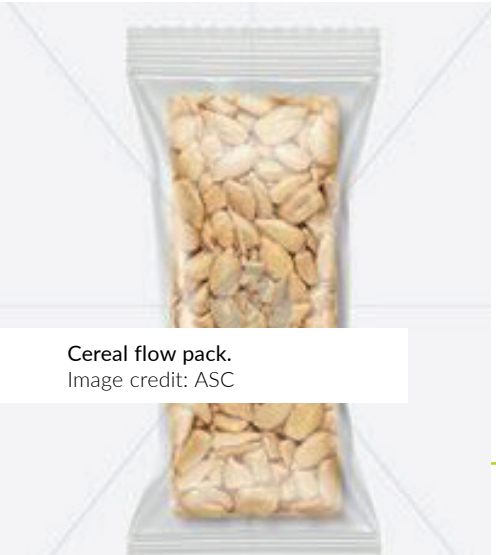
Hans Lepelaars, expert in non-destructive leak testing equipment

Packaging integrity: an essential check

Only a few decades ago, dye ingress testing was the only way for testing containers and packaging. Today, every company aims to reduce the impact of its activity on the environment and seek to make its processes as lean as possible to achieve the best quality at the lowest cost. Dominique Huret interviews Hans Lepelaars, international director at ASC Instrument, and discovers why is it important to test food packaging for leaks

A lack of packaging integrity opens the door for bacteria ingress and may lead to the food product becoming improper for consumption and even a risk to consumer health. Formation of mould is a visible indication of food degradation, but the process starts well before, and it is not always visible. Another primary function of packaging is to preserve the freshness, flavour, and aroma of the product. Great effort goes into developing unique properties in this area, and it is highly important that from the moment of production these qualities are preserved right until the opening of the package by the consumer. For cookies, savoury biscuits and snacks, crispness is a prime quality criterion for consumers. This aspect is known to degrade quickly when in contact with O_2 or moisture. The products are often packed under modified atmosphere, ie a dry inert gas (like CO_2 or N_2) is injected into the packaging to reduce the initial quantity of O_2 in contact with the product. The barrier films used for their packaging are developed to contain this gas as long as possible. Proper sealing of the film is then crucial for this containment.



Cereal flow pack.
Image credit: ASC

The factors determining seal quality are film characteristics, sealing bar temperature, sealing pressure and sealing time. Knowing that packaging machines are often pushed for maximum output, their adjustment is a compromise between maximum speed and optimal sealing bar closure time, which is often a fine line. It is therefore necessary to verify regularly that the sealing operation still does the job correctly and produces airtight packages. A sealing problem starting to develop generally starts small and grows bigger with time. At the speeds of packaging lines, within 30 minutes thousands of products have been put out. Frequent sample testing therefore is the answer, so that issues are detected early and do not lead to massive amounts of improperly sealed packages, for scrap or repackaging, if possible.

What are the main methods of testing leaks on the market?

Bubble testing has been a common way of testing for leaks for decades. In its most simple form, it consists of holding a package under water, squeezing it, and checking for any bubbles escaping from the seams. As it is difficult to make all operators squeeze in the same way, and ideas varied on how hard the squeezing should be, the squeezing was replaced by planting a hollow needle in the pack, connected to a compressed air supply, allowing it to inflate the pack at a fixed pressure.

The test was "standardised", and results were less operator-dependent. But the drawbacks were that any bubbles from the entrance point of the needle in the package were to be disregarded of course, not making the process easier, and the needle presented a safety risk for the operators. Plus, an aspect not having as much focus in the past as today, this method created a lot of waste, as the packs were punctured. Another variant of bubble testing gets rid of the needle problem: the package is pushed under water by a plate in a reservoir, in which subsequently a partial vacuum is drawn. All these tests still use water, with its health and safety risks, including potential contamination, and are still

Pouches pack.
Image credit: ASC

depending on operator eyesight and alertness to spot the bubbles.

Another method, leak flow measurement, also uses a needle, connected to a pressure source with a flow metre. It allows puncturing and inflating the package, which is clamped between two plates, and after it is fully inflated, it measures the air flow through the needle, which should correspond to the packaging leak rate. This is more "scientific" than bubble tests, and uses no water. Still a destructive test however, and not free from false readings due to needle clogging with product, or leaks at needle entry.

Modified atmosphere packaging with CO_2 allowed a new way of testing, CO_2 detection. This consists of placing the package in a test chamber, drawing the surrounding air from the chamber and detecting if any CO_2 is present in the air being extracted. This non-destructive method produces no waste but has a significant drawback: inevitably the factory air becomes gradually more "charged" with this gas from the packaging line, and the sensor in the test equipment will detect more and more false "leaking packages" during the day, as it detects the packaging gas in the surrounding air. So not surprising , many factories kept their bubble bath to double-check.

Positive control package with calibrated pinhole.
Image credit: ASC

Another non-destructive method is vacuum decay, the package is enclosed between rubber membranes, between which a vacuum is drawn. The vacuum between the membranes is measured and will continue to decay after the first stage in case of a small leak. With an airtight package, no further decay is measured. This works as long as you don't mind not detecting the large leaks. With a larger leak, the initial vacuum stage will have drawn out all the air from the package, and no further decay will happen during the measurement stage, generating a PASS result. But most often, not detecting large leaks is not an option.

How is ASC Instrument's testing method different and what are the advantages?

Our engineers worked to alleviate the previous issues. The package is placed in a test chamber, in which gradually a vacuum is installed. The package "inflates", and comes in contact with a sensor placed in the top of the test chamber. This sensor registers the pressure inside the package. This increases as the vacuum becomes stronger. When a target pressure is reached, the vacuum is stabilised, and the internal pressure decay (ΔP) is recorded during a few seconds.

An airtight package will give a near-zero value, a package with a small leak will show a drop-off of the pressure. The larger the leak, the larger the pressure drop. Gross leaks are detected in the first stage, the "inflation" will not take place, as all air is drawn out straight away, or not sufficiently: it inflates, but the internal pressure target will not be reached as the packaging loses air too quickly.

Both types of leaks, small and big are not only detected but also quantified as well. The pressure decay is measured in Pascal (1 Pa=0.01 mb), allowing very high sensitivities. ASC's application team typically carries out a series of trials on customer samples and sets up the initial parameters, based on the requirements. This allows the instrument to hit the ground running at delivery, a big time gain for the customer. Extensive testing has been carried out during development to determine the cycle control parameters that allow the method to be adapted to the widest possible range of requirements and applications.

What products can be tested with ASC's method?

Applications include any food product that has a sell-by date, packed in a sealed film package, but also trays, tubs and pots sealed with a film or aluminium lid are successfully tested with this method. Instruments of various sizes are available, covering sizes from stick packs to bulk packs for the catering industry. FDT

7400S.2 for cereal.
Image credit: ASC