The Magazine for ENERGY EFFICIENCY in Compressed Air Systems

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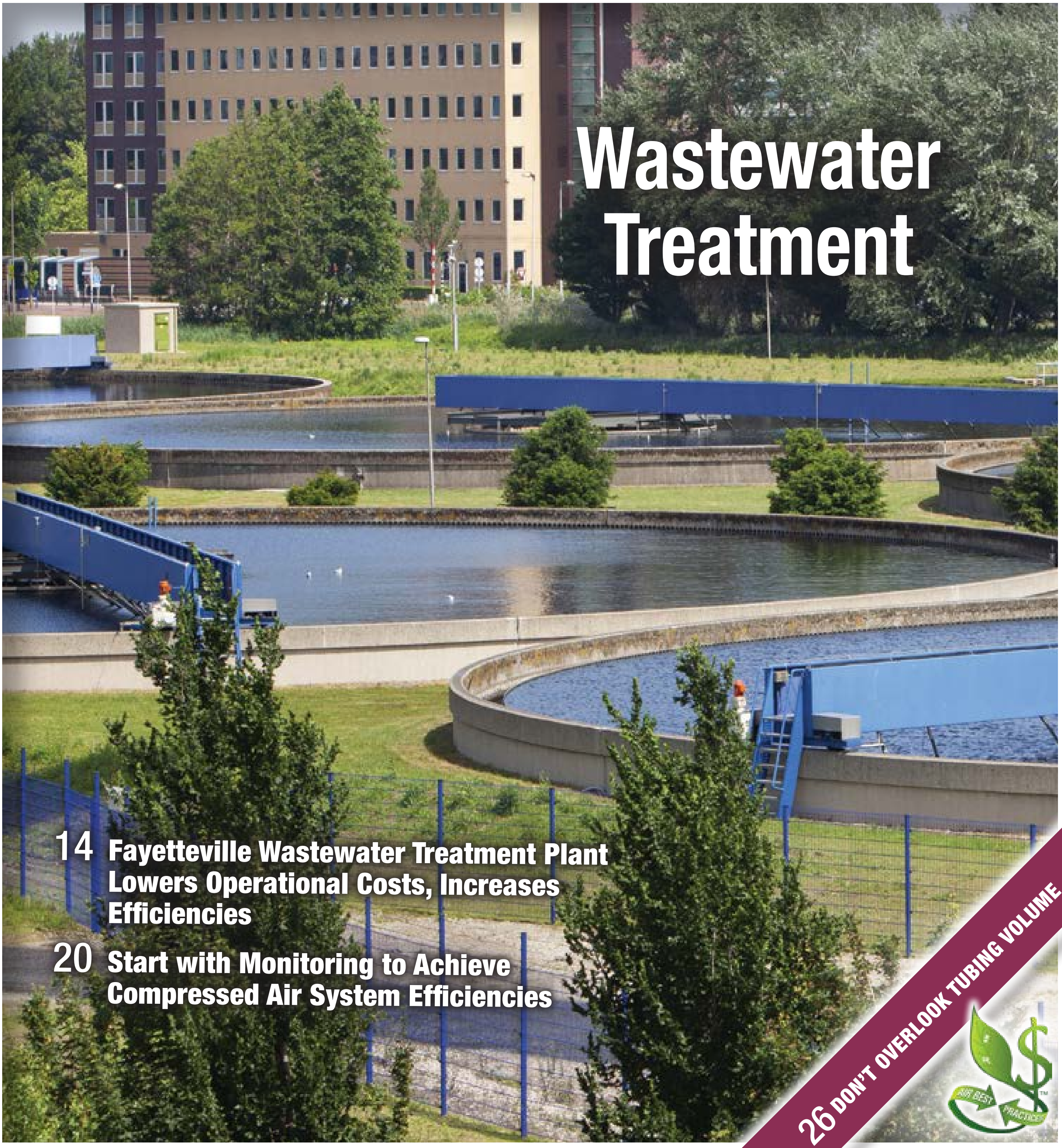
July 2019



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FEATURES

QUALITY, SAFETY & RELIABILITY FEATURES

PRODUCTIVITY, SUSTAINABILITY & ENERGY CONSERVATION FEATURES

COLUMNS

FROM THE EDITOR | Chemical Plants

I'm hearing of more and more demand for blower and vacuum system assessments. This is great news! I encourage both end users and compressed air industry firms to consider making investments in this highly profitable (and sustainable) area of opportunity to improve systems.

Quality, Safety and Reliability

Aluminum piping systems should be in every plant. Due to the numerous benefits to plants, aluminum piping use is growing rapidly. If it's not in yours, please put this on the project list. Keith Harger, from Parker Hannifin, sends us an interesting article about a new development where they are installing wireless monitoring sensors (pressure, humidity, flow) as part of their aluminum piping system solution.

I believe "measurement" will be the single biggest change in compressed air systems ten years from now. By that I mean most systems will be providing multiple measurement key performance indicators to plant managers. Tom Taranto, from Data Power Services, provides us this month with a quite technical article on baseline measurements.

Productivity, Sustainability & Energy Conservation

We are really enjoying our collaboration with the Tennessee Department of Environment and Conservation (TDEC) as we ramp up interest in our October 13-16, 2019 Best Practices Expo & Conference in Nashville, TN. This month, TDEC put us in touch with the Fayetteville, TN wastewater treatment plant to learn how they optimized their aeration blower system. Enjoy!

Pneumatic circuits are almost always an area of opportunity for assessors of compressed air systems. This is where leaks and pressure drops are commonly found. John Martin, from SMC, provides an excellent article where he examines tubing volume with manifold-mounted pneumatic valves.

I have no idea if this idea will ever make any impact on the market, but I thought it'd be fun and interesting to publish Ron Marshall's report on his meeting in Canada with some folks working on a commercially viable hydraulic air compressor!

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

ROD SMITH, *Editor*
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INDUSTRY NEWS

Atlas Copco Celebrates 70th Year in Canada

We are pleased to announce that Atlas Copco is celebrating its 70th anniversary in Canada throughout 2019. In 1949, George Blomdal, a Norwegian Engineer, was dispatched to Canada to test the mining market's reaction to a new type of Swedish designed rock drill and a new drilling method. This drill could be operated by one man instead of two.

Blomdal targeted Northern Ontario to sell this machine due to the vast gold mining industry. He received a call from a prospect wanting to meet while he was in Kirkland Lake and due to his excitement (and not realizing it was -34 degrees Celsius) left without his hat and coat.

Blomdal reached his final destination and had one of his ears frozen. He continued on with his sales pitch while one of the prospect's men massaged the ear. Following this, the first sale was made and the Swedish Method made its way to Canada where these drills outperformed anything that was available at the time. The method revolutionized Canadian mining and quickly spread.

On May 9, 1949, Canadian Copco Ltd. was born and headquartered in Kirkland Lake. Canada was the first country in the Americas to open an Atlas Copco office and the eighth international office established after Norway (1916), UK (1919), Spain (1931), Kenya (1936), France (1946), South Africa (1946) and Morocco (1948).

Throughout the year, we are commemorating this very important milestone in our history with our employees, customers, distributors and other stakeholders, hosting several activities and events.

Atlas Copco Group

Great ideas accelerate innovation. At Atlas Copco we have been turning industrial ideas into business-critical benefits since 1873. By listening to our customers and knowing their needs, we deliver value and innovate with the future in mind. Atlas Copco is based in Stockholm, Sweden with customers in more than 180 countries and about 37 000 employees. Revenues of BSEK 95/9 BEUR in 2018. For more information: www.atlascopcogroup.com

Mattei Holds Annual Sales & Service School

The annual Mattei sales & service school took place at the North American Training Facility outside Baltimore.

Each spring, Mattei holds its Annual Service & Sales Training School, a three-day-long conference educating our distributors on every aspect of our products. This year's conference, held in our North American Training Facility outside Baltimore, MD, took place between March 6 and March 8. We had more attendees than ever before, and it was certainly among our more memorable training events.

In addition to learning about Mattei's Blade Series and rotary vane compressors, attendees were treated to a special presentation lead by Fabio Farneti of Mattei Italy. Mr. Farneti was eager to share his in-depth knowledge of Mattei compressor controls and networking with our attendees. Overall, this year's service school was a great success.

About Mattei Compressors, Inc.

For nearly 60 years, Mattei Compressors, Inc. has served a multitude of industries, including agriculture, automotive and body shop, dry cleaning, energy, food and beverage, manufacturing, medical and dental, natural gas, pharmaceutical, plastics and woodworking, among many others.

For more information, visit www.matteicomp.com.

INDUSTRY NEWS

nano-purification solutions Wins 2018 Distributor of the Year

nano-purification solutions was recently awarded 2018 Distributor of the Year by AKG Thermal Systems. As AKG's national channel partner, the relationship has been a perfect alignment for both companies. Through AKG, we offer a wide variety of aftercoolers and brazed air-cooled heat exchangers.

nano-purification solutions was recently awarded 2018 Distributor of the Year by AKG Thermal Systems.

nano-purification solutions, Charlotte, NC joined forces with AKG Thermal Systems as their national channel partner for the compressed air distribution channel for North America in late 2017.

After teaming up nano-purification solutions more than a year ago as our National Compressed Air Distributor, AKG Thermal Systems has seen market share growth within this market sector. Throughout the process, nano's discipline and experience have developed and established OEMs for long term growth as well servicing the distributor sector with expert service and support" said AKG Thermal Systems Product Manager, Compressed Air Manager, Tommy Williams.

The relationship with AKG has been superb, the product quality and customer service commitment by AKG blends well with our culture and our distributor network. As a result, the performance has been well above expectations and we are confident the nano team will continue to grow the AKG aftercooler business well into the future," said nano Director of Distribution, Nick Herrig.

AKG Thermal Systems is a division of AKG North America located in Mebane, NC. AKG Thermal Systems is a leading supplier for standard catalog cooling products for the industrial and portable compressed air markets. AKG Thermal Systems offers a wide variety of brazed air-cooled aluminum coolers for oil, air and water/glycol mixtures.

For more information, contact Purification Solutions LLC, tel: 704.897.2182 or email: marketing@n-psi.com

EPA Announces 2018 ENERGY STAR® Certified Manufacturing Plants

The U.S. Environmental Protection Agency (EPA) announced today that 100 manufacturing plants earned ENERGY STAR certification for their superior energy performance in 2018. Together, these plants reduced their energy bills by more than $400 million, saved more than 70 trillion British thermal units (TBtu) of energy, and achieved broad emissions reductions, including 4.5 million metric tons of greenhouse gas emissions. The energy savings are enough to meet the annual energy needs of nearly 440,000 American households.

"We applaud these companies who are taking the lead in cutting energy costs and reducing waste,"said EPA Assistant Administrator for Air and Radiation Bill Wehrum. "These leaders are proving that energy efficiency is good for business and for the environment – by fostering innovation, increasing competitiveness, and reducing air pollution."

EPA's ENERGY STAR industrial program provides industry-specific energy benchmarking tools and other resources for 19 different types of manufacturing plants, enabling plants to compare energy performance to others in the same industry and establish meaningful energy performance benchmarks and goals. Only plants in the top 25 percent of energy performance nationwide can earn the ENERGY STAR. Plants from the automotive, baking, cement, corn refining, food processing, glass manufacturing, pharmaceutical manufacturing, and petroleum refining sectors are among those that qualified in 2018.

Manufacturing plants earning ENERGY STAR certification for the first time in 2018:

Argos USA: Harleyville, South Carolina (cement manufacturing)

Bimbo Bakeries USA: Roseville, Minnesota (commercial bread and roll baking)

Flowers Baking Company: Batesville, Arkansas (commercial bread and roll baking)

Flowers Baking Company: Tuscaloosa, Alabama (commercial bread and roll baking)

GCC: Pueblo, Colorado (cement manufacturing)

Honda of America Manufacturing: Anna, Ohio (automobile engine manufacturing)

Kellogg Company: Kansas City, Kansas (cookie & cracker baking)

Klosterman Baking Company: Springboro, Ohio (commercial bread and roll baking)

Nissan North America: Decherd, Tennessee (automobile engine manufacturing)

Northeast Foods: Schmidt Baking Baltimore, Maryland (commercial bread and roll baking)

Tennessee Bun Company: Dickson, Tennessee (commercial bread and roll baking)

Weston Foods Canada: Front Royal, Virginia (cookie & cracker baking)

Weston Foods Canada: Gaffney, South Carolina (commercial bread and roll baking)

Weston Foods Canada: Green Bay, Wisconsin (cookie & cracker baking)

Weston Foods Canada: North Sioux City, South Dakota (cookie & cracker baking)

INDUSTRY NEWS

All ENERGY STAR certified manufacturing plants in 2018 listed by state include:

Alabama:

Argos USA, Calera (cement manufacturing)

Flowers Baking Company, Tuscaloosa (commercial bread and roll baking)*

Lehigh Cement Company, Leeds (cement manufacturing)

Arizona:

Bimbo Bakeries USA, Phoenix (commercial bread and roll baking)

CalPortland, Rillito (cement manufacturing)

Flowers Baking Company, Tolleson (commercial bread and roll baking)

Salt River Materials Group, Clarkdale (cement manufacturing)

Arkansas:

Flowers Baking Company, Batesville (commercial bread and roll baking)*

California:

Ardagh Glass, Madera (container glass manufacturing)

Bimbo Bakeries USA, Sacramento (commercial bread and roll baking)

Bimbo Bakeries USA, San Diego (commercial bread and roll baking)

Bimbo Bakeries USA, San Luis Obispo (commercial bread and roll baking)

CalPortland, Oro Grande (cement manufacturing)

CEMEX, Victorville (cement manufacturing)

Lehigh Cement Company, Redding (cement manufacturing)

Lehigh Cement Company, Tehachapi (cement manufacturing)

Colorado:

GCC, Pueblo (cement manufacturing)*

Florida:

Argos USA, Newberry (cement manufacturing)

CEMEX, Brooksville (cement manufacturing)

CEMEX, Miami (cement manufacturing)

Titan America, Medley (cement manufacturing)

Idaho:

The J.R. Simplot Company, Caldwell (frozen fried potato processing)

Lamb Weston, American Falls (frozen fried potato processing)

Illinois:

Marathon Petroleum Company LP, Robinson (petroleum refining)

TreeHouse Foods, South Beloit (cookie & cracker baking)

Indiana:

Ardagh Glass, Dunkirk (container glass manufacturing)

Honda of America of Indiana, Greensburg (automobile assembly)

Klosterman Baking Company, Morristown (commercial bread and roll baking)

PepsiCo, Indianapolis (juice production manufacturing)

Tate & Lyle, Lafayette (corn refining)

Toyota Motor Manufacturing Indiana – East, Princeton (automobile assembly)

Toyota Motor Manufacturing Indiana – West, Princeton (automobile assembly

Iowa:

Bimbo Bakeries USA, Dubuque (commercial bread and roll baking)

Kansas:

Kellogg Company, Kansas City (cookie & cracker baking)*

Kentucky:

Toyota Motor Manufacturing Kentucky – Plant 1, Georgetown (automobile assembly)

TreeHouse Foods, Princeton (cookie & cracker baking)

Louisiana:

Flowers Baking Company, Baton Rouge (commercial bread and roll baking)

Flowers Baking Company, New Orleans (commercial bread and roll baking)

Marathon Petroleum Company LP, Garyville (petroleum refining)

Maryland:

Lehigh Cement Company, Union Bridge (cement manufacturing)

Northeast Foods, Auto Rolls Baltimore (commercial bread and roll baking)

Northeast Foods, Schmidt Baking Baltimore (commercial bread and roll baking)*

Minnesota:

Bimbo Bakeries USA, Fergus Falls (commercial bread and roll baking)

Bimbo Bakeries USA, Roseville (commercial bread and roll baking)*

Lamb Weston/RDO Frozen, Park Rapids (frozen fried potato processing)

Missouri:

Buzzi Unicem USA, Festus (cement manufacturing)

Continental Cement Company, Hannibal (cement manufacturing)

New Jersey:

Ardagh Glass, Bridgeton (container glass manufacturing)

New Mexico:

GCC, Tijeras (cement manufacturing)

New York:

Bimbo Bakeries USA, Olean (commercial bread and roll baking)

Bimbo Bakeries USA, Auburn (commercial bread and roll baking)

TreeHouse Foods, Tonawanda (cookie & cracker baking)

North Carolina:

Bimbo Bakeries USA, Gastonia (commercial bread and roll baking)

Kellogg Company, Cary (cookie & cracker baking)

North Dakota:

The J.R. Simplot Company, Grand Forks (frozen fried potato processing)

Ohio:

Honda of America Manufacturing, Anna (automobile engine manufacturing)*

Honda of America Manufacturing, East Liberty (automobile assembly)

Honda of America Manufacturing, Marysville (automobile assembly)

Kellogg Company, Cincinnati (cookie & cracker baking)

INDUSTRY NEWS

Klosterman Baking Company, Cincinnati
(commercial bread and roll baking)

Klosterman Baking Company, Springboro
(commercial bread and roll baking)*

Marathon Petroleum Company LP, Canton
(petroleum refining)

Oklahoma:

Bama Pie, Tulsa
(commercial bread and roll baking)

Bama Frozen Dough, Tulsa
(commercial bread and roll baking)

Oregon:

Dave's Killer Bread (Flowers Baking Company)
(commercial bread and roll baking)

Lamb Weston, Boardman West
(frozen fried potato processing)

Pennsylvania:

Bimbo Bakeries USA, Reading
(commercial bread and roll baking)

Puerto Rico:

Merck, Las Piedras
(pharmaceutical manufacturing)

Avara Pharmaceutical Services, Arecibo
(pharmaceutical manufacturing)

South Carolina:

Argos USA, Harleyville
(cement manufacturing)*

Holcim (US), Holly Hill
(cement manufacturing)

Weston Foods Canada, Gaffney
(commercial bread and roll baking)*

South Dakota:

Weston Foods Canada, North Sioux City
(cookie & cracker baking)*

Tennessee:

Bayer U.S., Cleveland
(pharmaceutical manufacturing)

Buzzi Unicem USA, Chattanooga
(cement manufacturing)

Nissan North America, Decherd
(automobile engine manufacturing)*

Nissan North America, Smyrna
(automobile assembly)

Tate & Lyle, Loudon (corn refining)

Tennessee Bun Company, Dickson
(commercial bread and roll baking)*

Texas:

Alamo Cement Company, San Antonio
(cement manufacturing)

Allergan, Waco
(pharmaceutical manufacturing)

Buzzi Unicem USA, Maryneal
(cement manufacturing)

Flowers Baking Company, El Paso
(commercial bread and roll baking)

Flowers Baking Company, Tyler
(commercial bread and roll baking)

Phillips 66 Company, Sweeny
(petroleum refining)

Utah:

Bimbo Bakeries USA, Salt Lake City
(commercial bread and roll baking)

Holcim (US), Devil's Slide
(cement manufacturing)

TreeHouse Foods, Odgen
(cookie & cracker baking)

Virginia:

Flowers Baking Company, Lynchburg
(commercial bread and roll baking)

Flowers Baking Company, Norfolk
(commercial bread and roll baking)

Titan America, Troutville
(cement manufacturing)

Weston Foods Canada, Front Royal
(cookie & cracker baking)*

Washington:

The J.R. Simplot Company, Othello
(frozen fried potato processing)

The J.R. Simplot Company, Moses Lake
(frozen fried potato processing)

Lamb Weston, Quincy
(frozen fried potato processing)

Lamb Weston, Warden
(frozen fried potato processing)

Phillips 66 Company, Ferndale
(petroleum refining)

Wisconsin:

Bimbo Bakeries USA, La Crosse (commercial bread and roll baking)

Bimbo Bakeries USA, Milwaukee (commercial bread and roll baking)

Weston Foods Canada, Green Bay (cookie & cracker baking)*

*Represents first-time certification

About the ENERGY STAR Industrial Program

Since 2006, the ENERGY STAR Industrial Program has annually certified manufacturing plants for performing within the top 25 percent of energy performance in their industries nationwide. More than 200 plants have achieved this distinction since 2006. For more information, see: www.energystar.gov/plants. For a list of all certified plants, see: www.energystar.gov/buildinglist To learn more about how ENERGY STAR and industry work together, see: www.energystar.gov/industry

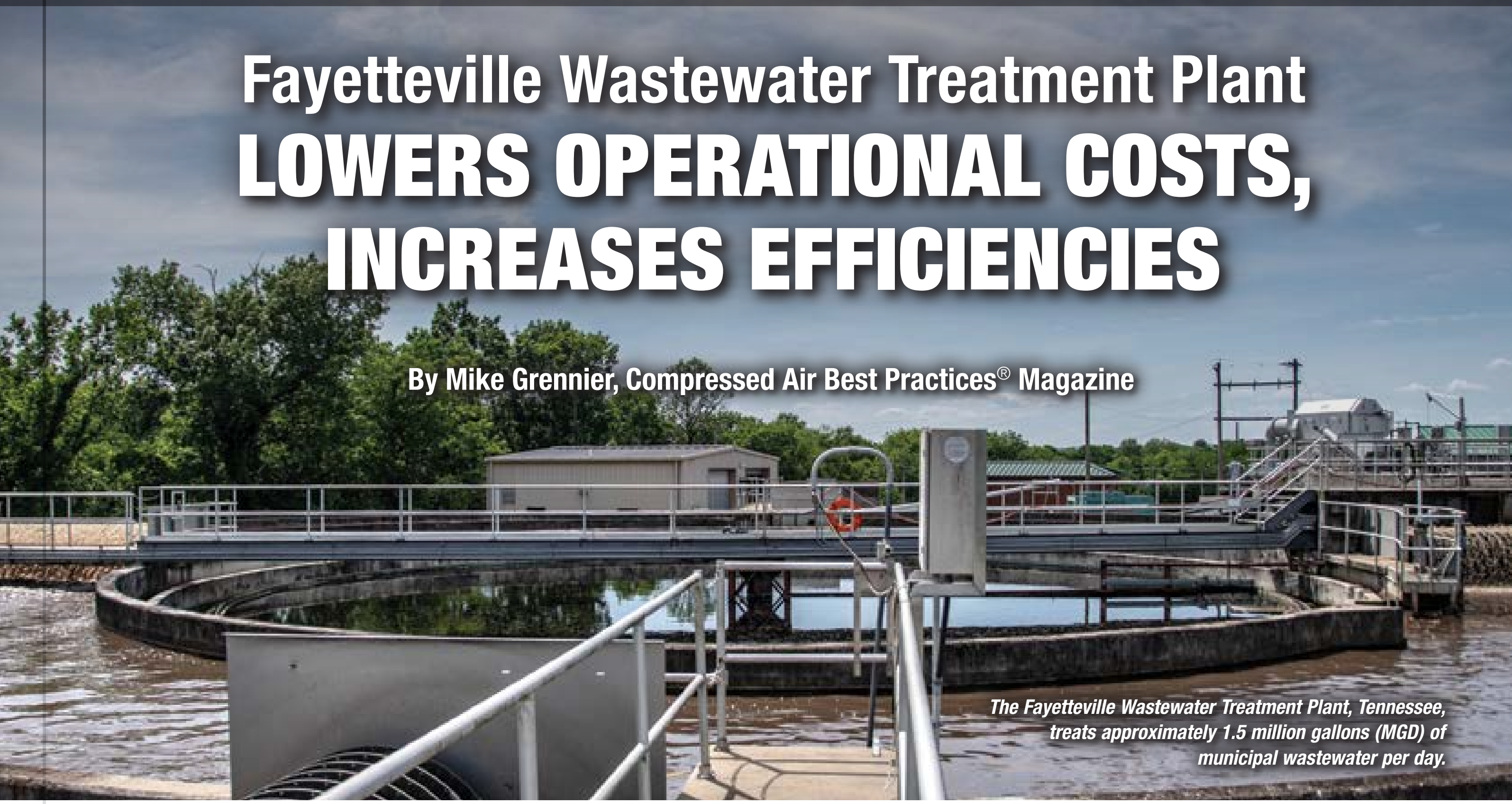
About ENERGY STAR

ENERGY STAR® is the government-backed symbol for energy efficiency, providing simple, credible, and unbiased information that consumers and businesses rely on to make well-informed decisions. Thousands of industrial, commercial, utility, state, and local organizations – including more than 40 percent of the Fortune 500® – rely on their partnership with the U.S. Environmental Protection Agency (EPA) to deliver cost-saving energy efficiency solutions. Since 1992, ENERGY STAR and its partners helped American families and businesses save nearly 4 trillion kilowatt-hours of electricity and achieve associated reductions of over 3 billion metric tons of greenhouse gases. In 2017 alone, ENERGY STAR and its partners helped Americans save $30 billion in energy costs. More background information about ENERGY STAR can be found at: www.energystar.gov/about and www.energystar.gov/numbers

PRODUCTIVITY, SUSTAINABILITY & ENERGY CONSERVATION

Fayetteville Wastewater Treatment Plant LOWERS OPERATIONAL COSTS, INCREASES EFFICIENCIES

By Mike Grennier, Compressed Air Best Practices® Magazine



The Fayetteville Wastewater Treatment Plant, Tennessee, treats approximately 1.5 million gallons (MGD) of municipal wastewater per day.

The Fayetteville Wastewater Treatment Plant (WWTP) in Fayetteville, Tennessee, is an example of a treatment plant that does more than just talk about efforts to achieve water quality and effluent goals – while holding down costs. Instead, it puts words into action.

At the Fayetteville WWTP, action has taken the form of a forward-thinking approach to plant operation and multiple initiatives designed to lower the costs of operation and improve efficiencies. Among its initiatives is a $5 million plant upgrade involving the installation of advanced technology, including:

- A Supervisory Control and Data Acquisition (SCADA) system.
- Updated aeration basins featuring Luminescent Dissolved Oxygen (LDO) probes. Before the plant upgrade, it also installed Variable Speed Frequency Drives (VFDs) on mechanical surface aerators used on the aeration basins.
- High-efficiency aeration blowers for optimization of its digester storage tanks.
- A state-of-the-art dewatering system, featuring a high-efficiency centrifuge and other equipment designed to save costs and more.

The plant upgrades, in combination with a progressive management strategy, allows the plant to consume less energy and reduce its reliance on outside contractors for biosolids removal, resulting in total operational savings of approximately $60,000 per year. The plant is also positioned to efficiently manage the area's wastewater for decades to come.

> "FPU is an example of a utility that fully appreciates the value of measuring and controlling energy use at its wastewater treatment plant in addition to implementing ongoing best practices in environmental stewardship."
>
> — Ben Bolton, Energy Programs Administrator, Tennessee Department of Environment and Conservation

"As a publicly owned wastewater treatment plant our job is to put out quality water in keeping with state and federal regulations, while keeping costs down," said Fayetteville Public Utilities (FPU) CEO/General Manager Britt Dye. "It's why we've always taken a proactive approach to investing in the future and upgrading our plant. For us, it's all about moving forward."

Oxidation Ditch Process

Located approximately 90 miles south of Nashville, Tennessee, Fayetteville is a city of approximately 7,000. FPU manages the plant and the city's water services.

Fayetteville WWTP treats approximately 1.5 million gallons per day (MGD) of municipal wastewater with an influent BOD5 of approximately 225 mg/l. The plant uses an oxidation ditch process with two parallel ditch trains to treat 3.35 MGD at average daily flow conditions and 7.7 MGD of peak daily flow. An oxidation ditch is a modified activated sludge biological treatment process that utilizes long solids retention times (SRTs) to remove biodegradable organics.

The final effluent is discharged to the Elk River with monthly average National Pollution Discharge Elimination System (NPDES) effluent

Fayetteville Wastewater Treatment Plant Supervisor Dwight Jeans.

FAYETTEVILLE WASTEWATER TREATMENT PLANT LOWERS OPERATIONAL COSTS, INCREASES EFFICIENCIES

limits for both BOD5 and suspended solids of 30 mg/l. The U.S Environmental Protection Agency (EPA) establishes NPDES limits.

Since mid-2009 the average daily flow has been approximately 1.5 MGD, but peak daily flows can exceed five to six MGD, requiring the operation of both ditch trains. The plant consistently produces a high quality effluent with BOD5 values averaging 5 to 8 mg/l. and Total Suspended Solids (TSS) values averaging 5-9 mg/l.

Energy Management Initiatives Launched

FPU and WWTP operators have continuously looked to lower plant operating costs since the plant's inception. Yet FPU accelerated its cost-savings measures at the plant in 2011 when the EPA (Region 4 – Atlanta) and the Tennessee Department of Environment and Conservation (TDEC) assembled a team to conduct an Energy Management Initiative (EMI). Since then, the plant has never looked back.

The EMI process included an energy assessment, as well as various workshops to help the plant operate more efficiently and cost-effectively. The team included EPA R4, TDEC, the Tennessee Department of Economic and Community Development and the Tennessee Valley Authority (TVA). It also involved the help of the University of Memphis – Civil Engineering Department, University of Tennessee – Municipal Technical Advisory Service, and the University of North Carolina Environment Finance Center.

"FPU is an example of a utility that fully appreciates the value of measuring and controlling energy use at its wastewater treatment plant in addition to implementing ongoing best practices in environmental stewardship," said Ben Bolton, an energy programs administrator with TDEC. "It is this type of commitment that makes Tennessee an attractive place to live, work, and visit."

Through the EMI process, the plant identified a number of opportunities to save energy. One such measure included the decision to reduce the run times of the blowers used on its aerobic digesters. Doing so allowed the plant to save considerable energy costs. Two years later, the plant took yet another major step toward energy reduction by only operating one of its two oxidation ditch trains during normal conditions.

Fayetteville WWTP's split-level oxidation ditches use VFD-controlled surface aerators to save energy and ensure proper aeration.

Yet FPU continued to see more opportunity for cost savings. As such, it took advantage of financing through a state revolving fund and moved forward with a $5 million plant upgrade project to further enhance plant efficiencies. The project would also allow the plant to comply with more stringent EPA effluent discharge limits.

Oxidation Ditch Upgrades Reduce Energy Use

A key focus for the plant's energy-saving efforts involves the oxidation ditches. At the plant, gravity-fed influent passes through a bar screen and into a main pump station, where it is then pumped through a fine-screening process and into the plant's two, split-level oxidation ditches. Each oxidation ditch (or aeration basin) is designed to process 1,959,360 gallons of wastewater.

The oxidation ditches incorporate a concentric loop design, which consists of an inner and outer ring with dedicated zones for specific treatment processes. The process also includes the use of secondary clarifiers to separate activated sludge biosolids from the mixed liquor.

The ditches use mechanical surface aerators to maintain 1.0 to 3.0 mg/L of dissolved oxygen in the mixed liquor at the effluent end of the outer ring, just prior to entering the inner ring. In all, the ditches use eight electric-driven surface aerators, including four 25-horsepower (hp) units and four 50-hp units.

To save energy, the plant installed LDO probes in the oxidation ditches to monitor Dissolved Oxygen (DO) levels and communicate data to the plant's new SCADA system. Additionally, it added VFDs to the surface aerators. Today, the plant no longer runs all of its surface aerators at all times. Instead, the SCADA system automatically starts and stops the appropriate number of units needed based on the established DO setpoints.

"The LDO probes and the use of VFDs on the surface aerators made total sense," said Fayetteville WWTP Supervisor Dwight Jeans. "Now, we're not running them wide open and over-aerating. Instead, our surface aerators only use the specific amount of energy needed to maintain the DO levels, which results in substantial energy savings."

Optimized Aerobic Digesters Increases Energy Savings

In addition to its aeration basins, FPU chose to optimize the plant's aerobic digester operation to drive down energy costs even further, even though it got a good head start on digester energy reduction in 2011 as part of the EMI process.

At the plant, Waste Activated Sludge (WAS) from the clarifiers flows into two aerobic digesters, each of which is rated to process 296,000 gallons of sludge. Each tank is equipped with coarse bubble air diffusers to aid in the aeration process.

The EPA and TDEC-led EMI process determined the plant had been over-aerating its digester tanks. FPU subsequently chose to reduce the blower run times, allowing it to save energy while also providing the proper level of aeration needed.

When planning the upgrade, FPU determined it could realize more cost-savings with updated aeration blowers used to provide oxygen needed to metabolize the organic compounds in the sludge, while also meeting BOD5 levels. As such, it replaced its two 125-hp blowers with three, new 75-hp positive displacement

Shown is one of two aerobic digesters used at the Fayetteville WWTP.

FAYETTEVILLE WASTEWATER TREATMENT PLANT LOWERS OPERATIONAL COSTS, INCREASES EFFICIENCIES

blowers as part of its plant upgrade. Each blower is rated to deliver 1,500 CFM at 6 psig.

During normal load conditions, the plant operates the digesters at 50 to 75 percent capacity. During the 36-hour aeration period, plant operators manually activate a single blower to provide all the aeration needed for both digesters. The aeration strategy calls for operators to activate a second blower during a rare situation when the plant has reached its peak daily flow and both digesters are at full capacity. The third blower provides system redundancy. The primary blower is turned off during non-aeration periods.

"Just one of these new blowers does the same amount of work as the two older blowers combined, yet it uses less horsepower and consumes less energy. Today, we're not putting more energy into the digester aeration process than needed and we have reliable blowers that allow us to meet our water quality goals," Jeans said.

Recently installed aeration blowers play a key role in helping the Fayetteville WWTP optimize its aerobic digesters and achieve energy savings.

Jeans said the plant is proud of its continued progress and the efforts of all involved at the plant and FPU.

"Keeping the plant running efficiently and managing costs is a team effort, which includes everyone here at the plant, as well as people in administration like Dana Pollock who are able to study and glean the information about cost savings that have accumulated for FPU since the deployment of the new technology at the WWTP," Jeans said.

Dewatering System Saves Costs, Creates Self-sufficiency

In addition to improving efficiencies through the use of upgraded plant controls, and optimized oxidation ditches and digester tanks, FPU took a new approach to sludge dewatering and removal of biosolids.

Following the aeration process at the plant, digester sludge enters the operation's dewatering phase. In the past, FPU relied on a local contractor to dewater the sludge and haul away the biosolids. However, as the costs for the service continued to escalate and eventually doubled FPU decided to explore ways to eliminate its reliance on outside contractors for dewatering and biosolids removal.

After thorough analysis, FPU chose to build a dewatering building with new equipment, including a high-speed centrifuge, conveyor system, pug mill mixer, and storage silo.

The centrifuge starts the process by processing wet sludge at a rate of 55 gallons per minute (GPM), which essentially converts the treated sludge to biosolids. The biosolids are then routed to the pug mill, which blends kiln dust with the sludge to stabilize the alkaline level of the materials and to initiate a biochemical heating process. The biosolids are then conveyed to storage area for a 72-hour

Shown is the high-speed centrifuge used in the dewatering process at the Fayetteville WWTP.

period, which results in a Class-A biosolids end product.

In total, the plant produces 250 tons of Class-A biosolids per year. The biosolids are available to local farmers and others in the community who can use it as a fertilizer.

"When the lowest bid for the dewatering contact climbed to $914 per ton from $491 we needed to find a more cost effective approach for managing this part of the plant," Jeans said. "The new dewatering system was the answer, and even though it offsets some of our energy-savings, its saves $80,000 per year in dewatering costs."

An Eye Toward Continued Efficiencies

Since completion of the plant upgrade in 2017, the plant saves an estimated $60,000 in operational costs thanks to advanced, energy-saving technology and FPU's decision to produce Class-A biosolids for use throughout the community.

According to Dye, the cost-savings measures at the plant are the result of a forward-thinking approach and a commitment to continuous improvement. As an example, he said, the WWTP is developing plans to operate its dewatering process during electric utility off-peak hours to save energy.

"We decided long ago to be a leader in wastewater treatment," Dye said. "Thanks to the help of the EPA, TDEC and other organizations in the community, as well as our knowledgeable staff, we've been able to make substantial improvements that not only save on energy and help us reduce costs, but also enhance the plant's ability to protect the environment for decades to come." BP

All photos courtesy of Fayetteville Public Utilities.

To read more about the ***Wastewater Treatment Industry***, please visit www.airbestpractices.com/industries/wastewater

QUALITY, SAFETY & RELIABILITY

Start with Monitoring to Achieve COMPRESSED AIR SYSTEM EFFICIENCIES

By Keith Harger, Parker Hannifin

Compressed air represents one of the largest opportunities for immediate energy savings, which accounts for an average of 15% of an industrial facility's electrical consumption. In fact, over a 10-year period, electricity can make up 76% of the total compressed air system costs.

Monitoring compressed air usage, identifying compressed air waste and inefficiencies, and making investments in new compressed air equipment – including piping – are tangible ways businesses can cut their operating costs by lowering their electricity bill.

Installing Wireless Monitoring Sensors

The right approach to eliminating efficiencies can pay dividends. It's not uncommon to see typical savings of up to 30% of the energy input to the air compressor. These savings are achievable through initially selecting the most efficient type of air compressor, ensuring the correct air system design and ongoing efficient operation and good maintenance. It also includes maximizing the use of the latest technologies available and also ensuring attention is paid to the simple measures of keeping leakage rates to a minimum.

An excellent place to start is to monitor compressed air usage, which is especially important since proper layout of the compressed system and piping material is often ignored. When this happens it causes the air compressor to work overtime and consume energy unnecessarily.

Monitoring sensors should be installed to identify where the problem areas are and give a quantifiable data on what needs corrected before any system modifications take place.

The type of monitoring sensor used depends on personal preference. Data can be collected

> "Often the best advice is to have a trained compressed air expert identify what sensors are required and where they need to be placed as part of compressed air system assessment."
>
> — Keith Harger, Parker Hannifin

using the traditional analog style sensor, or a wireless sensor that reports data to a cloud-based monitoring platform. Sensor style aside, pressure, humidity, and flow should be collected to create a full health profile of the compressed air system.

Some wireless sensors specifically designed for compressed air system monitoring not only provide the appropriate measurements but also report key data to cloud-based monitoring platforms and access at all times to real-time data. In addition, the latest technology automatically alerts users to readings that fall outside a desired performance band.

Often the best advice is to have a trained compressed air expert identify what sensors are required and where they need to be placed as part of compressed air system assessment.

Pay attention to piping material in a compressed air system to identify areas for improved efficiencies.

Monitor and Measure System Pressure

Having an inefficient compressed air system could be costing tens or even hundreds of thousands of dollars in wasted energy per year. These inefficiencies result from several causes, including:

- Inadequately sized piping
- Internal corrosion of the distribution piping
- Too many elbows
- Reductions in pipe diameter
- Wrong sized compressor
- Lack of compressed air storage

Air leaks are often a main source of energy loss in a compressed air system. For instance, a 14.5 psi pressure drop uses 10% additional energy. Also, every 2 psi of compressed air generated equals 1% of a system's total energy cost.

START WITH MONITORING TO ACHIEVE COMPRESSED AIR SYSTEM EFFICIENCIES

Humidity sensors in compressed air pipelines alert users to excess moisture in the system.

Any of these issues will cause the air compressor to work overtime, shortening its life expectancy – all of which supports the need for monitoring and measuring compressed air system pressures. Taking pressure readings throughout the compressed air system at key locations: the compressor room, point of use, and the distribution piping will identify if and where these issues exist in the system. Without collecting pressure data at these points, a pressure profile cannot be done to identify the area of pressure drop.

Humidity Readings Uncover Issues with Moisture

The level of humidity must also be monitored and measured. Excess moisture corrodes pipes and damages internal components of machinery, increasing maintenance costs and causing production downtime. In certain applications, the excess moisture can cause product damage resulting in rework and scrap. Moisture also breeds harmful bacteria that will contaminate the finished goods.

Humidity sensors can prevent these issues. Taking humidity readings from the compressed air lines in the compressor room and point of use will determine if a system is operating at peak efficiency. High levels of humidity in a compressed air system can indicate either a problem with the dryer, condensate removal system, or simply the location of the air compressor and dryer.

Flow Sensor Data Can Reveal Multiple Issues

The need to record system airflow cannot be understated. A common cause of inefficient air systems is clogged piping. In traditional piping materials, the interior will corrode over time, restricting the flow of air. Undersized piping will also cause inefficiencies. In some cases, the pipe was sized correctly for the original demand, but as the facility grew in air demand, the piping system became too small to deliver the correct air pressure to the point if use.

Leaks also cause compressed air system inefficiencies. Leaks are mainly seen in older pipes, but newer installations can still leak as well. Eventually, threaded connections start to separate, creating a path for air to escape from the distribution network. Installation mistakes will also lead to leaks, as well as the potential for serious injuries. Aside from measuring and monitoring it's also important to assemble the system to the manufacturer's specifications when attaching connectors to avoid leaks and potential injury.

Placing flow sensors at the correct locations in a compressed air system will identify potential leaks, unnecessary or inappropriate uses of compressed air, and the demand of the entire facility and each individual department. The best way to check for system leaks is to monitor the artificial demand of air during idle (no production) times. The higher the artificial demand, the more leaks exist in the system.

Analyzing the data also determines the health of the piping. The interior of pipes will corrode and create blockages without ever showing signs on the outside. An area with poor flow readings means the pipe has begun to corrode.

The Ins and Outs of Proper System Layout

After collecting pressure, humidity, and flow data of your compressed air system, an analysis and redesign of the new system can begin. Making layout modifications can reduce pressure drop, increase flow, and provide better quality of air.

The results may show that new equipment and new piping will be required. A properly designed, maintained and energy efficient compressed air system could save thousands of dollars each year. It will also minimize the risk of lost production by increasing the reliability of supply and improve the strength and safety aspect of operating a pressurized system.

Piping that can be easily bent helps avoid too many elbows in a compressed air system.

The first step of system redesign is to survey the layout of the pipe system. During your survey look for the following trouble areas.

- Too many elbows
- Abrupt changes in airflow
- Excessive lengths of pipe
- Non-isolated lengths of unused compressed air piping
- Under or Over sized piping

Too many elbows many not be an obvious cause, but the shape of the elbow causes the air to abruptly change direction, losing flow. A way around using too many elbows is to bend the pipe. All diameters (1/2" to 6") of Parker's Transair aluminum piping, for example, can be bent due to the Qualicoat-certified finish. Some types of piping can be bent using a conduit bender. For the larger diameters, the pipe needs to be packed with sand prior to bending.

Proper support is another key factor in the design of the piping layout. If not supported properly, excessive lengths of pipe will start to sag overtime. This sagging will create sharp bends that compressed air slams into and reduces the flow. When hanging compressed air piping, always use the recommended number of hangers. Some piping allows users to reduce the number of hangers needed. Due to the lightweight aluminum construction, a 20-foot section of Transair, for example, requires only two hangers, versus four or more with traditional systems.

Reducing the sag in piping also eliminates excess moisture from building up in the pipe and causing corrosion and blockage. Piping made of high-grade aluminum alloys used in some piping creates a natural resistance to corrosion in the pipe's interior. Piping is also available with a strong external barrier to protect against environmental factors that can cause damage to the exterior of the piping.

The Advantages of Aluminum Piping

Replacing worn, steel or copper pipe with aluminum pipe is a good approach for correcting the issues of a compressed air system. Copper and black iron have been the preferred choice for compressed air systems due to the low material costs. However, threaded joints often serve as a source

START WITH MONITORING TO ACHIEVE COMPRESSED AIR SYSTEM EFFICIENCIES

of leakage. To compensate for these leaks, the air compressor starts to work overtime to maintain the necessary flow. This overtime work reduces the life of the air compressor and causes premature failures in the equipment.

Traditional metal systems are also more susceptible to corrosion. Interior corrosion causes scaling and pitting on the inside of the compressed air piping. As the corrosion particles build, blockages in the pipe start to occur, causing more occurrences of pressure drop in the system. The particles can also dislodge and travel to the point of use, causing significant damage to the equipment.

Additionally, the traditional metal systems require specialized labor to install. Due to the need to solder copper pipe, a fire watcher is required to be on-site as the piping is installed. The weight of the pipe also requires additional safety features to me in place. Steel pipe needs to be lifted into place with a pipe lull, but some piping is light enough for one or two workers to move into place just using a scissor lift. Also available is quick connection technology, which eliminates the need for specialized installation labor. BP

About the Author

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About Parker Hannifin Transair Piping

With 22 years of experience and over 750,000 installations worldwide, Parker Hannifin's Transair aluminum pipe system has become the trusted brand for compressed air, vacuum, and inert gas applications. To help with the design of compressed air systems, Parker Transair has developed a suite of tools, including design software, CAD files, energy savings calculator, flow calculator, and BIM design files. For more information, visit www.parker.com/transair.

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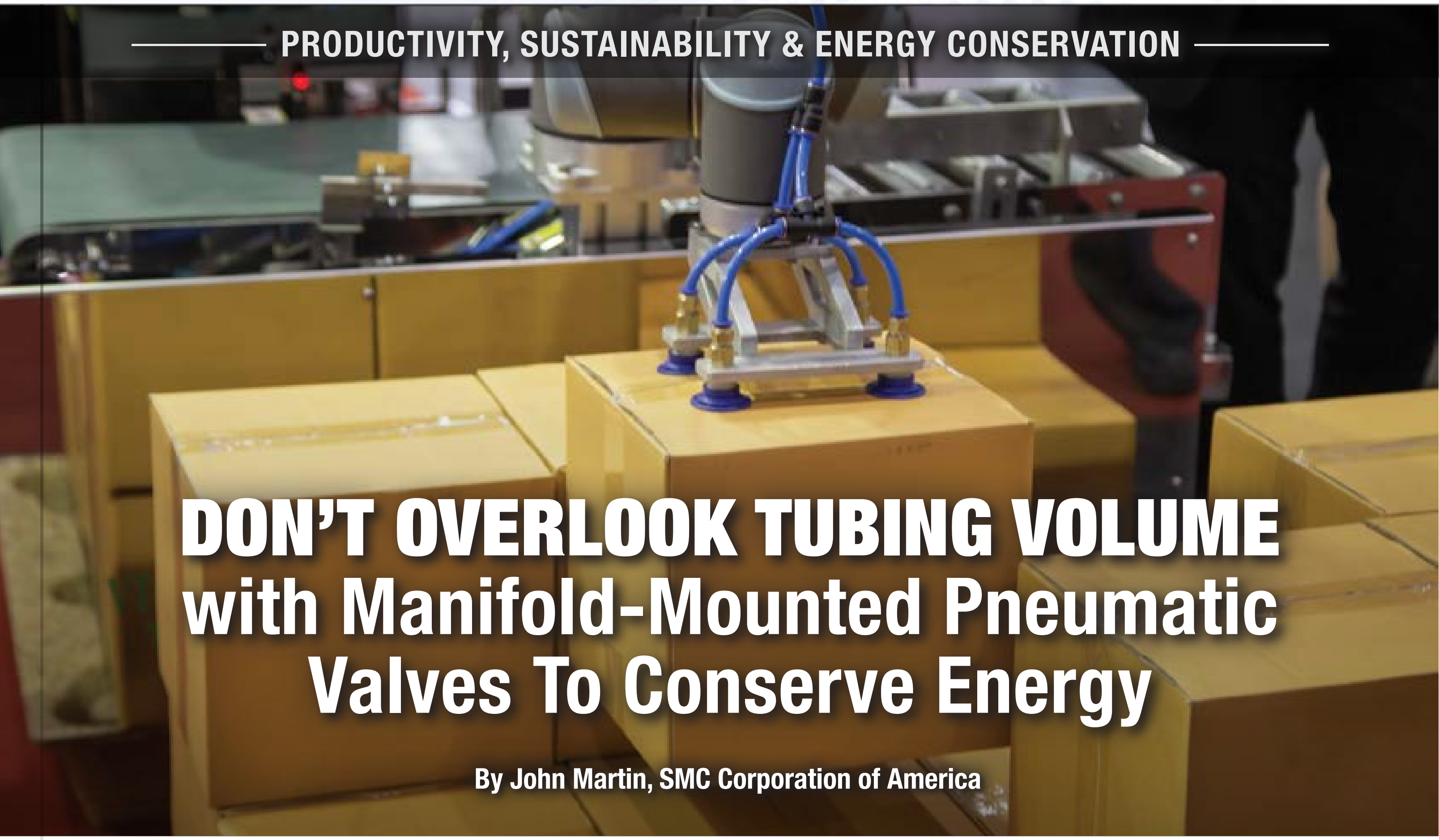
PRODUCTIVITY, SUSTAINABILITY & ENERGY CONSERVATION



DON'T OVERLOOK TUBING VOLUME with Manifold-Mounted Pneumatic Valves To Conserve Energy

By John Martin, SMC Corporation of America

The advent of manifold-mounted, plug-in pneumatic valves has been a boon for machine builders. It allows them to mount complete valve packages in a safe and secure location on a machine. Using a D-sub connector, serial interface module, or similar single-point wiring system, all of the electrical control outputs can feed into one location on the manifold, greatly simplifying the wiring.

With this advancement, plumbing issues are reduced, since a single air pressure line can be used to feed a common pressure gallery. The same advantage applies to the common exhaust gallery. No longer would both a plumber and an electrician be required to replace a valve, since any valve can be replaced without disturbing electrical connections or plumbing lines.

Like most advances, there can be some downsides to this type of arrangement, depending upon the application. One of these revolves around considerations for energy conservation. Most circuits include two airlines extending from the valve to the actuator, one for extend and one for retract. Each time the valve cycles, the actuator is pressurized on one side or the other. Of course, the hose or tube that connects them must also be pressurized. This tubing volume is typically ignored as inconsequential when doing our sizing calculations, but should not always be overlooked.

"The dollar savings is the reduction in air consumption by half. In our plant, that could be up to $5,500 every year."

— John Martin, SMC Corporation of America

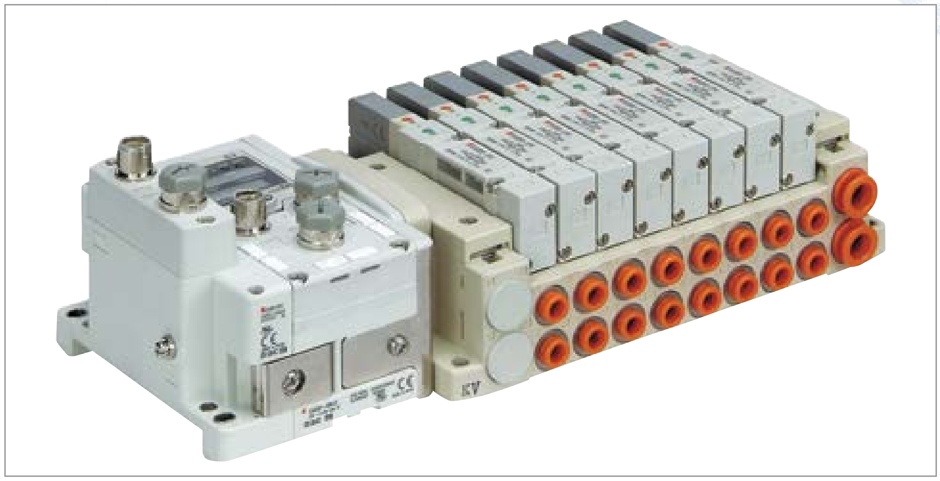
Tubing Volume not Always Inconsequential

The tubing volume offers no work at all… only a means of transferring the energy of the compressed air to the actuator. Inconsequential? Maybe. But depending upon the application, those volumes can be significant. Here is an example:

A packaging facility has corrugated boxes being erected at a mezzanine level and dropped down to the main floor where they are filled, sealed and palletized. The box drop-down employs gravity to lower the boxes, but incorporates a series of mechanical stops to sequence them as required.

Each of the stops includes a pair of two-inch bore by one-inch stroke air cylinders to operate a brake that stops the box and releases it when needed. In all, four stops are included for each drop-down, meaning eight actuators in total and four valves to control them.

The directional control valves are located at a central location on a single manifold, presenting a clean and compact package. However, the distance from manifold to



SMC's Series SY Solenoid Valve Manifold with Serial Interface Module.

DON'T OVERLOOK TUBING VOLUME WITH MANIFOLD-MOUNTED PNEUMATIC VALVES TO CONSERVE ENERGY

actuator varies from 10 to 25 feet. In operation, each time a valve shifts, it exhausts one length of tubing and fills another. Given the small volume, we might still think this to be inconsequential, but let's look at the numbers.

Calculating the Costs of Air Volume

Assume ¼-inch OD tubing with an ID of approximately .180 inches. With the first station being 10 feet away from the valve, the volume of tubing going to the actuators is only 3.05 cubic inches. Since there are two lines from the valve to each actuator pair, the total volume is 6.10 cubic inches per complete cycle. To put this in perspective, each of the two by one-inch cylinders has a total volume of 5-½ cubic inches. That's the sum of both the extend and retract sides. Since there are two of them, the total cylinder volume is 11 cubic inches. The volume in the tubing is over half that of the actuators. Much of the energy developed at the air compressor is being used to fill the tubing lines.

Let's leave aside the potential problem with poor response times, and just look at the costs. Let's also assume the working pressure to be 80 psi. By calculating the compression ratio to be 6.33, and multiplying that by the volume, the normalized volume becomes 38.6 standard cubic inches. If we have the cylinders being actuated five times a minute, we will be consuming 193 standard cubic inches per minute, or using more meaningful terms, 0.11 scfm. That is just for filling the air tubing to the closest single station on the drop-down.

How about the other three stops on the drop-down? Figure 1 shows the air volume for each of the stations, with a total for all. Note the total volume of the airlines extending out to the cylinders is 42.8 in³. When we calculate the total volume of all eight cylinders we get 44 in³. The volumes are almost identical. Now we have a situation where half the compressed air is consumed filling all the airlines.

If that single drop down operates 24 hours/day, seven days a week and the cost for electricity is \$.10 per kWh, the annual cost to fill those lines is about \$110, the same costs we incur to fill the cylinders. With multiple drop-downs, the costs are multiplied. Staying with our example, the facility has 50 packaging lines, for an annual cost of \$5,500.

While this may be viewed as an extreme example, think back on all the applications where long air feed lines were employed in order to have a clean valve package. Or consider the oversize tubing that was utilized just because it was handy. Many of us might figure larger tubing is better anyway, and everything will run more efficiently. However, take into account the larger tubing may double the volume to be filled without adding any productive benefit at all.

	Tubing Length (inch)	Tubing Volume (in³ x 2)	Tubing Volume x Compression Ratio (in³)	Time 5 Cycles per minute (scim)	SCFM
Station 1	120	6.1	38.6	193	0.11
Station 2	180	9.16	58	290	0.17
Station 3	240	12.2	77.2	386	0.22
Station 4	300	15.3	96.8	484	0.28
Total	**840**	**42.8**	**270.6**	**1353**	**0.78**

Figure 1: Air volume for multiple stations.

Larger Tubing Equals Higher Costs

What happens to the same example when 3/8-inch tubing is used instead of the ¼-inch? The tubing ID increases to .27 inches and the volumes increase by a factor of 2.28, as do the costs. Now the annual price tag has jumped to $250. Again, that is just to fill the tubing for one drop-down.

As a side note, there is also some potential for liquid moisture build-up in those long lines when an excess of air is left between the valve and the actuator, even when good air filtration and drying is in place.

Problems can arise due to the adiabatic expansion that occurs with each exhaust cycle. Condensation may occur as the exhausting air temperature falls below that of the atmospheric dewpoint. With long airlines and many cycles, the moisture may not be completely exhausted and can accumulate in the lines. That accumulation will occur near the actuator ports and will eventually work its way into the actuator, shortening its life.

What's the solution? Have the valves mounted on or near the actuators so all or most of the air volume is used to actuate the cylinders. This will require a pressure line running the length of the drop-down with a connection to each valve. However, that pressure line represents energy capacitance that works in our favor. We will also have fewer connections, which will translate into fewer potential leaks. Of course, the downside is that electrical lines will have to be extended independently to each valve. However, with low voltage, low wattage coils, this probably is not that difficult. Another benefit to be gained is that electrical response times remain unaffected, while pneumatic response times improve dramatically.

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DON'T OVERLOOK TUBING VOLUME WITH MANIFOLD-MOUNTED PNEUMATIC VALVES TO CONSERVE ENERGY

The dollar savings is the reduction in air consumption by half. In our plant, that could be up to $5,500 every year.

OEM-level Solution Adds Little Cost

Reducing the costs for compressed air needs to be an ongoing project for any company that uses substantial amounts of air as part of the manufacturing process. There is a tendency to approach the issue at the compressor room and look for answers there. The resulting recommendations can be expensive as well as require a long ROI. However, dealing with demand side issues, as described here, offers an easy solution that can be incorporated at the OEM level with little additional cost.

A case can even be made for modifying these types of applications in the field when machines come due for refurbishment. Addressing these "inconsequential" issues will offer significant savings on the bottom line. Watch the pennies and the dollars take care of themselves. BP

About the Author

John Martin has worked in the fluid power industry for more than 35 years in various capacities. Most of his initial work on the distribution and manufacturing side of the industry was in hydraulics and process controls. Pneumatics became his focus after joining SMC more than 20 years ago. At SMC, he has held various positions, typically in a sales support role as Application Engineer, Sales Engineer, and Product Specialist.

About SMC Corporation of America

SMC Corporation of America is a part of a global organization that supports customers in every industrialized country, and is the U.S. subsidiary of SMC Corporation based in Japan. Since its establishment, SMC has been a leader in pneumatic technology, providing industry with technology and products to support automation based on the guiding principle of "contributing to automation labor savings in industry." Over the past 50-plus years, SMC's products have become established as a recognized international brand through sales, technical, supply and after sale services in world markets.

Subsidiaries and joint ventures have been setup in a total of 53 countries. Production facilities are in 30 countries. In addition, a sales network extends throughout 83 countries, with local services in 500 locations. SMC offers technology accumulated through the years, engineers that bring it to life in new products, production capacity which can deliver a variety of products in a short time, and an extensive sales network in the United States and throughout the world. For more information, visit https://www.smcusa.com/.

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QUALITY, SAFETY & RELIABILITY

Use Baseline Measurements to Improve COMPRESSED AIR SUPPLY PERFORMANCE

By Tom Taranto, Data Power Services, LLC

Baseline measurements include flow, power, pressure, production output, and other relevant variables impacting compressed air use. These data evaluate trending averages to develop Key Performance Indicator (KPI) and Energy Performance Indicator (EnPI) parameters and establish base year performance. The focus of this article is the application, evaluation, and analysis of baseline measurements to provide information necessary to improve Compressed Air Supply Efficiency.

According to the Compressed Air Challenge® Fundamentals of Compressed Air Systems Training, baselining involves taking measurements that determine the effectiveness of your compressed air system in meeting loads efficiently.

According to ASME EA-4–2010 § 1.3.2., the system energy efficiency for a given level of production output for compressed air system assessment requires two important measures:

- The total amount of primary energy resource used to generate the total amount of compressed air consumed.
- The total amount of compressed air consumed for a given level of production output.

Baselining a compressed air system involves measurement to establish how a compressed air system is presently operating. Base year performance is established before implementing changes to improve performance and energy efficiency. Post implementation baselining, commonly referred to as Evaluation, Measurement, and Verification (EM&V), evaluates the effectiveness of these changes.

Three Opportunities for Energy Reduction

Optimization of energy consumption and system performance includes three fundamental opportunities:

1. Improve compressed air supply efficiency.

"Baselining a compressed air system involves measurement to establish how a compressed air system is presently operating."

— Tom Taranto, Data Power Services, LLC

2. Eliminate irrecoverable pressure loss and reduce air compressor discharge pressure.

3. Reduce compressed air consumption through the elimination of waste.

For each of the three areas of opportunity, appropriate EnPI's or KPI's can be used to quantify operating parameters and identify savings opportunities.

Supply/Demand Balance Performance Indicators

The performance indicators below are common measures of performance related to compressed air supply efficiency.

- Improve supply side generation efficiency with improved control strategy & supply/demand balance.
  - KPI Q(FL) = scfm – Airflow at full load capacity of all running air compressors.
  - KPI Q(AVG) = scfm – Average airflow rate delivered to the system.
  - KPI Q(PEAK) = scfm – Peak airflow rate delivered to the system.
  - EnPI SP = kW/100 scfm – Specific Power.
  - EnPI CASE = scf/kWh – CASE Index Compressed Air Supply Efficiency.

Evaluating KPI's for the following operating conditions indicate a potential opportunity for improving the supply/ demand balance to achieve energy savings:

- Full load capacity of running air compressors Q(FL) is greater than average air demand Q(AVG).
- Full load capacity of running air compressors Q(FL) is greater than peak air demand Q(PEAK).

Daily Operating Profile - KPI & EnPI Analysis

Compressed Air System Operating Profile on Monday 02/26/2018

Operating Profile Statistics	Daily Profile	Annual Profile	Air Demand Profile
24 hrs / day	2.96 MMCF / Day	1,077.44 MMCF / Year	2,058 scfm Avg. Airflow
7 days / week	11,717 kWH / Day	4,264,908 kWH / Year	1,421 scfm Min. Hourly Avg.
52 weeks / year	$1,171.68 / Day	$426,491 Annual Cost	2,750 scfm Max. Hourly Avg.
Power Cost	$48.82 / Hour (average)	$395.84 / MMCF	3,157 scfm Max. Peak
$0.1000 / kWH	488 kWH (average)	$207.26 per cfm / yr.	1,043 scfm Min. Valley
	24.3 (kW/100scfm) avg.	251.3 (scf / kWh) avg.	97.2 psig avg.

	KPI Q(AVG)	KPI Q (FL)					ENPI SP	ENPI CASE	
Hour of the Day	Average Airflow (scfm)	Running Capacity (cfm)	Total Power (kWh)	Operating Cost ($ / hr.)	Compressed Air Cost $ / MMCF	Compressed Air Cost $ / scfm / yr	Specific Power (kW/100 cfm)	C.A.S.E Index (scf / kWH)	Average Pressure (psig)
0:00	2060	3720	450.2	$45.02	$364.00	$190.79	21.9	274.5	93.5
1:00	2116	3720	459.7	$45.97	$362.00	$189.75	21.7	276.2	92.8
2:00	2543	3720	518.4	$51.84	$340.00	$178.21	20.4	294.4	90.8
3:00	2468	3050	475.1	$47.51	$321.00	$168.26	19.3	311.7	92.5
4:00	2508	3720	478.1	$47.81	$318.00	$166.68	19.1	314.8	90.4
5:00	2228	3720	486.8	$48.68	$364.00	$190.79	21.9	274.6	93.3
6:00	2589	3720	545.8	$54.58	$351.00	$183.98	21.1	284.6	90.6
7:00	2049	3050	437.0	$43.70	$355.00	$186.08	21.3	281.3	94.8
8:00	2750	3720	582.6	$58.26	$353.00	$185.03	21.2	283.2	90.0
9:00	2138	5220	521.4	$52.14	$406.00	$212.81	24.4	246.0	96.8
10:00	2437	3880	578.1	$57.81	$395.00	$207.04	23.7	252.9	97.0
11:00	2105	3880	514.2	$51.42	$407.00	$213.33	24.4	245.6	98.1
12:00	2388	4550	579.2	$57.92	$404.00	$211.76	24.3	247.4	98.1
13:00	2248	3880	541.8	$54.18	$402.00	$210.71	24.1	248.9	97.1
14:00	2689	3880	634.4	$63.44	$393.00	$205.99	23.6	254.3	95.9
15:00	1741	3880	446.2	$44.62	$427.00	$223.82	25.6	234.1	99.6
16:00	1481	2890	430.6	$43.06	$485.00	$254.22	29.1	206.4	104.2
17:00	1421	2890	425.7	$42.57	$499.00	$261.56	30.0	200.3	105.1
18:00	1515	2890	432.2	$43.22	$475.00	$248.98	28.5	210.3	103.6
19:00	1560	2890	433.5	$43.35	$463.00	$242.69	27.8	215.9	102.0
20:00	1579	2890	433.4	$43.34	$457.00	$239.54	27.4	218.6	101.2
21:00	1568	2890	433.9	$43.39	$461.00	$241.64	27.7	216.8	101.8
22:00	1561	2890	434.2	$43.42	$464.00	$243.21	27.8	215.7	102.1
23:00	1643	2890	444.5	$44.45	$451.00	$236.40	27.1	221.8	101.5
NOTE:	Minimum	Maximum	488.2 avg.	48.82 avg.	405 avg.	212.22 avg.	24.3 avg.	251.3 avg.	97.2 avg.

Figure 1: Daily operating profile – KPI and EnPI analysis.

USE BASELINE MEASUREMENTS TO IMPROVE COMPRESSED AIR SUPPLY PERFORMANCE

- Full load capacity of running air compressors Q(FL) is so great that multiple air compressors are operating at part load capacity, such that one or more air compressors can be shut-off while the unit that remains running can supply system air demand Q(SYS) while still operating as less than full load capacity Q(FL).

Data Mining Hourly Average Operating Profile

Data mining and review of performance indicators can provide insight and a starting point to investigate opportunities for improved control strategy. Baseline data measurement of flow, power, and pressure should be measured at frequent data intervals.

To allow for dynamic analysis of system events and air compressor control response intervals of 1 to 10 seconds are normally used. The KPI's and EnPI's are calculated as averages of baseline measurements. For example, performance data shown in Figure 1 represents hourly average performance of baseline data measured using a 100 millisecond sample rate and six-second data interval.

Important insight to performance is gained by observing that the system's compressed air supply efficiency is at 4:00 am, Specific Power EnPI SP = 19.1 kW/100 scfm and EnPI CASE is 314.8 scf/kWh. By comparison, at 5:00 pm EnPI SP is 30.0 kW/100 scfm and EnPI CASE is 200.3 scf/kWh. That is a 36% drop in the system supply efficiency between 4:00 am and 5:00 pm. What is different? Investigation shows the average air compressor discharge pressure has increased by 14.7 psi. Comparing KPI's Q(FL) and Q(AVG) shows the supply/demand balance [Q(FL) minus Q(AVG)] is slightly greater when efficiency is lower. There is only 257 scfm difference; 1,212 scfm of extra capacity operating at 4:00 am and 1,469 scfm at 5:00 pm. Further investigation of the dynamic performance would show that during the more efficient time there are four air compressors running. Three of the four units are delivering close to 100% capacity. The fourth air compressor is operating between 65 and 85 percent of full capacity. During the less efficient time three air compressors are operating. One air compressor is continuously operating unloaded and consuming 46 kW of power while delivering no compressed air to the system. This air compressor should be stopped.

Data Mining Daily Operating Profiles to Improve Annual Results

Many compressed air system assessments present the baseline period of data as an annualized average without regard to the resulting profile differences between "typical operating periods." In addition, analysis of

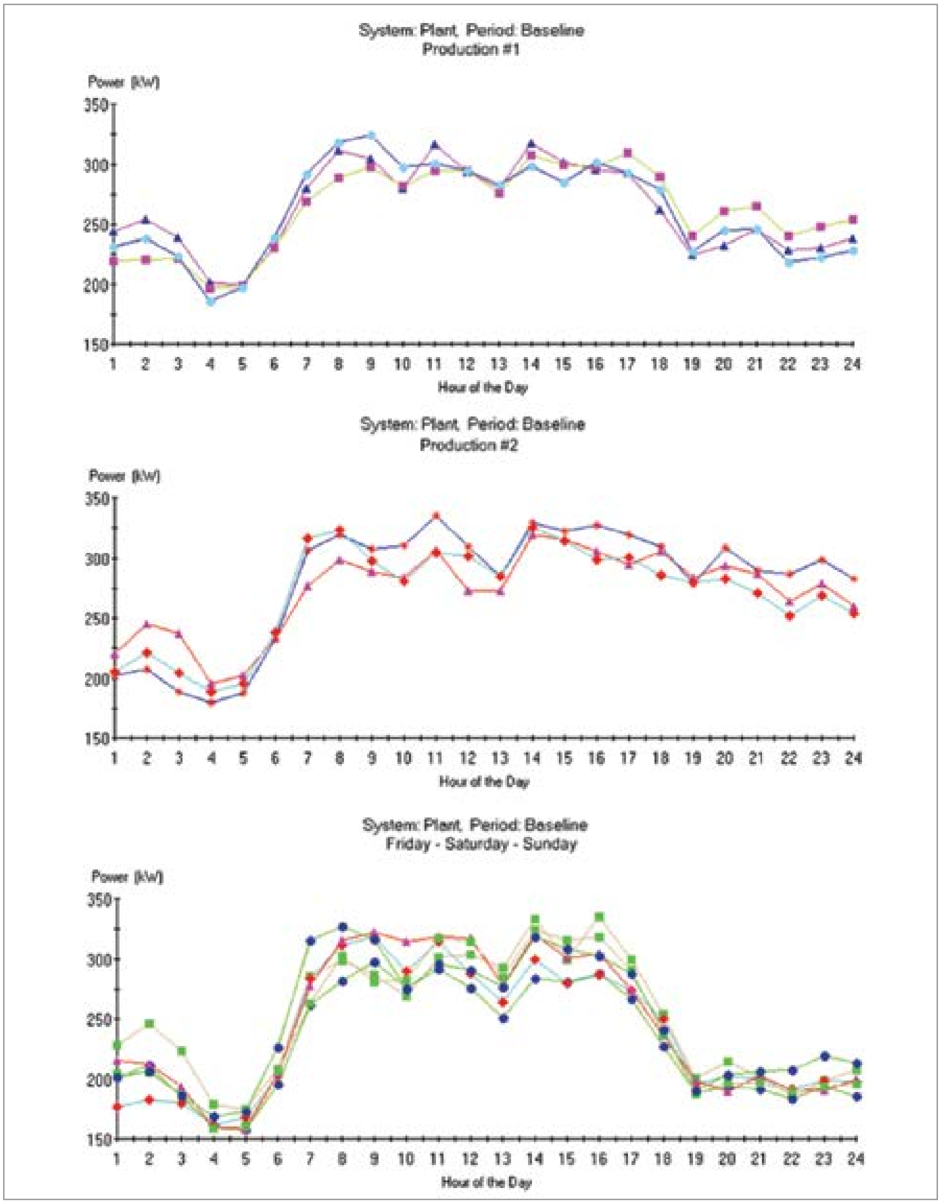


Figure 2: Shown are daily operating profiles with three typical operating periods.

energy efficiency measures is often applied as an average improvement of the average annual operation without regard to normal performance variations.

It is essential that performance analysis be sufficiently granular so as to properly model actual system operation. The variations in performance and the results of Energy Efficiency Measures (EEMs) are not proportional. For example, in the data above the average Total Power is 488.2 kWh and average Specific Power is 24.3 kW/100 cfm. At noon specific power is equal to the average of 24.3 kW/100 cfm while total power is 579.2 kWh, much greater than the average. On the other hand, at 5:00 am when the average Total Power is 486.8 kWh which is close to the average of 488.2 kWh; the average Specific Power is 21.9 kW/100 cfm, much lower than the average of 24.3 kW/100cfm. Performance characteristics of power – versus flow for air compressor capacity controls – are not linear. Therefore, granularity of performance analysis is necessary for valid results.

Also, it is unlikely every day of operation in any manufacturing facility is repeated exactly every day of the year. Annualized KPI and EnPI performance parameters are shown in shown in Figure 1. The operating profile statistics for the annual base year results are shown to be 24 hours per day, seven days per week, and 52 weeks per year. The actual base year performance for this system will likely be significantly different than the results described.

Identifying Typical Operating Periods

To improve accuracy of base year EnPI results, daily profiles of flow and power can be used to identify typical operating periods. When comparing daily operating profile charts as seen in Figure 2, three typical operating periods have been identified:

1. Production No. 1 has slightly lower hourly average power (kW); particularly in the evening hours.
2. Production No. 2 typical operating period by comparison has slightly higher kW.
3. Friday – Saturday – Sunday typical operating periods all having similar hourly average power (kW).

Annualized performance is projected by assigning the total annual operating time of each typical operating period. For example, using typical operating periods identified in Figure 2, and assuming 50 weeks (350 days) per year of operation, the Friday – Saturday – Sunday typical operating period would be assigned to 150 days of operation. Then if there are expected to be 20% more Production No. 1 than Production No. 2 typical operating periods; Production No. 1 would be assigned 110 days and Production No. 2 for 90 days.

Data mining and identification of typical operating periods combined with increased granularity of data analysis improves accuracy of annual projections for base year performance. When EEM's are evaluated with the same granularity, and typical operating periods of base-year analysis, the energy and cost savings projections are more realistic and reliable than when using only data averaging without regard to actual operating conditions.

Data Mining for "Right Size" Air Compressor Selection

The system shown in Figure 2 has a maximum air demand of 1,400 acfm. The proposed

USE BASELINE MEASUREMENTS TO IMPROVE COMPRESSED AIR SUPPLY PERFORMANCE

design is three, 150 horsepower (hp) air compressors with 750 scfm capacity each at 100 psig (110 psig max. full flow) and load/unload control, for baseload/trim/and reserve capacity. Does this appear to be a reasonable size selection? Is 750 cfm the air compressor size for the best supply/demand balance? What is the normal range of airflow required to the system? How much air demand is there and for what portion of the operating hours? Data mining baseline flow data, and analysis using a Histogram Chart will give us insight as to the normal variations in compressed air demand and operating hours at various air demand.

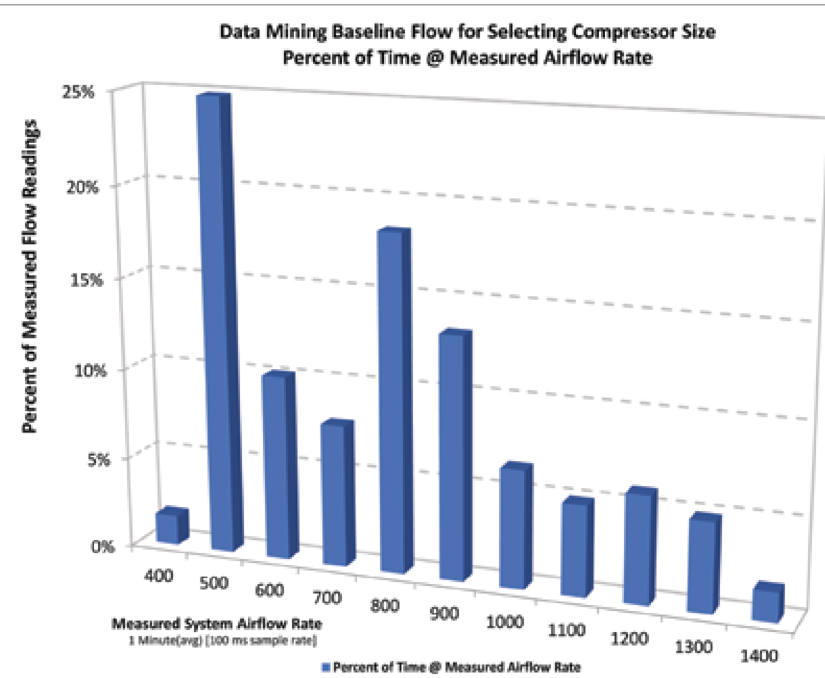
What is a histogram chart? A histogram is a type of bar chart used to sort numbers and determine how many times each number appears. As an example, let's roll the dice. Start with 999 dice and roll the dice to see how often the number is 1 or 2, how often it is 3 or 4 and how often it is 5 or 6. The histogram starts with three bins labeled "1 – 2," "3 – 4," and "5 – 6" and after rolling each dice we will place it in the bin for the number that was rolled. If we do this 999 times there should be 333 dice in each bin. The histogram chart would simply be three bars, one representing each bin and the height of each bar would be equal to 333, the number of dice in the bin.

Consider a system with baseline flow data measured once every six seconds for 13 days (187,200 flow measurement data points). Data at a six-second interval will capture dynamic performance including rapid increases and decreases in airflow. For the histogram analysis we want a more average flow rate, as would be delivered by the air compressors. Therefore, the first step is to calculate a one minute average of the six-second data, which results in 18,720 average flow readings as shown in Figure 3 (Note: it is also possible to calculate a rolling or moving one minute average). For the histogram plot, the bins have been assigned in 100 cfm increments up to 1,400 scfm. Do we expect an equal number of flow measurements to land in each 100 cfm bin, as with the dice? Of course not, airflow is not random like the dice are designed to be.

The histogram sorting 18,720 flow readings shown in Figure 3 reveals the lowest flow is between 300 and 400 scfm (only 13 readings, 0.1% are lower), and the highest flow readings are 300 data points (1.6%) are between 1,300 and 1,400 scfm.

Which of the three air compressor size selections below is the "right size"?

1. What insight is gained for our three 750 scfm, 150-hp air compressors sized with baseload/trim/reserve selection from the histogram of compressed air flow baseline data? The performance is 750 scfm at 100 psig (110 psig max. full flow) and 129.9 kW package power.
   - Airflow is in the range of 400 – 600 scfm for 35.0% of the operating time. Using a 750 scfm air compressor, the air demand is 53 to 80 percent of full load capacity for 35% of the time.



Bin		# of Data Points Bin Frequency	% Time Frequency
0 -	100	2	0.0%
100 -	200	1	0.0%
200 -	300	10	0.1%
300 -	400	310	1.7%
400 -	500	4652	24.9%
500 -	600	1897	10.1%
600 -	700	1457	7.8%
700 -	800	3444	18.4%
800 -	900	2487	13.3%
900 -	1000	1211	6.5%
1000 -	1100	931	5.0%
1100 -	1200	1102	5.9%
1200 -	1300	916	4.9%
1300 -	1400	300	1.6%
1400 -	More	0	0.0%
	Total	18720	100.0%

Figure 3: Shown is a histogram of baseline airflow measurement.

Air Compressors Qty x capacity & hp Storage volume	3 x 620 scfm 125 hp 1,860 (3 gal. / cfm)	3 x 750 scfm 150 hp 2,250 (3 gal. / cfm)	3 x 1030 scfm 200 hp 3,090 (3 gal. / cfm)	3 x 620 scfm 125 hp 3,100 (5 gal. / cfm)
Annual energy use	1,328,000 kWh / yr.	1,409,000 kWh / yr.	1,420,000 kWh / yr.	1,302,000 kWh / yr.
Annual cost ($0.10 / kWh)	$ 132, 800 / year	$ 140, 900 / year	$ 142, 000 / year	$ 130, 200 / year

Table 1: Charted is the comparison of annual energy use and costs for various air compressor sizes.

- Airflow is in the range of 700 to 900 scfm for 32% of the operating time. When the single 750 scfm air compressor is not enough capacity the second 750 scfm trim air compressor will start and operate between 0 to 20 percent of full load capacity.

2. As an alternative, consider a system with three, 125-hp air compressors delivering 620 scfm at 100 psig (110 psig max. full flow) and 107.4 kW full load (FL) package power.

   - Airflow is in the range of 400 – 600 scfm for 35.0% of the operating time. Using a 620 scfm air compressor, the air demand is 65 to 97 percent of full load capacity for 35% of the time.

   - Airflow is in the range of 700 to 900 scfm for 32% of the operating time. When the single 620 scfm air compressor is not enough capacity the second 620 scfm trim air compressor will start and operate between 13 to 45 percent of full load capacity.

   - Two 620 scfm air compressors would supply the system for 93.5% of the operating hours. The remaining 6.5% of the time all three air compressors would be required. If reserve capacity is necessary to cover 100% of the operating time, additional air compressor capacity would be required.

3. Finally considering future increase in air demand, proposed operation is two, 200-hp air compressors with a third machine as reserve capacity. The performance is 1,030 scfm at 100 psig (110 psig max. full flow) and 170.8 kW package power.

The energy use for each of the three systems is calculated with results plotted in Table 1. For each bin of the histogram chart energy use is calculated on the median air demand, e.g. for the 400 – 500 scfm bin air demand of 450 scfm is used. Energy calculations are based on using load/unload capacity control assuming three gallons of storage volume per cfm of the trim air compressor size. The right hand column is calculated with five gallons per cfm of storage, which is the same volume (3,100 gallons) as required for the system with three, 200 hp-air compressors.

Using insight gained through analysis of the system airflow histogram, it is determined that the 125-hp air compressor system will save $8,100 per year as compared to the system using 150-hp air compressors. Larger air compressors are often selected based on some unknown "expansion" and "future increase in air demand". The system operating 200-hp air compressors will cost $9,200 per year more for electricity than the 125-hp system. Over a five-year period, right sizing provides $40,000 to $46,000 in savings. In the future, if additional air compressor capacity is actually needed, energy savings could virtually pay for a new air compressor.

Data Mining – Valuable Information and Insight

As described in this article, compressed air system baseline performance measurements:

- Identified a control strategy improvement to shut down an air compressor running unloaded for long periods of time.
- Provided improved base-year performance EnPI's by identifying typical operating periods.
- Given information to "right size" air compressor selection with the most efficient supply/demand balance.

Data mining compressed air system baseline performance measurements can unlock the vast pool of baseline data to provide valuable information and fascinating insights in other areas of compressed air system design, performance and efficiency. Dynamic performance analysis can identify air storage opportunities. Pressure profile data can identify irrecoverable pressure loss and opportunities to reduce air compressor operating pressure. Compressed air waste, particularly losses to artificial demand can be identified and evaluated. BP

For more information, contact Tom Taranto, Data Power Services, tel: 315-635-1895, email: tom@datapowerservices.com.

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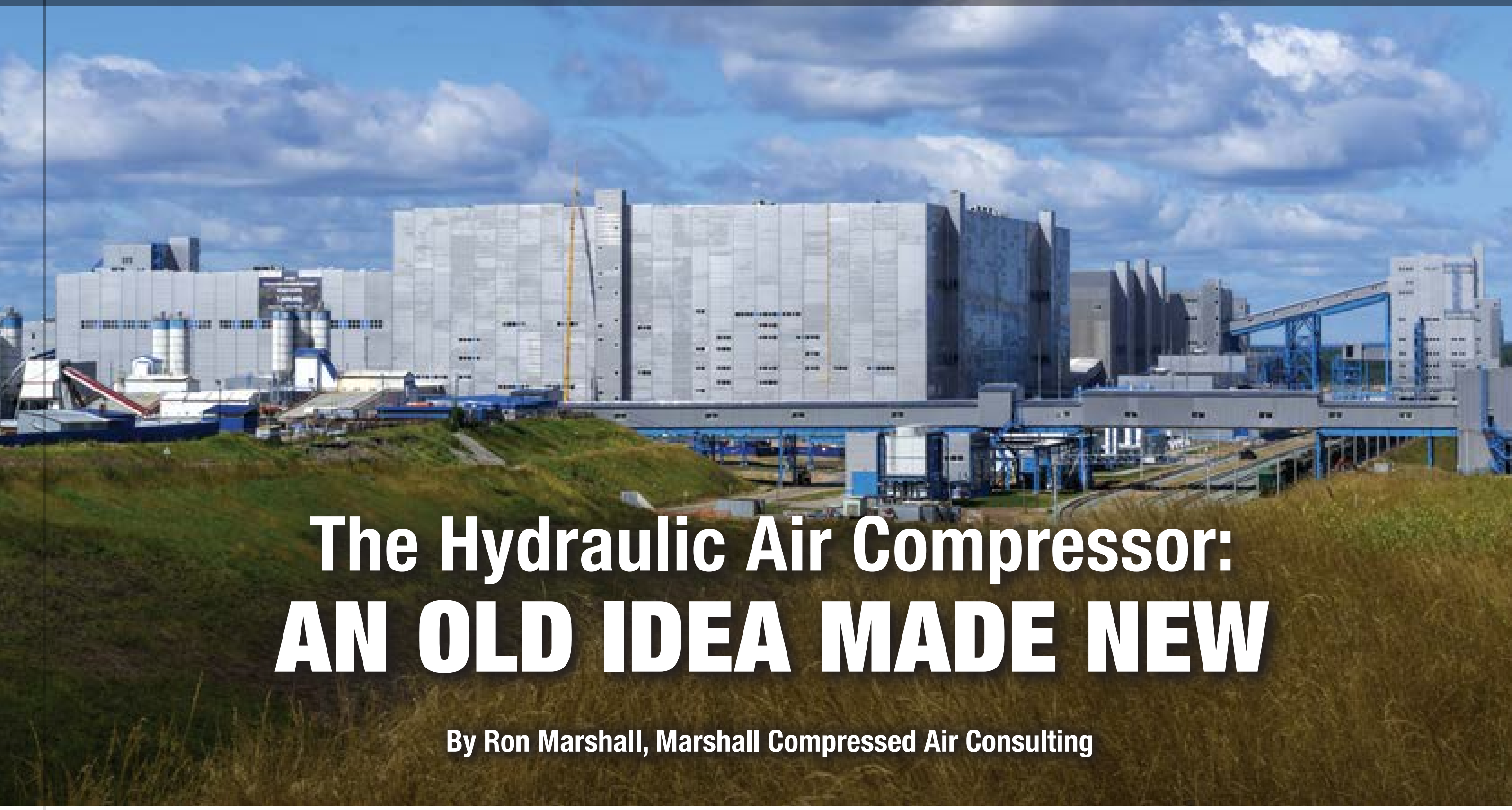


The Hydraulic Air Compressor: AN OLD IDEA MADE NEW

By Ron Marshall, Marshall Compressed Air Consulting

At Laurentian University in Northern Canada, a team of well-educated individuals, headed by Professor Dean Millar, Full Professor at the Bharti School of Engineering, are striving to make the old new again. Their efforts are directed toward developing commercially viable hydraulic air compressors (HACs) for the world to use, especially since these devices can more efficiently produce compressed air isothermally, rather than through polytropic compression as with a typical mechanical air compressor.

In pursuing this goal the team is building on engineering concepts that were used to develop the first hydraulic air compressor at Dominion Cotton Mills, Magog, Quebec, Canada, over 100 years ago. The basic principles of the HAC were then used to produce compressed air at 17 locations worldwide, including the last at Ragged Chutes near Cobalt, Ontario, Canada, over 100 years ago. This article discusses the development the HAC in this decade and the continuing work at Laurentian University, Ontario, to modernize the concept.

Taylor's Hydraulic Air Compressor

Professor Millar said his interest in the HAC technology started with a bit of serendipity.

"I was at the local Vale smelter in Sudbury studying the design of a direct-contact heat exchanger, and then someone told me to go have a look at an industrial heritage website where I came across a diagram of Taylor's Hydraulic Air Compressor at Ragged Chutes," Millar said.

> "Research on reviving the use of hydraulic air compressors started when the mining industry was looking for ways to efficiently power turbo coolers for reduction of ambient air temperature in ultra-deep mines."
>
> — Ron Marshall, Marshall Compressed Air Consulting

"At first I thought I was looking at a 100-year-old direct contact heat exchanger, but then realized this device was both an air compressor and a heat exchanger, and the design could be used to improve compression efficiency compared to current methods."

Millar, a mining engineer who also cut his teeth in his formative years working on wave power generation in the United Kingdom, was fascinated. It was the start of a wonderfully interesting project, improving on Charles Havelock Taylor's design to make it more useful for industry. Taylor was a New Brunswick businessman and engineer.

As the story goes, it was during the construction phase of a water dam in Quebec in 1895 when Taylor noticed something strange during winter conditions. Specifically, the water flow through the dam spillway carried air bubbles under the river ice, which then pushed up to form ice domes. When probing the dome, Taylor noticed the air beneath the ice was compressed due to the weight of the water.

Taylor immediately realized there were commercial uses for this phenomenon and started to experiment with hydraulic air compressor models in his Montreal warehouse; he soon had enough confidence to persuade investors to form Taylor Air Compressor Company, building the first commercial hydraulic air compressor for Dominion Textile, a 155-horsepower (hp) assembly putting out 52 psi at 60% efficiency. The unit operated successfully until 1953 when fabric weaving machine technology changed and pressures had to increase.

Two other air compressors were built in the late 1800's, including one with a 1,354-foot wooden plume, and one at Peterborough Lift Lock in Canada, which caught the interest of companies worldwide. In the early 1900's, two other plants were built in Washington state and Michigan, with pressures reaching 117 psi. Other plants were constructed in Germany and Peru.

Enough Air to Power Multiple Mines

Taylor's crowning achievement was the development of the Ragged Chutes HAC on the Montreal River in Cobalt. Mineral deposits of silver, cobalt and nickel were found in around 1884 in this then isolated area located about 300 miles directly north of Toronto, Canada, and about 100 miles North East of Sudbury, Ontario.

Transmitted electrical power was not available, and coal power was thought to be too expensive, so it fell on the mine developers to come

This demonstration HAC was built at Dynamic Earth in Sudbury, Canada, and is open for tours to allow visitors to see the technology. Photo courtesy of Electrale Innovation Limited.

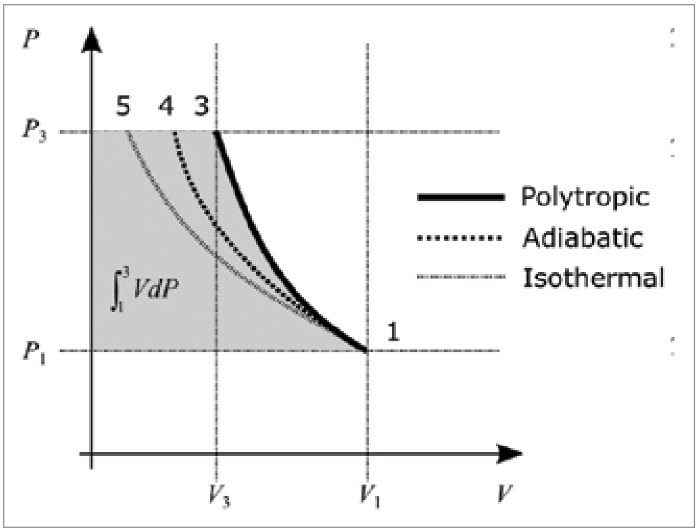
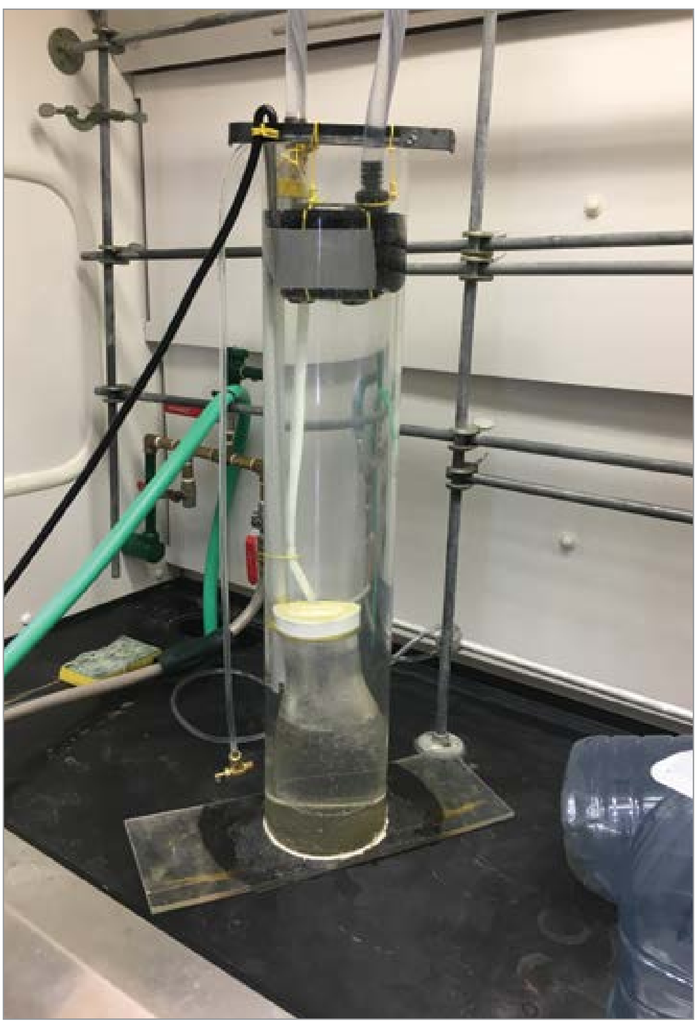


Figure 1: The hydraulic compressor is nearly isothermal (light-dotted grey line). Therefore, the production of compressed air requires less work than a standard polytropic compressor (black solid line). Chart courtesy of Electrale Innovation Limited.

THE HYDRAULIC AIR COMPRESSOR: AN OLD IDEA MADE NEW

up with an economical way to power mine power tools and drills, which were pneumatically operated, as some are today. Taylor paid a visit to the area and found conditions suitable for a hydraulic air compressor, so plans were put in place to harness the nearby Montreal River to provide water power.

This HAC was built and placed in service in 1910 and was by no means a small device. The capacity of the air compressor was 40,000 cfm at a pressure of 120 psi compressed through dual downcomers, measuring 8.5 feet in diameter and 341 feet in depth carved into the Canadian Shield rock. An underground cavern, used to separate the air from water, was 927 feet long and 20 by 26 feet in width. The air compressor was connected to approximately 30 mines in the area using 40 kilometers of 24-inch steel pipe. There was enough compressed air volume in the system to power the various mines for a week with the air compressor shut down.



This PortaHAC tabletop unit demonstrates the basic principles of a HAC on a small scale. A video of a working model can be viewed at https://www.youtube.com/watch?v=Sqn0nThkPh4&feature=youtu.be.

Leveraging River Water at Ragged Chutes

The HAC at Ragged Chutes used the flow of river water across an elevation change in the Ragged Chutes rapids to provide flow into the network of caverns. The river did not provide the full 341 feet of head required to compress to 120 psi, it only needed to push the water first through the inlet shafts, then through the separation chamber, and then up though the discharge shaft that returns the water to the river.

As the water flows into the intake shaft, it carries with it entrained air bubbles. As the air gets deeper and deeper into the water column the compression takes place. Unlike a normal air compressor, the compressed air temperature does not rise appreciably, making the compression process isothermal as detailed in Figure 1, which is the most efficient way to compress the gas. Pressure regulation is provided by a blow-off system. As the air pressure increases the water level in the underground chamber lowers, uncovering the end of a blow off pipe. This is the most impressive part of the old Ragged Chutes air compressor. The blow-off of compressed air and water created a plume reaching 220 feet in the air.

This air compressor had no moving parts and required no external energy input. Once its construction cost was paid for it essentially gave free compressed air over its 70-year lifespan. The air compressor in its applied design, however, required a good supply of river water and a very deep hole in the ground, conditions that are not always available where compressed air is needed. However some of these requirements are present in modern day mine sites. With a few modifications to the design, it was felt by the Laurentian University team that a viable HAC could be constructed without river water power. (For more about the Ragged Chutes HAC, visit www.cobaltmininglegacy.ca/power.php.)

Making the Old New

Research on reviving the use of hydraulic air compressors started when the mining industry was looking for ways to efficiently power turbo coolers for reduction of ambient air temperature in ultra-deep mines. If this could be done economically the depth of the mines could be extended, prolonging the life of some mines by a decade or two.

After a few years of research a group of organizations wrote a paper, "Conceptual Design of a Modern-day Hydraulic Air Compressor," and presented it at the 2015 International Conference on Efficiency, Cost,

This laboratory-scale HAC, which is about 15 feet tall, is used for basic testing in a controlled environment. Alex Hutchison (pictured) is a Project Engineer with Electrale Innovation Limited. He played a key role in the development of the modern HAC.

Optimization, Simulation and Environmental Impact of Energy Systems. The paper proposed construction of an HAC demonstrator unit in Sudbury at Science North's Dynamic Earth. The construction of the unit was completed in the summer of 2017. It was used for testing to prove predicted efficiency and the viability of commercial-sized air compressors.

The demonstration unit differs from the Ragged Chutes air compressor in that the head of water used to provide the down flow of water in the intake shaft, and the entrainment of bubbles, is now provided by a system of parallel pumps. In addition, the water flow operates in a closed loop rather than being a once-through design.

THE HYDRAULIC AIR COMPRESSOR: AN OLD IDEA MADE NEW

HAC units of modern design are projected to provide much longer useful life than standard screw-type air compressors and be easier to maintained once installed due to the few moving parts. The units are capable of variable flow due to the design, making it easy to match the output to the demand. The production provides cool and clean oil-free air that does not contain excess moisture that might be produced by air-cooled air compressors in hot environments.

For demonstration and testing purposes there are actually three models of HAC units at the University, including a tabletop "PortaHAC" unit used to demonstrate the basic principles shown in Figure 1, a laboratory sized model, and the unit at Dynamic Earth producing about 30 psi.

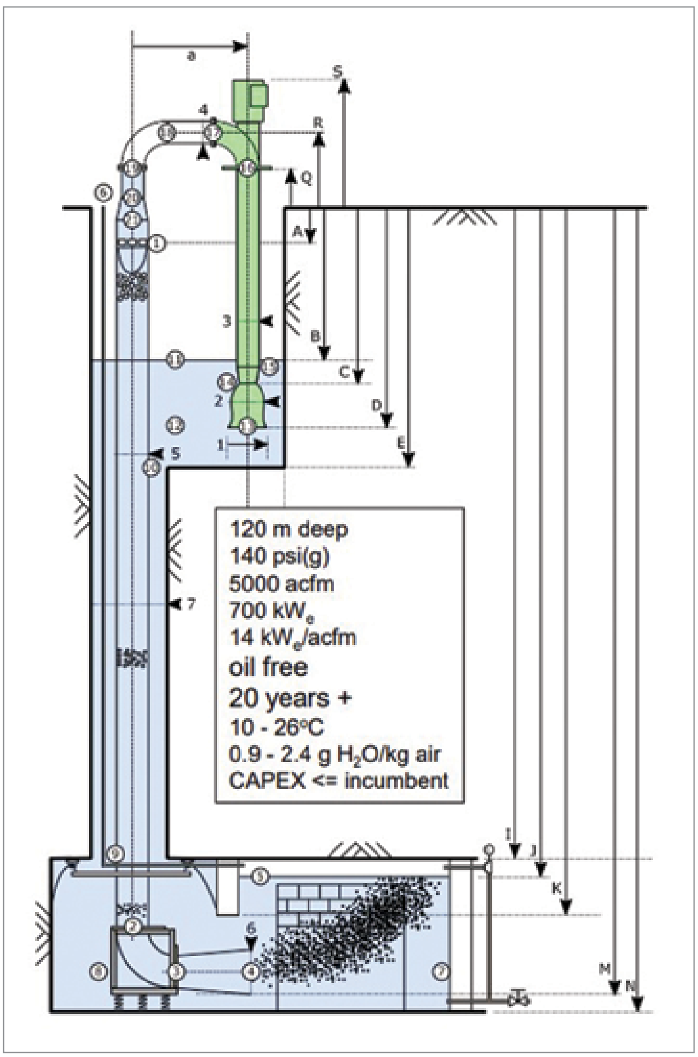


Figure 2: Shown is a conceptual diagram of a large scale HAC for the mining industry that would produce 5,000 acfm at 140 psi at a specific power of 14 kW/100 cfm. The unit is expected to have a 20-plus year lifespan. Image courtesy of Electrale Innovation Limited.

The extensive testing of these units with very precise instrumentation has confirmed that the modern closed-loop design produces compressed air within expectations at around 71% efficiency. In terms of specific power the demonstration unit achieves 10.9 kW per 100 cfm at 31 psi discharge pressure while producing 244 scfm of compressed air. The most important theoretical prediction confirmed experimentally at the HAC demonstrator is that the temperature rise of the air during compression is consistently and repeatedly on the order of 0.01 °C – nearly isothermal!

Work is proceeding on the design of the HAC unit for a number of interested clients worldwide. Electrale Innovation Limited, a company formed by Professor Millar, who also serves as the company CEO, is in the business of promoting commercial development of the modern HAC. The company's estimates show specific power of 14 kW/100 cfm is expected for an example system producing 5,000 acfm of oil-free air at 140 psi as shown in Figure 2.

"We are looking to develop commercial large-scale Hydraulic Air Compressors for both underground and above ground installations." said Professor Millar. "Think of a large wind turbine with no rotor or nacelle at the top. This could be the configuration of modern HAC units where there are no mine shafts to use."

He said efforts are continuing to develop very large scale HAC units, where it seems the bigger they are, the more efficient and economical they become.

Energy Efficiency for Large Applications

The work in developing the modern day HAC shows some old ideas can become new again and will be useful in providing energy efficient solutions for large industrial applications. HAC units can be used to produce a large flow of good quality compressed air through a simple process that requires minimal maintenance and lasts for decades. And with above-ground HAC units the sky is the limit! BP

For more information about the HAC project, please contact Dean Millar, CEO, Electrale Innovations Limited, email: dmillar@electrale.com; tel: 705-918-1613, or visit https://electrale.com/.

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

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RESOURCES FOR ENERGY ENGINEERS

TECHNOLOGY PICKS

New Kaeser VFD Models with Improved Efficiency

Kaeser Compressors has redesigned its Sigma Frequency Control (SFC) 45, 55, 75S, 90S and 110S compressors with advanced SynRM motor-drive combinations. These 60-125 hp units offer better part-load efficiency, longer service life, and reduced maintenance costs.

Developed in partnership with Siemens and specifically designed to work with Kaeser's SFC models, the SynRM motor-drive combination achieves top tier IES2 classification. This results in better specific performance, especially in the part-load conditions that call for variable speed compressors.

They do not use aluminum, copper, or expensive rare earth metals in the rotors. Instead, they are made of electrical steel and feature a special profile. With this unique rotor design, the motors run cooler – resulting in lower bearing and winding temperatures and increased motor life. And because there are no magnets in the rotor, motor service is safer and easier.

To further enhance overall sustainability, SFC T models with the optional integrated refrigerated dryers have been upgraded with R-513A, a non-flammable, non-toxic advanced formulation refrigerant. R-513A has 56% lower global warming potential (GWP) compared to the current US standard (R-134A). This, combined with Kaeser's advanced heat exchanger design, reduces refrigerant requirements without compromising dryer performance.

For more information, visit us.kaeser.com/SFC or call (877) 417-3527 to be connected with your local authorized Kaeser representative.

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Kaeser Compressors is a leader in reliable, energy efficient compressed air equipment and system design. We offer a complete line of superior quality industrial air compressors as well as dryers, filters, SmartPipe™, master controls, and other system accessories. Kaeser also offers blowers, vacuum pumps, and portable gasoline and diesel screw compressors. Our national service network provides installation, rentals, maintenance, repair, and system audits. Kaeser is an ENERGY STAR Partner. For more information, visit www.us.kaeser.com.

Kaeser Compressors has redesigned VFD models in the 60-125 hp range.

New Fluke ii900 Sonic Industrial Imager Pinpoints Compressed Air Leaks

According to the Compressed Air and Gas Institute (CAGI), the average compressed air system loses 30 percent of its air through leaks but locating those leaks has been a time-consuming and tedious process. The new Fluke™ ii900 Sonic Industrial Imager enables maintenance teams to quickly – and visually – pinpoint the location of compressed air, gas, and vacuum system leaks even during peak production periods. Leaks can be detected in a matter of minutes.

With minimal training, technicians can identify compressed air leaks considerably faster than using traditional diagnostic methods. Now checking for air leaks can be performed during the typical maintenance routine. An array of microphones combined with the new SoundSight™ technology, the handheld Fluke ii900 Sonic Industrial Imager filters out background noise so maintenance teams can accurately locate leaks in compressed air systems, even in the noisiest environments.

"We rely heavily on air – it's one of the most important utilities we have coming into the building," said Josh Stockert, maintenance technician III at Genie (A Terex Brand). "With the Fluke ii900 Industrial Imager, we can stand on the sideline and inspect the air line that goes across while carts and people are moving underneath. We're not affecting them, but we can tag it then fix it at lunch instead of waiting for a premium weekend shift to fix it. "Now we don't have to look at adding new, bigger

TECHNOLOGY PICKS

The new Fluke ii900 Sonic Industrial Imager uses new SoundSight™ technology.

compressors or receiver chains, so not only is it capacity and energy savings, but now we're talking about a capital savings."

The seven-inch LCD touchscreen overlays a SoundMap™ on a visual image for quick leak location identification. The straightforward, intuitive interface allows technicians to isolate the sound frequency of the leak to filter out loud background noise. In a matter of hours, the team can inspect the entire plant – during peak operations. Images can be saved and exported for reporting purposes.

The Fluke ii900 was designed in partnership with Sorama, an Eindhoven-based company specializing in noise control and sound analysis solutions. The combination of Sorama's long history and expertise in acoustic imaging and Fluke's leadership in diagnostic industrial test and measurement equipment lead to the creation of a tool that has the durability and usability required for industrial maintenance applications.

How much could a company save if you could see sound? Watch the video. For more information on the Fluke ii900 Sonic Industrial Imager visit www.fluke.com/ii900.

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Gardner Denver Launches Air Cooled Oil-Free Ultima U-Series

Gardner Denver is excited to announce an addition to the Ultima family of compressors with the launch of the air-cooled Ultima U 75-160 Series, the first and only air-cooled oil-free air compressor on the market, capable of both air and water cooling. Utilizing heat recovery for process water heating, the air-cooled Ultima allows for the collection and recovery of up to 98% of the heat generated by the compression process. The Ultima U-Series is a game changing oil-free compressor design. The addition of the air-cooled U-Series models helps solidify Gardner Denver's edge in the market. For more information visit www.gardnerdenver.com/gdproducts

About Gardner Denver

Gardner Denver (NYSE: GDI) is a leading global provider of mission-critical flow control and compression equipment and associated aftermarket parts, consumables and services, selling across multiple attractive end-markets within the industrial, energy and medical industries. For more news and information on Gardner Denver, please visit www.gardnerdenver.com.

Gardner Denver U-Series Air-Cooled Oil-Free Air Compressor

RESOURCES FOR ENERGY ENGINEERS

TECHNOLOGY PICKS

The new Atlas Copco NGM Membrane Nitrogen Generator.

New Atlas Copco Low-Flow Membrane Nitrogen Generators

The latest addition to its family of nitrogen generators, Atlas Copco's new, low-cost NGMs 1–3 membrane technology units offer a highly efficient, compact and simple on-site solution for low-flow N2 requirements, with the added benefits of minimal maintenance and operational costs. There are three models in the new NGMs range.

The NGM generators boast an extremely fast start-up time, taking only a few seconds to produce nitrogen at the outlet, resulting in maximum uptime assurance and continuous availability of nitrogen 24 hours a day, seven days a week. Additionally, the generator offers zero performance loss at high ambient temperatures and very low service requirements.

"Atlas Copco's membrane nitrogen generators are flexible enough to adapt to specific applications, including tire filling, safety blanketing in hazardous environments, and many other general industrial uses with purities ranging from 95 to 99.99-percent," stated Brett Maiorano, business development manager of Industrial Gases at Atlas Copco. "With this versatility, combined with low operating costs attributed to an industry-low air factor, these new low-flow generators offer an attractive return on capital investment."

The NGMs generator units consist of one or multiple high-performance membrane modules that are combined to achieve the nominal inlet flow, ensuring the maximum output of compressed nitrogen for the minimum input of compressed air in a wide range of operating conditions.

COMPRESSED AIR BEST PRACTICES®
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A Publication of: Smith Onandia Communications LLC, 37 McMurray Rd. Suite 106, Pittsburgh, PA 15241

Compressed Air Best Practices® (USPS# 17130) is published monthly except January-February combined by Smith Onandia Communications LLC, 37 McMurray Rd., Suite 106, Pittsburgh, PA 15241. Periodicals postage paid at Pittsburgh, PA and additional mailing offices. POSTMASTER: Send address changes to: Compressed Air Best Practices®, 37 McMurray Rd, Suite 106, Pittsburgh, PA 15241.

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Dry compressed inlet air is separated into component gases by passing it through semi-permeable membranes consisting of bundles of extremely small individual hollow fibers packed into a limited space. This provides a very large membrane surface area to produce a relatively high-volume product stream. As water vapor also permeates through the membrane, the nitrogen gas stream is very dry, with dewpoints as low as -58 ˚F.

In order to allow continuous operation during its extensive lifetime, the nitrogen generators are equipped with a two-stage premium pre-filtration system to ensure an inlet air quality of [1:-:1] according to ISO 8573-1:2010. This eliminates the risk of the membrane being damaged by a low-quality compressed air supply, a poor start-up or an unexpected shut-down.

The generators are supplied as an all-in-one, integrated package complete with filters. An oxygen sensor is an optional feature. Fitted with pressure gauges to ensure accurate system monitoring at all times, the ready-to-use units are housed in a fully enclosed protective canopy. No specialist installation or commissioning is required – only a supply of dry compressed air. Optional features include an oxygen sensor and an economizer valve set – which uses two differential pressure valves to cut off the nitrogen supply to avoid wasting power – which can dramatically increase the savings and reduce cost.

The NGMs 1–3 generators complement Atlas Copco's existing range of on-site gas solutions, including both nitrogen and oxygen generators. Its range of nitrogen generators are available with both membrane and PSA technologies, covering a wide range of flow capacities, purity levels and guaranteed reliability, supported by a wide range of options – all with the goal to provide the lowest cost of ownership for your nitrogen supply.

Atlas Copco Group & Atlas Copco Compressor Technique

Great ideas accelerate innovation. At Atlas Copco, we have been turning industrial ideas into business-critical benefits since 1873. Our passionate people, expertise and service bring sustainable value to industries everywhere. Atlas Copco is based in Stockholm, Sweden, with customers in more than 180 countries and about 37,000 employees. In 2018, revenues were BSEK 95, approximately 10 BUSD. Atlas Copco Compressor Technique partners with customers to turn industrial ideas into smart, connected air and gas solutions and leading-edge compressed air technology. By listening to our customers and knowing their needs, we deliver value and innovate with the future in mind.

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Atlas Copco Compressors

Atlas Copco Compressors LLC is part of the Compressor Technique Business Area, headquartered in Rock Hill, South Carolina. Atlas Copco Compressors provides innovative solutions including world-class compressors, vacuum pumps, air blowers, quality air products and gas generation systems, all backed with full service, remote monitoring and auditing services. With a nationwide service and distribution network, Atlas Copco Compressors is your local, national and global partner for all your compressed air needs. Learn more at www.atlascopco.com/air-usa.

New Safety Cable for VPFlowScope M

Over the past 20 years VPInstruments has supplied many compressed air flow meters to customers worldwide. We had zero accidents with them in the field, and we would like to keep it that way.

To ensure safe installation, our VPFlowScope M comes with a proprietary safety cable for installation under pressurized conditions. The design has proven itself. At VPInstruments we highly value safety though and we have decided to upgrade the safety cable further to a thicker and sturdier version so use applications are covered.

The thickness of the cable has been increased from 2.5 mm (0.098") to 3 mm (0.118"), resulting in a 1.4 times higher strength. Furthermore, the endings of the safety cable have also been strengthened.

At VPInstruments, we continuously strive to improve the quality of our products, to make them more reliable, and easier to use over time. That's also a way to provide easy insight into energy flows.

About VPInstruments

VPInstruments offers industrial customers easy insight into energy flows. We believe that industrial energy monitoring should be easy and effortless, to enable insight, savings and optimization. VPInstruments' flow meters are calibrated on state-of-the-art calibration facility. Our calibration equipment is maintained under our ISO 9001 Quality Management System and is traceable to National Standards. Let us open your eyes and start saving energy. For more information, visit www.vpinstruments.com

Ashcroft T6500 Gauge Withstands Overpressure

The Ashcroft® T6500 stainless steel, solid front pressure gauge is now available with the XRA overpressure option. This feature adds an overpressure mechanism that restricts the motion of the Bourdon tube after the specified full scale value is reached. As a result, the gauge can withstand up to 400% overpressure without damage, often eliminating the need for an external pressure limiting valve. It is especially useful in applications where pressure spikes and water hammer are a threat.

For more information, please call 203/385-0635 or visit www.ashcroft.com

To ensure safe installation the VPFlowScope M comes with a proprietary safety cable.

The Ashcroft T6500 Pressure Gauge.

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Mikropor America Inc. is seeking exciting, self-driven & performance oriented compressed air professionals to join our team. We are searching for 2 team members to fill our Northeast and Midwest Territories. Position focus is to assist distributors in growing their business through the application and sale of Mikropor products.

Mikropor America Inc., headquartered in Michigan City, Indiana, offers a broad range of energy efficient solutions for the compressed air industry such as: Refrigerated and Desiccant Air Dryers, Nitrogen Generators, Air/Oil Separators, Compressed Air Filtration, Air Intake Filters, and aftermarket replacement filtration elements for compressed air. Mikropor is proudly a CAGI Performance Verified Group Member.

To learn more about us visit www.mikroporamerica.com. Please send resume with cover letter to nitin@mikropor.com.

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