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# Pervasive sensing saves moneyand prevents downtime

By Deanna Johnson

**ABOUT THE AUTHOR**

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There has never been a greater need for plant reliability and energy efficiency. Both depend upon actionable information: plant operators need to know what is happening everywhere in the plant, often in close to real time. This was seldom done in the past, mainly for cost reasons. However, the availability of innovative sensors (many of them nonintrusive) and advances in wireless technology and analytic capabilities have greatly facilitated the spread of what has come to be called *pervasive sensing*.

Pervasive sensing devices include vibration sensing of rotating equipment, ultrasonic leak detectors, wireless steam trap monitors, corrosion and erosion detection technology, and wireless bolt-on surface temperature probes. These devices save energy and reduce maintenance costs and downtime. Following are some examples.

**Rotating equipment:** One of the earliest industrial applications of pervasive sensing was the use of small, battery-operated wireless vibration sensors to monitor the condition of motors, pumps, gearboxes, and other rotating equipment. Readings from the sensors can be fed into an analysis program that alerts the plant's asset management system when a piece of equipment shows abnormal readings.

A Minnesota refinery needed to prevent vapor cloud releases when pumps failed. Wireless vibration sensors now let operators know which pumps need service. They monitor more than 100 pumps at one-tenth the cost of the previous manual checking of just a few pumps. The system has given early warning of three impending pump failures in its first year of operation.

**Compressed air and gas leak monitoring:** The Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) states that leaks often waste as much as 20 to 30 percent of compressor output. EERE recommends using ultrasonic acoustic detectors to identify leaks. They can also detect process gas leaks, including toxic and flammable gases, although in the latter two cases it is a good idea to back up the acoustic sensors with fixed gas detectors and optical flame detectors.

An excellent way to get a handle on waste in the plant is to monitor flow rates on all utility fluids: compressed air, steam, natural gas, and water. Today this is easily done using wireless sensors, and the cost savings can be significant. In plants that already measure these flows, newer technology can reduce costs. Orifice plates in compressed air lines create permanent pressure losses; replacing them with averaging Pitot tube flowmeters saved a Brazilian chemical company $750,000 annually in electricity costs.

**Steam traps:** EERE estimates that failing to maintain steam traps for three-to-five years typically results in a failure rate of 15 to 30 percent. A steam trap that fails open vents live steam into the condensate return line or the atmosphere. One that fails closed allows condensate to build up in the steam system.

The most effective device for monitoring a steam trap is a wireless ultrasonic acoustic sensor. Units are available that detect the ultrasonic hiss of a leaking steam trap and also have temperature sensors to detect cold or dropping temperatures from a clogged valve or steam trap.

One chemical company calculated that cold or leaking steam traps on a six-bar steam system cost it €40,000 per year. The calculated return on investment from installing acoustic sensors was less than two years.

With one of the highest energy costs in the world, Singapore requires energy-intensive companies to register with the country's National Environmental Agency, appoint a certified energy manager, and submit an energy-use report and energy-efficiency improvement plan annually. Steam traps are high on the list of areas to examine.

**Corrosion:** There are estimates that 36 percent of a typical refinery's maintenance budget is spent on corrosion remediation and repairs. Until recently corrosion monitoring required a shutdown to install a monitoring device (e.g., detection coupons), and then subsequent shutdowns to inspect them. But in the past few years, wireless corrosion monitors that provide near real-time data on corrosions rates have been introduced.

**Heat exchanger monitoring:** A major petroleum company had been experiencing problems with a crude unit due to preheat train fouling. Installing wireless temperature and flow instruments made it possible to use heat duty calculations to analyze heat exchanger efficiency. This resulted in annual energy savings of about $55,000 per heat exchanger. Pervasive sensing is cutting both downtime and maintenance costs. We can expect ever more benefits in the future. ■