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August 2021

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Food & Beverage Processing & Packaging Monthly Feature

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QUALITY, SAFETY & RELIABILITY FEATURES

SUSTAINABILITY & ENERGY/WATER EFFICIENCY FEATURES

SUSTAINABILITY & EFFICIENT TECHNOLOGY NEWS

EVERY ISSUE

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FROM THE EDITOR

Quality, Safety and Reliability

The monthly food & beverage industry feature article is titled, "Sterile Compressed Air Filters Remove Bacteria." Peter Gray, from Air Solutions Canada, writes, "…the removal of bacteria is often overlooked in compressed air systems." I agree and encourage readers to take a close look at this article.

Nitrogen is the gas most-often used in manufacturing. The Compressed Air & Gas Institute has sent us an excellent article titled, "Nitrogen Characteristics and Benefits of On-Site Generation."

Sustainability & Energy/Water Conservation

Experienced compressed air auditor John Molnar, P.E., from Rogers Machinery, has sent us an article about two-stage VFD rotary screw air compressors providing efficiency levels he believes are the "second stage" for energy efficiency.

Compressed Gas Mixing (CGM) in "mixing limited" waste water treatment applications is a very interesting topic introduced by David Lauer, P.E., from EnviroMix. This innovative approach saves energy by firing compressed air through engineered nozzles located near the tank floor.

Quad prints this magazine in one of the largest commercial printing plants in the U.S., located in Sussex, Wisconsin. We were so impressed by the compressed air system, installed at this 1.7 million-square-foot plant, we asked permission to write an article about it!

Registration is Officially Open for the 2021 Best Practices Expo & Conference taking place November 2-4, 2021 – in the Chicago outskirts near O'Hare International Airport! Please mark your calendars and register at https://cabpexpo.com.

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

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CORPORATE GHG-REDUCTION NEWS*

Featuring: Tetra Pak, Tessy Plastics, thyssenkrupp Elevator, Waste Management, Porsche, Bentley

* Scope 1 and 2 GHG Emissions from Direct Operations

Tetra Pak Recognized with Rare "Double A" Score from CDP

Tetra Pak announced, in December 2020, it has been recognized for leadership in corporate sustainability by global environmental non-profit CDP, securing a place on its prestigious A List for tackling climate change, as well as acting to protect forests – two of the three environmental themes covered by CDP. Tetra Pak is the only company in the carton packaging sector to be included in the CDP leadership band for five years in a row and to score an outstanding double "A" for climate and forests in 2020.

Tetra Pak is part of a very small number of companies (1%) that achieved a double "A" score, out of 5,800+ companies that were scored based on data submitted through CDP's questionnaires in 2020. Through significant demonstrable action on climate and deforestation risks, the company is leading on corporate environmental ambition, action and transparency worldwide.

Markus Pfanner, Vice President Sustainability, Tetra Pak, commented: "Transparent disclosure is at the core of how we measure and improve our sustainability performance. This recognition – a first in the carton packaging sector – is a result of our continuous efforts to reduce GHG emissions and meet ambitious climate targets, to take action in protecting and enhancing biodiversity and to strengthen responsible sourcing of raw materials. Earlier this year, we set an ambition for net zero emissions across the value chain by 2050, supported by a 2030 target of net zero emissions in our own operations."

"This is another key step in our journey towards the ultimate sustainable food package, fully made from renewable or recycled materials. The ultimate sustainable food package is convenient and safe, enabling a resilient food system, and is fully recyclable and carbon-neutral. Creating this future food package will not be easy and will also not happen overnight. Being recognized as a sustainability leader by CDP, we remain fully committed towards this goal."

To learn more about Sustainability at Tetra Pak visit https://www.tetrapak.com/sustainability

Markus Pfanner, Vice President Sustainability, Tetra Pak

Tessy Plastics Receives CDP "A" Rating

Tessy Plastics has been recognized, in December 2020, for leadership in corporate sustainability by global environmental non-profit CDP, securing a place on its prestigious "A List" for tackling climate change.

Tessy Plastics was recognized for its actions to cut emissions, mitigate climate risks and develop the low-carbon economy, based on the data reported by the company through CDP's 2020 climate change questionnaire.

Tessy Plastics Owner and President, Roland Beck, states, "We have come a long way in the past ten years and it is truly remarkable how we are now recognized as a leader in corporate sustainability. It is not only important to us, but to our customers, suppliers, and vendors that we provide sustainable quality-driven solutions across the board. Our Environment, Health, and Safety team has paved the way to make conscious decisions and take action to reduce our operations carbon footprint. I am very proud of the efforts put forth and I look forward to raising the bar even higher allowing us to redefine the corporate sustainability standard. As we continue our sustainability journey, it is my hope that others will follow in our footsteps to cut emissions and mitigate climate risks."

To learn more about the Sustainability TP3 Program at Tessy Plastics visit https://tessy.com/sustainability/

Tired of downtime and scrap as a result of poor compressed air quality?

Moisture is found in compressed air lines and exhausting from valves and actuators on equipment thereby reducing component life and machine efficiency. Tired of draining water and oil from your compressed air lines every spring? Tired of cleaning or replacing pneumatic components well before their lifespan?

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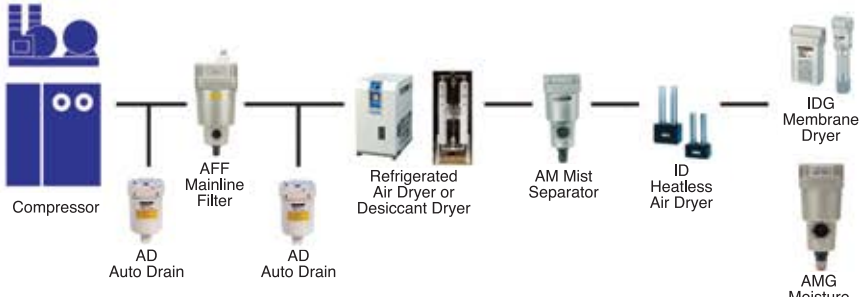

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Corporate GHG-Reduction News

thyssenkrupp Elevator Sets 50% GHG Reduction Target by 2040

thyssenkrupp Elevator announced, in May 2020, its long-term carbon targets as it continues its mission to significantly reduce its greenhouse gas emissions (GHG) moving forward. By 2030, thyssenkrupp Elevator is targeting a carbon footprint reduction of 25%, and by 2040, the company is aiming to reduce its GHG emissions by 50%, based on its current carbon-footprint for Scope 1 and 2 emissions.

These carbon targets are in line with science criteria that enforces the commitments to the Paris Climate Agreement to capping climate change to 2 degrees Celsius.

"Our climate targets are ambitious – but in view of the tasks and challenges facing us in terms of climate protection, they are not exaggerated. We see a clear responsibility on the part of the companies and are determined to make our contribution – and it should be sustainable in the long term," says Peter Walker, CEO of thyssenkrupp Elevator.

More than half of thyssenkrupp Elevator's carbon emissions are related to the vehicle fleet. Reductions of emissions over the next 10-20 years will be highly focused on the company's fleet, including initiatives for optimization and route efficiency planning. The use of hybrid and electric vehicles will be also extended within the fleet as infrastructures become appropriate to our activity.

"thyssenkrupp Elevator's long-standing commitment to sustainability starts at our own operations with these ambitious carbon targets. Our reduction of carbon emissions throughout our full operations will not only help our bottom line, but will also allow us to provide the best answer to our customers while acting in an environmentally responsible way in all phases of our business" said Paula Casares, Head of Sustainability at thyssenkrupp Elevator.

For the last five years, thyssenkrupp Elevator has worked towards reducing its energy consumption, both in the fleet and the factories. In 2015 thyssenkrupp Elevator committed to report energy efficiency gains by 2022 for an amount equal to 10% of its energy consumption. Since then the company has reduced carbon footprint by 10%.

As part of thyssenkrupp Elevator's strategy to improve energy management in the factories, all energy relevant factories are ISO 5001 certified. Additionally, the company has LEED Gold certified facilities in US and China and last summer, thyssenkrupp Elevator announced it would pursue LEED v4 certification for its new elevator test tower being built at The Battery Atlanta.

To learn more about the Sustainability at thyssenkrupp visit https://www.thyssenkrupp.com/en/company/sustainability/sustainability-strategy-and-targets

Waste Management Reports Progress Towards 2025 and 2038 Sustainability Goals

Waste Management (NYSE: WM) released, in October 2020, its 2020 Sustainability Report, highlighting progress toward the Company's 2025 and 2038 sustainability goals, key performance indicators, recycling advancements and recent awards.

Waste Management (WM) remains focused on improving and creating sustainable solutions for all of its stakeholders. With a commitment to consistent public disclosure, WM is shifting

to an annual reporting cadence, publishing content in two formats, to further reporting transparency.

- The Sustainability Report, available as an interactive website and PDF, details progress on important issues and annual updates.

- Complementing the report, a new Environmental, Social and Governance (ESG) Resource Hub provides easy access to data related to performance, policies and initiatives. Relevant updates and an archive of past reports are available within the ESG Resource Hub.

"The world is rapidly changing and to sustain and succeed, we must remain agile and adaptable," said Jim Fish, WM president and chief executive officer. "Our 2020 Sustainability Report is a testament to how we address challenges and opportunities related to the environment, social issues and governance. The report outlines progress in 2019 and speaks to the shifts we made to power through turbulent months, mitigate climate change, keep people first, and work together with our communities."

To learn more information about Waste Management, www.wm.com.

Porsche Calls for Suppliers to Switch to Green Energy

Porsche is making further efforts to reduce CO2-emissions in its supply chain: the sports car manufacturer is calling for its around 1,300 series suppliers to use exclusively renewable energy in the manufacture of Porsche components as of July, 2021.

It applies to any contracts awarded for providing production material for new vehicle projects. Suppliers who are unwilling to switch

Corporate GHG-Reduction News

to certified green energy will no longer be considered for contracts with Porsche in the long term. "Our battery cell suppliers have already had to use green energy since 2020. And now we are taking the next important step: we stipulate that our series suppliers also use only renewable energy to produce our components, to help reduce CO2-emissions even further. We recognize that we have a responsibility to ensure that supply chains are transparent and sustainable," says Uwe-Karsten Städter, Member of the Executive Board for Procurement at Porsche AG.

Porsche has set itself an ambitious goal: the company wants to be CO2 -neutral across the entire value chain by 2030. At the moment, the sports car manufacturer's supply chain is responsible for around 20 percent of Porsche's total greenhouse gas emissions. This percentage is set to rise to around 40 by 2030 due to the increasing electrification of vehicles. But Porsche is tackling this issue head on: "By using only renewable energy sources, our suppliers are following our example in our efforts to reach CO2-neutrality. We plan to have even more intensive talks with our partners in order to drive forward improvements in our sustainability. It is only by working together that we will be able to combat ongoing climate change," explains Städter.

As well as in its supply chain, Porsche is reducing CO2-emissions in its own plants: the production of the Taycan – the first all-electric sports cars made in the Zuffenhausen plant in Stuttgart – has been carbon neutral since it was launched in 2019. Since 2020, this has been true for all vehicles made at the company's headquarters, and thus for the 911 and 718 as well. At the start of 2021, the Development Centre in Weissach and the plant in Leipzig, where the Macan and Panamera models are produced, followed suit. This means that all of the large Porsche sites are already CO2-neutral in terms of operations.

The company will also be investing more than a billion euros in decarbonization measures over the next ten years. Porsche reached a milestone with the world premiere of the Taycan Cross Turismo at the beginning of March. The all-rounder among electric sports cars is the world's first ever vehicle to be carbon neutral throughout its entire service life. More model series are set to follow. And by 2030, the aim is for more than 80 percent of all new vehicles sold to be purely electric or plug-in hybrid models. As early as 2025, at least 50 percent of new vehicles sold are to feature an electric drive.

*Taycan: CO_2 emissions combined 0 g/km (NEDC), Electricity consumption combined 28.7 – 28.0 kWh/100 km (NEDC)

For more information on Sustainability at the Volkswagen Group visit https://www.volkswagenag.com/en/sustainability.html

Data Confirms Boost to Sustainability at Bentley Headquarters in Crewe

Bentley, in March 2021, revealed the latest environmental and sustainability data for the company's production operations in Crewe, taking the brand closer to its ambitious bid to become the world's most sustainable luxury car manufacturer. Compared to its 2010 baseline, the British luxury brand reported significant improvements in all areas, and is on track to deliver an ambitious 75 per cent reduction in production-related environmental impact by 2025.

Data for the period 2010-2020 shows a dramatic fall in CO_2 emissions at the Pyms Lane plant, down a remarkable 99.5 per cent to just 29 kg per vehicle, which are offset. This drop in CO_2 emissions is predominantly the result of Bentley utilizing energy generated through its onsite solar PV system, alongside green gas and electricity supplies in the factory for the first time over a full 12-month cycle.

A range of other innovative measures taken at the home of the world's most sought-after luxury car brand have also added to the impact. These include the installation of hydrotreated vegetable oil (HVO) fueling facilities – an ultra-low emissions alternative to conventional fuels for in house logistics.

The amount of water used in vehicle production has fallen by 55.9 per cent over the same 10-year period, from 21.1 cubic meters per vehicle, to 9.31 cubic meters per vehicle. This saving of nearly 12 cubic meters per vehicle equates to around 150 bathtubs full of water – and has been achieved by installing water recycling systems, coupled with a reduction in "domestic" water use on site as more colleagues worked from home.

Meanwhile, thanks to improvements in recycling processes, which reflect a circular economy approach, the very small amount of waste material that cannot be recycled and is sent to landfill fell by 99.1 per cent compared to 2010, to just 3.57 kg/vehicle last year.

Peter Bosch, Member of the Board for Manufacturing, explains: "Creating Bentley's climate positive 'dream factory' sits at the heart of our Beyond100 strategy to become the world's most sustainable luxury car brand, and reflects the "go to zero" ethos of the entire Volkswagen Group, which is now in its tenth year of measuring production related environmental impact.

"By focusing on resource efficiency and a circular economy approach, our 2025 target is to reduce our production-related environmental impact by 75 per cent compared to 2010 – so we're delighted that the latest data shows such positive progress in the areas of energy, water and materials.

"Everyone within Bentley's production operations has a part to play to ensure we meet these targets, so we have begun 2021 by engaging colleagues in the launch of our new 'Wings' manufacturing strategy, which will see us pioneer a paradigm shift in onsite sustainability".

For more information on Sustainability at the Volkswagen Group visit https://www.volkswagenag.com/en/sustainability.html

FOOD & BEVERAGE PROCESSING & PACKAGING MONTHLY FEATURE

Sterile Compressed Air Filters Remove Bacteria

By Peter Gray, Air Solutions Canada

➤ Since the beginning of the COVID pandemic, it has become very apparent just how dangerous viruses and bacteria can be. Awareness has unfortunately grown of airborne bacteria transported in the ambient air.

Airborne bacteria can also be present in a compressed air system. The difference being the concentration is significantly higher in compressed air compared to ambient air. In most cases the concentration is 7 times as severe, as when the system pressure is 102 psig (7 barg).

Removal of Bacteria from Compressed Air Often Overlooked

When compressed air comes into direct contact with a product, many applications believe their "standard" particulate and coalescing oil-removing filters, installed either side of a compressed air dryer,

Stainless steel housings for sterile compressed air filtration.

are sufficient to protect the downstream processes. Strangely enough, the removal of bacteria is often overlooked, despite this level of filtration being readily available, easy to procure, install and maintain.

We must protect against the contamination of bacteria, as it will typically destroy any product it comes into contact with. The benefits of removing bacteria from compressed air (and make it sterile), wherever compressed air comes (directly or indirectly) into contact with any type of food, beverage, or pharma product, are to increase shelf life, reduce product spoilage, negate the risk of recalls and bad press, all while increasing the quality and integrity of the end product.

Let us take as examples dairy production, food process, brewery, pharmaceutical or beverage manufacturing facility. Most of these processes, direct inject, blanket/purge tanks, open or fill packaging, or move their product using compressed air. Many do so without realizing that with the addition of a sterile filter, we elevate the compressed air quality to an absolute retention rate of 99.99998% related to 0.2 micron. This eradicates bacteria and microorganism contamination from the downstream compressed air flow.

Ensuring 0.2 Micron Sterile Filtration

The conditions, within a compressed air system, are ideal environments for the growth of bacteria when the compressed air carries water vapor. Compressed air at higher temperatures carrying water vapor provides an environment in which bacteria are able to grow and reproduce quickly. In order to protect and preserve products from being contaminated with bacteria it is critical to provide the filtration able to produce sterile air.

In most factories we visit, this simply means all they require is the installation of one sterile filter assembly. It is critical to ensure the filter element rating is 0.2 micron to guarantee the bacteria do not penetrate the filter. Otherwise the filter element would not ensure sterility. The 0.2 micron rating is required and sized accordingly because it is the most difficult particle size to capture. Sterile filters are specifically designed to remove microorganisms and bacteria which are on average 0.2 micron.

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Sterile Compressed Air Filters Remove Bacteria

It is recommended to place sterile compressed air filters as close to the application as possible.

Stainless steel housings are highly polished allowing no place for bacteria to grow.

Because the removal of moisture from compressed air can sometimes be inconsistent, it is recommended to protect processes by placing the sterile filter assembly as close to the direct compressed air contact with product/packaging as possible.

We recommend compressed air is dried, before it reaches the sterile filter assembly, because the moisture has a derogatory effect on the sterile element. If we remove the moisture to a pressure dew point of -40°F (-40°C) through the use typically of a desiccant air dryer, we are sufficiently removing water vapor to prevent bacteria and virus growth. It is always essential to dry and prefilter the compressed before the compressed air enters the sterile filter.

Stainless Steel Housings for Sterile Filters

The sterile filter assembly is made up of two components, the housing and the filter element.

The housing is constructed of stainless steel, with 304 and 316L SS being the most common off the shelf offering. The housing must be stainless steel to make certain it will not corrode. Corrosion is created by oxidation and the generation of unwanted particles, some of which provide food for the bacteria to feed on. The surface of the stainless steel housing is highly polished, as a rough surface of an unpolished stainless steel housing creates hiding places, in which the bacteria continue to grow.

Special order/custom options are also available, such as electro-polished outer surfaces on housings and all manner of inlet and outlet connection options. Connection options can include ASA (weld), DIN/ANSI, NPT, Tri-clamp ASME, Dairy Union DIN 11851, Flange EN1092-1 and Weld End.

Sterile Filter Elements and Media

High quality sterile filter elements are available with FDA and EC validation and end users must insist the cartridges be shipped in a sealed and sterile package to ensure the filtration integrity and validation is guaranteed at every level. High quality elements are biologically and chemically inert, ensuring there is zero breeding ground for bacteria or separated microorganisms to reproduce. Consumers should also ensure the elements they are purchasing/using are 100% guaranteed non-shedding.

The filter media itself is also very important. High quality sterile filter element media

will be binder-free. The fibers are thermally welded (sintered) together and with that are totally chemically inert offering no feeding ground for bacteria.

All other common types of filter elements use binders, glues and additives to hold the fibers together. This has two disadvantages:

1. When the filter elements are sterilized, the glue becomes soft allowing movement of the fibers, which can cause them to become unsterile.

2. Glues offer a feeding ground for bacteria.

This is not the case in a sterile filter element, which is manufactured using only a binder-free filter media.

Sterile filter elements for compressed air.

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Sterile Compressed Air Filters Remove Bacteria

Steam Sterilization "Regenerates" Sterile Filter Elements

Once Bacteria is trapped by the sterile filter, we must exterminate the bacteria and prevent it from migrating beyond and growing through the filter element. It is recommended to sterilize a sterile filter after every production run – or at least after 14 days.

Extended product shelf life, and the peace of mind that sterile filtration provides, is further enhanced by the fact that the sterile filter elements can be "regenerated" between 100 and 200 times, depending on the grade of the sterile filter element.

Sterile filters can be "sterilized in-place" **(SIP),** with steam. Alternatively, the element can be removed from the housing and externally sterilized by autoclave. If a spare filter element is available, the elements can be rotated between the autoclave and the housing. Replacing the element with a new one is another option if steam or autoclave are unavailable.

The Steam sterilization temperature will need to be between 230°F (110°C) and 284°F (140°C), subject to the availability and temperature of steam. The sterilization times are between 30 minutes (at 230°F) to 10 minutes (at 284°F).

The sterilization process is simplistic and highly effective.

Step 1. Valve (1) and valve (4) close, to isolate the sterile housing and element.

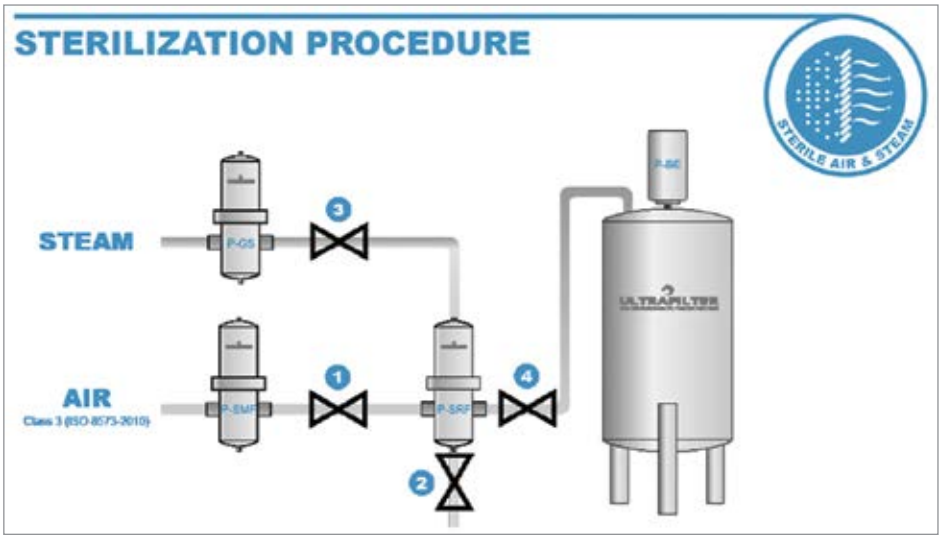
Step 2. Drain valve (2) opens, to exhaust compressed air pressure.

Step 3. Valve (3) opens to allow steam to flow into the sterile filter housing.

Step 4. After reaching a temperature of 212°F(100°C), the steam begins to condense, with valve (2) remaining open. Steam pressure increases to the desired sterilization temperature.

Step 5. After reaching the required steam temperature, the actual sterilization process begins, using the following temperature and timeline ratios:

- Saturated steam 250°F (121°C) = 30 minutes



- Saturated steam 268°F (131°C) = 20 minutes
- Saturated steam 286°F (141°C) = 10 minutes

When the sterilization time has passed, valve (3) can be closed. Partially open valve (1) to introduce compressed air into the housing and purge any residual steam condensate out of the drain valve (2). Next close valve (2) and slowly open valves (1) and (4) fully.

Preventive Maintenance Ensures Sterile Filtration

Ensuring preventive maintenance is adhered to is a critical part of ensuring compressed air remains sterile at all times. From our experience, it goes well beyond replacing filter elements on time. One must create a maintenance plan outlining:

- The location of the filter on the plant floor
- The date the element was installed and when it should be replaced
- The frequency of steam sterilization, autoclave or element replacement
- Location of element inventory, onsite stores or vendor-controlled stores. BP

About the Author

Peter Gray is the President of Air Solutions Canada. For more information about Air Solutions Canada visit www.airsolcan.com or email: info@airsolcan.com

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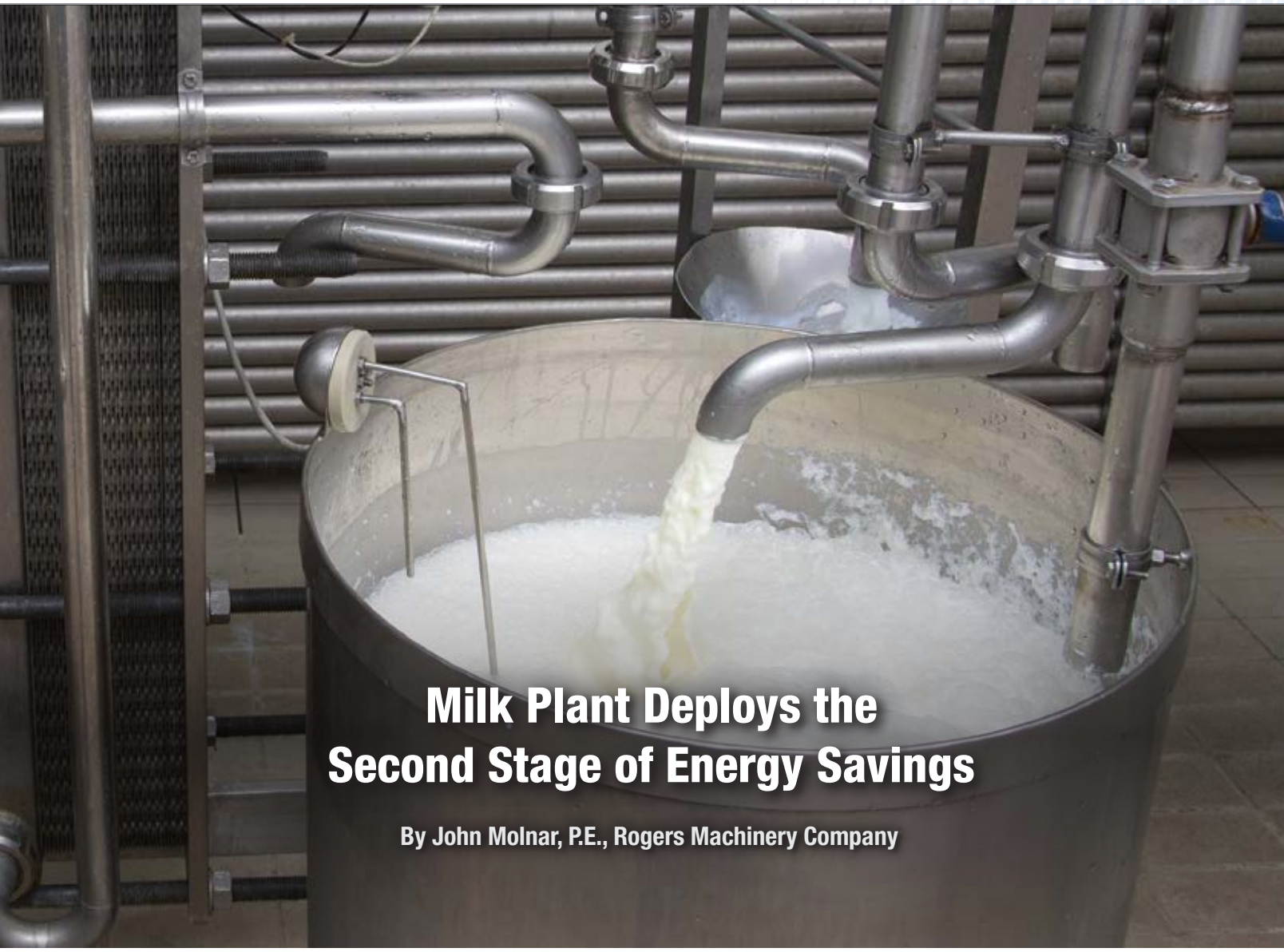


Milk Plant Deploys the Second Stage of Energy Savings

By John Molnar, P.E., Rogers Machinery Company

Energy efficiency for air compressors has been a large target for industrial energy efficiency programs throughout the country. The Department of Energy states 16% of all industrial motor energy use in the United States is consumed by air compressors (Motor Market report, XENERGY Inc.,1998). Many organizations are involved with air compressor efficiency: Compressed Air Challenge, non-profits, public and private utilities, vendors, and distributors. The groups come together to offer outreach, system analysis, training, and financial incentives. Compressed air efficiency projects have saved incredible amounts of energy and help keep our industries competitive.

Figure 1: Single Stage VFD Compressor

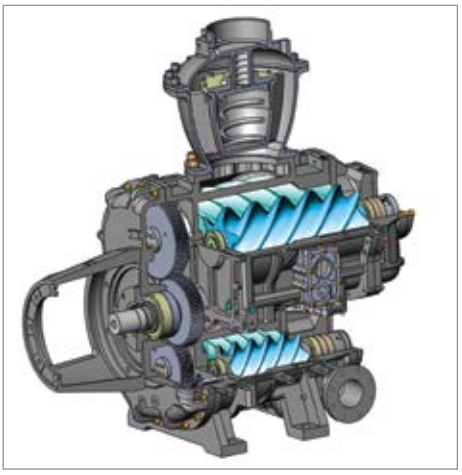


Figure 2: 2-stage air-end

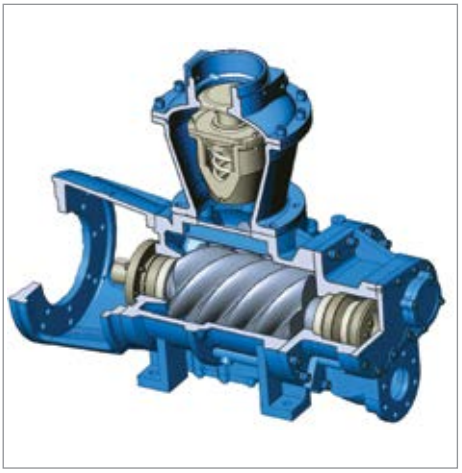


Figure 3: Single-stage air-end

The First Stage of Energy Efficiency

During the early years of energy efficiency programs, lucrative projects were abundant. The wild, wild, west days of 1,000,000+ kWh/yr projects are behind us. There aren't many sites across the country who haven't been contacted by an air compressor salesperson, energy consultant or utility representative to discuss compressed air energy efficiency.

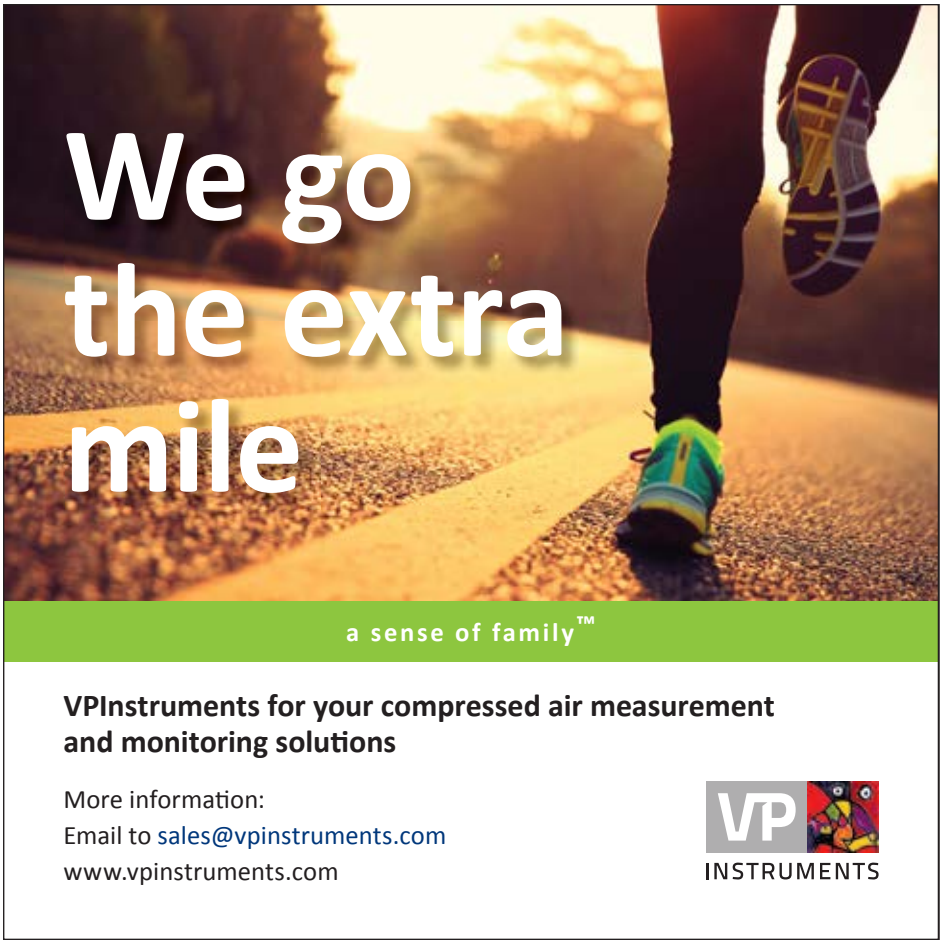
The sites who are interested have invested in efficient equipment, taken advantage of financial incentives, and reaped the benefits of upgraded equipment, improved system operation and lower energy costs.

The Compressed Air Challenge (CAC) recommends supply side (air compressor room) improvements and demand side (out in the plant) improvements to happen simultaneously. The most common improvement is a VFD (variable frequency drive) compressor with controls to stage fixed speed compressors on as needed.

Dryer upgrades come in a close second in the form of cycling refrigerated dryers or if a lower dew point is needed, desiccant dryers with purge saving controls and external heaters/blowers. With a VFD compressor and efficient dryer, the energy used by the system is now proportional to the flow produced by the system. An energy assessment (audit) and incentives usually help get a project going.

With the system now producing air in an efficient manner through a broad range of flows, reducing compressed air consumption through demand side (in the plant) projects is the next logical step. Demand side energy savings are funded by many utilities at higher levels than supply side projects. Many of the solutions are inexpensive and easy to implement. Common demand side projects include:

- Fixing air leaks
- Lowering plant pressure
- Removing inappropriate uses
- Finding alternate technology



Milk Plant Deploys the Second Stage of Energy Savings

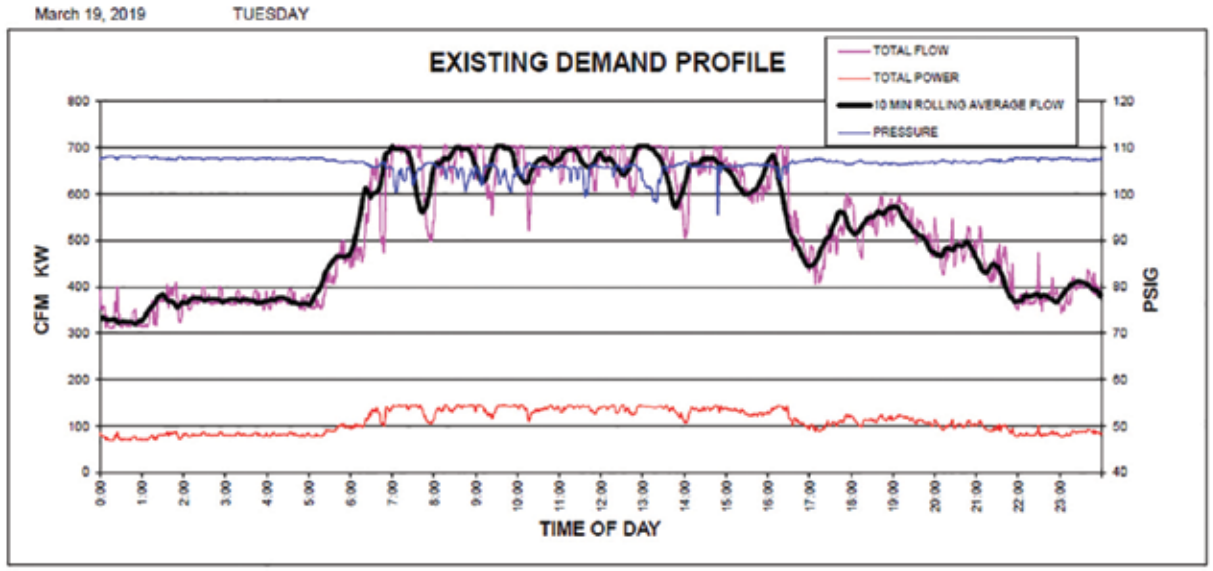
Figure 4: 2-stage enclosed compressor

However, the benefits can be short term if not properly maintained. New leaks re-appear as hoses, valves, and equipment wears. Plant pressure can get raised with the push of a couple buttons fully intending to lower it again once a crisis has been addressed. Sometimes new technology isn't as reliable or works as well. New production equipment usually shows up needing more compressed air as well.

Yearly energy reduction quotas drive utilities, plant, and energy managers to continue to reduce energy consumption in all areas. A frequent question asked is, "Where can we find more energy savings once we have a VFD compressor and we have fixed all our leaks?"

The Second Stage

An option to explore, for supply-side efficiency gains, is 2-stage VFD oil-flooded air compressor technology. While not new to the market, 2-stage compressors are becoming a more viable option for achieving best-in-class energy efficiency.



	FLOW	KW	CFM/KW	C1	PRESSURE	HOURS/DAY
NON ZERO AVERAGES	523.8	110.0	4.76	110.0	106.4	24.00
INCLUSIVE AVERAGE	523.8	110.0	4.76	110.0	106.4	

Table 1: 2019 Typical operation single-stage 150 hp VFD

Efficiency Comparison

This table compares the compressed air efficiency of single and two-stage air compressors. The data comes from a general survey of several different VFD compressors, across the full flow range, rated at 100 psig including fan power:

	CFM/KW	KW/100 CFM
Single-stage	4.8 – 5.5	18.3 – 21.0
Two-stage	5.9 – 6.2	16.0 – 18.5
Efficiency increase	9%	—

Note: Manufacturers use different air ends and motor ratings. Check specific data sheets for specific power verification. Efficiency varies at full speed and slow speed, cooling methods (air cooling or water cooling), and ambient conditions can also influence total power consumption.

Other advantages of 2-stage compressors include using a smaller horsepower motor to maintain the same flow levels or using the same horsepower motor to supply more compressed air.

Case Study: Milk Plant Successful Application of a 2-stage VFD Air Compressor

In 2006, a milk plant in Northwestern Oregon upgraded their system by installing a new single stage 150 hp VFD air compressor. Energy efficiency programs provided by a regional non-profit energy conservation organization provided an energy audit to identify savings. Significant energy savings and incentives helped the customer purchase a new 150hp VFD system with a 4-year payback after incentives. The system was started up and energy savings were verified.

After 13 years of nearly 24 hours/day 7 days/week operation, the compressor reached 100,000 running hours. When a well-maintained air compressor reaches 100,000 running hours, replacement or planned air-end rebuild is recommended. Energy incentives were available for an "end of life" replacement, but at a reduced rate. Be sure to check with the local utility for program rules and codes.

In 2019, another Compressed Air Energy Assessment was conducted on the 150hp VFD system. Several weeks of data collection showed very stable compressed air usage. A 24-hour graph of typical operation from the Energy Assessment is shown in the chart below. Note the average system efficiency of 4.76 CFM/KW.

After data collection, the analysis predicted an 18% reduction in energy usage to upgrade to a new 150hp 2-stage VFD air compressor. The system qualified for incentives, was purchased, and installed in late 2020.

A Measurement and Verification analysis was again conducted by Rogers Machinery Engineers for 2 weeks to tune the system, verify the results, and prove the energy savings. The results showed a 6% reduction in compressed air consumption due to production equipment changes, and a 27% overall decrease in overall energy usage.

A day of typical operation from the Measurement and Verification Energy Assessment is in the chart below. Note the average system efficiency of 6.1 CFM/KW.

The existing very old backup fixed-speed compressors were removed and single stage 150hp VFD compressor was moved to backup.

Milk Plant Deploys the Second Stage of Energy Savings

Figure 5: Installed 2-stage enclosed compressor with vertical ductwork

The increase in energy savings was partly due to the decrease in compressed air demands, but also due to variable efficiency of the old 150hp VFD compressor. At full or close to full load, the old 150hp VFD compressor is not as efficient as in the middle of the range. This is common with many types of single-stage VFD air compressors. Many single-stage air compressors are "oversped". The air end is turned at higher than optimal efficiency to achieve higher flows. The old 150 hp VFD compressor ran at the top end of the range most of the time at the milk plant.

The new 2-stage VFD compressor is more efficient at nearly full load than the single stage compressor, hence the 27% energy savings. The project benefits are listed here:

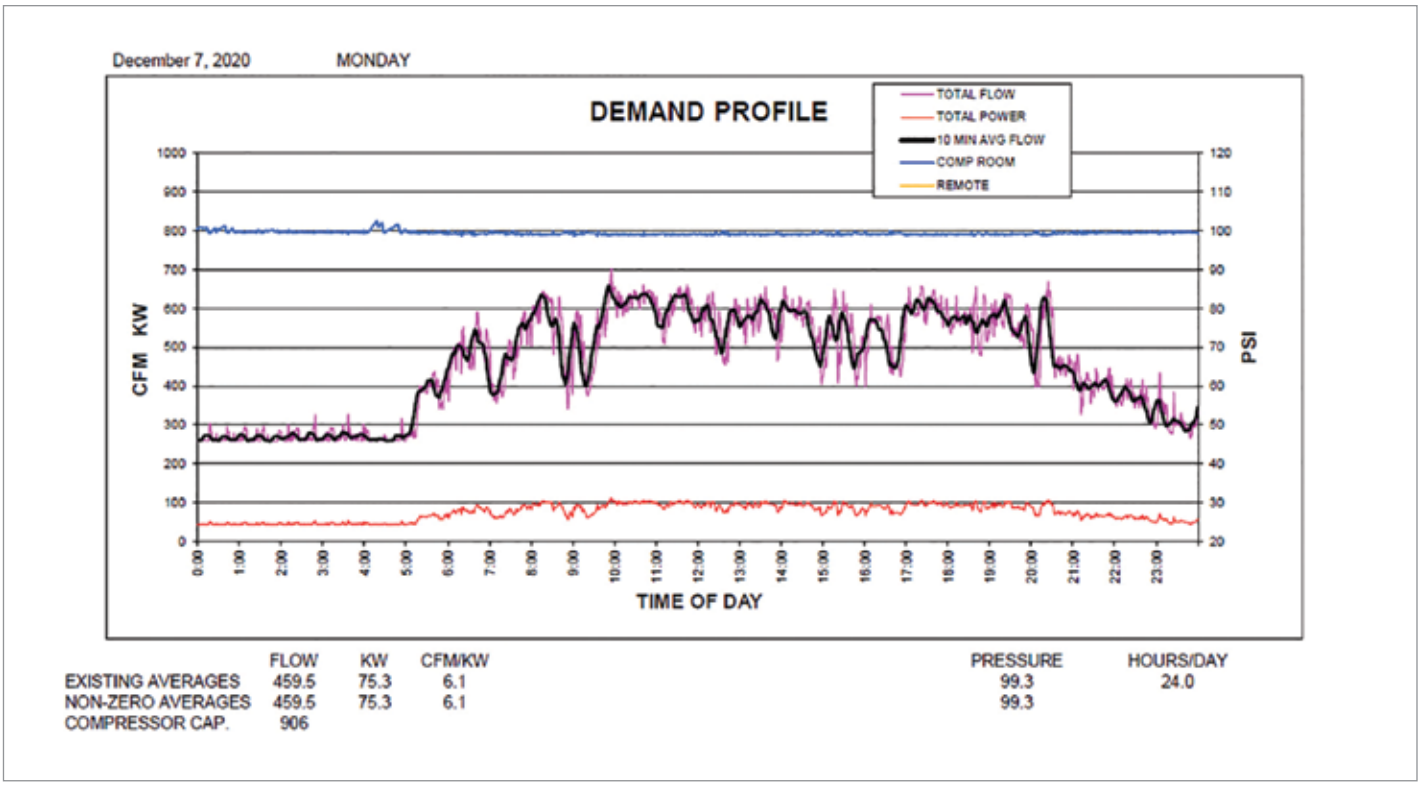


Table 2: 2020 Typical operation 2stage 150hp VFD

Energy Benefits

- Savings of 212,000 kWh
- Energy cost savings of $15,700/yr.
- Final Payback period of 2.6 years
- Reliable, clean compressed air

Non-Energy Benefits

- An improved standard acoustic compressor enclosure lowered sound levels in the compressor room and neighboring office area.
- The vertical discharge aftercooler eliminated the need for a roof-mounted aftercooler.
- Potential heat recovery by opening the duct to circulate warm air back into the room.
- Easier oil changes due to less oil and valves in the system and trips to the roof.
- Maintenance was reduced by having to maintain only 1 efficient standby backup instead of the 2 smaller, inefficient compressors.
- The new air compressor provides an additional 160 CFM in case demands ever spike to higher levels.

The additional cost and size of a two-stage air compressor, when compared to a single-stage compressor, should be taken into consideration as well as other factors.

Significant energy can be saved, by adding the second stage to an air compressor to help meet energy savings goals and improve plant operations now and in the future. Energy Assessments with continuous, or 2-3 weeks of temporary data logging, are recommended to predict and verify site-specific energy savings or a two-stage air compressor. Learn how an energy audit could save your company thousands here: https://rogers-machinery.com/pages/compressed-air-system-services-audits-consulting BP

About the Author

John Molnar P.E. received his BSME from Washington University in St. Louis and has worked at Rogers Machinery for the past 16 years and now heads the Rogers Machinery Co, Inc. Audit and Consulting Group. John has conducted nearly a thousand energy audits across the Northwest, helping customers solve system problems, save energy, and purchase new equipment. Since 1949 Rogers Machinery has been an air compressor and vacuum system manufacturer and equipment distributor based in the Pacific Northwest serving US and international markets. Visit https://rogers-machinery.com

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Nitrogen Characteristics and Benefits of On-Site Generation

By the Compressed Air & Gas Institute

An On-Site Nitrogen Generation System

A ship lost at sea for many days suddenly sighted a friendly vessel. From the mast of the unfortunate vessel was seen a signal, "Water, water, we die of thirst." The answer from the friendly vessel at once came back, "Cast down your bucket where you are." A second time, the signal, "Water, send us water!" went up from the distressed vessel, and was answered, "Cast down your bucket where you are." A third and fourth signal for water was answered, "Cast down your bucket where you are." The captain of the distressed vessel, at last heeding the injunction, cast down his bucket and it came up full of fresh, sparkling water from the mouth of the Amazon River.

This famous story was delivered by Booker T. Washington in an 1895 speech in Atlanta, Georgia. Its message was a command to take full advantage of what is currently available around oneself rather than pursuing different directions. This same message is timely advice for industrial users of nitrogen; take advantage of the plentiful and free nitrogen that surrounds us in the atmosphere that we breathe. By utilizing reliable and efficient technology, nitrogen users who currently rely on delivery of bulk or cylindered nitrogen can extract nitrogen of high purity levels directly from the atmosphere through nitrogen generators.

Modified Atmosphere Packaging (MAP) accounts for a significant amount of nitrogen usage in the food and beverage industry.

Nitrogen Characteristics

Nitrogen is the most widely used gas in industry and the most common pure element on earth. Nitrogen is a constituent element of air, making up 78% of the atmosphere that surrounds us. Oxygen is the second largest constituent of air comprising 21%. Nitrogen occurs naturally as a molecule consisting of two atoms of nitrogen that are held together by a very strong and stable triple bond. This triple bond makes the reaction of nitrogen with any other elements very unlikely, except under conditions of extreme pressures and temperature. This chemical inactivity makes nitrogen a perfect fluid to use in industrial processes and its inertness is key to what makes its use so prevalent. Nitrogen does not retain water molecules in the form of vapor which makes nitrogen a dry gas with an atmospheric dew point of -94°F. Nitrogen is colorless, odorless, and tasteless, additional characteristics that make it the go-to gas for countless industrial and scientific applications.

Applications

Nitrogen gas is used primarily for the following purposes and all of the nitrogen applications described below take advantage of at least one of these characteristics, many applications depend on all four:

- Prevent oxidation of materials
- Prevent bacteriological growth
- Reduce or remove the risk of fire and explosion
- Provide a dry atmosphere

Modified Atmosphere Packaging (MAP) accounts for a significant amount of nitrogen usage in the food and beverage industry. MAP involves injecting nitrogen into beverage or food packaging to purge and displace any oxygen-containing air with nitrogen. Oxidation of lipids in food products causes rancidity. Since oxygen is replaced with dry, inert nitrogen in MAP packaging, no product oxidation will occur. The result is maximized product shelf life.

The electronics industry relies on high-quality soldered connections to join electrical components together on printed circuit boards. The to-be joined components are wetted with hot, liquid metal solder that hardens to form a long-lasting joint. Oxygen reacts with the hot, liquid solder creating metal oxides, called dross, that interfere with the soldering process. Performing soldering in a nitrogen environment reduces harmful dross production, increases joint integrity, and increases productivity by minimizing scrap and re-work.

Metal fabrication industries rely on lasers to cut shapes from different types of metals. To produce a clean edge with a laser, the molten metal must be blown away by an assist gas. By using nitrogen as the assist gas, oxygen is excluded from the cutting zone thus eliminating the unwanted effects of oxidation and discoloration. This results in a clean-cut edge that does not require additional work to properly finish.

Paints and adhesives require oxygen to harden. Storage and processing vessels within these industries that use these products

Nitrogen Characteristics and Benefits of On-Site Generation

are filled with nitrogen so that a blanket of nitrogen covers the area above the surface of the product held within a storage tank.

By blanketing with nitrogen, the oxygen-initiated hardening or curing process is rendered inactive. By using nitrogen rather than air to dispense or transfer materials between stages of the manufacturing process, the manufacturer retains the integrity of the product by eliminating unwanted oxidation.

The benefits of nitrogen include reduced spoilage, reduced scrap and rework, increased safety, and increased process efficiency.

The metal heat treating process uses controlled heating and cooling of metals to change their properties of hardness, ductility, surface finish, and corrosion resistance. Metals oxidize due to their reaction with oxygen in the atmosphere at room temperature and at an increased rate at elevated temperatures. Oxidation affects the surface finish of the metal as well as its mechanical structure and strength. Heat treating, performed in an environment of nitrogen, eliminates this unwanted oxidation and increases the efficiency of the heat-treating process.

PSA nitrogen generation technology can be used from 95% to 99.9995% purity, flow rates ranging from 1 scfh to 100,000 scfh.

Three elements must be present for combustion; fuel, heat, and oxygen. Remove or reduce any one of the elements and there is no fire. In processes where combustion is prohibited, an easy and reliable method of removing oxygen from the combustion equation is to replace the oxygen with nitrogen. By blanketing tank-stored volatile liquids, such as gasoline and solvents, with an atmosphere of nitrogen there is no chance of fire within the tank. Similarly, in critical environments such as computer server operations, document storage facilities, museums, and libraries where the act of extinguishing a fire by common methods is often more damaging than the fire itself, a controlled oxygen environment can proactively eliminate the chance of combustion by removing the oxygen variable from the combustion formula.

In the oil and gas industry, the processes of inerting, well stimulation, and well drilling consume large quantities of nitrogen. The industry has long depended upon the inertness

of nitrogen to provide combustion-preventing atmospheres for tank and pipeline blanketing. In a process called nitrogen lifting, high pressure nitrogen is injected into the oil-bearing formation to maintain optimal well productivity by increasing the downhole natural formation pressures that dwindle as the well ages. In the drilling process, the introduction of pressurized nitrogen gas allows the use of lighter drilling fluids which are pumped to the drilling face to facilitate debris removal and cool and lubricate the bit. Lighter drilling fluids reduce the load on drill bits which increases their efficiency.

Most bacteria need oxygen and water to survive. If oxygen is removed from a product or the product is desiccated so that no water is present, bacteria cannot live and grow. If there is no presence of bacteria then there is no mold, mildew, or spoilage. Sterile environments void of bacteria are crucially important within the pharmaceutical industry. Because product contamination with microorganisms is extremely costly and dangerous, pharmaceutical manufacturers use nitrogen to move fluids, both liquid and solid, from one stage of production to another. Nitrogen eliminates exposure to oxygen and, due to its inherent dryness, nitrogen eliminates exposure to water.

As shown in the previously described applications, nitrogen plays a key role in modern industry. One way to look at nitrogen usage is not to determine where it should be used, but rather to use nitrogen wherever oxygen is not allowed. By removing the deleterious effects of oxidation, a nitrogen environment void of oxygen provides tremendous benefits to many industrial processes. These benefits include reduced spoilage, reduced scrap and rework, increased safety, and increased process efficiency.

Availability of Nitrogen

Nitrogen is abundant, safe, and readily available for use. The traditional method of supplying nitrogen to industry is to separate it from atmospheric air by cryogenic distillation. Once separated, the nitrogen is containerized and delivered to site for use. Depending upon the amount of nitrogen required, the containers could be relatively small high-pressure gas cylinders or larger dewars; specialized vacuum flasks used for storing cryogenic, liquid nitrogen. For larger nitrogen demands, bulk cryogenic liquid nitrogen tanks are installed at site that are routinely topped off as tank volume reduces. In liquid cryogenic storage systems where nitrogen gas is required, the liquid must be evaporated into a gas through the use of heat exchangers or evaporators. Nitrogen supplied in the above fashion has a purity of 99.998%.

Separation Technologies

In addition to the cryogenic process described above, nitrogen can be separated from air by two other technologies: Pressure Swing Adsorption (PSA), and Membrane Separation. In the PSA process, pressurized air is forced through a vessel filled with carbon molecular sieve material (CMS). The CMS selectively adsorbs the smaller oxygen molecules and allows the larger nitrogen molecules to pass through. The discharge stream has a nitrogen purity range of 95% to 99.999%. Once the CMS has adsorbed its maximum amount of oxygen, it is regenerated by purging the vessel with compressed nitrogen, making it ready to

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Membrane nitrogen generation technology can be used from 95% to 99.5% purity. Flow rates ranging 1 scfh to 180,000+ scfh.

adsorb oxygen again. The nitrogen membrane module technology uses thousands of hollow fibers contained within a tube. As compressed air flows through the hollow fiber membrane, the gas components separate by selective permeation. Oxygen and other waste gases diffuse through the membrane fiber wall to the atmosphere, while nitrogen is retained and passes through the center of the fiber to the application. Fast gases, such as oxygen along with water vapor permeate easily through the membrane wall and exits permeate port. Slow gases, like nitrogen do not easily pass through the membrane wall, therefore exiting the end of the tube. In both technologies, the volume of purge nitrogen is significantly less than the nitrogen produced during one generation cycle.

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Today's gas generation technologies are able to cover flow rates from 1 scfh to 180,000+ scfh. PSA technology can be used from 95% to 99.9995% purity, flow rates ranging from 1 scfh to 100,000 scfh. Membrane technology can be used from 95% to 99.5% purity. Flow rates ranging 1 scfh to 180,000+ scfh.

Benefits Of Generating Nitrogen On-Site

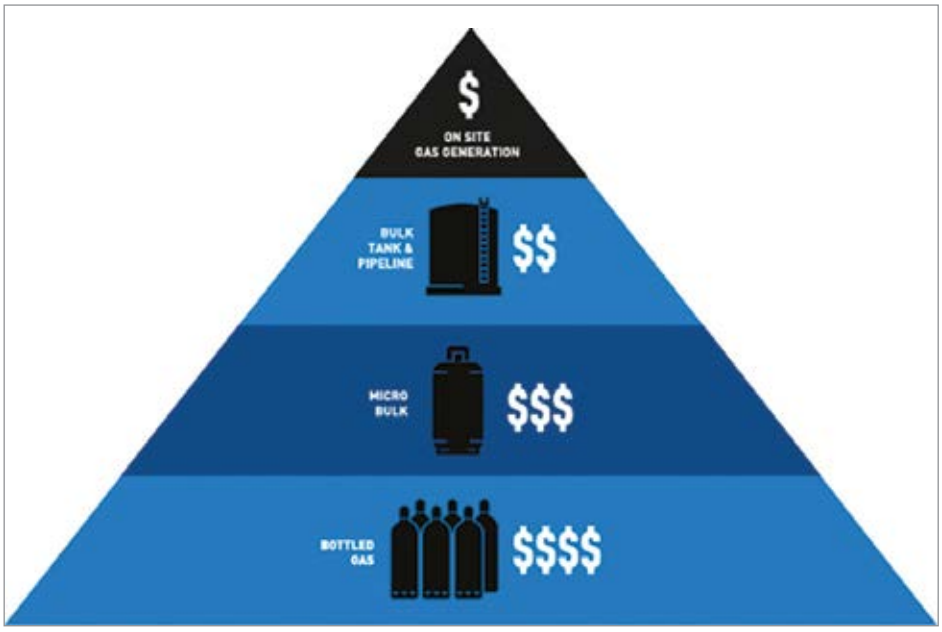
Cost

Both PSA and Membrane Separation operations can be installed on-site where the nitrogen is used, providing a multitude of advantages over the traditional nitrogen delivery methods previously described. In many instances a properly sized on-site nitrogen generation plant can provide a two year or less simple payback versus a cryogenic system, potentially making the on-site option a very cost-effective capital investment project.

For starters, if nitrogen demand is sufficient, on-site generation is typically more cost effective versus delivered gas (gas cylinders or liquid dewars or tanks). Delivered nitrogen carries delivery charges, fuel surcharges, and hazmat fees in addition to the storage tank rental fees in the case of bulk storage systems.

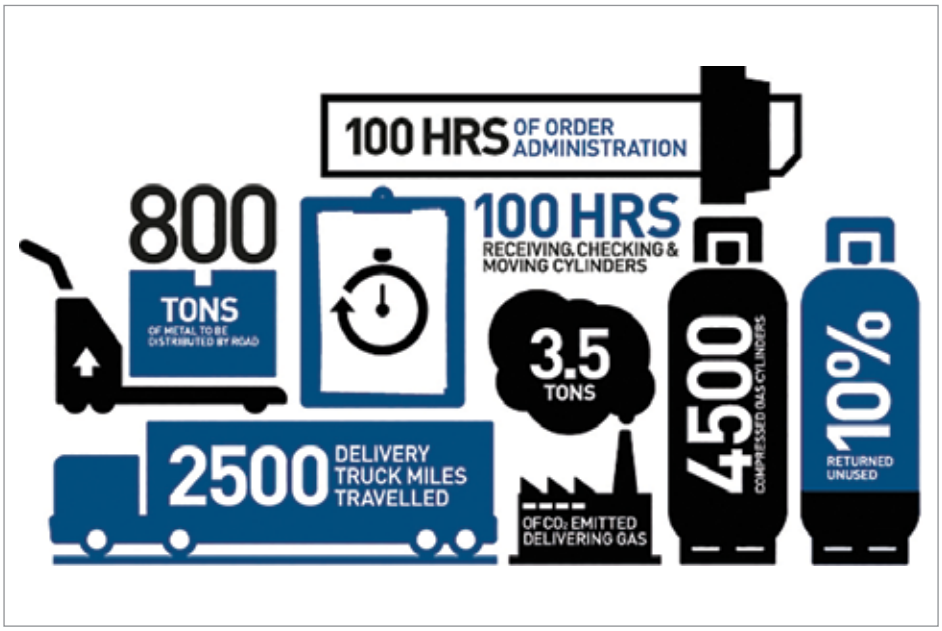
Safety & Quality

Safety is always a concern when dealing with high pressure and cryogenic liquids. High pressure cylinders are often pressurized to several thousand psig, presenting a safety hazard if not properly stored and used. Both high pressure cylinders and liquid dewars are heavy and cumbersome to stage where the nitrogen is required. Furthermore, continually connecting and disconnecting high-pressure cylinders and liquid dewars increases safety concerns and the chances for an accident. Due to its -321°F boiling temperature,



The cost of delivering nitrogen.

Nitrogen Characteristics and Benefits of On-Site Generation



Inefficiencies and Waste in Liquid Nitrogen Logistics

liquid nitrogen stored in closed containers must continuously vent evaporated gas to atmosphere. If not vented, the gas will quickly create high pressure within the container, dewar or bulk tank, and present an explosion risk. This vented gas is a costly waste.

On-site nitrogen generation delivers nitrogen of a consistent purity level. On-site plants are fitted with oxygen analyzers that constantly monitor delivered nitrogen purity with relation to its oxygen content and alarm the customer if delivered gas purity is less than specified. Continuous system monitoring and control of the on-site nitrogen operation is available via multiple connectivity devices to the customer's building management software (BMS) to ensure reliable system operation and performance. This allows for proactive adjustment of the process to rectify any purity or delivery issue before it becomes a problem. Many times, high-pressure gas cylinders are re-filled with different gasses, making contamination a real possibility and making it difficult to ensure the purity of the delivered nitrogen. The purity of liquid nitrogen from dewars or bulk tanks can vary and the expansion process is difficult to control. These variables make for unreliable nitrogen purity from liquid systems.

Reliability

On-site nitrogen generation places the reliability of nitrogen supply under the control of the user. With on-site generation there is no middleman to deal with regarding on-time delivery of nitrogen; the user is in complete control. Inclement weather, natural disasters, road conditions, and far distances can negatively affect the reliability of gas delivery. On-site systems can be sized and set up to provide redundancy to avoid unscheduled downtime in the event of an issue or when maintenance is required, thus further

increasing the peace-of-mind factor of not being dependent upon a gas supplier to make timely deliveries.

On-site Nitrogen Generation is the Solution

On-site nitrogen generation systems provide a reliable, efficient, and sustainably safe solution to supplying the nitrogen that industry requires. On-site generation provides consistently high-purity nitrogen to match the demand of the application at a fraction of the cost compared to traditional methods of delivering gas to site. On-site generation increases operations safety, eliminates cumbersome gas cylinder logistics, ends long-term contractual obligations, and places process control firmly in the hands of the customer. By following Booker T. Washington's advice to, "Cast down your bucket where you are.", industries that invest in on-site nitrogen generation systems are discovering that they can economically and reliably harvest the endless supply of nitrogen in the atmosphere to deliver a continuous supply of high purity, clean, and dry nitrogen gas to satisfy their production requirements. BP

All photos are courtesy of the Compressed Air and Gas Institute.

For more information, visit the CAGI website at www.cagi.org.

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When Mixing is the Goal, Why Would You Aerate?

Compressed Gas Mixing Provides An Alternative Approach

By David Lauer, P.E., EnviroMix

At the beginning of the 20th century, biological wastewater treatment – more specifically, the activated sludge process – was developed and became widely accepted as the treatment method for municipal wastewater, helping to protect our lakes and rivers from pollutants and support public health. In 1947, the Committee on Development of Uniform Standards for Sewage Works was created by the group known as the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environment Managers. This committee prepared wastewater treatment facility design standards which were first published in 1951.

These standards were intended (1) to define parameters for reviewing authorities to use in evaluations of wastewater treatment facility plans and specifications and (2) to reasonably establish uniformity among the Great Lakes – Upper Mississippi River Board's members, which included U.S. states and Canadian provinces. Over the years, additional U.S. states have adopted guidelines based on these original standards.

Throughout the following decades, the standards – commonly referred to as Ten State Standards – were revised and updated with conventional municipal wastewater treatment facilities in mind.

The Ten State Standards cover a wide range of topics, from wastewater treatment facility engineering reports and facility plans to actual wastewater treatment processes such as flow equalization, activated sludge, and sludge

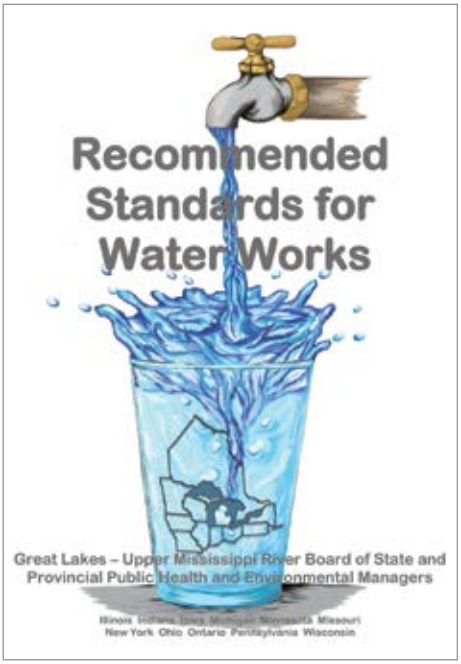

Figure 1: Ten State Standards

storage. They also define criteria for aeration or mixing equipment for these processes.

Ten State Standards Limitations

Since reviewing authorities have adopted Ten State Standards or similar standards as the basis for evaluating or approving wastewater treatment facility plans and specifications, consulting engineers typically develop equipment designs around the same standards to minimize rejection of their plans and specifications.

As an example, standard design criteria for flow equalization basins states that aeration or mechanical equipment should be provided to maintain adequate mixing. Aeration equipment should be sufficient to maintain a minimum of 1 mg/l of dissolved oxygen in the basin's contents, and air supply rates should be a minimum of 1.25 cfm per 1000 gallons of storage capacity. This equates to approximately 0.5 horsepower per 1000 ft^3 of tank volume.

In another example, standard design criteria states that mixing equipment should be designed to provide vigorous agitation within the tank, maintain solids in suspension, and provide a homogeneous mixture. Mixing may be accomplished either by diffused air or mechanical mixers. If diffused aeration is used, an air supply of 30 cfm per 1000 ft^3 of mixing tank volume should be provided, requiring an energy input of approximately 1.5 horsepower per 1000 ft^3 of tank volume.

In both examples, broad generalizations are made regarding the process and equipment design requirements. Moreover, the focus is on one type of technology, diffused aeration, without any reference to alternative technologies. Seemingly, the standards dictate that all applications should be treated the same regardless of site-specific requirements. This limited perspective leads design engineers to follow the guidelines without consideration of alternative technologies that may be more energy efficient, lower maintenance, or generally in the best interest of the end user.

The Ten State Standards' board acknowledges that it is not possible to cover innovative processes and equipment in the design criteria. However, their policy is to encourage, rather than obstruct, the development of new processes and equipment.

Diffused Aeration

Aeration represents one of the most energy intensive operations in municipal wastewater treatment, accounting for 50-90% of a treatment facility's total energy costs. In a typical diffused aeration application, air is delivered by aeration blowers (positive displacement or multistage centrifugal) through a diffused aeration system (fine or coarse bubble) which shears the air into relatively small bubbles. The small bubbles provide both the transfer of oxygen needed for treatment and complete mixing of the tank's contents, keeping the microorganisms or solids suspended.

The primary uses of aeration in wastewater treatment are in pre-aeration tanks, activated sludge bioreactors, aerobic digestors, and post-aeration tanks, where the function of the diffused aeration system is to satisfy the oxygen demand for biological treatment. In some instances, the application is mixing limited,

When Mixing is the Goal, Why Would You Aerate?

whereby the air serves as a gas for mixing processes in, for example, flow equalization basins or sludge holding tanks.

Utilizing diffused aeration to transfer oxygen capitalizes on the strength of the technology – this is what the technology does best. Though diffused aeration can also mix effectively, it does so at relatively high energy cost and is therefore not the best technology for a mixing limited application. When using diffused aeration, a mixing limited application design generally results in the following issues:

- Excess aeration, resulting in high energy consumption.
- Diffuser fouling and plugging, resulting in high maintenance costs and downtime.
- Hair accumulation and ragging, resulting in labor costs and manpower.
- High air volume, resulting in high air handling requirements for odor control.

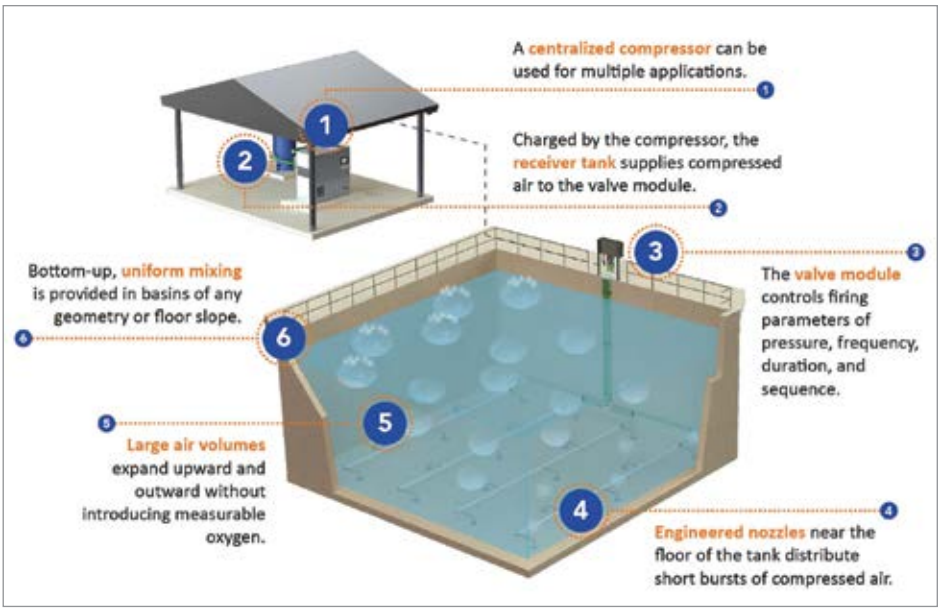

Figure 2: How compressed gas mixing works

Figure 3: Short-duration bursts of compressed air mix an area of the tank 2-3 times per minute.

A Different Approach

We have all heard the phrase, "Use the right tool for the job." In the case of mixing limited applications, engineers should not blindly follow criteria standards that treat all applications the same. Thoughtful project designers will ask themselves: Why would you aerate when mixing is the goal? The engineers at EnviroMix have answered that question with the BioMix Compressed Gas Mixing System.

Compressed gas mixing (CGM) provides uniform mixing of tank contents by firing programmed, short-duration bursts of compressed air through engineered nozzles located near the tank floor. The mixing parameters may be adjusted to optimize mixing and power utilization, either through operator input or automated process feedback.

All in-tank components of a CGM system are maintenance free, non-clogging, and self-cleaning. Systems require minimal maintenance of out-of-tank components (compressors, receivers, and air control valves) in controlled environments. Electrical requirements are limited to the power needed to operate the air compressor and the valve modules.

The adjustable firing parameters (pressure, sequence, duration, and frequency) enable

ideal mixed conditions without deposition. The system provides complete mixing with proven negligible oxygen transfer. CGM easily integrates with aeration equipment for swing zone applications, and the technology is able to operate concurrent with or independent from aeration for optimized process conditions.

CGM systems provide significant power savings compared to mechanical mixers by uniformly distributing mixing energy across the basin floor rather than directing it outward from a localized point in the tank. Multiple studies have documented a 60% or greater reduction in power usage versus mechanical mixers and even more versus diffused air mixing. Mechanical mixers require at least one unit per basin, while one BioMix compressor may be used to mix dozens of tanks.

Leveraging common compressors and controls, CGM systems are able to accommodate multiple applications. The system is able to mix through a range of operating depths. CGM nozzles and headers are compatible with any tank geometry or configuration, and circular headers conform to the slope of the tank floor, eliminating "dead spots." The technology is able to uniformly mix sludge at concentrations up to 8% solids.

While conventional solutions require diffusers, blowers, motive pumps, impellers, and more, CGM utilizes a centralized compressor system that minimizes maintenance and maximizes energy efficiency.

Case Study: Manatee County, FL

Just south of Tampa, Manatee County is located on the western coast of Florida and is part of the North Port-Sarasota-Bradenton metropolitan area. The county operates three regional wastewater treatment plants that offer reclaimed water for irrigation to farms, golf courses, and private residences in the region.

In 2017, the county upgraded the 7.5 million gallon per day North Regional Water Reclamation Facility (NRWRF) located in Palmetto, Florida. Utilizing a BioMix CGM system, treatment was improved through the construction of three 1-million-gallon influent flow equalization tanks.

In the equalization tank system, return activated sludge is introduced to provide odor control and to facilitate anaerobic selector operation, thereby enhancing biological phosphorus removal. The BioMix system provides efficient mixing without the introduction of measurable oxygen, ensuring optimal anaerobic conditions for biological nutrient removal (BNR). Equalization of flow and loading to the treatment process ensures consistent and efficient nutrient removal, and it guarantees the supply of reclaimed water for reuse.

In any treatment process, consistency of flow and loading provide the optimal conditions for treatment efficiency. Through the implementation of the flow equalization tanks and CGM system, NRWRF is able to process wastewater more efficiently and at a higher quality.

The system utilizes two 30 horsepower compressors (one duty and one standby) to provide the mixing energy for all three

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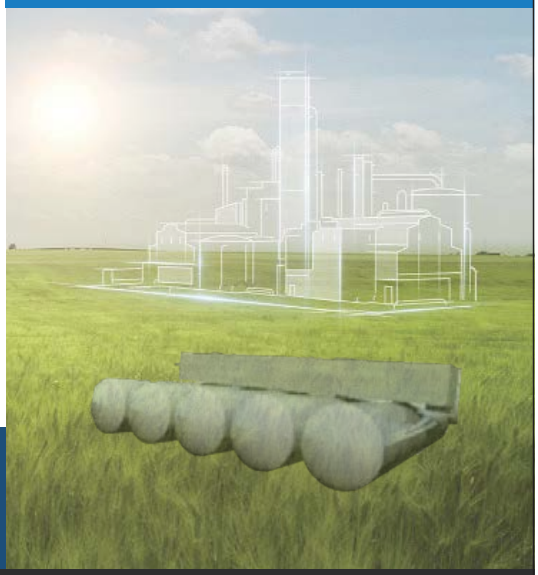

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equalization tanks. This is an energy consumption of 0.07 hp per 1000 ft^3 of tank volume. A traditional diffused aeration mixing system would require ten times the horsepower to provide equivalent mixing, or 300 horsepower blowers.

A local control panel at each tank controls the mixing air from the compressor system and distributes it uniformly to each tank as necessary. Optimal mixing energy for each tank is automatically adjusted for the range of depth operation, ranging from a few feet of liquid depth to a maximum of 23 feet.

Manatee County selected CGM based on its lowest total cost of ownership versus mechanical and diffused air mixing technologies. Use of the CGM system in lieu of conventional diffused air mixing has resulted in annual energy cost savings of over $150,000 for NRWRF. The system also eases the maintenance burden for the facility and offers a high level of flexibility. Thanks to the efficiency of the CGM system, the facility's O&M costs will be reduced by 90% versus conventional diffused air mixing. BioMix will save Manatee County millions of dollars over the life the system.

Figure 4: Compressors under a canopy meet the process mixing air demands of the BioMix system for all three equalization tanks.

Figure 5: Local control panels distribute the optimal mixing energy.

Case Study: Broomfield, CO

Broomfield is a consolidated city and county located approximately 20 miles northwest of Denver, Colorado. Broomfield provides services to an estimated population of 70,000, including the treatment of wastewater which is discharged to Big Dry Creek or diverted to the reclaimed treatment process, making it suitable for reuse in irrigation.

As part of the treatment process, the 12 million gallon per day Broomfield Wastewater Reclamation Facility (WRF) thickens waste activated sludge (WAS) and primary sludge to 6% prior to anaerobic digestion. Before being sent to centrifuges for dewatering and recycling of the biosolids through land application, the thickened anaerobically digested sludge is transferred to two concrete sludge holding tanks. Both round tanks were originally constructed in the 1950s as primary clarifiers, converted to sludge holding tanks in the 1980s, and retrofit with diffused air mixing in the late 2000s.

Focused on the goals of reducing energy consumption, improving mixing, and reducing maintenance, the plant upgraded the mixing equipment in the thickened sludge holding tanks in 2020. The plant selected EnviroMix's BioMix CGM system for the project, enabling them to meet all three goals. With zero in-tank maintenance, the system provides

homogenous, energy efficient mixing while saving the plant approximately $10,000 annually.

The previously used coarse bubble aeration system relied on positive displacement aeration blowers. The new CGM system consists of two 20 horsepower rotary screw compressors (one duty and one standby), an automated valve control panel, and concentric rings of nozzle headers. The total power required for BioMix to achieve homogenous mixing of 6% sludge in this application is approximately 15 horsepower, representing energy savings of more than 50%.

The amount of hair, rags, and other stringy material that winds up in the sludge fouled the previous aerated mixing system, resulting in high maintenance requirements and poor

Figure 6: Low-maintenance compressor system matches mixing air demand with duty and standby configuration.

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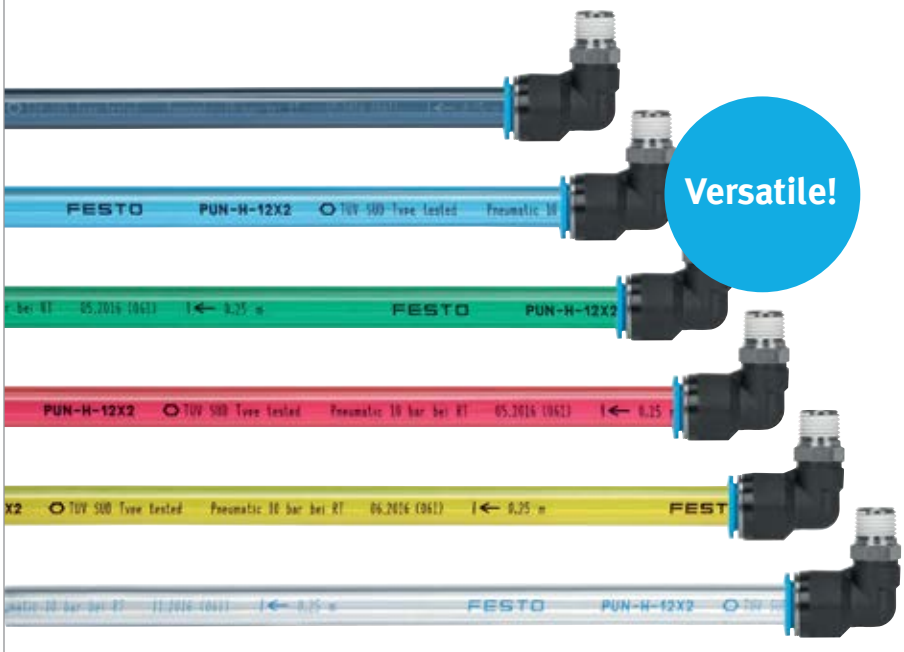

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Figure 7: Concentric rings of nozzle headers uniformly mix the basin contents from the bottom up.

mixing effectiveness. The tanks are also covered, resulting in confined space safety requirements to perform maintenance. The BioMix system has only non-clogging, self-cleaning components in tank. With no mechanical or electrical components in the sludge, maintenance demands are minimized.

Additionally, the Broomfield tanks have sloped floors and a cone bottom. The previous aeration system was unable to suspend solids at the bottom of the tank due to the significant dead space beneath the aeration system. The circular headers of the BioMix system easily conform to the slope of the floor, eliminating "dead spots."

A New, Innovative Standard

The Ten State Standards provides essential guidelines that enable uniformity in wastewater treatment across the country, protecting the environment and public health. But as innovative technologies are developed, engineers in the industry will naturally gravitate toward using the right tool for the job.

Selecting the right technology for mixing limited applications can save significant amounts of time and money, while ensuring process performance is met. Upgrading from diffused air mixing to an innovative technology like EnviroMix's BioMix CGM system allows plants to experience:

- Energy efficiency – typical energy savings of 60% or more versus diffused air mixing.
- Straightforward operation – zero in-tank moving parts requiring maintenance.
- Process optimization – efficient mixing without the introduction of measurable oxygen and the ability to mix thickened sludge without plugging.
- Unparalleled flexibility – variable mixing intensity based on operating depth and ability to mix at any liquid depth. BP

About the Author

David Lauer, P.E., is Vice President of Marketing and Business Development for EnviroMix. He is an accomplished sales manager with more than 30 years of technical product sales experience in the wastewater treatment equipment market. David received an M.B.A. from Marquette University and a B.S. in environmental engineering from Michigan Technological University, and he is a Registered Professional Engineer in the State of Wisconsin.

About EnviroMix

Headquartered in Charleston, South Carolina, EnviroMix designs and manufactures treatment systems for municipalities and industrial facilities to dramatically reduce energy costs and help meet nutrient removal limits. Utilizing patented and proprietary technology, EnviroMix provides complete mixing systems, process controls, and energy management solutions to enhance plant performance in the water and wastewater markets. For additional information please visit www.enviro-mix.com.

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Quad Drives Compressed Air Efficiencies at 1.7 million-square-foot Printing Plant

By Mike Grennier, Compressed Air Best Practices® Magazine

Compressed air is a major component of production at Quad's 1.7 million-square-foot printing plant in Sussex, Wisconsin.

➤ The philosophy toward compressed air at Quad's 1.7 million-square-foot printing plant in Sussex, Wisconsin, is as clear-cut as it gets: The more you know about it, the more you'll come out ahead – environmentally and economically.

To say the Production Support Team at the Quad plant knows a bit about compressed air is an understatement given numerous best practices at play for managing both supply and demand of the utility. At the end of the day, said Ken Berg, Quad's Corporate Engineering Manager for Production Support, the importance of compressed air reliability and efficiency cannot be understated.

"Compressed air is a component of the production process itself. Without it, equipment just won't function and we won't make product," said Berg. "It's also our third largest energy consumer behind our printing presses themselves and processing paper trim waste. We're always driving to be more efficient with our air."

An Industry Leader

Quad (formerly known as Quad/Graphics) is a worldwide marketing solutions partner. Headquartered in Sussex, Wisconsin, just west of Milwaukee, it leverages its robust print foundation as part of a larger integrated marketing solutions platform with approximately 50 locations around the globe.

The company, founded in 1971, gained widespread recognition early on as one of the printing industry's foremost innovators and grew to become an industry leader with a A-list client base including some of most well-known media brands in the world. The company continues to print magazines (including *Compressed Air Best Practices Magazine*), along with other types of commercial products, such as direct mail and consumer packaging, and today leverages its data-driven print expertise as part of an integrated marketing platform that helps clients not only plan and produce marketing programs but also deploy, manage and measure them across all traditional and digital channels.

At its plant in Sussex, Quad (www.quad.com) creates magazines, catalogs and other materials using high-speed web offset presses, along with advanced finishing techniques. Its approximately 1,700 employees handle printing, finishing, mailing and distribution, maintenance and work-in-process operations (including two High-Density Storage Systems).

Managing the efficiency of compressed air and other utilities at the Sussex plant – and all Quad operations – is due to company's dedication to sustainability.

"Quad has always been and always will be focused on operating in a socially responsible and environmentally sustainable manner," Berg said, noting how Quad's holistic approach includes a wide range of activity, such as conserving raw materials, minimizing waste, developing new manufacturing processes and materials, and working with employees and vendors to minimize waste and reduce the environmental impact of our processes.

Quad Drives Compressed Air Efficiencies at 1.7 million-square-foot Printing Plant

High- and Low-pressure Systems

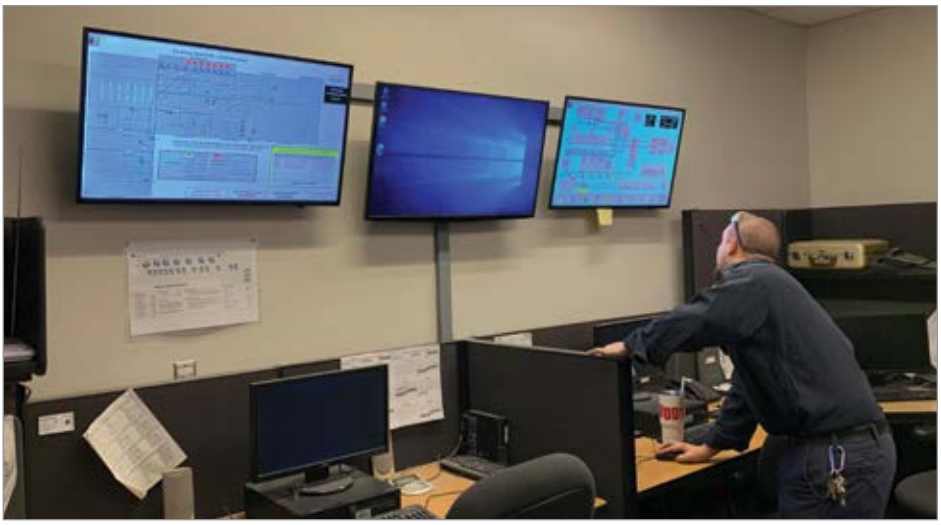
The Sussex plant operates no less than 22 air compressors to keep pace with demand, which ranges from 11,000 to 16,000 cfm. The water-cooled, rotary screw air compressors, which are predominately 200-horsepower (hp) machines, in addition to a select number of 100-hp and smaller units, are strategically located throughout the sprawling complex to consistently deliver clean dry air where needed. A total of 18 air compressors are fixed-speed machines while the remainder are Variable Speed Drive (VSD) machines. The plant's system also includes 26 refrigerated dryers, as well as various receiver tanks.

Compressed air at the plant powers pneumatically controlled cylinders and solenoid valves used to control numerous functions of printing presses, including vital operations such as plate changes and delivery of ink. It is also used in the finishing process to keep sheets of paper separated and in alignment as they make their way through finishing activities, such as binding and decorative processes. Compressed air is also used to ensure smooth operation of large cyclones used in the plant's recycling center to separate scrap from the air stream as its fed to balers. Additionally, compressed air is necessary for reverse pulse-jet cleaning of baghouses and a host of other applications.

At the plant, a high-pressure compressed air system is used to supply air at 120 psi in keeping with the requirements of the plant's three new, high-tech Man Roland web offset presses. A house-pressure system supplies air at 90 psi to the remainder of the plant.

Whether it's the high- or low-pressure loop, the plant uses a master control system to closely monitor and manage compressed air. The control system consists of a Texas Instruments program interfaced with Wonderware graphics package. In addition to compressed air, the system is used to monitor and tightly control the plant's process cooling system and low-pressure blowers.

The plant uses the fixed-speed units as baseload machines with the VSD air compressors serving as trim units to satisfy spikes in demand. The Production Support team takes pride in how the control system in combination with the VSD air compressors



Mitch Koenigs of Quad monitors the compressed air system at the company's Sussex plant.

gives it the ability to optimize the compressed air to meet production and energy-saving goals.

"We just don't have load/no-load machines sitting there. They'll stage up or down with the VSD machines trimming between steps," said Berg, adding how operation of compressed air is consistently held to within three psi of the established setpoint. "We're matching supply with demand. It's controlled very tightly."

Energy Conservation a Natural

Carefully managing compressed air comes naturally to Quad since energy conservation has been a focus for the company for decades, said Berg. It's also important since the plant's compressed air system consumes approximately 1,040 MWh of electricity per year.

"Energy has always been one of those elements we manage tightly and consistently. It's always been important," Berg said.

The majority of Quad's plants have an energy team comprised of a Production Support engineer or facility manager, as well as system and equipment experts from the building and electrical maintenance teams. Members from the maintenance teams represent both the press and finishing departments. Often, the teams also include representatives from various areas of production, which is particularly beneficial as they are the energy end-users. Berg said the most successful plants are those with cross departmental participation and a true energy champion on the team to focus efforts.

"Having an active energy champion tends to generate excitement," Berg said. "Plants with energy teams do really well because it provides a mechanism for pushing forward our energy program."

Aside from the energy champions, the team members at the plants are responsible for monitoring data and researching initiatives to reduce energy consumption and thus CO_2 emissions. They also meet regularly to review tracking models to evaluate performance of energy-saving initiatives and review projects that offer the best opportunities for energy reduction.

All the while, Quad has embarked on a journey to tie energy initiatives into a more comprehensive Energy Management System (EnMS) as part of a bigger effort to achieve ISO 50001 Ready and the associated benefits. In 2019, Quad's plant in West Allis, Wisconsin,

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attained 50001 Ready status, which provides organizations with a self-paced, no-cost way to build a culture of structured energy improvement and more sustained energy savings. Quad has also been active in the Department of Energy's Better Plants program since 2010.

The Sussex plant uses airflow meters on all major pieces of equipment and processes to measure compressed air performance. Shown is an airflow meter on a high-pressure line.

"We encourage teams to set objectives and targets to manage energy as part of our ISO 50001 efforts," Berg said. "Once these are identified during our annual energy planning session, the team brainstorms project ideas to meet our goals."

Metering a Standout Practice

Quad's Sussex plant has adopted numerous best practices that set high standards for managing the demand side of compressed air in order to conserve energy and ensure efficient performance, which is in addition to its proven approach to optimization of compressed air supply.

One standout best practice – in addition to a long-standing leak detection and repair program – is monitoring and measuring the use of compressed air to make informed decisions. Nearly every major piece of equipment and process at the plant that uses compressed air is equipped with airflow meters.

Joe Valoe, Quad Production Support-Regional Manager, and Ken Berg, Quad Corporate Engineering Manager for Production Support (left to right).

"We're trying to increase the level of awareness about how much compressed air we're actually using on a continuous basis. And it's not only for economic reasons but also for production," said Quad Production Support-Regional Manager Joe Valoe, citing how the airflow meters allow the team to establish a baseline for acceptable compressed air leakage rates.

"Let's say you install a new piece of equipment and determine it consumes 'X' amount of compressed air, but then you come back at a later date to find out the number has doubled," Valoe said. "Now we start to look at that change and it becomes an economic decision. For example, when is the best time to go search for that leak and get it fixed?"

First implemented in 2004, the use of airflow meters is key to Quad's ongoing energy program at the plant, said Valoe.

"Bringing that information from each piece of equipment back to a central point helps drive our energy program," he said. Valoe said it definitely contributes to better choices for where to invest dollars to achieve efficiencies.

"We try to point out that high-pressure compressed air is an inefficient source of energy. As an example, if it takes five horsepower of electricity to make one horsepower of pneumatic air, I like to say, 'I'll give you one dollar if you give me five back. We can play this game all day long.'"

Saving Air with Automatic Shutoff Valves

While measuring and metering compressed air consumption clearly delivers value, Quad hasn't stopped there to achieve energy efficiencies. A prime example is the use of automatic shutoff valves on major equipment.

"We took it one step further," Valoe said. "When equipment isn't used and goes idle, automatic shutoff valves will close down the air to the piece of equipment so we're not supplying any air to it if it's not running."

The use of automatic shutoff valves is a significant departure from the days when the plant manually shut off valves when air wasn't needed.

"In the past we relied on the equipment operator to turn off the air with a hand valve if the equipment shut down," Valoe said. "But we knew a lot times an operator may not remember to shut it off sooner rather than later. But with automatic shutoff valves, it takes another step out of the process."

Valoe said compressed air is also a priority item when the plant shuts down each year for scheduled maintenance.

"When the plant is down, we'll audit a lot this and make sure those valves are closing properly," he said, noting the team also uses the time to check other aspects of the compressed air system. An example is using an ultrasonic leak detector to investigate leaks, Valoe said.

"When the plant is down, we want to get out there and listen to see what equipment is still leaking, even if our automatic shutoff valves are closing and what have you," he said. "It's a focal point for our energy groups."

A Promising Energy Future

Looking ahead, Quad plans to continue its journey of energy efficiency by continuing to adopt compressed air best practices and encouraging select plants to participate in the ISO 50001 certification process. In the meantime, the Sussex plant continues to set an example of compressed air management at its best. Compressed air metering and the value it provides is an example of another step in the right direction.

"It's an ongoing effort and we're evaluating the opportunities metering can uncover here in Sussex," said Berg. "I think it will allow us to drive action at other plants. That's our hope."

Whether it's compressed air or another utility, energy savings for Quad is a priority.

"Energy conservation directly impacts Quad's strategic goals and aligns with the social and environmental responsibility interests of our employees and customers," Berg said. "A well-maintained and well-managed compressed air system certainly goes a long way toward supporting energy targets, which improves the bottom line, supports financial strength and helps create shareholder value." BP

To learn more about Quad visit https://www.quad.com

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COMPRESSED AIR INDUSTRY & TECHNOLOGY NEWS

Lone Star GC-Series Centrifugal Compressor

Lone Star Houston Texas USA has launched a centrifugal compressor product line for air or gas services. Product range will include 9 standard models from 200 hp to 13,000 hp and up to 1,100 PSIG with ability to offer standards to API617, API672, API614 or custom engineered solutions. This product line is offered with an agreement with SêAH Engineering with the option to package, build, test, set up distribution and service of the CHORUS product line in the Americas. Andrew Balberg, President said, "Lone Star has a service first mindset as a new equipment manufacturer. While we manufacture new machines, we also completely support other brands as an OEM alternative to service our customers. With Lone Star manufactured parts, Lone Star manufactured control systems, re-rates, overhauls, field service for all other brand centrifugal compressors along with a large rental fleet we offer a total solution like no other in the market."

Lone Star, www.lonestarblower.com

PneuTech Unipipe All-Aluminum Compressed Air Pipe

Manufacturers using compressed air in their processes have a new option when it comes to compressed air pipe. Unipipe now offers the largest array of aluminum piping systems available anywhere. These all-aluminum compressed air pipes come with a 20-year guarantee against leaks and failures. Aluminum is an excellent option for compressed air systems and for multi-fluid, vacuum, high-pressure and nitrogen systems. It is lighter and easier to install than black iron or plumbing pipe often used for compressed air and less prone to leaks, and it is more durable and longer-lasting than plastic compressed air pipe options. Unlike most aluminum options, Unipipe is all aluminum, with no plastic fittings or connectors. This construction delivers long-lasting, leak-free performance and the highest-rated working pressure in the industry, with ratings up to 1015 PSI.

PneuTech, www.pneutech.com

ABC Compressors First North American Location in Miami

Since the arrival of ABC Compressors in the North American market in 2017, the Spanish manufacturer has installed compressor units in 19 states in the USA and Canada, selling tens of units per year. The last move of the European manufacturer was to set up a location in Miami, Florida, to stock critical parts to optimize the maintenance cycles assuring rapid response in the field. Although ABC Compressors has presence in many sectors such as biogas, water treatment, natural gas, and petrochemical, the location was set up to service the beverage industry. The HORIZON range is designed to supply 100% oil free high- and low-pressure airflow to the PET blowing lines in the packaging industry. The new location will also respond to inquiries from other markets and countries.

ABC Compressors, www.abc-compressors.com/en

Siemens SIMOTICS SD200 Severe-Duty Motor

Siemens announced the immediate availability of the SIMOTICS SD200 severe-duty motor in frame size 440 as its latest offering in the low-voltage SIMOTICS motor family. Providing high productivity and energy-efficient operation in all torque ranges, these new cast-iron NEMA motors are built to power pumps, fans, compressors, hoists, winders, and similar equipment in harsh environments. With a three-year warranty, the SD200 motors offer 75-800 hp output and feature 444-5013 cast-iron frames for operation in 460V and 575V ranges. They meet or exceed NEMA Premium® MG1 Table 12-12 efficiencies. A wide selection of options is offered, including IP56 ingress protection, encoders, brakes, and blowers plus others to suit the applications presented. On these motors, the frame, end-shields, fan guard and easy-access, diagonally split, oversized terminal box are all cast-iron.

Siemens, www.siemens.com

COMPRESSED AIR INDUSTRY & TECHNOLOGY NEWS

SONOTEC SONAPHONE DataSuite V

The SONAPHONE digital ultrasonic inspection device combines innovative sensor technology, intuitive apps and browser-based software. Thus, classic maintenance tasks such as machine diagnostics, leak detection, steam trap testing, and the inspection of electrical systems can be performed efficiently. With the SONAPHONE product family, SONOTEC offers its customers solutions that are precisely tailored to the respective ultrasonic applications in maintenance. For example, the user can choose between the multi-application LevelMeter app and the special apps LeakExpert for leak detection and SteamExpert for steam trap testing. The SONAPHONE DataSuite is used to store, trend, analyze and manage ultrasonic measurements. It is the heart and central data hub of the SONAPHONE web-and-app concept. It also enables the organization of all ultrasonic measurements within an asset tree as well as the trend evaluation of various levels and characteristic values as the basis for condition-oriented, predictive maintenance.

SONOTEC, www.sonotec.com

Anderol B.V. Long Life Synthetic Lubricant

Anderol B.V. has launched a new synthetic compressor lubricant with extreme long-life properties. Available for food grade and industrial applications, Anderol SYNcom HiPerf 46 is a high-performance screw compressor lubricant specially formulated to last a full maintenance cycle. Along with its extreme long life properties, the lubricant has been developed to provide low deposit formation, outstanding oxidation and thermal stability, as well as low evaporation, fast water separation and copper and steel protection. Ingrid Ooms, Global Technical Manager at Anderol B.V. said, "Equipment can operate for much longer without interruption with Anderol SYNcom HiPerf 46, which means reduced maintenance requirements and enhanced productivity. It also offers a more sustainable solution as the longer oil life properties means less oil consumption and less waste.

Anderol B.V., www.anderol.com

Atlas Copco Compressors Acquires CAS

Atlas Copco Compressors announced the acquisition of the operating assets of Compressed Air Systems, Inc. (CAS) – a distributor of compressors, quality air systems, and associated equipment. Established in 1984, CAS provides professional equipment sales, system design, installation, 24/7 service for compressed air and industrial vacuum systems to North Carolina, South Carolina, and Central Virginia. "CAS has a strong service business and a very knowledgeable team," said Vagner Rego, Business Area President Compressor Technique. "North Carolina, South Carolina, and Virginia are areas with great growth potential, and the acquisition will enable us to reach our goal to get closer to customers." Located in Salisbury, North Carolina, CAS is a privately owned company and has 30 employees.

Atlas Copco Compressors, www.atlascopco.com/air-usa

SUTO iTEC Dew Point Meter Series

SUTO iTEC announced the release of their new dew point meter series S211/S215/S220. Developed with a clear focus on high quality and customer benefits, their new dew point meters are now even more flexible with great additional features. All models are now available with an integrated pressure sensor, which makes them unique on the market, offering all important measurement parameters in a single sensor. Their compact design paired with robust materials, made of stainless-steel and high-class aluminum, protect the sensor from external influences and make them a reliable measurement tool. The newly designed S220 combines two sensor types into a single unit, using the QCM sensor for low dew points and the Polymer sensor for higher dew points. The S220 can provide an outstanding accuracy over the full range of -100 to +20 °C.

SUTO iTEC, www.suto-itec.com

COMPRESSED AIR INDUSTRY & TECHNOLOGY NEWS

Festo Manual and Mechanical Pneumatic Valves

Festo recently introduced the manually operated VHEF and the mechanically operated VMEF pneumatic valves. These small, durable, and versatile valves are core Festo products and guaranteed to ship within 24 hours. Whether the valve is triggered by a workpiece, a component, or a person, manual and mechanical valves are the most direct way to control a process. VHEF and VMEF do not require energy conversion, additional reaction time, or long cables. The actuated plunger simply switches the valve and triggers the next step in the process. Given that the conditions in the field are sometimes quite harsh, for example with sawdust in furniture production, or even in agricultural automation, these manual and mechanical valves are designed to withstand environmental stresses.

Festo, www.festo.com/us

Quincy Compressor Acquires MidState Air Compressor

Quincy Compressor has acquired the operating assets of MidState Air Compressor based in Berlin, CT, with sales and service covering Connecticut, Rhode Island and Massachusetts. The acquired company has been in business more than 11 years. MidState Air Compressor has a strong reputation for outstanding customer service with a large, loyal customer base, which is supported by an experienced team of knowledgeable and dedicated employees. This acquisition allows Quincy Compressor to focus on growing the business with the intention of continuing to strengthen our market presence in the region. MidState Air Compressor has about 18 employees and offers a wide portfolio of air compressors, dryers and accessories including full service options, systems auditing and equipment rentals.

Quincy Compressor, www.quincycompressor.com

VPInstruments New Firmware for VPFlowScope M

VPInstruments announced new firmware for the Transmitter of the VPFlowScope M flow meter. Firmware 2.2.0 has improved reliability and stability. With this new firmware the VPFlowScope M is even easier to use. Simultaneously, they released the VPStudio 3 software to configure and readout your VPFlowScope M. The VPFlowScope M provides a complete solution for compressed air and technical gas flow measurement. It covers the entire compressed air system, from supply to demand side. Thanks to the built-in pressure sensor and temperature sensor, the VPFlowScope M is a powerful tool to detect what is really going on in your system. As a customer you can now update your VPFlowScope M Transmitter free of charge. Updating goes via a VPFlowScope M Firmware Updater, which is enclosed with VPStudio 3.

VPInstruments, www.vpinstruments.com

Universal Compressed Air Appoints Rick Kowey VP & COO

Universal Compressed Air (UCA), a Pennsylvania-based provider of innovative compressed air systems, has appointed Rick Kowey as Senior Vice President & Chief Operating Officer. Reporting to Sam Piazza Sr., President and Chief Executive Officer, Kowey will lead UCA's commercial, technology, and operating functions. Kowey holds over 37 years of experience in the industrial and specialty gas industry and has previously served in multiple senior leadership positions, most notably at Matheson Tri-Gas, Inc., Scott Specialty Gases, Inc. (now Air Liquide), and Weldship Corporation. Throughout his years in business, Kowey has gained experience in strategic marketing, commercial leadership, operations, general management, business development and mergers and acquisitions. He has held previous C-level positions as Chief Marketing Officer and Chief Commercial Officer.

Universal Compressed Air, www.universalcompressedair.com

COMPRESSED AIR INDUSTRY & TECHNOLOGY NEWS

FLIR A50 and A70 Thermal Cameras

The new A50 and A70 thermal cameras come in three options – Smart, Streaming, and Research & Development to fit the needs of professionals across a variety of industries – from manufacturing to utilities to science. The new cameras offer improved accuracy of ±2 °C or ±2% temperature measurement, compared to the previous accuracy of ±5 °C, or ±5% temperature measurement. The cameras all include an IP66 rating, along with a small, compact size with higher resolution options compared to previous versions. Featuring a thermal resolution of 464 x 348 (A50) or 640 x 480 (A70), professionals can deploy the A50 or A70 cameras in a variety of capacities. This includes condition monitoring programs to maximize uptime and minimize cost through planned maintenance.

Teledyne FLIR, www.flir.com

Cullum & Brown Celebrates 135 Years

Cullum & Brown, a leading industrial equipment distributor and service provider in the Midwest, is celebrating its 135th Anniversary. In 1886, Cullum & Brown started as a small family-owned water well drilling business serving the Kansas City area. It later expanded into the company you know now, supplying air compressors, blowers, and pumps across western Missouri and eastern Kansas. Cullum & Brown has a rich history of helping customers find the right equipment they need for their manufacturing businesses and providing them with the services to keep equipment up and running. When it comes to quality, Cullum & Brown guarantees its team of experts is ready to provide exactly what its customers need to succeed.

Cullum & Brown, www.cullumandbrown.com

Xebec Acquires Tiger Filtration

Xebec Adsorption Inc., a global provider of clean energy solutions, announced that it has closed the acquisition of all the outstanding shares of United Kingdom based Tiger Filtration. The acquisition of TFL will provide Xebec with a very profitable and recurring aftermarket manufacturing business for elements and filters. TFL's R&D capabilities will also allow for expansion of its product portfolio to include filtration products for hydrogen and renewable natural gas. Founded in 2004 by former Walker Filtration employees, TFL has gained worldwide recognition for providing high-quality alternatives for the compressed air and gas industry. TFL was established 17 years ago and has become an internationally active company with worldwide sales. Two of its principals will retire and Gary Ashton will remain with TFL as Managing Director and continue his leadership in sales and business development.

Xebec Adsorption, www.xebecinc.com

Diversified Air Systems Acquired by Motion and Control Enterprises

Founded in 1979, DAS is a full service, stocking distributor of air compressors and related products including vacuum & water recovery systems, nitrogen/oxygen generators, cooling towers and chillers. The company also provides a full offering of repair, routine service, and aftermarket parts. Based in Cleveland, OH, Diversified employs 42 associates, servicing industrial markets in OH, WV and western PA from four locations – Cleveland, OH; Akron, OH; Toledo, OH and Washington, PA. As a division of MCE, the Company will continue to operate under the Diversified Air Systems name with the same leadership team, employees, and suppliers. "We are excited to welcome the Diversified Air Systems team to MCE," said Charles Hale, Chairman & CEO of MCE. Hale further noted that "DAS' products are a natural fit with MCE's fluid power capabilities and will position the combined business to provide a broader range of highly-engineered solutions to its consolidated customer base."

Motion & Control Enterprises, www.mceautomation.com

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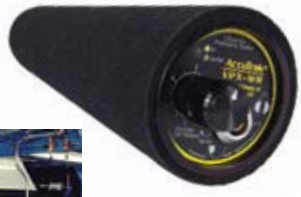

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