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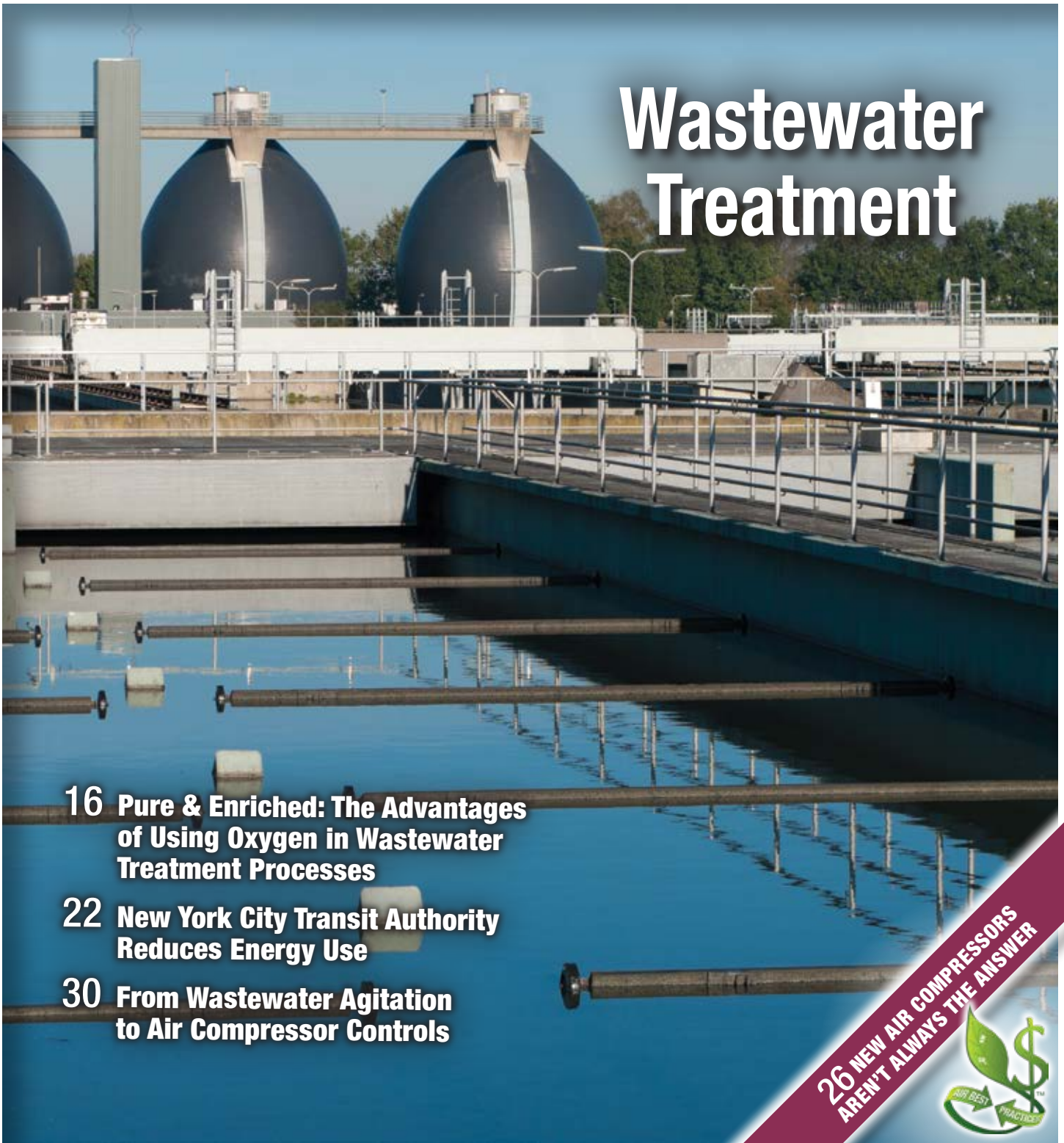
September 2018



Wastewater Treatment

SUSTAINABLE MANUFACTURING FEATURES

COLUMNS

FROM THE EDITOR | 2018 BEST PRACTICES EXPO & CONFERENCE

If you are reading this before September 17th, there's still time for you to visit us at our inaugural BEST PRACTICES EXPO & Conference, taking place September 17-19, 2018 at the Chicago O'Hare Crowne Plaza. The EXPO has 65+ exhibitors and is free of charge. The Conference has almost 100 speakers and is very reasonably priced. Register today at www.cabpexpo.com!

I wasn't familiar with pure oxygen enrichment practices, for wastewater, until the folks at Airgas sent me an article explaining it's benefits. Their article does a nice job of explaining when a source of pure oxygen can help the main compressed air/blower air aeration supply to secondary wastewater treatment processes.

Heat recovery systems, using the hot oil in the air compressor, are sometimes hard projects to pull off. Why? Technically it's not that difficult but it requires a good understanding of (normally) a process water application. The New York City Transit Authority recently turned to Wendel Engineering who in turn hired SRW Engineering to do a heat recovery project for the showers at their bus depot in Maspeth (NY). SRW selected Iacono Inc. and HydroThrift and the resulting project has the rotary screw air compressors heating the water for the shower system. Pretty cool.

Compressed air auditors Ron Marshall, Hank van Ormer and Paul Edwards all provide interesting articles this month. They share a common denominator – the most profitable savings for factories normally come when the effort is made to reduce compressed air demand. It's more time consuming, but ultimately all projects should start with a firm understanding of the demand side of a compressed air system.

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

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INDUSTRY NEWS

Solberg Celebrates 50th Anniversary

Solberg turned 50 this year! Over the past five decades Solberg has supplied filtration, separation and silencing products for the Blower, Compressor and Vacuum pump markets from their home base in the greater Chicago area. All employees, including international personnel from Solberg's 19 locations around the world, gathered to celebrate the company's history and discuss plans for an exciting future.

Solberg CEO Charlie Solberg said, "As we celebrate our 50th Anniversary, we are looking ahead. We will continue finding new ways to take care of our customers and employees while building meaningful supplier partnerships. We have a strong foundation in place for the next generation of Solbergs who will play an important role in cultivating these critical relationships and defining market focus over the next 50 years. We will build on what has worked from our past – and readily adapt to a changing world. Although we have been around for a while, in many ways, we are just getting started."

For more information, please visit www.solbergmfg.com

Kaishan Compressor USA Breaks Ground on New Facility in Alabama

Kaishan Group, a leading worldwide manufacturer of industrial air compressors, announced plans to begin construction on a new U.S. corporate headquarters and manufacturing facility in Loxley, Alabama. At a July 2018 event, the company broke ground on their new 65,000 square foot facility, which is scheduled to be completed in the second quarter of 2019. The Loxley location will bring 62 new manufacturing jobs and more than $11 million in capital investment to Baldwin County during its first three years of operations.

"Kaishan is proud to locate its corporate headquarters to Loxley, where we can better serve the North American market with locally produced goods and services," said Keith Schumacher, CEO of Kaishan Compressor USA.

Kaishan Group, based in Quzhou, China, is the world's third largest manufacturer of air compressors. With modern, specialized manufacturing facilities positioned in seven strategic locations, Kaishan's global reach and diverse portfolio of highly engineered products have built a strong reputation for meeting the needs of their multi-national company clientele. With a 60-year track record, Kaishan has steadily grown to become a significant engineering and production company supplying compressed air, refrigeration, power generation and mining equipment to over sixty countries and regions, including Southeast Asia, Australia, Europe, Japan, Korea, Russia, Africa and Latin America.

"This expansion broadens our global footprint, providing access to a market that seeks high quality, durable, and energy efficient products," said Kevin Cao, president of Kaishan Group. "This project allows Kaishan to better meet the needs of our North American customers."

"We are excited to add Kaishan Group to the list of companies that have chosen Loxley as a great place to do business," said Billy Middleton, mayor of Loxley. "As our community continues to grow and thrive, Kaishan will play a key role in providing well-paying jobs for our residents, and I look forward to partnering with this company for many years to come."

Lee Lawson, president and CEO of the Baldwin County Economic Development Alliance, said this announcement further solidifies Baldwin County's status as a great location for international companies to invest in and lead their U.S. operations. Baldwin County was the 11th fastest growing MSA in the United States in 2017, and for the third year in a row, SmartAsset has ranked Baldwin County No. 1 in the state of Alabama for incoming business investment.

"Baldwin County is a fast-growing area and a superb place in Alabama to launch a new business venture," said Greg Canfield, secretary of the Alabama Department of Commerce. "Kaishan Group has selected an ideal location for its North American manufacturing operation, and we look forward to working with the company as its business grows."

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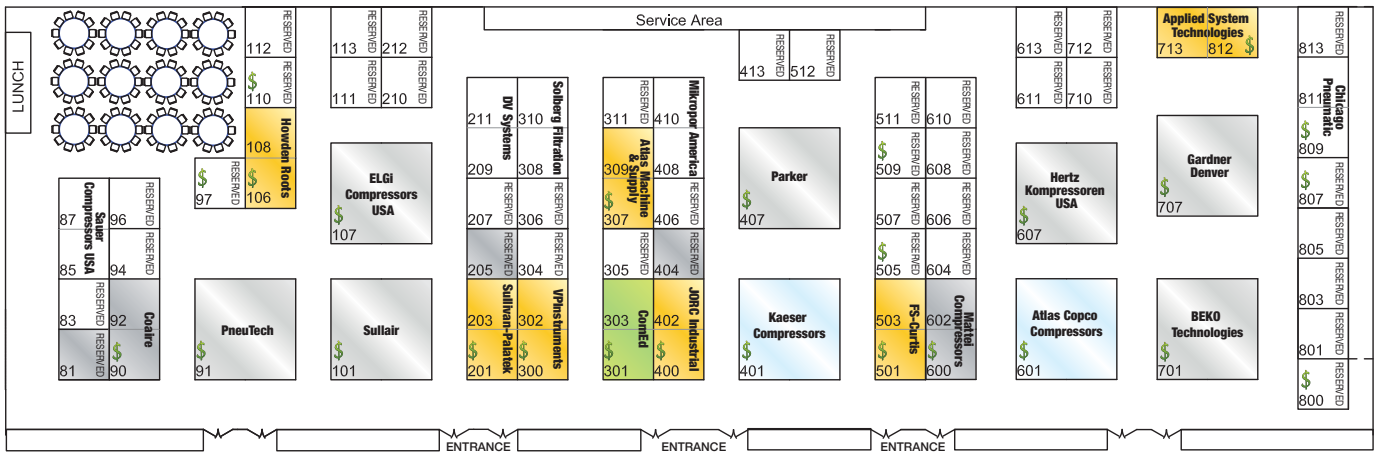

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INDUSTRY NEWS

"Companies from around the world are recognizing that Baldwin County is a business-friendly location with a workforce that already possesses the skills needed for a manufacturing operation to succeed," said Chris Elliott, Baldwin County Commission representative for economic development. "As our local economy continues to become more and more diverse, we are excited to welcome Kaishan Group to Baldwin County and the town of Loxley."

Kaishan Compressor USA is currently looking to fill a number of key positions for their organization and will be looking for many more talented individuals as the project plan progresses. For more information about Kaishan and job openings, please visit www.KaishanUSA.com

Kaishan Compressor USA broke ground on their new 65,000 square foot facility in Loxley, Alabama.

INDUSTRY NEWS

Kruman Brothers Retire – Business in "Good Hands" with Dearing

On January 29, 2018, Pittsburgh-based Kruman Equipment Company completed its final business transaction, with the acquisition of the third-generation company by Youngstown, Ohio-based Dearing Compressor & Pump Co. The acquisition marked the merging of two of the oldest Gardner Denver industrial air compressor distributors; that final transaction on January 29 also marked 82 years – to the day – since Eric and Brian Kruman's grandfather started the business.

The 82-year legacy of Kruman Equipment had come full-circle, and the Kruman brothers decided it was time to leave the legacy of the family business in the hands of Dearing's leadership, another third-generation family business with whom they could trust their reputation and their established customer base.

Retirement for the Kruman brothers came at what they believed to be a fortuitous time. The opportunity began with a conversation between Eric Kruman and Dearing Chief Operating Officer, Albin Dearing. What started as a phone call and an interest in a partnership opportunity between the two companies led to a developing of relationships and more than a year of discussions and negotiations. The end result was an acquisition that allowed Dearing to effectively double their industrial air compressor business while providing counterbalance to the dynamic energy market. The Kruman brothers, meanwhile, saw the opportunity to leave their family legacy "in good hands" with Dearing, said Eric Kruman as he spoke about the transition on the first official day of his retirement.

"My brother and I wanted to exit the business together," explains Kruman; thanks to a smooth transition and mutual agreement between the two companies, the brothers were able to do exactly that as they officially ended their roles at Kruman in June. As for what comes next for the Kruman brothers, Eric adds that "neither of us have had a summer vacation since high school," and both Eric and Brian are looking forward to having the time for volunteer work and community service, to give back to the community that gave them and their family so much over the past 82 years. Kruman will retain ownership of the building located at 3000 Penn Avenue in Pittsburgh, and Dearing maintains its plan to keep the Pittsburgh facility in operation.

As Dearing Vice President Becky Wall explained, "The cultures of both Dearing and Kruman reflect common values of family owned and operated, multigenerational businesses – making the blending of the two a natural fit and bringing together the best assets of both companies. With over 150 combined years of industry experience, both Dearing and Kruman have spent decades delivering a deep working knowledge of the products, parts and processes that ultimately have allowed them to offer their customers the most precise and effective application of systems and components."

Dearing President, Richard Dearing, describes the motivation behind Dearing's interest in Kruman; "It was just the right fit culturally, strategically, geographically – and the timing made sense for both sides." The acquisition positions Dearing for growth through territory expansion in a demanding marketplace by extending their overall footprint. The value of the Kruman brand will be a complement to Dearing's industry-leading strengths in service, technology and packaging operations, and the combined resources will allow them to better

serve new and existing customers across a seamless map of territories from northern Ohio down through southern Pennsylvania and into West Virginia and Maryland.

Albin described Dearing's investment in Kruman as "a bold next step, and part of a comprehensive vision plan that includes continued expansion, increased revenue, ongoing implementation of technology, a balance between our industrial and energy operations, consistency of standardized processes, and contributions to community – all while maintaining the integrity of both families' values and a responsibility to create continued opportunities for all employees."

As for the Krumans, they are confident that their customer base will be taken care of and positioned for continued success and growth in this new era under Dearing leadership. "Without our customer base, we wouldn't have anything," Eric gratefully acknowledges. "We want to thank them for their loyalty and their business, and we want to say thank you for a long run," he concluded.

ABOUT DEARING COMPRESSOR & PUMP CO.

Dearing is a family business operating in Youngstown, OH as the industry leader in industrial compressor distribution and packaging. For over 70 years, Dearing has based their reputation on service, reliability, integrity and innovation, and responsibly serves industrial and energy customers with dependable equipment and systems for compressed air, gas, process gas and hydraulic applications. The manufacturers they represent provide the absolute best equipment and support available in the marketplace today. Dearing continually matches these quality products with engineering, design expertise, installation experience and quality service to keep customers' equipment running properly for years. Today, Dearing's air and gas compressors serve automotive, aluminum, plastic, chemical, food, high-tech, lumber, rubber, steel and mining, as well as oil and gas industries. http://www.dearingcomp.com/

ABOUT KRUMAN EQUIPMENT

Established in 1936, Kruman Equipment Company in Pittsburgh, PA was a full service distributor for energy-efficient and reliable lubricated and oil-free rotary screw and reciprocating air compressors, refrigerated and regenerative desiccant air dryers, air filtration, regulation and lubrication

INDUSTRY NEWS

products, aluminum piping systems, oil/water separators, electric drain valves, and nitrogen generators. Kruman is a 3rd generation family-owned business with a reputation for its standards in customer support and service across territories that include Pennsylvania, West Virginia and Maryland.

ABOUT GARDNER DENVER

Gardner Denver is a global manufacturer of compressors, pumps, blowers and other engineered solutions for various industrial applications. They specialize in highly engineered compressed air and vacuum solutions used across a range of industries, including pumps and consumable products used in oil and gas production, as well as air treatment systems, genuine replacement parts, and fluid transfer equipment for the chemicals, green technology and food and beverage industries. http://www.gardnerdenver.com/en/brands-overview

New ISO Standards for Greener Machine Tools

When the topic of energy efficiency comes up, energy-efficient machine tools don't immediately spring to mind. Yet machine tools contain motors and auxiliary components whose energy demand varies widely during machining operations. Happily, a new series of ISO standards can help measure energy supplied and improve machine design and performance.

Machine tools are complex power-driven industrial devices employed to manufacture ready-for-use parts or semi-finished products. Encompassing a whole array of tools for cutting and forming metal, wood and plastics, and all their accessories, machine tools are used by companies in a variety of sectors like the automotive industry, general machinery, precision engineering, the medical sector, transport, aerospace, and dies and mould. Machine tools obviously use different forms of energy, such as electrical energy, compressed air, hydraulic energy, energy hidden in the cooling and lubrication system, etc. Therefore, the energy demand of a machine tool is considered as key data for investment, but does not stand alone. The performance of a machine tool is multidimensional regarding its economic value, its technical specification and its operating requirements, which are influenced by the specific application. Hence why the ecological footprint is a common challenge for all these products and, as natural resources become scarce, environmental performance criteria for machine tools need to be defined and the use of these criteria specified.

ISO has recently published the first two parts of a new International Standard for the environmental evaluation of machine tools, which proposes to analyze machine tools with regard to the delivered functions in order to highlight the commonalities in the huge variety of existing machine tool types.

ISO 14955-1, Machine tools – Environmental evaluation of machine tools – Part 1: Design methodology for energy-efficient machine tools, addresses the energy efficiency of machine tools during their working life. It identifies the main functions and machine tool components that are responsible for energy demand during the use phase. These components are then compared with previous components or with the state-of-the-art for their future improvement.

ISO 14955-2, Machine tools – Environmental evaluation of machine tools – Part 2: Methods for measuring energy supplied to machine tools and machine tool components, supports the energy-saving design methodology according to ISO 14955-1 by providing practical methods for measuring the energy supplied to machine tools.

Ralf Reines, Convenor of ISO/TC 39/WG 12 that developed the standards, explains: "This is, to my knowledge, the only standard concerning this topic that is tailored for machine tools. It covers the topic in a way that it can be applied to each and every machine tool, despite the fact that the product group of machine tools is extremely diverse, e.g. different technologies (such as milling, turning, grinding, laser processing, forming), processing of material (metal, wood, plastics), sizes (to produce parts the size of a tooth or to process gears for windmills of 10 m in diameter). The standard focuses on the relevant energy users to achieve a higher environmental performance without loosing in technical possibilities."

According to the study Market Report 2016 by the German Machine Tool Builders' Association, the world production of machine tools represents EUR 67.7 billion. The increasing demand for machinery and production systems to be more energy-efficient is a relatively new challenge for machine designers. Now, with the new ISO 14955 series, energy efficiency is likely to become an increasingly important quality attribute of modern machine tools.

ISO 14955-1 and ISO 14955-2 were developed by ISO technical committee ISO/TC 39, Machine tools, whose secretariat is held by SNV, ISO's member for Switzerland. They can be purchased from your national ISO member or through the ISO Store.

Read more:
https://www.iso.org/news/ref2262.html

Alliance Announces 2018 Stars of Energy Efficiency Award Winners

The Alliance to Save Energy named its 2018 Stars of Energy Efficiency Awards winners, recognizing companies, organizations and individuals who have demonstrated profound leadership in energy efficiency. The 2018 winners are: Agder Energi and Microsoft; Legrand, North and Central America; Southern

California Edison; Target; thyssenkrupp; and Thomas Wenning of Oak Ridge National Laboratory. The awards will be presented before 400 executives, government officials and advocates at the 26th annual *Evening with the Stars of Energy Efficiency Awards Dinner* in Washington, D.C., on September 26, 2018.

"We are excited to honor and recognize these companies and individuals that have not only demonstrated tremendous leadership, but have also pioneered new, cutting-edge ways to use energy more efficiently and productively," said Alliance to Save Energy President Jason Hartke. "We saw countless energy efficiency innovations and initiatives over the last year. These winners stand out as innovators who are making a difference and driving tremendous energy and economic benefits to help our country."

Agder Energi and Microsoft are receiving the *Innovative Star of Energy Efficiency Award: Power Generation and Supply* for their work on the Smart Grid Pilot Program, an Azure solution, which has been implemented at one of Agder's substations. Microsoft's game-changing technology helped Agder identify ways to operate the grid more efficiently through utilization of distributed energy resources, device controls and predictive forecasting – thus avoiding costly and time-consuming energy upgrades. The solution demonstrates an innovative way to use distributed energy resources as flexibility assets in the distribution power system, which allows the power company to meet demands and avoid costly outages.

Tom Nysted, CEO of Agder Energi, said: "The Smart Grid Pilot Program will transform the way we operate the power system and interact with customers while saving money and energy in the process. We look forward to continuing our partnership with Microsoft and working to replicate this technology on a broader scale. Thank you to the Alliance to Save Energy for this honor."

INDUSTRY NEWS

Legrand, North and Central America, is being honored with the *Industry and Manufacturing Star of Energy Efficiency Award* for its multifaceted commitment to integrating efficiency and sustainability into its business operations. Legrand has successfully met its second Better Plants goal of 20.3 percent energy reduction five years ahead of the initial 2022 target year, after having already achieved a 28.2 percent improvement in energy intensity between 2009 and 2012. To achieve these goals Legrand conducted energy audits and installed submeters across a number of its U.S. facilities. The company also implemented a variety of energy-saving projects, including lighting retrofits, machinery upgrades, and numerous process improvements within its factories and warehouses. Legrand also focused on stimulating employee behavioral changes by conducting a series of "Energy Marathons" – internal cross-company competitions designed to save as much energy as possible over a 26.2-day period. The company is proud to have recently achieved LEED certification at its 100-year old North and Central American corporate headquarters, located in West Hartford, CT. The West Hartford site is also home to the company's first fuel cell installation, providing onsite generation for approximately 85 percent of the headquarters' electricity needs.

John Selldorff, CEO of Legrand, North and Central America, said: "At Legrand, we believe that optimizing the way we manage energy, water, and waste is not only good for the environment, it's good for business. We are honored to be receiving this recognition, and we intend to continue our efforts to serve as a leader in energy efficiency."

Southern California Edison is being honored with the *Transportation Star of Energy Efficiency Award* for its Charge Ready pilot program, which has supported the installation of more than 1,000 electric vehicle charge ports since April 2016. Through this program, SCE installs and maintains the supporting EV charging infrastructure, and participants operate and maintain qualified charging stations. This pilot has helped increase the availability of EV charging stations in areas where people park their cars for extended periods of time – including workplaces, campuses, recreational areas and apartment and condominium complexes – with half of these installations deployed in disadvantaged communities. The Charge Ready pilot program sets SCE on a path toward electrifying the transportation sector, and successfully reduced gasoline-powered trips by 900,000 miles after just a few months of operation.

Jill Anderson, SCE Vice President of Customer Programs & Services, said: "Electric vehicles are a cornerstone element of future transportation, and at SCE we believe it is our responsibility to facilitate this transformation and help make this technology readily available. We are honored that our Charge Ready pilot program is receiving this award from the Alliance to Save Energy."

Target is receiving the *Built Environment Star of Energy Efficiency Award* for its commitment to reducing energy consumption and improving efficiency. Target has successfully decreased energy use by 405 million kilowatt-hours per year since 2015 through its Store Remodel Program – an accelerated replacement program aimed at upgrading equipment with more efficient designs – and utilization of demand-side energy management strategies. Additionally, Target leads the retail sector in number of ENERGY STAR certified stores and has been named an ENERGY STAR partner of the year for the past three years.

"At Target, we're designing for tomorrow and putting solutions in place across our business to leave our homes better for future families," said John Leisen, Vice President, Property Management, at Target. "And we're proud to have earned ENERGY STAR status in more than 80 percent of our U.S. buildings as we continue investing in ways to reduce energy use across our business, including converting over 1.5 million lights to LED in our stores, saving 35 percent of our lighting energy needs. It's an incredible honor to be recognized by the Alliance to Save Energy for our achievements and continued commitment to supporting our local communities as we strive to achieve our long-term energy goals."

thyssenkrupp is receiving the *Innovative Star of Energy Efficiency Award: Built Environment* for its MULTI elevator. As buildings continue to grow taller, traditional elevators require more energy to power larger motors and cables and take up more space to allow for multiple elevator shafts. MULTI seeks to solve both of these space and energy-related inefficiencies by consolidating multiple elevator shafts into only a few and eliminating the need for cables – with multiple rope-less, horizontally-moving cars traveling in a continuous loop. The MULTI can increase a building's usable space by up to 25 percent, while also reducing peak power needs by as much as 60 percent when compared to conventional elevator systems. The technology also has the ability to regain energy, store it in batteries and then send it back to the internal grid.

Michael Cesarz, CEO of MULTI, said: "The MULTI elevator has the potential to revolutionize the way buildings consume energy and utilize space. We appreciate the Alliance for recognizing this pioneering technology with this award and look forward to building on this technology and continuing to drive elevator technology into the future."

Thomas Wenning, program manager for industrial energy efficiency at the U.S. Department of Energy's Oak Ridge National Laboratory (ORNL), is being honored with

the *Rising Star of Energy Efficiency Award.* Wenning manages ORNL's domestic and international industrial energy efficiency technology assistance and deployment activities. Under his leadership, the Department of Energy's Better Buildings, Better Plants program has grown to 200 industrial partners, generating over $4.2 billion and 830 trillion BTUs in cumulative energy savings. Over 50 Better Plants partners have achieved their long-term strategic energy efficiency goals ahead of schedule. Wenning has helped grow the resources of the program, creating new opportunities for networking and recognition, developing new technical assistance guidance, and facilitating industry-lab R&D innovation. Additionally, he is leading the DOE's effort to modernize its legacy energy-system analysis software and associated training resources to create an open-source tool suite that can help drive energy efficiency throughout industry. Finally, Wenning has led dozens of international industrial energy efficiency workshops, trainings, and assessments on behalf of the DOE.

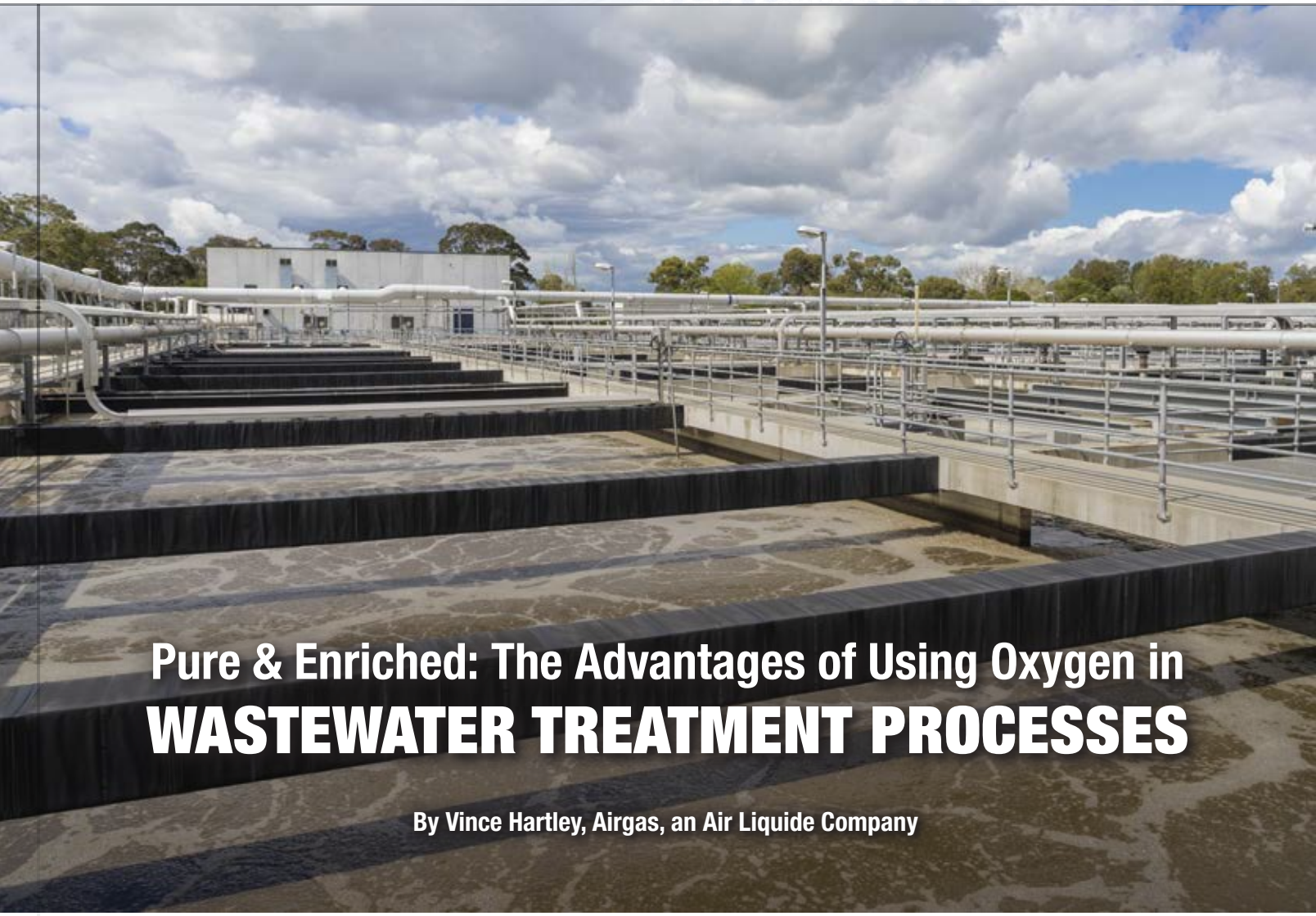
Thomas Wenning said: "I am grateful to be recognized by the Alliance to Save Energy with this honor and I look forward to promoting and advancing energy efficiency."

Information about the *Evening with the Stars of Energy Efficiency Awards Dinner* is available at www.ase.org/dinner.

About the Alliance to Save Energy

Founded in 1977, the Alliance to Save Energy is a nonprofit, bipartisan alliance of business, government, environmental and consumer leaders working to expand the economy while using less energy. Our mission is to promote energy productivity worldwide – including through energy efficiency – to achieve a stronger economy, a cleaner environment and greater energy security, affordability and reliability.

For more information, visit http://www.ase.org



Pure & Enriched: The Advantages of Using Oxygen in WASTEWATER TREATMENT PROCESSES

By Vince Hartley, Airgas, an Air Liquide Company

Wastewater treatment processes have come a long way in the past century, but demand continues to grow for more reliable and efficient treatment technologies. As a result, industry professionals are searching for an all-encompassing solution to enhance their treatment plants and processes. One of the purest environmental aids on the market is **oxygen.**

Typically, secondary wastewater treatment is done using blowers and associated air-based equipment, including diffusers. Secondary treatment is used to remove dissolved and suspended biological and organic matter, and this works very well in many cases. However, there are instances where the use of pure oxygen to supplement the air system can be particularly effective.

"Traditionally, oxygen systems are pressure-based, which means they often can operate with significantly less power consumption than equivalent air systems and, in some cases, can operate with no power at all."

— Vince Hartley, Airgas, an Air Liquide Company

When to Use Oxygen to Supplement, or Enrich Compressed Air

When should a wastewater treatment facility evaluate its equipment needs and look for a source of pure oxygen to supplement, or enrich compressed air? There are five situations to consider:

1. If the facility is experiencing problems, or doesn't have sufficient airflow at a secondary or biological treatment facility.
2. If the treatment plant operator is trying to get more out of an existing system, or has limitations, power concerns and space issues.
3. If a plant is looking to avoid issues with older equipment such as breakage, motor failure and clogging.
4. With summer or heat-related issues that are not present in cooler months or climates
5. Peak conditions (seasonal changes in flow/loading, etc.)

Of course, if none of these, or other related issues exist, there is probably not a need for pure oxygen within a given facility. If they do exist, there is a good chance oxygen can help.

There are several energy-saving benefits to this supplemental oxygen process that could potentially make daily tasks easier. Traditionally, oxygen systems are pressure-based, which means they often can operate with significantly less power consumption than equivalent air systems and, in some cases, can operate with no power at all.

In addition, the fact that the oxygen-based equipment can almost always be incorporated into the treatment process without interruption provides much more flexibility with little impact on the plant operations.

What Happens When Oxygen is Used?

Sufficient transferred oxygen is the key to all secondary aerobic treatment operations. There are several ways that the use of pure oxygen can help to ensure the system operates correctly and has this needed oxygen level with fewer detrimental impacts.

Often as changes occur in production rates, flows, product specifications, and more, the loading oxygen demand (BOD/COD) at the treatment plant changes as well. Wastewater systems are often not sized sufficiently to handle these changes. This is yet another area where pure oxygen can provide some relief.

Oxygen can help to alleviate multiple other problems prevalent in secondary treatment systems. For example, dead zones – areas with no- or low-dissolved oxygen due to poor mixing or non-functioning equipment – can be addressed with targeted injection of oxygen.

In most cases, the oxygen is added via separate means in the treatment area, which means it can be used on an as-needed basis and operated independently. This provides flexibility to meet plant needs while minimizing chemical usage and operating costs.

When air is added to wastewater, it can strip hydrogen sulfide and/or VOCs (volatile organic

PURE & ENRICHED: THE ADVANTAGES OF USING OXYGEN IN WASTEWATER TREATMENT PROCESSES

compounds such as benzene, toluene or methanol) that might be present during the aeration process. Compared to the traditional compressed air approach, pure oxygen often achieves a higher level of dissolved oxygen. Pure oxygen injection can result in improved mass transfer since it is typically transferred at a high rate (70-90%) and there is no nitrogen to interfere. These factors help to minimize the potential stripping that is typical of air-based systems where VOCs are present.

In some cases, even low doses of oxygen utilized prior to secondary treatment can help maintain the system health by ensuring sufficient dissolved O_2, which prevents filamentous and other undesired bacteria from developing.

Appropriate levels of oxygen lead to healthy bacteria, which lead to improved treatment capabilities. Pure oxygen can play an important role.

What is an Oxygen System?

An oxygen system consists of three main parts:

1. The oxygen storage and supply tank, usually called a bulk tank. It is a vessel designed to store cryogenic liquids, including oxygen. Note: Although the oxygen is used as a gas, it is stored in a concentrated form as an extremely cold liquid, approximately -250 ˚F, depending on tank pressure.

An oxygen system is installed to supplement wastewater treatment processes.

2. The oxygen is vaporized in an ambient air vaporizer, which looks like a giant radiator, and then flows to the valve train/control panel. The oxygen flow and pressure are adjusted appropriately depending on the particular system design.

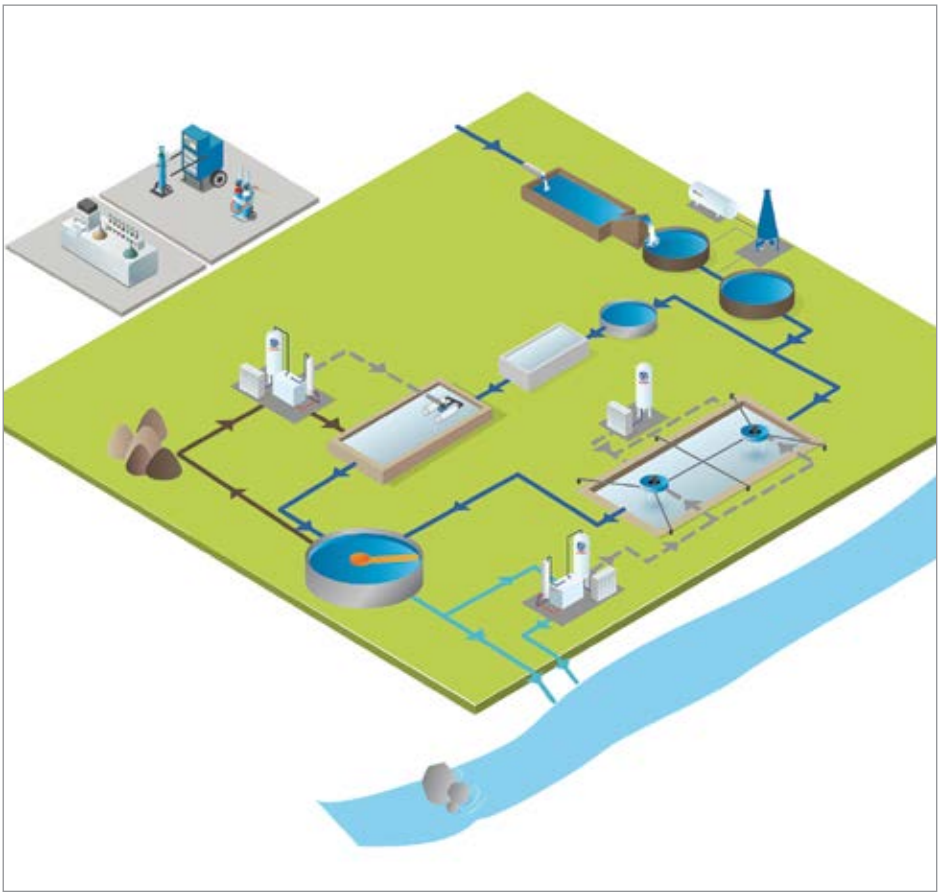
3. Finally, the oxygen is injected. There are several methods of injection. Simple devices such as spargers, diffusers or porous hoses can be used. More complex devices can provide additional mixing energy and typically improve transfer efficiency. These devices can be floating, sit on the bottom of the basin, or even be side stream and will vary based on the applicable criteria (e.g. basin depth and size, quantity of O_2 needed, need for mixing, availability of power, and many other factors).

Configuring the Right Oxygen System for your Facility

There are multiple ways to add oxygen in water treatment based on the need and the existing system design. Regardless of configuration, there is almost certainly an option that would be a fit.

Typically, oxygen can be injected directly into the aerobic basin, or in a side-stream and then pumped back into the basin.

A well-informed oxygen supplier specialist will look at each individual site situation to



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TRACK 1, SESSION #2
Working Together as the United Voice of the Compressed Air Industry

Chair: Chad Larrabee, Education Committee Chair, Compressed Air & Gas Institute

Industry Trends in Compressed Air Efficiency
Brian Freeman, Second Vice President, CAGI

How to Compare Performance Claims to Ensure the Highest Efficiency
Dave Prator, Immediate Past President, CAGI

Quick Hits to System Optimization
David Booth, System Assessment Section Member, CAGI

Are You Hiring the Right Professional to Assess Your Compressed Air System?
Wayne Perry, System Assessment Section Chair, CAGI

PURE & ENRICHED: THE ADVANTAGES OF USING OXYGEN IN WASTEWATER TREATMENT PROCESSES

design a solution that meets the unique needs of a specific plant. This will take into account oxygen demand, as well as criteria such as the water depth and existing aeration equipment.

How Does Pure Oxygen Improve Wastewater Treatment?

Using pure oxygen achieves the highest level of dissolved oxygen as compared to the traditional approach, strictly using air.

There are several potential benefits when utilizing pure oxygen to enhance the air system in secondary treatment:

- Reduction in odors
- Improved sludge settling
- Increased loading (BOD/oxygen demand)
- Reduced VOCs (volatile chemicals)
- Potential to improve ammonia treatment
- Increased flexibility in system operation (blower turndown, etc.)
- Ability to meet peak demands/high production
- Help meet permit limits (e.g., NPDES)
- Aid in emergency cases (i.e., aerator failure)
- Maintain system health (sufficient dissolved oxygen in pipelines, final dissolved oxygen)
- Permit limits can be met without substantial upgrades to the entire plant

This can be the most cost-effective process to attain goals – meeting permit limits, allowing higher production, lowering costs, and avoiding capital expenditure – year after year.

When assessing the need for pure oxygen within a wastewater treatment plant, a perfect place to start is by having a conversation with a reputable supplier who can guarantee a reliable supply of high-purity oxygen. With a steady supply and a top-notch specialist, wastewater treatment processes will be streamlined to ensure quality requirements are met, equipment is operating smoothly, and costs are in check. In the wastewater treatment field, it's important to explore and know all options, as technology can lend a hand in making a plant more efficient for years to come. BP

About the Author

Vince Hartley is a senior applications specialist in Airgas' Engineering Solutions Group.

With more than 20 years of experience, Vince supports gas applications in industrial settings with a strong focus on water treatment. For more information, please contact Vince Hartley at vince.hartley@airgas.com, tel:713-896-2382 or visit www.airgas.com

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New York City Transit Authority Reduces Energy Use with COMPRESSED AIR HEAT RECOVERY SYSTEM

By Bruce Williams, HydroThrift Corporation

When the New York City Transit Authority (NYCT) set out to comply with local regulations calling for reductions in energy usage, it leveraged new air compressors for use in transit bus maintenance and repair – and took things to another level by recovering air compressor waste heat to provide hot potable water for the bus depot. The air compressor and heat recovery system, installed in spring 2017, is on its way to helping NYCT achieve the best energy savings possible.

Local Laws Require 18% Reduction in Energy Use in Large Buildings by 2025

In 2009, New York City began to implement a series of local laws that requires building owners to reduce energy usage 18% by 2025. The local laws (84-88) focus on building upgrades in lighting, HVAC, Energy Star Appliances, and other updates to buildings. The laws cover commercial, residential, municipal and city government buildings larger than 25,000 square feet.

In addition to greatly tightening building codes for the city, the laws require the establishment of baselines for building energy usage. The city

"NYCT has capitalized on high-efficiency air compressors that not only provide the required amount of compressed air to match the need, but also deliver the added benefit of heat recovery to the bus depot's potable hot water system."

— Bruce Williams, HydroThrift Corporation

of New York decided to take a leadership role in this effort and made no exception for buildings it operates.

One building that qualifies under the laws is the Mass Transit Authority Building on 4805 Grand Ave. Maspeth, NY. At the bus depot, NYCT wanted to replace air compressors used for maintenance and repair. When tackling the project, NYCT wanted a system that would give it the best impact for energy efficiency and energy recovery so they could apply the energy reduction to the new legal requirements. It also wanted to take advantage of financial opportunities available through the new laws when procuring equipment.

NYCT retained the services of the New York Power Authority (NYPA), who then hired Wendel, an engineering construction management firm, to specify the job and oversee construction of the project. Wendel hired SRW Engineering for the detailed design. Iacono Inc. (www.iaconoinc.com), Bohemia, NY, was selected to supply the air compressors and an energy recovery system.

Air Compressors Designed for Energy Recovery

The specified system includes three Atlas Copco GA26VSD+ air compressors. The load dictated that one air compressor would likely run continually, while the second unit would be required some of the time, and the third air compressor would be used as needed and serve as a backup.

The air compressors are oil-flooded and each is equipped with a Variable Frequency Drives (VFD) to control/match capacity requirements. Wendel suggested the energy recovered from the air compressors be used to heat potable water to reduce the use of the existing oil fired boiler. As such, the machines have an added

The HydroThrift Heat Recovery System at the Mass Transit Authority Building in Maspeth, NY.

NEW YORK CITY TRANSIT

energy recovery heat exchanger that allows for heat transfer from the lubricating oil to an energy recovery fluid. Any heat not recovered is sent to an air-cooled heat exchanger on the air compressor. The heated water is used for general cleaning, restrooms, and showers. The boiler was left in place should it be needed for hot water if the demand exceeds the capabilities of the heat recovery unit.

Iacono, Inc. partnered with HydroThrift Corporation (www.hydrothrift.com) to design a heat recovery unit capable of heating the potable water from 110 ˚F to 120 ˚F, at a given flow of 20 gallons per minute (gpm) based on significant analyses and discussions. The conditions needed to represent the best compromise between the actual normal air compressor running mix and realistic performance for heat recovery.

The high temperature of 120 ˚F was chosen for personnel safety and continual heat transfer at the upper limit of the potable water temperature, plus the upper limit of the coolant temperature from the compressor, and allowing the approach for the heat exchanger. Water temperatures below normal would take all of the heat available from the air compressors. At the upper limit, the heat recovery system would control the temperature and send any unneeded heat back to the air compressors.

Once the conditions were set, the amount of heat to be transferred to the water could be calculated. The calculated heat is as follows: 20 gpm X (120 ˚F – 110 ˚F) X 500 =100,000 Btu/hr. This represents the nominal heat that would be deferred from the oil-fired boiler at the higher temperature limits. The actual amount of heat could be more if the entering temperature of the water is below 110 ˚F and/or the number of air compressors and load are higher.

AUTHORITY REDUCES ENERGY USE WITH COMPRESSED AIR HEAT RECOVERY SYSTEM

Heat Recovery System Designed for Optimal Results

Once HydroThrift knew how much heat was to be transferred to the potable water, it was able to determine how this would be accomplished with the air compressors. Using air compressor data sheets, the team knew it could recover as much as 31.1 horsepower from each air compressor at full load. The system was designed so that all of the heat could be recovered from all of the air compressors as long as the outlet potable water temperature was at or below the design maximum of 120 ˚F.

An Alfa Laval double-wall stainless steel heat exchanger was selected for the heat recovery system. The coolant flow was engineered for the best flow of 30% industrial inhibited propylene glycol and water mix with the proper temperature differential for efficient heat transfer from the air compressors. The water side was selected from the driving set of conditions at 110 ˚F in and 120 ˚F out at 20 gpm of potable water.

A double-wall heat exchanger was selected to protect the potable water from cross contamination from the PG/water coolant mix. The flow of 20 gpm of potable water was provided by the end user. The closed-loop glycol and water side of the heat exchanger pump was selected by determining the total pressure loss in the closed circuit, including the field piping, compressor heat exchangers, the heat recovery heat exchanger pressure loss, and the loss through all of the piping on the packaged skid.

The pump and control skid also included a motorized three-way valve that could regulate the flow through the heat recovery heat exchanger and bypass around it. The valve was driven by the maximum required outlet for hot potable water and set to 120 ˚F. As the hot potable achieves the 120 ˚F outlet temperature, the bypass valve dumps the excess heat back to the air compressors to be dissipated into the ambient air from the air compressor's air-cooled heat exchanger.

System Up and Running

As part of the installation process, HydroThrift traveled to the site and performed a post start-up inspection. There, the team adjusted the balancing valve to mirror the flow through the heat recovery heat exchanger.

The air compressor and heat recovery system began operating continually beginning in spring 2017. Since then, NYCT has capitalized on high-efficiency air compressors that not only provide the required amount of compressed air to match the need, but also deliver the added benefit of heat recovery to the bus depot's potable hot water system.

Given the need for NYCT to establish a baseline and begin to reduce energy at the Mass Transit Authority Building, the upgrades to the compressed air system in combination with the heat recovery system will go a long way to allowing the building to achieve the required reductions in energy usage and a reduced carbon footprint. BP

For more information, please contact Bruce Williams, Regional Sales Manager, HydroThrift Corporation, tel: 330-236-2023, email: bwilliams@hydrothrift.com, or visit www.hydrothrift.com.

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NEW AIR COMPRESSORS Aren't Always the Answer

By Paul Edwards, President, Compressed Air Consultants, Inc.

Replacing unreliable air compressors is often a smart choice. Sometimes there is a better one.

Take the case of a wallboard plant with two compressed air systems, including one for its board mill and another for its rock mill. Each had two 100 horsepower air compressors, all of which constantly overheated. When they did, plant personnel had to scramble to turn on a machine manually every time a unit shut down. Three units ran the plant so any shutdown had them walking on pins and needles.

Clearly, compressed air was a major nuisance. As such, decision-makers added two replacement compressors to this year's budget and two to next year's budget. The cost was in the $70,000 range for each year for a total compressed air investment of $140,000.

The air compressors didn't need to be replaced, the system required improvements.

However, the company decided to define the problem more precisely first before making the final investment.

Tapping into Compressed Air Expertise

The plant chose to hire independent consultants to define the problem by asking questions about the business, production processes and the compressed air system.

The complimentary interview process required minimal time and produced surprising results. The broader perspective showed the plant could reduce operating cost and avoid a significant capital outlay for air compressors – all while improving productivity. In addition, it was likely the project could be done as a ROI project.

Yet the crucial step was to gain important insights, including how the compressed air system was running, where the plant could improve demand, and how the supply could be set to react to the new realities. The cost for gathering this information was reasonable, which prompted the decision to move forward with a team of consultants and more technical work.

The plant originally ran on three air compressors. However, ongoing efforts had gotten them to the point where two air compressors could run the plant. It also became clear that no one would be blamed for issues uncovered later on given the lack of information available.

Data Collection Deep Dive Reveals Multiple Issues

Since this plant had bigger issues to address beyond its compressed air system, the system itself only received attention when it interrupted production. That meant the plant put up with a number of issues, such as glazing of the dust collector elements, which led to premature replacement. There were also minor

NEW AIR COMPRESSORS AREN'T ALWAYS THE ANSWER

Wallboard manufacturing

Two pressure gauges were off by 10 and 20 psi respectively.

pressure issues at the wet transfer station. In addition, there was concern about moisture issues that some thought to be a big problem. Others believed it to be minor one.

With multiple issues to address, the team dove deeper into the data to develop a solution for the most effective management of the compressed air system. To do so, it collected hundreds of thousands of data points on the demand side, as well as within the distribution system, and on the supply side. The team also interviewed multiple individuals to determine what processes turned on at what time. Additionally, it examined each user of compressed air and explored whether individual consumption would be equally effective, while at the same time, lowering demand for compressed air.

Addressing Challenges with Compressed Air Spikes, Piping and Moisture

Data collection showed existing average plant demand overall was 477 cfm with spikes driving the need to run the third air compressor. The team subsequently showed decision-makers how they could pull the spikes out of the system and reduce the average demand to 352 cfm, which was less than the capacity of one air compressor. The work also revealed how the wet transfer station was not the biggest compressed air user as originally thought. Instead, three other applications used more air.

An analysis of the piping system showed it to be adequate for the current loads, as well as the reduced future load. Closer examination of the wet transfer station, in the meantime, pointed to a problem with two main gauges, which were used to determine whether there was a problem in the system or not. The gauges were off by 10 and 20 psig, respectively. In addition, the piping was a bit convoluted, yet the downstream gauge read the higher pressure.

To tackle the moisture problem, the team took measurements of the two air compressor rooms to determine how the machines were operating. Data showed there were multiple root causes, including heat exchanger performance issues, a potentially incorrectly sized compressed air dryer, maintenance issues, and excessive room temperatures. They even discovered drainage issues, which led to two tanks filling up partially with water. Given the complexities, it was impossible for dry compressed air to be delivered to the plant.

Another issue involved the control method for the air compressors, which are known brands that had performed reliably. The standard control method made it difficult to know what an individual machine was doing. It also limited the ability to effectively coordinate how each unit responded. As a result, more air compressors were often running than required and once a compressor was on, it had to be manually turned off.

Final Analysis Shows Major Savings Potential

Looking at this 400 hp system from a wider perspective showed the plant could reduce its operating costs on the system by 50%.

Approaching the compressed air system improvements through precise analyses – rather than replacing air compressors – demonstrated the ability to save $159,000 over a two-year period, including $50,000 per-year in reduced operating costs.

The 19-month payback for the project also justified the addition of a new air compressor to the project, assuming the desire to meet the internal return requirement. In addition, the project stood to significantly improve air quality resulting in longer life of production equipment and baghouse elements.

Investing in new air compressors may sometimes be the best economic approach, but more often than not, the supply side investment can be reduced substantially or eliminated. BP

For more information, contact Paul Edwards, tel: (704) 376-2600, email: paul.edwards@loweraircost.com, or visit www.loweraircost.com

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From Wastewater Agitation to Air Compressor Controls – Food Processor Finds 74% SAVINGS POTENTIAL

By Ron Marshall, Marshall Compressed Air Consulting

As many well know, system measurement is essential to ensuring a compressed air system is running efficiently and effectively, with good air quality and adequate pressure. This is also well understood by a multi-national food company (name has been withheld to protect the innocent) who started a focused effort to measure and improve their compressed air systems in their many processing plants worldwide.

Typically the savings potential in studying compressed air systems falls in the 10 to 30 percent range, but every once and a while some higher percentage potential savings are seen on systems that are extremely inefficient due to unique problems. This article focuses on one such system audit, initiated as a result of this worldwide effort, that had very poor efficiency due to compressor control problems, lack of storage and high leakage waste.

TABLE 1: OPERATING PROFILE LOOKED SUSPECT BASED ON PERCENT LOAD

	BEFORE			AFTER		DIFFERENCE		
	LOAD	RUN	% LOADED	LOAD	RUN	LOAD	RUN	% LOADED
C1	31477	89599	0.35	31481	89886	4	287	0.01
C2	25738	74124	0.35	25907	74439	169	315	0.54

> "Typically the savings potential in studying compressed air systems falls in the 10 to 30 percent range, but every once and a while some higher percentage potential savings are seen on systems that are extremely inefficient due to unique problems."
>
> — Ron Marshall, Marshall Compressed Air Consulting

Background

The facility studied was a small food processing and packaging plant. The air compressor capacity consists of two 25 hp air-cooled lubricated screw compressors with dedicated refrigerated air dryers. Storage capacity was 80 gallons in the compressor room, with 80 gallons located at the far end of the system in the plant (ineffectively installed with small tubing connection). A system of eight oversized parallel filters acts to remove the compressor lubricant from the compressed air before it enters the plant.

Initial observation was that the system was intended to have one main compressor and one fully redundant back-up, however, it

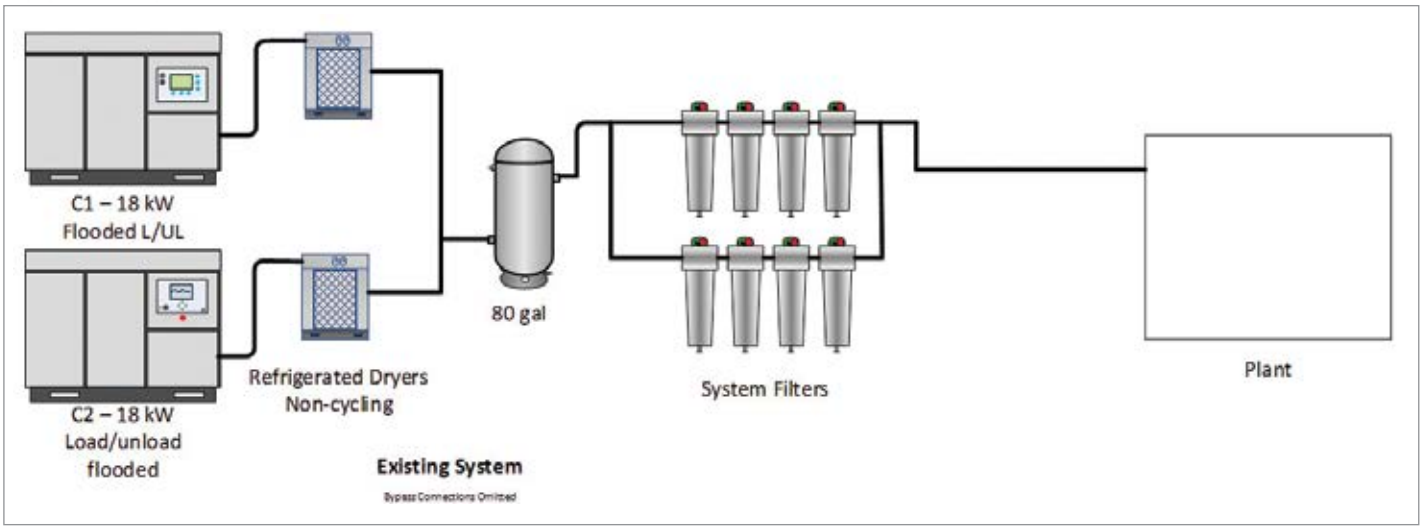

Figure 1: System configuration set up with one main and one standby intended.

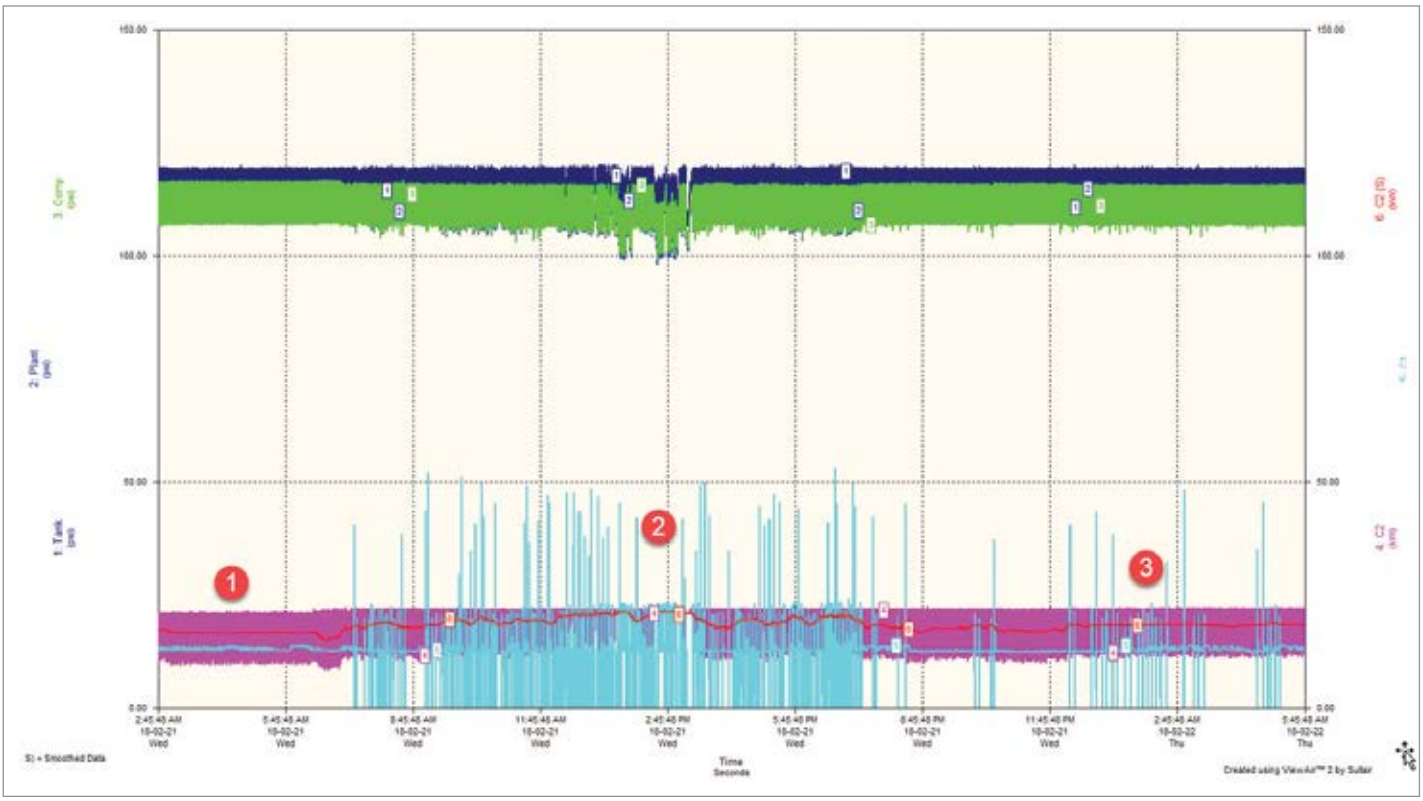

Figure 2: Typical daily profile shows problems with compressor control

FROM WASTEWATER AGITATION TO AIR COMPRESSOR CONTROLS – FOOD PROCESSOR FINDS 74% SAVINGS POTENTIAL

appeared that both compressors were running the majority of the time. The following table shows the operating hours of both units, both at the time of initial site inspection and two weeks later as shown in Table 1.

Both the lifetime operating hours, and the hour differential between the two observations, showed that the compressors were spending significant hours running unloaded, in particular unit 1 with only 1 percent loaded hours. These readings suggested there could be significant wasted unloaded power consumption, so further work was done to measure a baseline.

Measuring instruments were installed to measure pressure at the compressor discharge, after the filters and dryers, and in the plant production area. Power meters were installed on each compressor. Air dryers were measured with a hand held power meter and it was found they had a constant load, showing they were non-cycling units, consuming power even when the associated air compressor was off.

Figure 2 shows a typical daily operating profile captured by the data loggers. At point 1 we can see that during nighttime non-production hours both compressors are running constantly with only one loaded. Point 2 shows, during production hours, the loading on the main compressor reaches near 100 percent at times, with the second compressor starting and stopping, never staying loaded for more than a few seconds. Closer analysis of the standby compressor duty (Figure 3) shows that the second compressor loads only for very brief periods during this time span, and that the compressors are fighting for control within this period, this shows poor pressure settings coordination and reveals the problems brought on by lack of adequate control storage receiver volume.

The data also showed that the unloaded power consumption of the compressors was much higher than the rated 25 percent, with actual consumption at 54% and 42% respectively for the two units. This meant that the wasteful unloaded hours consumed quite bit of extra power.

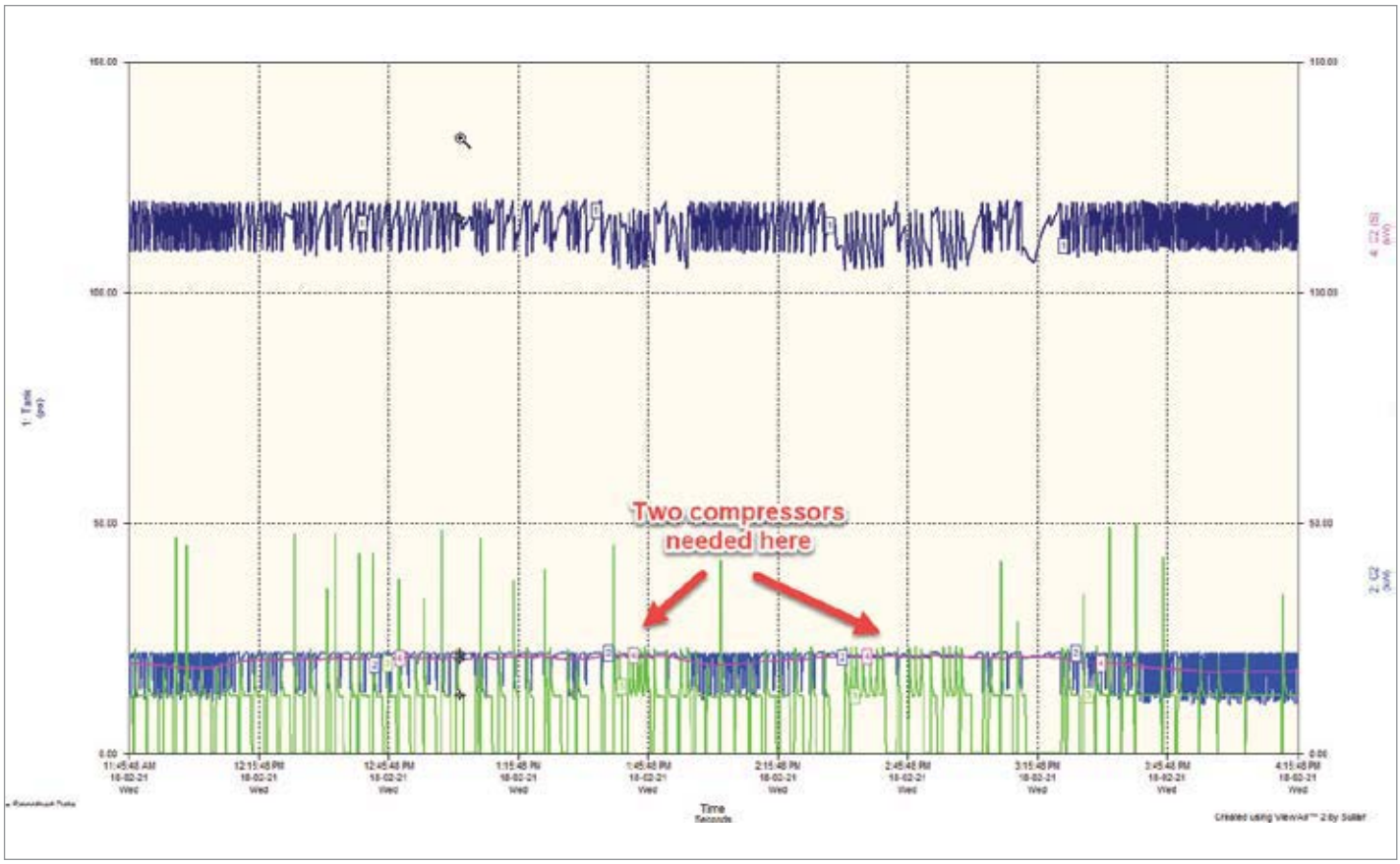

Figure 3: Compressor profile during production shift showed the compressors fighting for control

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TRACK 2, SESSION #1
Best Practices for Compressed Air Leak Management

Managing Compressed Air Leakage
Chair: Brad Taylor, Sales Manager, Fluid-Aire Dynamics

Tabulating Costs Associated with Compressed Air Leaks; Selling to Management
Ron Marshall, Chief Auditor, Marshall Compressed Air Consulting

Compressed Air Leak Repair Process
Mike Simms, Corporate Energy Engineer Lead, General Mills

Ultrasound Technology for Compressed Air Leak Detection
Dean Wolever, Great Lakes Regional Manager, UE Systems

FROM WASTEWATER AGITATION TO AIR COMPRESSOR CONTROLS – FOOD PROCESSOR FINDS 74% SAVINGS POTENTIAL

The data showed that the peak production demand was slightly more than one compressor could handle, requiring a second compressor to maintain pressure. This was at odds with the desire to have 100% redundant back-up capacity.

The system was found to have the baseline readings as shown in Table 2.

As can be seen, the specific power of unit 1 was an eye popping 571 kW/100 cfm, extremely poor compared to an optimum value of about 22 kW/100 cfm for an efficiently running compressor.

The general assessment of the system was that there was poor efficiency in the production of compressed air due to the lag compressor (C1) running unloaded most of the time. This unloaded run time was caused by a lack of storage receiver capacity in the compressor room, causing an internal control algorithm to keep the lag compressor running unnecessarily. The compressors run in load/unload mode which limits the efficiency of the compressors at lighter loads compared to more efficient VSD or start/stop operation.

TABLE 2: BASELINE READINGS

	HOURS	FLOW	SP POWER	AVE KW	KWH	COST
Peak				35.6		$1,934
C1	8760	2.1	571.4	12.0	105120	$13,666
C2	8760	58.9	28.4	16.7	146292	$19,018
Dryer	8760			1.3	11738	$1,526
Total		61		30.0	263150	$36,144

Lack of Storage Affects Efficiency

The existing compressors have only 160 gallons of storage receiver capacity with which to work. Only 80 gallons of capacity is located in the compressor room, on the dry side of the air dryers. This deficit causes the compressors to cycle at a high frequency, about one cycle every 40 seconds. The effectiveness of this receiver capacity is limited by a 4 psi pressure differential across the air dryers and about 2 psi pressure differential across the system filters. This means the compressors are

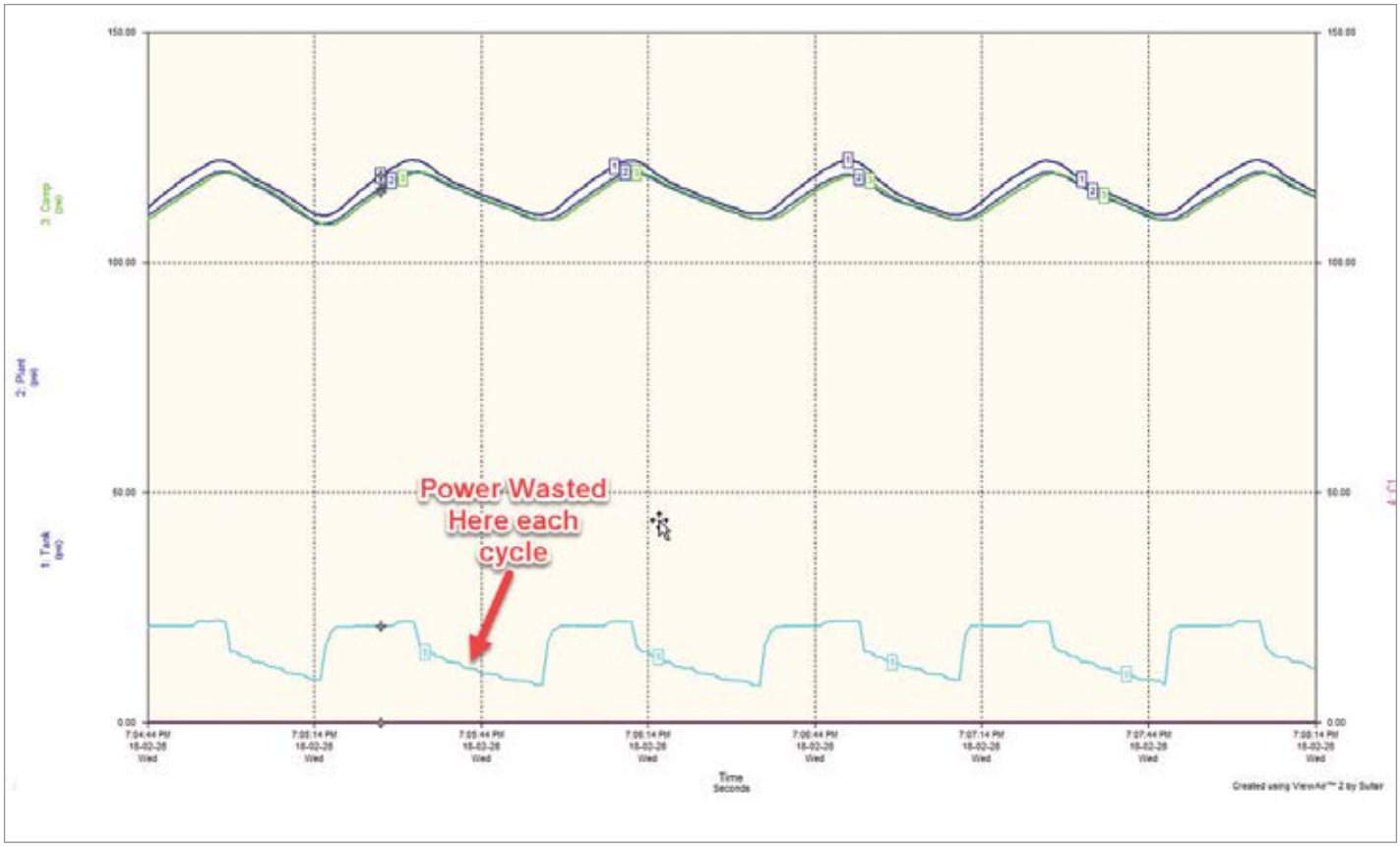

Figure 4: Compressor power profile shows slow unloading periods

operating "as if" only 120 gallons are attached to the unit. Typical recommended effective storage volumes for compressors with 105 cfm output would be between 500 and 1,000 gallons, this would give compressor cycle times of about 240 seconds (4 minutes), which would reduce the compressor power consumption substantially and better stabilize pressure during peak demands.

This lack of storage capacity also causes another problem with the rotary screw air compressors due to an internal algorithm that tracks the slope of the pressure decay during the compressor cycles. If the decay is fast, the compressor control will start the compressor in anticipation that it will be needed by the time the pressure reaches the unload pressure setting. Reduced storage capacity allows a fast slope even in normal load/unload operation, tricking the compressor into starting, even though a second running compressor is not necessary. For this reason compressor 1 runs most of the time unloaded (93 percent of the time through the measurement period, only 2 percent loaded). And since C1 has higher than normal unloaded power consumption (54% of full load) the unloaded run time wastes considerable power. If substantial storage is added, and the compressor pressure bands coordinated, an excellent saving could be gained using the existing compressors (with adjusted unload kW). This measure will reduce the operating hours of the second compressor to almost zero, saving maintenance costs.

Figure 4 shows the power profile of C2 when it is operating alone (C1 turned off). As can be seen, when the compressor unloads it takes a significant amount of time for the power to fall to a minimum level. The more cycles per minute, the more power waste. Adding storage, and setting the system up so the second compressor will not normally run, will save power.

Leakage Testing

Leakage testing with an ultrasonic detector was done and 20 significant leaks were identified consuming about 38 cfm. Based on the compressor duty cycles, the leakage calculates to about 62 percent of average compressed air production. The majority of the leakage locations were found to be on push lock fittings on pneumatic tubing connections and on leaky filter drains.

Based on the observations it appears about 20 cfm or so of the leaks could easily be repaired.. Reducing the leakage would bring peak plant flow down to within the capacity of one compressor, giving redundant back-up. This plant had no leakage repair program and no way to easily measure leakage. The auditor has recommended installing an inexpensive thermal mass flow meter for use in determining non-productive load. It is recommended the plant choose a maximum allowable leakage rate, with leakage detection and repair initiated any time the leaks exceed the desired level.

Inappropriate End Uses

While doing the leakage survey some potentially inappropriate end uses were found:

FROM WASTEWATER AGITATION TO AIR COMPRESSOR CONTROLS – FOOD PROCESSOR FINDS 74% SAVINGS POTENTIAL

Figure 5: Air agitation of a sewage treatment vessel is a potentially inappropriate end use.

Figure 6: The lack of continuous ducting (left) allows hot air to spill into the cooling intake of both the compressors (thermograph right) and dryers causing overheating. This becomes obvious when looked at with a thermal camera.

- Compressed air was being used to provide a slight positive pressure of about 20 psi on a seal in a production machine.
- Large compressed air operated diaphragm pumps had been installed in a sewage treatment area. These pumps had the capacity to consume 60 percent of the capacity of one 25 hp compressor when they run (normally off).
- Air agitation was installed to help mix sewage sludge in a vessel. Each of these agitation nozzles, if allowed to operate at full flow, has the potential to consume most of the output of one compressor.

Compressor Cooling Issues

During site observations thermal readings were taken in the compressor room. These readings were done during times when the ambient cooling air was near 70 degrees F, yet the compressed air produced by the compressors was at or near 100 F, even at light loading. The cooling air was being heated by incomplete ducting above each compressor. Hot air spilled out of a gap in the ducting and was sucked in the cooling air intake of both the compressors

"Based on the various options the potential savings for this project, depending on the items chosen, would save between 37% and 74%. The potential financial savings gained could be up to $27,000 per year in reduced power costs."

— Ron Marshall, Marshall Compressed Air Consulting

and dryers, causing excessively hot discharge air. This air heavily loaded the air dryers causing higher than desired compressed air dew point. It should be noted that both compressors had internal air dryers, but these had failed in the past, perhaps due to excessive cooling air temperatures.

Recommended Efficiency Measures

Based on the compressor profile a projected base case was calculated for various efficiency options. This is done by using compressor CAGI data. Four optional compressor types are summarized below:

1. Use the existing compressors, add storage capacity, repair unloading circuitry, estimated savings 37%,
2. Install new VSD compressor and some smaller additional storage, savings 54%
3. Install VSD oil free compressor and some smaller storage, savings 41%,
4. Install water lubricated compressor and small storage. Savings 54%.

Some additional recommendations would save more power:

- Reduce the compressor discharge pressure to an average of 100 psi, about 2 percent savings,
- Modify compressor ventilation, gaining improved reliability and air quality,
- Install airless drains instead of timer drains, about 1% savings,
- Repair 20 cfm in leakage, about 10 percent savings,
- Install cycling dryers so the dryer consumes minimum power when the associated compressor is off, about 4 percent savings.

Based on the various options the potential savings for this project, depending on the items chosen, would save between 37% and 74%. The potential financial savings gained could be up to $27,000 per year in reduced power costs.

Part of the costs for this study were funding by the local power utility. Further to this, the utility is prepared to fund the project as high as $19,000 to pay for new equipment.

Conclusion

The results of this study show that this system was extremely inefficient and that there were high levels of waste. The plant personnel had no idea that their system was running so poorly until someone measured it. It should be noted that a sharp eyed service technician could have noticed the system was running poorly simply by calculating the loaded versus run time ratio when they did the regular maintenance on the units. Unfortunately, these service technicians were not sharped eyed and simply did their normal maintenance on a compressor that was running unnecessarily without consideration of the cost to the customer.

The plant is currently considering their options for system upgrade, starting with leakage reduction. Time will tell if they will be able to get their compressors under control. BP

For more information contact Ron Marshall, Marshall Compressed Air Consulting, tel: 204-806-2085, email: ronm@mts.net

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Missed Demand-Side Opportunities Part 6

LOOK TO AODD PUMPS TO LOWER COMPRESSED AIR DEMAND

By Hank van Ormer, Contributing Editor

Air Operated Double Diaphragm (AODD) Pumps are popular and versatile. Often, they also offer an excellent opportunity to lower the demand for compressed air, especially given the latest advances in controls and the energy savings to be realized.

A Good All-around Pump

It's not unusual for an operation to have AODD pumps already in place because they there's a good chance they arrived at the plant from an equipment supplier as part of the package, or someone selected them in the past. Regardless of how they got to the plant, there are number of reasons why they're widely used in a variety of industries.

For one, they work well as long as they are "big enough." They also have many desirable operating characteristics compared to some other types of pumps. Specifically, they:

- Can be designed to handle aggressive chemical or physical product throughput.
- Are relatively insensitive to running empty without catastrophic failure.
- Can often be quickly fixed or repaired.
- Automatically adjust to significant head pressure increases as long as the pressure is available and the stroke/min throughput is acceptable.

> "Over the years of auditing AODD industrial applications we have found effective compressed air reduction opportunities in 80 – 85% of operations."
>
> — Hank van Ormer, Contributing Editor

In summary, this is a very "forgiving design." Yet the management of compressed air use calls for monitoring and controlling AODD pumps.

Typical Compressed Air Operated and Electric Pump Data

Table 1 shows a generic 2 inch AODD pump using 90 to 120 scfm with an average 95 psig inlet pressure. However, the only accurate way to identify compressed air use other than a flow meter is to count the cycles.

If an AODD pump is left uncontrolled several things will occur. Most performance curves are based on a fluid with a specific gravity of 1 (H_2O).

- As the fluid increases in viscosity and the head pressure rises the strokes per minute (compressed air used) will fall at the same inlet pressure. If the viscosity is reduced the compressed air use will increase.
- As the strokes per minute increase from 48 str/min to 325 str/min the compressed air use goes from 25 cfm @ (5hp) to 150 cfm @ (35hp) and the throughput from 20 gpm to 140 gpm.
- It is very important to apply the pump at the lowest acceptable str/ min the lowest effective inlet pressure, monitoring these parameters will help to optimize the air demand.

AODD Pump Control is Paramount

While all compressed air-operated equipment should be controlled, it is especially important with AODD pumps.

AODD pumps are reciprocating, positive displacement pumps. The area in which the pumping media is contained consists of an inlet and discharge manifold and two liquid chambers. An air valve alternately directs compressed air behind the diaphragms in the air chambers. Fluid to be pumped is drawn into one liquid chamber from the inlet manifold as a similar fluid is expelled from the other liquid chamber through the discharge manifold during this cycle.

There are a number of advantages to AODD pumps. They do not require electricity, are self-priming, can pump fluids with solids in suspension, and can run dry or be dead-headed without damaging the pump. In addition, they can transfer a wide range of media from wastewater to more vicious substances such as slurries or even cement. However, automatically controlling compressed air use has been a challenge.

Leveraging Inlet Pressure Control

One method of gaining control over compressed air use is by controlling AODD pump inlet pressure. Is the pump running most of the time at the lowest possible pressure? The higher the pressure, the more compressed air is used. Setting a fixed pressure is often somewhat limited in success as conditions may change in product viscosity, or short-term needs for higher pressure, etc., which may require constant adjustment.

Cycle (stroke/min) control is potentially the most effective optimizer available. It controls the cycle to the lowest and proper speed to assure a full transport line of product, while using the least amount of compressed air.

Over the years this has been tested with the use of backpressure regulators, manual controls, etc. One of the basic drawbacks of the method, however, has always been pump efficiency. As the cycles are cut back, it tends to reduce pump efficiency and when conditions change the inefficiency may get worse.

To address the issue, some manufacturers developed modifications to the air distribution system inside the pump. This allows operators to optimize performance at the available pressure by adjusting the inlet passage size until the throughput flow is acceptable. The solution has shown to be effective when feasible.

Consider Electric-Driven Pumps to Achieve Savings

There are good reasons why some choose air-driven AODD pumps, one of which is overall simplicity. Another is because there is no need to run electric power to any given pump. Still another is their ability to withstand a dirty, hostile environment. Yet don't overlook electric-motor-driven pumps, including diaphragm types, to achieve potential compressed-air savings now or in the future.

TABLE 1: TYPICAL COMPRESSED AIR OPERATED AND ELECTRIC PUMP DATA

NOMINAL PUMP SIZE	AIR PRESSURE RANGE	NOMINAL SCFM	ESTIMATED ELECTRIC PUMP HP	TYPICAL DISPLACEMENT GAL/ CYCLE
<1/2"	65 – 100 psig (average 80 psig)	15-20	¾hp – 1hp	.08
1"	65 – 100 psig (average 80 psig)	25-30	3/4 – 1hp	.09
1 ½ "	70 – 100 psig (average 80 psig)	45-58	1 ½hp - 2 ½hp	.34
2"	80 – 100 psig (average 95 psig)	90-120	3hp – 5hp	.43
3"	90 – 100 psig (average 100 psig)	125-150	5hp – 7hp	1.25

MISSED DEMAND-SIDE OPPORTUNITIES PART 6

As shown in the earlier chart, a 2 inch AODD pump will use an average of 90-120 cfm of compressed air at 95psig or 23 hp to 30 hp of compressed air supply. An electric-driven pump under the same conditions would draw between 3 hp and 5 hp. If the net horsepower savings here is an average of 21 hp, it translates to a savings of $7,920 per year (x.746/.10 = 16.5kw x $.06kwh x 8000 hr/y) when an electric-driven pump is used for power rather than compressed air under these conditions.

A word of caution, however: As the head pressure increases the input energy required for the electric-driven pump increases. The stroke/min of the compressed-air driven pump will fall at higher pressure decreasing as long as the available compressed air pressure in the plant is "high enough."

To manage this, conduct product evaluations with good data input. Under head conditions and acceptable stroke/min, the compressed-air driven pump may actually be more cost effective.

Batch Pumping Versus Continuous Pumping

Does the pump run continuously because it can? Yes, that's the advantage of an AODD pump. It can run on empty and continue to operate and pump product as it is received. However, as the load falls off, the stroke/min goes up and thus the "highest air use" is at no load. This is often overlooked.

Figure 3 below compares a typical batch pumping system's annual electrical energy operating cost to that of a continuous

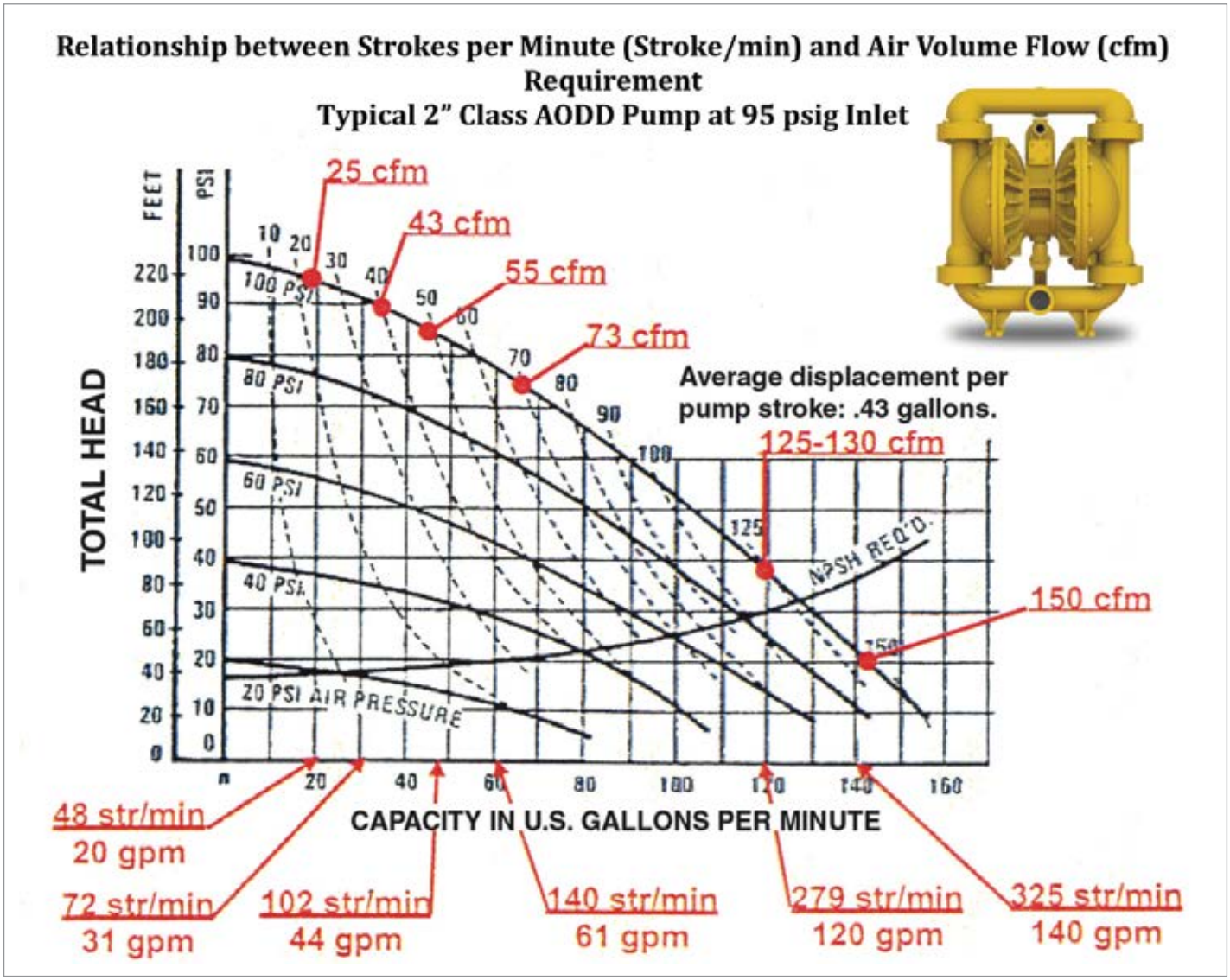

Figure 1

pumping system. The projected savings is a very conservative one.

The annual batch operation cost is driven by:

- The batch pump always running at full load (lowest possible compressed air demand without controls).
- Running the batch pump only 10% of the time as shown here from an actual plant compressed air system evaluation. The level switch trips and shuts off the compressed air supply to the pump when it is not needed.

Using a 2 inch AODD pump continuously running with an average demand of 80 scfm and the batch also at 80 scfm shows a cost of about $8,000/ year without the batch control and $800/ year with the batch control. This is calculated an annual electrical energy cost of $0.06 kWh at 8000 hours per year.

Controlling the batch pump operation will always yield savings if it can be implemented. Before assuming there is no budget to modify the system, be sure to know the true cost in recoverable energy cost.

Using Microprocessors to Control Efficiency

It is most important is to realize that in any air operated pump operation, monitoring and control of the inlet pressure and cycles is critical to compressed air use management. In all, 80 – 85% of the AODD pumps found in our compressed air system audits are uncontrolled.

Recently, there have been various microprocessor-based, AODD cycle/stroke control systems introduced which have proven to be very effective. Most utilize a special high-volume, high-speed (35 milliseconds to open / 35 milliseconds to close) air-piloted dispensing valve.

This dispensing valve is controlled by a microprocessor, which analyzes the stroke frequency and throughput flow characteristics to determine the proper and lowest cycle rate to optimize the throughput. Once established it then shuts off the air supply during the stroke and allows product flow and pump inertia to complete the stroke without any additional airflow, it then opens again.

The result is a full flowing line of product without air pockets or voids. The stroke is stopped at the proper point and the pump does not contact the housing as an

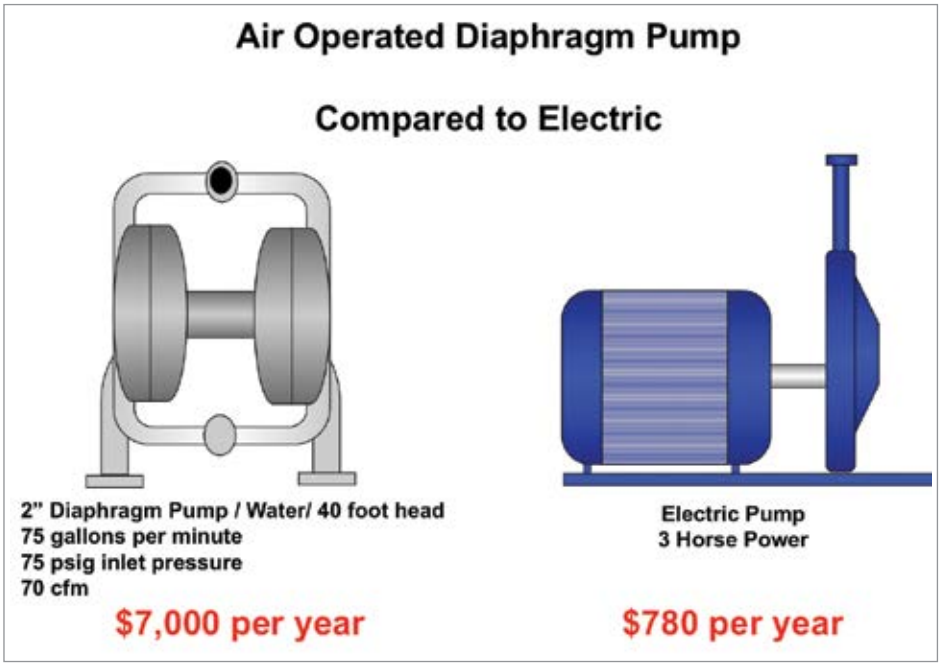

Figure 2

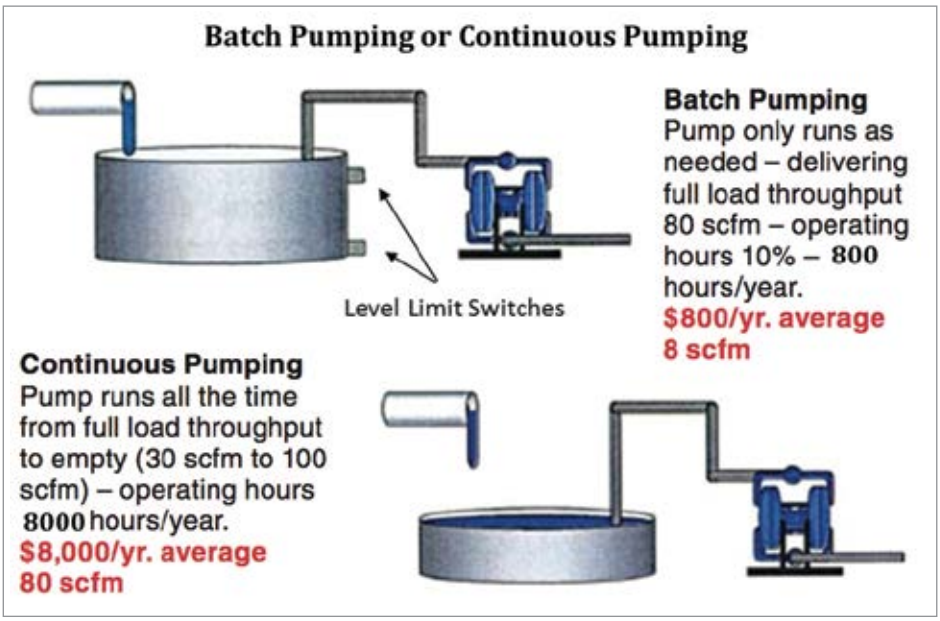

Figure 3

MISSED DEMAND-SIDE OPPORTUNITIES PART 6

TABLE 2: TABULATED TEST DATA WITH MICROPROCESSOR CYCLE/ STROKE CONTROL

INLET PRESSURE PSI	DISCHARGE PRESSURE PSI	PRODUCT AVERAGE FLOW RATE	AIR USAGE IN SCFM	STROKE RATE	PRODUCT CAPACITY PER STROKE	PRODUCT AVERAGE FLOW PER SCFM	% SCFM SAVINGS	$ FLOW RATE CHANGE
Control OFF								
100	0	240	160	249	0.92	1.58		
100	25	196	149	177	1.14	1.30		
100	50	150	132	135	1.12	1.14		
Control ON								
100	0	259	80	218	1.21	3.26	50%	8.1%
100	25	180	85	155	1.16	2.11	43%	-8.2%
100	50	140	84	124	1.15	1.69	36%	-5.4%

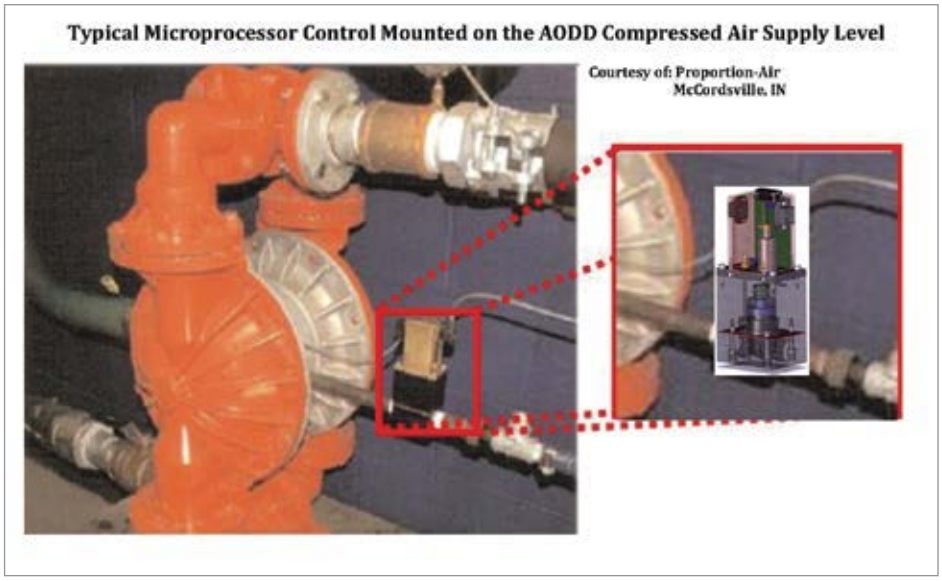

Figure 4

uncontrolled unit will. This results in longer pump life and lower maintenance costs.

If there is a change in product viscosity the microprocessor will operate several cycles and then readjust itself. It can also be equipped with auto air shutoff when no product is present.

As shown in Table 2, several key points are evident:

- At the same input pressure, the compressed air use, stroke, and cycle rate fall 35 – 40% with the control engaged.
- Product throughput per stroke increases the average product flow per scfm significantly (from about 50 – 100%).

These microprocessor controls have successfully eliminated the compressed air inlet control and pump inefficiency problem of the past by utilizing modern electronics. They should be evaluated on most applications from 1 ½" class AODD pumps and up, and other conditions that may show an opportunity.

Some are available only as part of the pump assembly and others, such as shown in figure 4, can be mounted on the inlet line to the AODD pump if applicable with the appropriate electric supply.

Summary

Over the years of auditing AODD industrial applications we have found effective compressed air reduction opportunities in 80 – 85% of operations. Many of these are just common sense – don't pump product any faster than you need to for productivity; don't over pressure the inlet; and don't run the pump empty; etc.

However, the availability of microprocessors to create a very responsive control while maintaining effective pump efficiencies has opened up even more opportunities to lower the compressed air use and operating energy costs. They may not be economical for every size, type, and application – but perhaps should often be considered and evaluated.

We hope you've found this interesting and look forward to your comments! Contact Hank van Ormer, email: hankvanormer@aol.com, tel: 614.580.2711

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Missed Demand-Side Opportunities Part 1 – Flow Restrictions from Pipe Headers

Missed Demand-Side Opportunities Part 2 – Integrating Multiple Air Compressor Controls

Missed Demand-Side Opportunities Part 3 – Controlling Open Blowing with Compressed Air

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Lowering Average Plant Pressure to 80 psi
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The Nuts and Bolts of Lowering Plant Pressure
Chris Gordon, President & CEO, Blackhawk Equipment

Lowering Pressure: Demand-Side Solutions
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Kaeser Announces New SmartPipeXL™ Piping Sizes to 8"

Kaeser Compressors, Inc. announced SmartPipeXL™ with piping sizes from 3" to 8". SmartPipeXL is a versatile, modular aluminum piping system featuring lightweight materials and simple, compression style connections.

With the recent release of SmartPipe+ in five sizes between 3/4" and 2-1/2", SmartPipeXL offers options 3", 4", 6", and 8" pipes. These are ideal for headers and branch lines, and coupled with the SmartPipe+ can provide a complete piping network all the way down to the point of use.

SmartPipeXL is made from smooth, calibrated aluminum and will not rust. It has a low coefficient of friction and provides the best possible laminar flow. The full bore fittings minimize pressure drop while the leak-free connectors prevent costly compressed air loss. SmartPipeXL can easily be integrated into existing steel, copper, or aluminum systems and can be modified to accommodate changing needs. SmartPipeXL also comes with a 10-year warranty.

Kaeser's New SmartPipeXL™ is Now Available in Sizes from 3" to 8"

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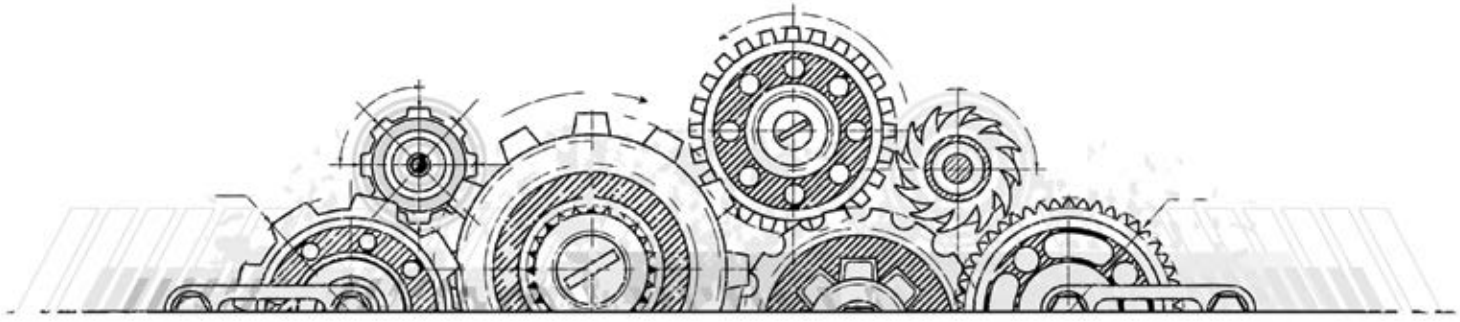
New ASCO Numatics™ Series 653 Air Preparation Products

Emerson announces the introduction of its ASCO Numatics Series 653 air preparation products. Available in ½-inch, ¾-inch and 1-inch port sizes, the Series 653 has a high flow rate for its size. This enables customers to power more products from the same Filter-Regulator or Lubricator (FRL), or reduce pressure drop across the system, both of which enable potential energy and cost savings. The range of the Series 651, 652, and 653 products consists of filters, regulators, filter regulators, lubricators, soft starts, quick exhausts, diverter blocks and shut off valves.

"The introduction of our Series 653 products greatly expands our global offering of high-flow air preparation products," said Scott Weickel, Vice President of Engineering for Machine Automation applications at Emerson. "The addition of the new port sizes enables international manufacturers to select a comprehensive range of advanced technology air preparation products, in sizes ranging from 1/8-inch to 1-inch, all from one supplier. This makes selection and purchasing simpler."



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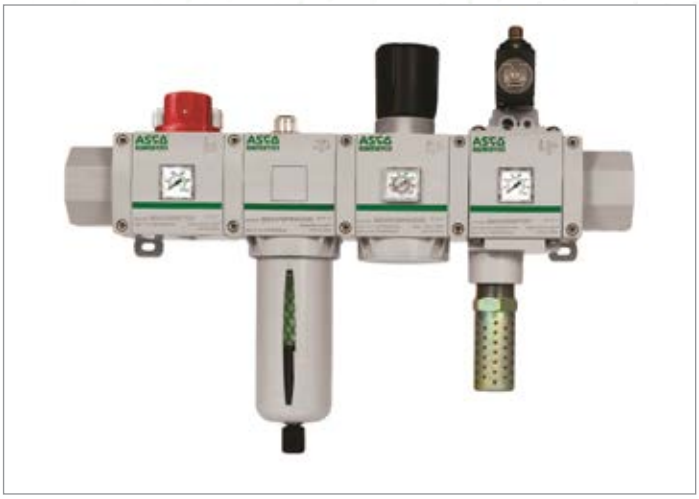

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The Series 651, 652, and 653 products incorporate front-facing easy-to-read, low-profile gauges. Optional integral red/green pressure range indicators make it easy to monitor the desired pressure. The small footprint and clean lines help achieve robust, modern-looking equipment. Long-lasting laser-etched tags and covers ensure product information will remain visible even in challenging - environments. In addition, an optional 3-micron pleated pre-filter has been added to the line's coalescing filters and coalescing filter/regulator combination units. This eliminates the need for a separate particulate filter unit and reduces cost, size, and weight.

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Broadband Ultrasonic Analysis for Compressed Air Leak Detection

Ultrasonic testing devices have long been established in the field of predictive maintenance to detect leaks on compressed air systems. These devices usually record a frequency range around 40 kHz. SONOTEC Ultraschallsensorik Halle GmbH is breaking new ground with the SONAPHONE ultrasonic testing device. The main difference between this device and the previously available devices is the broadband technology of the sensors in a frequency range from 20 to 100 kHz. This makes applications like automatic leak analysis more reliable.

Leak detection on industrial supply systems for compressed air and industrial gases for the purpose of energy saving and plant safety is by far the most common application of ultrasonic technology. This is because compressed air is one of the most expensive energy sources and is responsible for 10% of industrial energy costs. It is estimated that around 30% of this expensive energy is lost simply due to leaks in compressed air systems. This makes detecting and eliminating leaks worthwhile as part of a plant wide energy management program.

A significant advantage that the broadband range technology offers is evident even when searching for a leak. Earlier ultrasonic detectors use piezoceramic probes, which are resonant in a very small frequency range around 40 kHz. Because leaks emit broadband ultrasound, it is possible to find them with a 40 kHz detector. However, the 40 kHz probes can also pick up a great deal of interfering ultrasonic signals. New broadband sensors with very sensitive ultrasonic microphones and high sampling rates improve and simplify leak detection for the user. In challenging, loud environments, the spectrogram of the display on

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the SONAPHONE immediately informs the user if there is an interfering ultrasound and at what frequency the interference is present. Using the touchscreen, the user can simply move the frequency that they want to hear out of the range of the interfering ultrasound signals, enabling them to accurately detect leaks in these challenging environments.

Leaks are broadband phenomena as the LeakExpert app on the SONAPHONE easily demonstrates

After the leak has been detected, the broadband sensors offer another advantage. They enable the leak not only to be found, but also to be automatically analyzed. To correctly evaluate the leak, the user enters the system pressure and the type of gas into the device and runs the LeakExpert analysis application. With just the touch of a button, the service engineer initiates the measurement and automatic analysis of the leak, and the loss in volume per minute is displayed to them immediately. Additionally, the device will rank the leak in a class from 1 to 5 (1 = small leak, minor loss [green]; 5 = large leak, very high loss [red]). This evaluation process is based on a procedure patented by Sonotec.

The extensive documentation support embedded in the new SONAPHONE is another advantage. Upon completion of the measurements, a full report including photos can be generated and exported by the user.

Conclusion

With the new SONAPHONE and the LeakExpert app, leaks on compressed air and vacuum systems and other industrial gas lines can be detected and automatically analyzed with pinpoint accuracy. The multifunctional device with touchscreen processes the ultrasound

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signals directly. A report can be generated quickly and easily and used as a decision-making tool for follow-up actions and as proof of success for your energy management program. With a single click, the documentation of the results is available for management, with comprehensive information about the precise location of the leak, the energy loss, a photographic record and the priority level of the repair. By standardizing the process to search for and evaluate leaks, the device contributes to significant time and cost savings in maintenance. Error-prone paper records are a thing of the past, since all data can be evaluated and updated directly in the device.

About SONOTEC

Founded in 1991, nowadays SONOTEC GmbH is a leading specialist in ultrasonic measurement technology solutions. With more than 150 employees, the technology company based in Halle (Saale) in the heart of Germany develops and manufactures customer-specific ultrasonic transducers and sensors as well as testing equipment and measuring technology solutions for a wide variety of industries. These range from medical technology and the chemical and pharmaceutical industries to engineering and plant construction and non-destructive testing.

For more information, visit https://www.sonotec.eu/products/preventive-maintenance

A typical leak on a compressed air filter unit is simple to analyze. The color-coded spectrogram, which shows the frequency (Y-axis) over the time (X-axis), shows a high amplitude (red color) in a range of 20 to 90 kHz.

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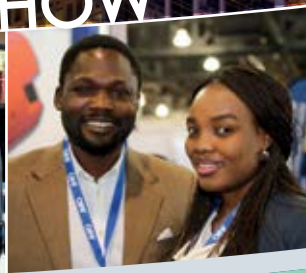

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JOBS & TECHNOLOGY

COMPRESSORENERGY SERVICES, LLC
Vendor Neutral, Energy Biased

Join the "A" Team

CES is an innovative and high growth energy services company based out of southern NH. We have several positions open and are looking for professionals in the industry to join our team. CES is a vendor neutral firm specializing in the implementation of comprehensive supply and demand side measures. Looking for driven individuals motivated to expand their knowledge in the field and assist industrial customers to optimize their compressed air systems. Learn more at our website.

Energy Efficiency Specialist **Project Engineer** **Sales Engineer**

Great Benefits ▪ Excellent Growth and Advancement Opportunities
Work/Life Balance ▪ Relocation Packages ▪ Signing Bonuses

Contact: Janice Woodbury jwoodbury@compressorenergy.com
www.compressorenergy.com

Accurate Air Engineering, Inc.
"Your Compressed Air Specialist"

COMPRESSED AIR SALES SPECIALIST – SOUTHERN CALIFORNIA

Accurate Air Engineering is a premiere Gardner Denver distributor specializing in compressor, blower and vacuum solutions, as well as, designing and building custom compressed air / vacuum packages. We have 4 offices located in California and we currently have two open sales positions: Southern California and San Diego areas. The focus is to grow the business by calling on end users, engineering firms, contractors, and inbound leads. Experience in the compressed air industry is preferred. We offer a comprehensive benefit package. Compensation and relocation negotiable. If you like working in a fun, winning, supportive environment, call Rick Sawaya (Director of Sales) at 714-904-4172 or send your cover letter and resume to rsawaya@accurateair.com.

KOBELCO KNW SERIES
ROGERS MACHINERY CO., Inc.

MIDWEST REGIONAL SALES MANAGER

Rogers Machinery Company, a leading supplier of oil-free air compressors, is seeking a Regional Sales Manager for the Great Lakes and Upper Midwest territory. The candidate may reside anywhere within the territory.

Candidate needs to be self-driven and travel in territory; with 3+ years experience in the compressed air industry. A bachelor's degree is preferred. Salary + commission + profit sharing, as well as medical, dental and vacation/sick leave. The focus is to assist distributors in growing their business as well as develop sales through engineering firms, contractors and direct sales to end users.

To learn more about us, visit www.knw-series.com and send resume w/cover letter to Beth.Wineland@rogers-machinery.com.

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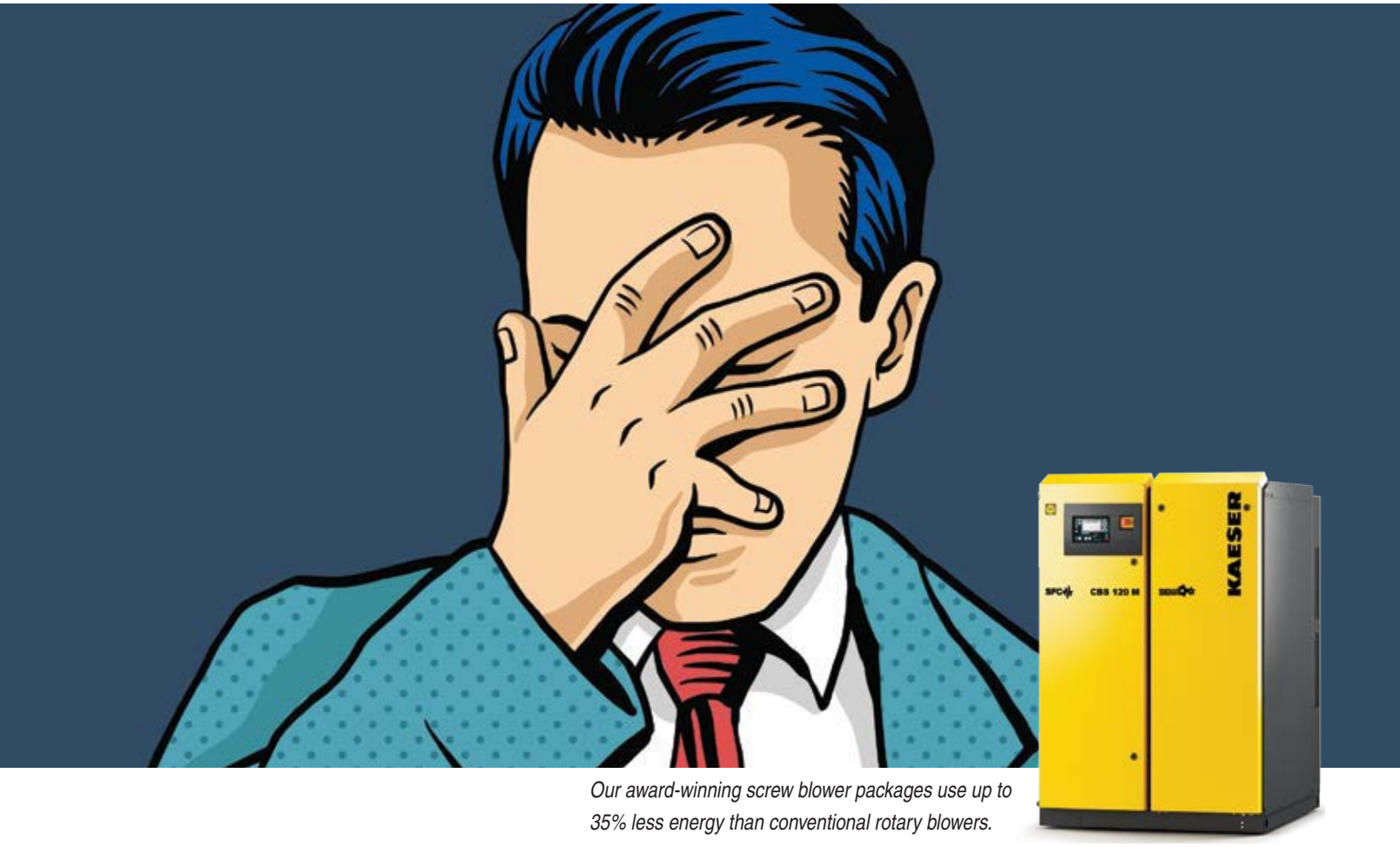

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