

Benefits of monitoring water activity in the food manufacturing and processing industry



Virtually all types and sizes of food manufacturing businesses can benefit from monitoring water activity, from artisan producers of charcuterie to large factories with multiple production lines.

Water activity is a key quality metric in the food industry, as it affects food safety, shelf life, taste, aroma, texture, mouth feel and colour. By establishing acceptable water activity levels and then monitoring water activity at various points in the production process, food manufacturers can reduce costs and avoid reputationally damaging quality issues and expensive product recalls. Water activity is even more important today, as manufactures come under pressure to reduce salt and sugar content. Furthermore, if packaging is redesigned to reduce or eliminate the use of plastics, the management of water activity plays a crucial role in maintaining food safety and shelf life.

Water activity (aw) is a measure of how much water is free from physical and chemical bonds and is therefore available for migration, chemical reaction, use by microorganisms (moulds and bacteria, for example) or other activity. At the extremes, a sample with water activity of 0 is completely dry, while pure water has a water activity of 1.0.

Moisture content, on the other hand, is a quantitative measure of the amount of water and can be found by weighing the product before and after drying. For many analyses moisture content is normalised and expressed as a percentage.

Any given food product will exhibit a relationship between water activity and moisture content at a given temperature. By taking a series of measurements, a graph can be plotted, known as an isotherm, showing the relationship between water activity and percentage moisture content. As water activity is temperature-dependent, a family of isotherms can be created by collecting data for water activity and percentage moisture content over a range of different temperatures. This can help to characterise a product and provide valuable insight when developing both a food product and its packaging.

There are many different points within a food manufacturing process at which water activity might be measured, with the first being goods inwards inspection of the ingredients. For example, if powders have a water activity that is too high, they can cake or clump and make handling problematic. Dried fruit, as might be used in granola-based breakfast cereal, need the right level of water activity if they are not to be too hard or cause moisture to migrate to the granola element of the mixture and reduce its crunchiness.

At the end of the production process manufacturers often use a sampling regime to check batches prior to despatch. By ensuring water activity is within acceptable bounds, manufacturers can have far greater confidence that, for instance, cakes will not grow mould, cured meats will remain safe throughout their shelf life and biscuits will still be crunchy when the packaging is opened.

For complex foods, it may also be advantageous to monitor water activity at other points in the process: pizza bases prior to the addition of toppings, and biscuits before chocolate coatings are applied are just two examples where identifying an out-of-specification water activity could avoid expensive ingredients being wasted.

Today food manufacturers and processors often use water activity measurements as part of a HACCP (hazard analysis and critical control points) process to ensure the products' safety and stability. These measurements are made at the end of the production process and/or part-way through the process as appropriate for the end product, ingredients and manufacturing processes.

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multiple production lines. Fortunately, instruments are available today for use in laboratory or production environments, that can analyse samples and give laboratory-quality results in five minutes or less, and that require no more operator skill than is necessary for a domestic microwave oven. A popular instrument for analysing water activity in the food industry is the AquaLab Series 4TE from METER Group, formerly Decagon Devices. This is used for a broad spectrum of applications including goods inwards inspection, in-process HACCP tests and end-of-line quality assurance analysis. It outputs water activity readings in five minutes or less, with a resolution of ± 0.0001 and an accuracy of ± 0.003 aw. Some users install the instrument in a laboratory, while others locate it lineside within the production environment to provide a near-real-time feedback loop. This benchtop instrument can also be moved between locations, and calibration is performed swiftly and easily with calibration salts. For performing analyses, a sample of just 7.5 ml is required, which can be solid, powder, paste or liquid. Running an analysis is simply a matter of placing the sample cup in the instrument and pressing 'start'.

The AquaLab Series 4TE benefits from built-in temperature equilibration that enables users to select an operating temperature of anywhere between 15 and 50 degrees C to ensure consistency of readings. For each measurement and calibration, the instrument logs the date, time and user. Up to 8,000 data points can be stored securely on the instrument and these can be downloaded to a PC using a USB port.