When Green Is Good Business

Sustainability Through Ultrasonic Energy Conservation

by Allan Rienstra

In 2008, there arose a broad selection of solution providers specializing in helping the community of maintenance and reliability professionals to 'Go Green'. It is unlikely that the original mandate of most of these companies was to "help save the environment", but it does show how nimble entrepreneurialism adjusts to accommodate the demands of corporate social responsibility. The term corporate social responsibility eventually gave way to the broader catchphrase "sustainability" in 2008. Maintenance departments formed energy management teams to focus on the dual win of saving both money and the environment with efficiency initiatives. For them, and most of us, the definition of "sustainability" closely mirrored that of the trusted EPA; "meeting the needs of the present without compromising the ability of future generations to meet their own needs." In 2009, sustainability may well be redefined as "doing whatever it takes to keep our doors open for business."

A stubborn economic and environmental crisis grips the globe. There are obvious virtues to positioning our business as a provider of green solutions with benefits for both energy savings and reducing a factory's carbon footprint. This is the re-emphasis of an original mission statement made some thirty years ago when ultrasound inspection first appeared as an answer to curbing sources of waste energy in factories, but this time around the stakes are higher.

As consumers we have an insatiable thirst for electricity, and the fossil fuels consumed by its creation. That fossil fuels are running scarce is not just rhetoric. Conservation must be made as mandatory as the ongoing search for alternative energy sources is. Those alternatives will have to be planet friendly, as the reckless use of energy has loaded our environment with CO2 and other greenhouse gases, changing our planet forever. Expect continued and dramatic changes in global weather patterns illustrated by extreme storms, draughts, cold waves, and heat waves. And while the price per barrel of oil was low at the time of writing, expect higher prices to return as the globe moves through, and out of recession. Now is the time to look to your airborne ultrasound program for some assurance about your company's sustainability in 2009.

Airborne Ultrasound Inspection

Airborne ultrasound inspection refers to the technology of detecting and localizing the sources of ultrasonic phenomena for the purpose of identifying a) sources of wasted energy, b) sources of mechanical failure, c) sources of electrical failure, and d) faults within a machine without intrusion or shutdown. These problems all have one characteristic in common; they produce noise in the ultrasonic range with peaks between 35-40 kHz. Ultrasound inspection is useful because it focuses on these specific noises while filtering away ambient plant noise, making it extremely handy in loud plants. This makes the technology available for use during peak production hours, reducing the need for overtime. It is advantageous to use this technology to pinpoint the source of problems because ultrasound is more directional than audible sound. Subtle changes to plant machinery can be heard in the ultrasonic frequencies first. Inspectors are rewarded with an earlier indication of a problem, and a larger window to schedule repair. So ultrasound inspection extends the abilities of human hearing and empowers companies to pursue some of the easiest wins in the sustainability business.

Going "green" and saving energy are two separate ideals that merge by circumstance, and focus on a campaign with huge potential wins. This battle starts in the air compressor room (supply side) and branches throughout the facility (distribution) to wherever air is needed (demand side). Along the way there are leaks, wasted dollars spent and energy consumed, all the while enlarging your carbon footprint. Take a look at the benefits of a well managed compressed air leak program.

Here are some compelling reasons to tighten your compressed air system.

- Compressed air production is the 2nd or 3rd highest source of energy consumption in most companies.
- On average, air compressors account for 18% of all industrial electrical consumption in European manufacturing plants. Some suggest that compressed air costs account for as much as 30% of a manufacturing plant's electricity bill.
- For every kWh spent on compressed air, an additional 0.8kg of CO2 per month is spewed into our atmosphere.
- 75% of the total cost of your compressed air

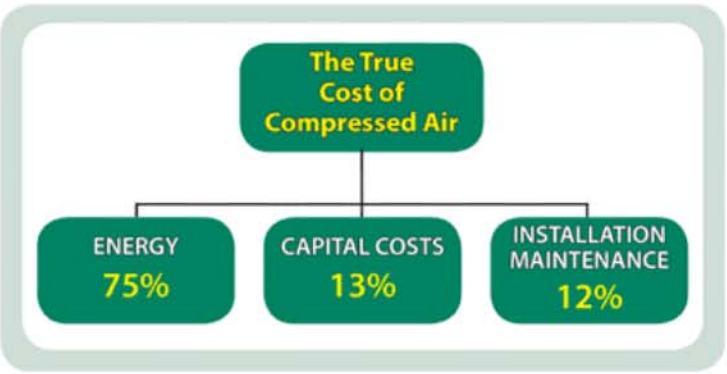

Figure 1 - The True Cost of Compressed Air

system goes to your electricity provider. The other 25% is accounted for by capital costs and ongoing maintenance.

- On average, only 43% of compressed air produced gets used to satisfy real demand.
- On average, 34% of compressed air produced is wasted to leaks.
- The remainder is consumed by wasteful applications and artificial demand.

Reducing energy consumption starts with getting your system leakage under control, but should include more than just ultrasonic leak detection. To get a handle on the total opportunity represented by a greener compressed air system, a plant should hire a consultant to conduct a compressed air audit. A consultant examines the entire system, which is broken down as Supply, Distribution, and Demand. The auditor looks at your system objectively and will recommend improvements that, when implemented, will see more SCFM flowing to demand, and a positive impact to bottom line. Partnering with a quality compressed air auditor is a definitive step toward sustainability.

The United States Department of Energy (DOE) says "The best way to detect leaks is to use an ultrasonic acoustic detector, which can recognize high frequency hissing sounds associated with air leaks. These portable units are very easy to use." The main point here is that leaks create a high frequency sound which can be difficult to hear, and to pinpoint, without the aid of an ultrasound detector. Leaks produce turbulence when air flows from the high pressure side to the low pressure side. It is this turbulent flow, which we associate with the characteristic hissing sound of a leak, which generates noises with both low and high frequency sound components. The low frequency sound components are audible to the human ear, but masked by the noise of the plant. The high frequency sound components (ultrasonic) are inaudible to the human ear, but are detected above the noise of the plant. Perhaps most important in our ultrasonic search for leaks is the directional nature of ultrasound. This gives inspectors the ability to hear leaks while the plant is operating, and to pinpoint their location quickly so they can be tagged or fixed.

Compressed Air Audits

Paul Edwards, a principle with Compressed Air Consultants, USA of Charlotte, NC is a compressed air auditor for whom I have a great deal of respect. He recently wrote, "Leaks are an important aspect of compressed air improvement projects and a good study documents the leaks without focusing on them… …The real value in ultrasonic detection is in increasing the speed at which leaks can be located and tagged." Edwards sees ultrasonic leak detection as a speedy alternative to listening with the unaided ear, or even using water and soap mixtures to look for bubbles.

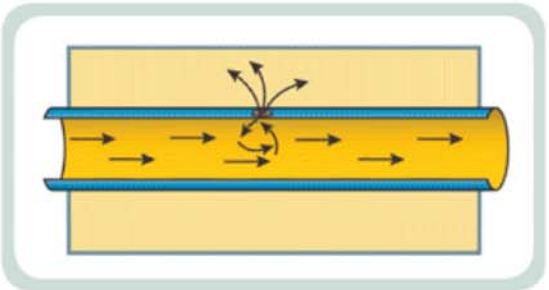

Figure 2 - Air Turbulence is determined by the size and shape of the leak and by air flow.

Figure 3 - Using a flexible sensor to find a compressed air leak on an instrument air line.

Leaks can be detected from as close as an inch or two, or as far away as fifty feet or more. The distance of detection depends on two factors: the energy of the turbulent flow, and the type of sensor used. The turbulent energy is dictated by the pressure of the system and the size or shape of the orifice (see Figure 2). Lower pressures will produce lower turbulent flow, but smaller orifice size will restrict flow and can actually increase turbulence. Think of a garden hose and what happens when you restrict the flow of water with your thumb. Less water flows from the hose, but with greater force. Likewise in an air line, a smaller orifice may mean less air, but more turbulence. The leak may sound louder in the ultrasound detector's headset, but in fact the loss from that leak may not be much. To accommodate both close up and far away leaks, ultrasonic detector manufacturers produce different sensors for different situations. Flexible wand sensors are used for near inspections and tight access areas while parabolic sensors with laser sights are used to pinpoint leaks in overhead piping without the need for ladders.

The Anheuser-Busch Story

One forward thinking industrial leader chose better economical times than today to ensure their sustainability. Anheuser-Busch is one of the world's largest brewers, operating 14 breweries, 12 in the United States and two overseas. In business since 1852, there is more than 150 years of brewing tradition in their keg, making them a true American success story. Anheuser-Busch did not get where

they are today without an effective predictive maintenance and reliability strategy. It's paramount to providing consumers with a high quality product that is well priced and profitably manufactured.

Anheuser-Busch began investigating Predictive Technologies in 2000. They had a vision of their ultimate goal, but recognized there would be hurdles along the way. Their decision to implement ultrasound inspection was based on the immediate return on investment through reduction of compressed air and CO2 leaks (no one likes flat beer), and improvement of their steam processes through the identification of faulty steam traps and leaks. The driving force was the immediate cost savings through the reduction in air loss because of leaks and misuse.

Where does a company start when developing a long-term program? The first step was to develop policies, best practices and standard operating procedures. "You must remove the option of performing Ultrasonic Inspections" recounts Dan Durbin, corporate engineer and the man charged with piloting this project. A policy was written which required Ultrasonic Inspections to be conducted. Best Practices and Standard Operating Procedures were written to support the policy. Procedures included "how to implement an ultrasonic program", "how to conduct a scan", and "how to use the equipment." Anheuser-Busch leaned heavily on their ultrasound vendor to implement their program.

An in-house Computer Based Training (CBT) module was developed for the large number of operators that had to be trained. Its focus was to provide the training necessary to identify and quantify air, steam, and CO2 leaks. A cost calculations spread sheet was developed so that each plant manager could select their Brewery and fill in the decibel readings to determine the potential savings from repairing the leak.

Two major hurdles that threatened the project were costing, and getting buy-in at the brewery level, especially since this was a corporate down initiative. The initial problem was that the utilities budget paid for the production of compressed air and the purchase of CO2, but wasn't the major user. Utilities used only a small portion of the air; mostly for instrumentation. Packaging was the majority user, mostly for moving and drying product, and Brewing was the major CO2 user. Deciding on budget allocation to get the program off the ground was a big hurdle, but Durbin negotiated to reach an accord.

The second challenge was to get buy-in at the brewery level. This issue was familiar; "Corporate Interference" in Brewery operations. It's also called the "not invented here" syndrome, yet getting upper level Brewery management to buy-in was essential. So a presentation was made showing potential savings from reducing air and CO2 loss and improving the steam system. Then a Quarterly Scorecard was implemented to ensure compliance to Corporate Initiatives.

Dan Durbin recounts how this program came together, "Once the Corporate program was established, we cross-seeded the program in phases. The first step was to build a baseline for air use to be able to track improvement. Next we added the requirement for Reliability Managers to go through the CBT for Ultrasonic Analysis. This built a base knowledge of Ultrasonic techniques in the audience responsible for equipment reliability. Next, we added the requirement for the Predictive Maintenance Plans to be developed in SAP. Last, we established a specific number of scans be conducted during a quarter."

Training and Certification in

MACHINERY VIBRATION ANALYSIS and MONITORING

INTRODUCTION TO MACHINERY VIBRATIONS
Syria, Virginia, April 21-24, 2009
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BASIC MACHINERY VIBRATIONS
Tempe, Arizona, February 24-27, 2009
Houston, Texas, May 19-22, 2009
Harrisburg, Pennsylvania, June 23-26, 2009
Knoxville, Tennessee, September 28-October 1, 2009
Willowbrook, Illinois, December 8-11, 2009

MACHINERY VIBRATION ANALYSIS
Tempe, Arizona, February 24-27, 2009
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New Orleans, Lousiana, August 11-24, 2009
Knoxville, Tennessee, September 28-October 1, 2009
Willowbrook, Illinois, December 8-11, 2009

ADVANCED VIBRATION ANALYSIS
Syria, Virginia, April 21-24, 2009

ADVANCED VIBRATION CONTROL
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BALANCING OF ROTATING MACHINERY
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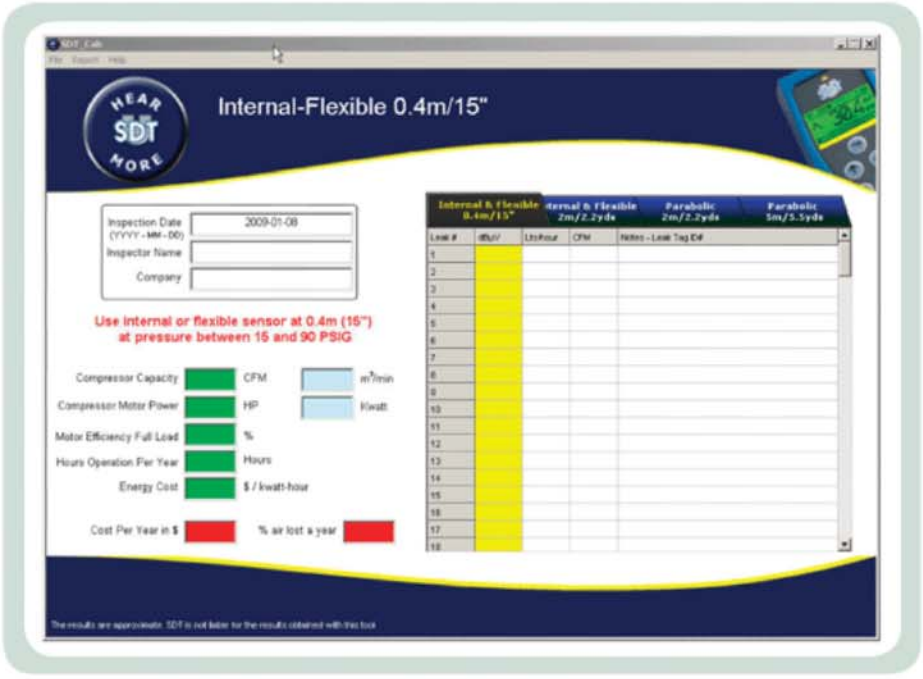

Figure 4 - This Compressed Air Leak Cost Calculator can be downloaded at www.sdtnorthamerica.com

Improvements were tracked and awarded through bonuses, and non-compliance was penalized through reduction in the Plant Manager's bonus. All breweries were surveyed during shutdowns. The logic was that during shutdown periods the air flow to Packaging and Brewing should be at a minimum. In fact, most air flow during a shutdown is consumed by leaks. The findings from these surveys confirmed that the savings justified the purchase of ultrasonic detectors for each brewery in order to standardize operations. The basis was a 25% cost reduction of compressed air, steam, and CO2. The target ROI was set at less than 12 months.

Implementation Guidelines

A set of guidelines was developed for each Brewery, based on the assumption that no ultrasonic program existed previously. Their first step was to separate the brewery by line or cost center. The work was assigned to the process support technician as part of his daily work package. It was decided to limit the scans to a 4 hour period, but that can change based on feedback from the previous scan results. Repetitive work orders for each scan area are generated in SAP. Any repair work generated as the result of the scan is tracked in SAP as "Corrective maintenance, Ultrasonic Analysis". This allows them to track the effectiveness of the program. Ultrasonic scans are performed as per the Computer Based Training modules taken. Documenting the meter reading and using the SCFM – dBμV correlation chart determines the potential savings from eliminating the air loss (see Figure 4). During the next scheduled ultrasound scan, repaired leaks are scanned and confirmed repaired.

Categorizing the leak is important, not only to save money, but also to ensure a more efficient process for the future. Ultrasonic inspectors are required to document not just the leak size, but also the cause of the leak. For instance, if the leak is a result of poor equipment design, the use of inferior fittings, or poor installation, it needs to be charted. If re-design can be documented to be cost effective, they not only eliminate present day waste, but prevent future losses through better design practices. Design issues are assigned to Reliability Managers to determine if a retrofit is cost effective. Tackling the root cause demonstrates more than just a band-aid approach to leak management.

The ultrasonic program at Anheuser-Busch is now in full implementation in the twelve domestic breweries and has acceptance all the way to the Vice President level. One of the successes of Anheuser-Busch's ultrasound program is that the VP approves all items that are added to the scorecard and personally monitors compliance at the brewery level. For this champion of the beverage industry, applying lip service to corporate sustainability was not enough. The management level and higher-up leadership levels understood from the start that sustainability for the environment, and for their bottom line, had to come from the top down.

Anheuser-Busch chose to start an ultrasound program to give sustainability to their company through energy savings, reduced environmental footprint, and improvement to their overall design processes. They went a step further by ensuring that their mistakes of the past didn't haunt them in the present and into the future.

Sustainability through Ultrasound

Companies searching for justification for their Sustainability agenda should not overlook the potential of an airborne ultrasound leak management program. In addition to the fast and measurable wins possible from reducing waste in the compressor room, you can put your stamp on a greener environment by utilizing this technology in many other areas of the factory. Leaking steam traps and poorly lubricated bearings are both energy wasters that can be spotted and fixed within your ultrasound program. Vacuum leaks on condensers and evaporators, electrical faults in switch gear, poorly tightened belts, and misaligned couplings are other issues which are a drain on energy and, therefore, negatively impact the environment, and threaten the sustainability of your plant.

Allan Rienstra is the General Manager of SDT North America providing ultrasound solutions to maintenance professionals since 1991. Allan has written countless articles on practical applications for ultrasound inspections including "Strategies for an Effective Airborne Ultrasound Program". These published works are considered the standard by companies implementing inspections programs. As a co-author of SDT's Level 1 Ultrasound Certification Program, Allan is recognized as a leader in his field. He is a graduate of Simon Fraser University, Vancouver, British Columbia, Canada and resides in Cobourg, Ontario with his wife and two children. He can be contacted at Allan@sdtnorthamerica.com