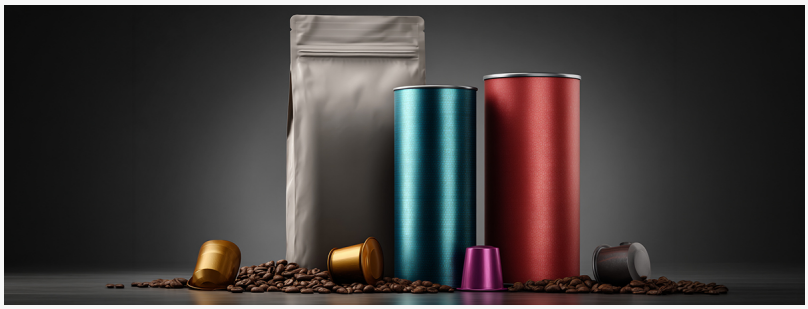
Invisible Gaps, Visible Gains: Advancing Leak Testing for High-Quality Food Packaging



MAULBURG, GERMANY, June 25, 2026 /EINPresswire.com/ -- Imagine preparing a bottle of milk for your baby — or a cup of coffee for yourself — and wondering whether the packaging has truly preserved its taste and healthiness. Many products use Modified Atmosphere Packaging (MAP): the air inside is replaced with a protective gas mix to extend shelf life by keeping oxygen out. But even tiny leaks can let oxygen back in, which influences the quality and expiry date of the product in a negative way. Vacuum-based leak testing methods offer clear advantages over traditional techniques, helping maintain quality without slowing down production.

Tiny holes, big responsibility

Cans of baby formula, once filled and sealed, are expected to protect their contents for a long period of time. That's an important requirement, especially when even invisible leaks can let in oxygen, slowly degrading the product. For foods like infant milk powder, that's a risk no one wants to take.

And it is not just about baby food. Comparable requirements apply to products like coffee capsules or chip canisters. In all cases, packaging must hold up over time, across transport, and under varying climatic conditions — while reliably preventing oxygen ingress. These products typically rely on protective gas atmospheres to preserve freshness. However, regardless of the packaging concept used, long-term product quality ultimately depends on one factor: a consistently tight and verifiable seal.

Watching for bubbles

There are several ways to check if a packaging is tight. One of the most commonly used methods for leak testing in food packaging is the water bath test, also known as bubble test. The principle is familiar to anyone who has ever searched for a puncture in a bicycle tire: submerge it in water and watch for bubbles. In food production, the process is similar.

Due to its simplicity and low equipment cost, the water bath test is widely used in food production. However, the method has clear limitations. It can be destructive, as tested packages

and often their contents must be discarded or at least dried before re-entering production. Manual bubble tests depend strongly on operator attention and subjective interpretation, leading to a higher risk of human error and inconsistent results. Even in automated setups, the test typically provides only a pass/fail result without reliable information on leak size. In addition, detecting very small leaks often requires long observation times, tiny leaks generate bubbles only sporadically.

Measuring leaks in vacuum

Where the bubble test reaches its limits, other methods come into play. One of these vacuum-based methods involves helium as a test gas. Therefore, a bit of helium is added inside the package, it is placed in a vacuum chamber, and a detector based on mass spectrometry checks how many helium atoms escape over time. The quantity defines the size of the leak.

This method is highly sensitive. Helium atoms are so small they can slip through even the tiniest gaps. That's why it is often used to develop and qualify new packaging on a laboratory scale. However, helium testing requires careful handling of the gas and extra steps after testing to verify conditions, especially in high-speed food production, where thousands of packages roll off the line. As a result, helium management and verification can increase both operational effort as well as overall cost.

An alternative method is Optical Emission Spectroscopy (OES). Rather than adding any tracer gas, OES analyzes gases already present inside the package — such as nitrogen or carbon dioxide. Under vacuum, escaping gas is briefly excited into a plasma, emitting light with a unique spectral signature. A sensor analyses this light pattern to identify even the smallest leaks — similar to recognizing a substance by its unique color signature.

Confidence without compromise

Unlike traditional water bath tests, both helium and OES methods are non-destructive and deliver objective, reproducible results. OES in particular offers a practical balance: high sensitivity without additional gas handling or sample preparation.

Modern OES systems can be positioned at-line, operating with short cycle times and minimal operator intervention. This allows manufacturers to increase testing frequency and ensure consistent packaging integrity without slowing production.

Whether it is milk powder, coffee capsules, or chips, tight packaging does more than just protect contents. It preserves shelf life, flavor, and consumer trust. Vacuum-based leak detection turns invisible risks into measurable certainty.

When a leak becomes a shelf life risk

In vacuum technology, leaks are quantified in units like mbar·l/s. In food packaging, quality is judged differently: how much oxygen enters a package over months or years. Connecting these two worlds is essential. A defined leak rate can be translated into oxygen ingress, helping

manufacturers predict whether a package will still meet its oxygen limits at the end of its shelf life. Understanding this relationship turns leak testing from a technical exercise into a tool for long-term quality assurance and helps bridge the gap between physics and food safety.

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