LESSONS IN LEAK DETECTION

By Rich Mizia

For centuries, leaks have presented a number of challenges. When we were kids, the biggest problem was to find and fix a hole in a bike tire. The old standby worked well: Plunging the inflated tube into a tub of water usually allowed you to find the air's escape route. Today, this technique still is employed to find leaks in everything from HVAC systems to critical medical devices.

Tracer gas as a quick and accurate water leak detector

The monetary cost of failing to detect leaks can run up to six or seven figures.

There are a slew of different leak detection and location methods. Tracer gas has proven to be particularly reliable.

Cities and towns have buried the distribution systems that deliver clean water to the population and remove the water after use. In many large metropolitan cities in the east, water mains and waste handling pipes installed in the late 1700s were made of wood. Many contractors have been surprised when they unearth one of these "logs." (In the late 1800s, these wooden pipes were used to carry and distribute natural gas. They also served the salt industry in central New York.)

The development of cast-iron and concrete piping helped improve the movement of water, both clean and dirty. Thousands of miles of pipe have been buried for decades. Due to the wear and tear of daily usage, the decline of the infrastructure is gathering speed. More often, the news reports a major disruption in some large city because the water distribution system has failed in a big way. For example, in May 2010, a 120-in. main supplying water to Boston ruptured, and, as a Massachusetts Water Resources Authority release put it: "... leak[ed] water into the Charles River at a rate of 8 million gal an hour."

The cost to repair and replace these valuable supply lines is expected to run into the billions. The loss of productivity and perishable materials when a water line turns "dry" can run into six or seven figures very quickly. It is important to consider how we can detect problems before they turn into a full-blown nightmare, as well as the thousands of storage tanks communities depend on for water storage.

Leak Detection

There are many ways to detect leak issues. The best indicator is the water meter. If water usage is creeping up and there are no new water use areas recently added, that should be a tip-off that something is amiss. The problem is, most of the leaks are buried and not easy to detect. One could have a significant leak and not have any visual indication.

A few years ago, a college in suburban Boston was experiencing an excessive need to replenish water in its closed-loop heating system. The college tried thermal imaging, using the logic that the amount of escaping hot water would provide an easily detected hot spot. Another logical assumption would be that that much water should have created a large wet area in proximity to the leak.

So, how do we detect subterranean leaks? Much has been done with ultrasound. This technique can be used with cast-iron piping but has its limitations with plastic, as the process requires passing the signal along the pipe. Ultrasound relies on the sound made by escaping fluids.

Tracer Gas

What about a situation in which the leak is too small to emit an audible sound? The World Health Organization developed and published an entire manual on leak management and control of leaks in water distribution systems (WHO/SDE/WSH/01.1). In the section "Leak Detection and Location," it discusses the various methods.

One technique, gas injection, has been used for many years. This technique uses a tracer gas, such as helium, hydrogen or sulfur hexafluoride (SF6). The gas is injected into the pipe, either empty or full. If full, the pressure must read 3 to 5 psi over the line pressure to ensure the presence of the tracer gas in the line. The advantage to tracer gas is the ability to detect small leaks before they become major problems. Tracer gases will escape from small openings faster than liquids, and just as fast as vapors.

Hydrogen vs. Helium & SF6

SF6 is a very special—and costly—gas. The amount needed to test most applications would break a budget quickly. Helium is the next choice because everyone is familiar with this inert (nonreactive) gas. The helium molecule is the smallest of the noble gases. It allows safe, fast and fairly accurate leak repairs. The problem is that helium comes out of the ground in natural gas wells. The cost is on the rise because of a tight supply.

That leaves hydrogen. For industrial leak testing, a safe, nontoxic, nonflammable mixture of 5% nitrogen and 95% hydrogen is used. It can be obtained readily anywhere in the world. This specific gas has been used for decades globally by the telecommunications industry. The industry had used helium, but had an issue with the way the gas acted as it percolated up from a leak. Telecommunications professionals discovered that the helium molecule was sticky: It would rise to the surface and then have a tendency to spread out under the asphalt or concrete.

Under these conditions, it is difficult to narrow down the leak location. Hydrogen does not have this problem. This gas mixture moves easily through the layers between the leak and the surface. When detected, it usually is within 3 ft of the leak location. These properties, and the low price of hydrogen, make it a serious alternative for operators and companies. As the need to use hydrogen has risen in the industrial market (especially HVAC, pharmaceutical, medical and automotive), companies have designed sensors to meet demanding requirements: light, portable, long-lasting battery (even wireless) and safe to use in dangerous areas.

The detectors used for hydrogen are solid state. The sensor generally is located at the tip of the probe. Escaping tracer gas will be detected by the sensor, and the LEDs located on the handle will start to light up to inform the operator. The greater the gas concentration, the more LEDs will light up. The operator can plug in a set of headphones for sound, as the sound also will

increase. There are extensions for most of these probes that will allow the operator to place the sensor within inches of the ground while standing upright. These extensions can be used for locating leaks in high areas or hard-to-reach spots.

In the battle to save infrastructure, tracer gas is a proven way to find and locate leaks in any type of fluid-handling system. These devices are becoming a major player in the fight to save water.

As for that large hot-water leak at the college, it turned out to be a corroded valve section at the far end of the run. It was located at the top of a hill, and the water was running underground, away from the leak. The engineer found it using the hydrogen method. WWD

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