5 Ways to Save Money Through Ultrasonic Analysis

Motion examines cost savings for aging equipment

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Figure 1—Handheld ultrasonic devices like this will show dB readings, which is especially helpful in noisy environments. Image courtesy of SDT Ultrasound.

When facilities are designed and built to meet the standards of the day, the plant is as efficient as it will ever be on day one. However, as the plant ages and production demands increase, aging equipment becomes strained leading to inefficiencies and escalating costs.

Utility expenses continue to rise with overall demand. Loads change, hold-down hardware loosens and maintenance intervals slip—causing equipment to operate below desirable parameters. Compounding these costs, threads back off on pipe fittings. Stress and strain can cause pipe fissures, and if the pipes are transporting gases, the leaks are not always easy to find.

Addressing these weak spots in your facility creates the potential for significant cost savings. While our human senses may not always be sufficient to identify these issues, various tools can help. One effective method is ultrasonic analysis, which can help identify and resolve these challenges.

Why Ultrasonic Analysis?

Ultrasonic analysis uses high-frequency sound waves, typically beyond the limit of human hearing at 20 kHz, to detect, analyze and interpret the properties of materials, structures or mechanical systems. An essential tool in multiple industries, it can detect flaws, measure thickness and ensure quality control without damaging materials. Its versatility and ease of use allow companies to follow many avenues to cost savings and enhance operational uptime.

Here are the five most effective strategies for reducing costs through ultrasonic analysis:

1. Decrease Compressed Air Costs

With a cost of over 40 cents per kilowatt-hour (kWh) in some areas, producing compressed air can greatly impact your bottom line. Add the fact that a rotary screw compressor can generate 3–4 cubic feet per minute (cfm) per kW, and air costs become quickly apparent.

Compressed air, often dubbed the "fourth utility," is the most widely utilized resource in industry due to its versatility. As a plant ages, many factors can cause inefficiencies in this system, accounting for up to 50 percent of the compressor output. Maintenance teams often overlook air leaks as they don't typically make a mess on the floor, don't always affect production and are invisible. Noises from the production floor can mask the sounds of compressed air hissing out of cracks, loose fittings and failed valves. This is where ultrasonic analysis comes in. (Figure 1).

An ultrasonic analysis device fitted with headphones and a directional attachment can help isolate the sounds of the leaks (typically around 40 kHz). Depending on the attachment, you can scan up to 300 feet away. Listen for higher-pitched sounds as you sweep the attachment toward the pipes—the leaks are evident where the decibels (dBs) peak as identified with your headphones.

Figure 2—As steam travels turbulently through the pipes, an ultrasound device can "hear" the movement of the steam, providing valuable insights into its flow and behavior. Image courtesy of Motion.

As leaks are repaired, the load on the compressor decreases, lowering operating costs and sometimes allowing the end user to benefit from utility provider incentives. Ideally, a team would regularly handle compressed air monitoring and leaks (often biannually). If your plant has not conducted a compressed air survey in the past 3–5 years, consider this opportunity to save upwards of tens of thousands of dollars.

2. Prevent Costly Mechanical Failures

Unplanned downtime is expensive. Prevent expensive disruptions by implementing condition monitoring and conducting regular inspections to maintain awareness of your assets' condition—especially the most critical ones. Ultrasound technology can detect friction, turbulence and impacts earlier than any other monitoring method, allowing your maintenance team to take proactive maintenance measures before issues escalate into major concerns.

Begin monitoring bearings by establishing a baseline. An accurate baseline for healthy equipment is crucial as there is no "typical" decibel range for bearings. If the asset is already in a state of decline, a baseline can be taken from the same type of bearing operating under similar loads. Once a baseline is set, take readings with your ultrasound device by placing a sensor at the top of the bearing housing (the same place where you established your reading). If you observe a dB gain of 8 or more, it's time to investigate. Once the gain doubles, it indicates bearing degradation, making it imperative to order repair parts. A 30 dB gain increase over the baseline is a forewarning of potential catastrophic failure.

To identify the cause of a dB gain, perform additional analysis in the recording's FFT timewave form on an advanced device. For instance, repetitive dB spikes often indicate bearing imperfections, while inconsistent spikes could indicate under- or over-lubrication.

3. Optimize Greasing Activities

If your facility lacks a well-maintained and proactive maintenance program, your bearings likely do not receive the right amount of grease. Establish a lubrication route to identify the amount of grease required based on current loading and update the requirements if any conditions change. Traditionally, plants have not taken baseline readings of assets when new (as described in the previous section).

Facilities can mitigate these pitfalls by adding an ultrasonic greasing attachment to a grease gun. The same handheld unit used for identifying air leaks can also be modified for greasing purposes. To use an ultrasonic grease gun, start by placing a contact sensor on the bearing housing to establish a baseline. As you pump grease, the dB level will begin to lower. Continue to gradually apply grease until the dB level slightly increases. If your device has a route programmed into it, you can set this as your optimal amount of grease, and it will remind you when your next maintenance cycle is required. Achieving the optimal grease level results in smoother operations, extending the life of the bearing and the parent asset.

4. Reduce Steam Usage

Steam systems are commonly used in manufacturing, food refining and meat processing. Like compressed air, steam is expensive to produce, and leaks are difficult to detect. Steam is crucial to cleaning and various processes, such as pasteurization, where the quality of steam is vital. Pure steam cools as it progresses from boilers to the intended point of use, forming a mix of condensate and gases. To maintain steam purity, steam traps are installed to capture and remove the condensate and waste that accumulate in the system. These traps are intended to modulate automatically, discharging condensate as it is formed to ensure consistent purity and efficiency throughout the system. However, steam traps with moving parts are failure-prone, potentially leading to up to 30 percent of waste in the system.

Ultrasound technology, capable of measuring turbulent flow even through thick pipe walls, can effectively monitor the progression of steam throughout the system.

As steam travels turbulently through the pipes, an ultrasound device can—under normal conditions—"hear" the movement of the steam, providing valuable insights into its flow and behavior (Figure 2).

When a steam trap fails, the valve can be stuck in the closed or open position, or it might flutter between the two. Each condition produces different ultrasonic signatures around the 25 kHz range. By simply pointing the directional device toward the steam trap and surrounding lines, you can listen for signs of turbulent flow. If the flow is nonexistent or cycling rapidly, it indicates that the team must replace or repair the trap.

5. Detect Hydraulic Leaks

Hydraulic systems convert electric power to mechanical energy using hydraulic fluid. These systems consist of pumps moving hydraulic fluid from a reservoir through high-pressure lines. Control valves direct the fluid, cylinders produce mechanical energy, and relief valves are included for safety. Hydraulics systems are often used in areas needing high pressures, but leaks, blockages and bypasses can restrict the system from producing the required power. These hydraulic unit issues could lead to malformed products, slower movement, increased lubricant consumption, downtime and potential environmental penalties.

Ultrasound technology can detect failure modes in hydraulics systems, such as bearing defects, cavitation and fluid leakage past valves or the head or wiper seals. If possible, establish a baseline by taking measurements of a "new" system; this will allow you to compare current conditions with best-case scenarios. Whether or not you have a baseline, you can use an ultrasound probe to listen to the airborne noise level (in A-weighted decibels, or dBA) about 1 meter (3 feet) downstream from the potential failure points. The most common components to test for leaks are valves, cylinders and pumps, and failure will result in the symptom of a higher-pitched sound compared to the surrounding areas. For bearing related concerns, refer to points 2 and 3 above.

Ultrasonic analysis is not only a method for ensuring safety and quality but also a powerful tool for cost savings. From preventing costly equipment failures to reducing material waste and avoiding regulatory fines, the financial benefits of ultrasonic analysis can significantly impact a company's bottom line. Integrating this technology into maintenance and production processes enables businesses to achieve greater efficiency, reliability and cost-effectiveness.

The information in this article serves as a solid starting point. To ensure the best results, engage a qualified professional trained in predictive maintenance. Your bottom line and your company will thank you.

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