ELGi North America and, Dr. Jairam Varadaraj, Managing Director, ELGi Equipments Ltd. Puck and Dr. Varadaraj cut the ribbon to officially mark the company’s relocation from Continental Blvd. to a larger space on Entrance Drive.

ELGi North America, www.elgi.com/us

Modular Desiccant Dryers

A new range of Hankison HSHD Series small, low flow, modular desiccant air dryers for critical air quality applications has been launched by SPX FLOW. The HSHD Series are pressure swing adsorption dryers delivering pressure dew points to ISO 8573-1:2010 Air Quality Class 1 (-94˚F/-70˚C) and Class 2 (-40˚F/-40˚C) with flow rates of 7 to 40 scfm (12 to 68 m^3/h).

Units are delivered as standard with an oil removal pre-filter and particulate after-filter.

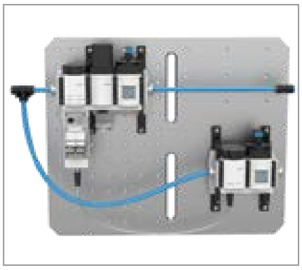
The dryers feature a controller with Modbus communication protocol and a 7" color touchscreen for optimized viewing and to facilitate navigation. Operators may also select pressure dew point performance for maximum application flexibility.

SPX FLOW, www.spxflow.com

COMPRESSED AIR INDUSTRY & TECHNOLOGY NEWS

Compressed Air Energy Saving Platform

Festo has expanded its intelligent pneumatic energy savings platform with two new modules – the MSE6-C2M (C2M) and the MSE6-D2M (D2M). They automatically shut off the compressed air supply to a machine when in standby mode, thus reducing energy consumption. They monitor system pressure and flow information in real time and enable faster response to compressed air leaks. These units flow up to 5,000 liters of compressed air per minute; program easily; connect to Festo MS series air preparation units, including the MS6-SV safety valve; and are suitable for new as well as existing machines. The new C2M is an intelligent combination of a proportional pressure regulator, on/off valve, sensors, and fieldbus communication. Similar to the C2M, the D2M intelligent module monitors the compressed air supply and automatically shuts off the compressed air during breaks in production. Unlike the C2M, the D2M completely depressurizes the system.



Festo, www.festo.us

Xebec Acquires The Titus Company

Xebec Adsorption Inc., a global provider of clean energy solutions, announced it has entered into an agreement effective October 30, 2020, to acquire all of the outstanding shares of "The Titus Company" (Titus). Titus' principals will remain with Titus after the acquisition to optimize their integration into Xebec's Industrial Service and Support business and to grow the operation over the coming years. With this acquisition, Xebec's Cleantech Service Network (CSN) coverage will increase to include Eastern Pennsylvania, Delaware and New Jersey. Total consideration payable by Xebec is approximately $8.0M, subject to certain holdbacks, adjustments and time-based payments. Titus had revenues of $12.3 million for FY2019 with an EBITDA margin of approximately 13.5%. "We're happy to welcome another member to the Xebec family. Titus has a stellar track record in the compressed air service industry with several Fortune 500 companies and the U.S. Navy as customers. Their expertise and presence will be helpful in rounding out our capabilities on the U.S. East coast as more customers explore decarbonization pathways that include renewable gases," said Dr. Prabhu Rao, Chief Operating Officer at Xebec Adsorption Inc.

Xebec Adsorption, www.xebecinc.com

Rugged Pleat Baghouse Dust Collector

Donaldson Company introduced the Donaldson Torit Rugged Pleat (RP) baghouse industrial dust collector. The collector is designed to capture heavy and abrasive dust inherent to woodworking, mining, grain processing and other industries. The new RP baghouse collector features the SuperSep inlet which pre-separates up to 97% of the dust before it hits the filters and the PerfectPulse cleaning system focuses cleaning energy directly over the filters, supporting long life. With its new Ultra-Web Spunbond filters, the collector is capable of providing up to 94% fewer emissions as compared to baghouses equipped with standard 16-oz. singed polyester bags, which makes it ideal for heavily regulated industries and operations that recirculate conditioned air in their facilities. The new RP baghouse dust collector utilizes 44% fewer filters than traditional baghouse collectors, resulting in a 72% reduction in change-out times. It also includes the iCue connected filtration monitoring service.

Donaldson Company, www.Donaldson.com

T6-1000 PRO Electrical Tester

Troubleshooting electrical systems can be time-consuming and potentially dangerous because it requires access to metallic contact points. The new Fluke T6-1000 PRO Electrical Tester measures voltage and current – without test leads – and displays both readings simultaneously, saving time and keeping workers safe. The product measures voltage up to 1000 V ac and current up to 200 A ac, all through the open fork and without test lead contact to live voltage. It also measures resistance 1 Ω to 100 kΩ and frequency 45 Hz to 66 Hz through open fork. It works with most wire up to AWG 4/0 (17.8 mm/0.7" jaw opening). The HOLD button temporarily freezes the large display screen with backlight for easy viewing.

Fluke, www.fluke.com

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Sullair	7	www.sullair.com
Best Practices Webinars	8,28	www.airbestpractices.com/magazine/webinars
Hertz Kompressoren USA	9	www.hertz-kompressoren.com
Sullivan-Palatek	11	www.sullivan-palatek.com
Clean Resources	13	www.cleanresources.com
Sahara Air Products	15	www.saharahenderson.com
SEVAIR	17	www.sevair.com
JORC Industrial	19	www.jorc.com
VMC-USA	21	www.vmc-usa.com
Tamturbo	23	www.tamturbo.com
Anest Iwata	25	www.anestiwata.com
Altec AIR	27	www.AltecAir.com
Case Controls	29	www.casecontrols.com
KTC USA	31	www.ktc-air.com
Compressed Air and Gas Institute	33	www.cagi.org/personnel-certification
Compressed Air Challenge	35	www.compressedairchallenge.org
Best Practices 2021 Expo & Conference	37	www.cabpexpo.com

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