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Leaking valves can have costly implications for ethanol plants. Senseven has developed a smartphone-operated system to make industrial inspection efficient and simple, automatically interpreting sensor signals and providing instant results on site.

IMAGE: SENSEVEN

Valve Inspection Gets Easier

A European company is turning smartphones into mobile inspection systems for leak detection in valves with an app that provides instant results.

By Michael Hettegger

Industrial valves are found in almost all production processes and are responsible for controlling flow, preventing backflow, regulating and relieving pressure and stopping the process flow when closed. In the production of high-quality ethanol using molecular sieve beds, valves are also particularly important. The sieve units are used to remove water from ethanol to ensure the desired purity and concentration. The molecular sieve process is therefore critical to the final product's quality, and the valves used in this process are crucial.

Reliable Valve Performance Critical to Process Efficiency

The performance of molecular sieve units is critically linked to the performance of valves in the process. Different valves direct the gas inlet and outlet streams between columns, allowing for the adsorption, regeneration and cooling phases (see figure 1).

The drying process requires a tight seal between the adsorption and regeneration streams to maintain efficiency and avoid loss of energy. The valves must close reliably despite abrasive dust and temperature changes between the ambient feed and 500 degrees F regeneration gas. Each column has several valves, and the units can

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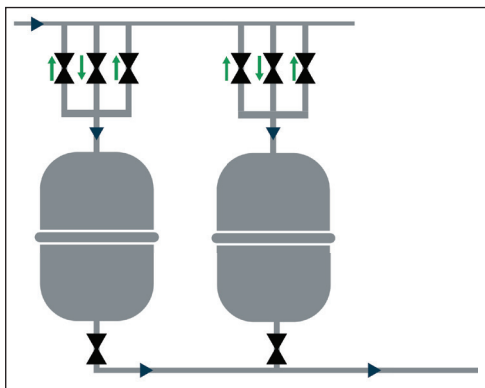


FIGURE 1: Valves in illustrative molecular sieve process.

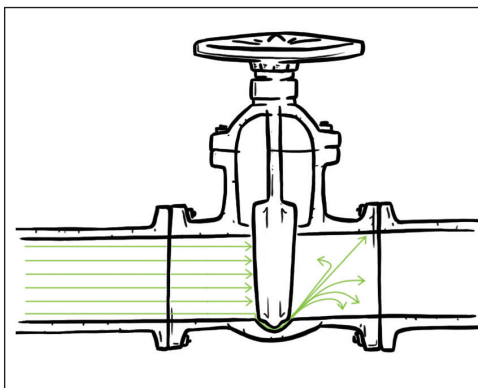


FIGURE 2: Turbulent flows caused by leaking valves create frequency stress waves.

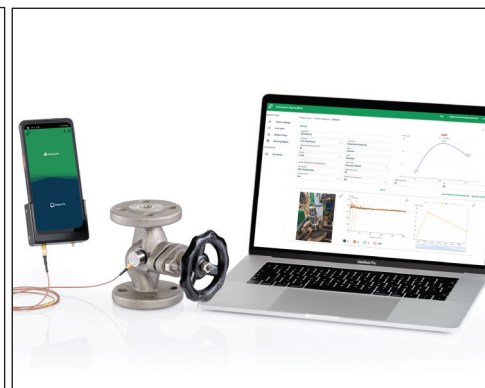


FIGURE 3: Valve Sense: smart and digital inspection system.

run for years between turnaround cycles while switching several times a day—for some plants, even 100 times per day.

Leaking valves on a molecular sieve system can have multiple implications for a plant. Valves that are leaking or not tight impact the final product quality; reduce the efficiency of the vacuum heat used for the regeneration of sieve beds, slowing the process; create a need for more steam generation to compensate the leaking heat capacity; reduce plant capacity by up to 5 percent; and reduce the lifetime of sieve beds, resulting in earlier replacement costs.

Regular Valve Inspection Crucial, Currently Difficult to Implement

Valve inspection during the actual operating process is a critical component of the maintenance program for any ethanol plant. The harsh operating environment with high temperatures, corrosive chemicals and abrasive particles can lead to valve damage, which can cause leaks, reduced efficiency, and ultimately, product quality issues and unplanned downtime. Scheduled maintenance opportunities are normally only once or twice a year.

Therefore, regular valve inspections during operation can help to identify and address potential problems before they become more significant issues. However, based on current inspection practices, there is further improvement potential:

- Valves in these processes are hardly inspected, rather routinely replaced during scheduled maintenance shutdowns.
- Companies do not have the required know-how to inspect valves on their own.
- Consequently, there is a great risk of reducing the performance of a molecular sieve unit, wasting energy and risking product quality.

Acoustic Emission: Established Methodology for Valve Inspection

A well-established way to test if valves are tight or leaking is the acoustic emission technology. One advantage of this technology is that leak detection is performed without disassembling the valves. It is a so-called non-destructive testing method which is conducted while the process is operational. The method uses sig-

nals in the ultrasonic spectrum that are emitted by a material under stress due to irreversible phenomena such as damage, corrosion, cracks, leaks or malfunction.

Applied to leaking valves, this means that internal valve leakage leads to high-frequency stress waves. They are created by turbulences due to the flow that occurs when a medium is pushed through the leak hole of the valve (see figure 2).

Through regular inspection, signal changes are detected early enough, and internal leakages are found before they can cause major damage to the equipment or harm employees.

Turning Smartphones Into Mobile Inspection Systems

Senseven, based in Vienna, Austria, has recognized the problem that valve inspection today can hardly be performed by companies themselves, as both a simple system and the internal expert know-how are missing. The company is therefore on a mission to empower maintenance personnel to inspect industrial assets on their own. The Senseven team has developed a software-based inspection system—Valve Sense—run on smartphones to make industrial inspection more efficient and easier with the help of digitalization and AI (see figure 3).

A mobile app for leak detection in valves supports the user during the inspection process, automatically interprets sensor signals and provides instant results on site (see figure 4). All measurement data is stored in a cloud platform for further analyses or standardized reporting.

Senseven focuses on simplicity of use. It is the first company in the market to apply today's digital capabilities to an inspection system. Existing solutions use proprietary, complex devices, while the Senseven open solution connects acoustic emission sensors to a smartphone. The user is guided through the inspection process by the software and algorithms, while artificial intelligence helps interpret the data.

Software Applied at Ethanol Plant

Valve Sense has already been successfully applied at a U.S. ethanol plant, supporting the identification of leaking valves to avoid high economic losses.

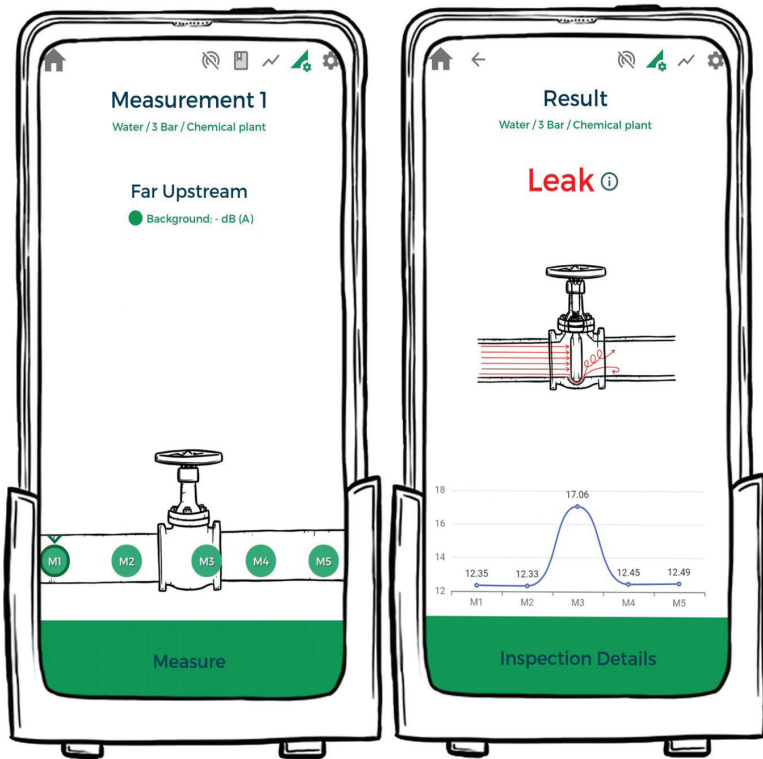


FIGURE 4: Leak detection app with inspection process and immediate results.

Facts about the plant:

- Plant capacity: 100 million gallons per year
- 16 sieve valves inspected
- 3 through-valve leaks identified

A Look at the Results:

- The leaking valves had a negative impact on dryer efficiency, causing energy (steam) loss.
- They were negatively impacting the performance of the molecular sieve unit, risking product quality.
- The leaking valves might have caused difficulties with increasingly strict fugitive emission requirements.
- The leaks could have caused a capacity reduction by up to 5 percent.
- Without taking action, the economic impact of product loss could have amounted to as much as \$3.5 million per year.

“Valve Sense provides a great opportunity for companies with little know-how in valve inspection,” says Shawn Anderson, chief engineer at API Solutions, which conducted the measurements with Valve Sense. “It is easy to use, inspections can be performed anytime, and companies can rely on the performance of their valves without having to wait for the next maintenance cycle.”

Visit: <http://www.senseven.ai> for more information.

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