

Water Activity and its Influence on Product Quality

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Water activity is defined as the current volume and availability of "**free**" water in a sample and should not be directly compared with the water content (g water/g substance). The water activity is given as the a_W – value and ranges between 0 (absolute dryness) and 1 (100% relative humidity). Only this component takes an active part in the exchange of moisture with the ambient air and can possibly form the ideal medium for microbiological growth on the surface which influences the microbiological stability. The water activity also has an important effect on the chemical reactions in food. Thus water activity became an essential quality parameter

What is the Influence of Water Activity in Foodstuff?

Water activity offers information about physical, mechanical, chemical and as well microbiological product stability and is jointly responsible for the growth of unwanted microorganisms such as bacteria or fungi, which produce "toxins" or other harmful substances. But also chemical/biochemical reactions (e.g. the Maillard reaction) increasingly take place as more free water is present in a product. Roughly speaking, water activity influences the following product properties:

- Microbiological stability (growth)
- Chemical stability
- Content of proteins and vitamins
- Color, taste and nutritional value
- Stability of the compound and durability
- Storage and packing
- Solubility and texture



The optimization and stabilization of the product properties require a partially narrow upper as well as lower aw value margin. The aw – value of a product can be changed by the adding of so called "Humectants" such as sugar or polymeric polyols, amino acid, proteins or natural extracts which normally bound water and thereby reduce the amount of free water and finally the water activity. The main quality requirements of a durable product are health safety and



perfect organoleptic properties. Quality and shelf life are influenced as well by raw material, recipe, production process and storage conditions.

How is Water Activity be measured?

Special laboratory equipment is required for water activity (a_w -value) determination which quantifies the air humidity directly over a sample in a closed chamber after reaching the humidity equilibrium between free water in the sample and water in the surrounding air. The measured air humidity is directly proportional to the a_w -value. A significant measurement is thereby only possible if the sample shows a constant temperature and if the measurement is finished after reaching the humidity equilibrium. Thus it is obvious that the measurement of water activity always take some time, means is not finished within a few seconds. The establishment of the equilibrium is sample-independent and can not be shortened anyhow due to the fact that it is physics.

There are three different measurement principles available to detect the air humidity over a specific sample. Feedbacks from various customers and experts have proven that the electrolytic-resistive detection method is best practice in terms of accuracy, repeatability and low maintenance / durability.

Where is Water Activity Required?

Water activity measurements can primarily be found in food and pharmaceutical applications but as well in those where nobody would never expect it. Or who knows that water activity is determined in leather for car seats where it plays an important role for leather durability? Although water activity is not a well-known parameter, there could be found more and more applications where it is measured. This includes the following:

- Chocolate and sweets / candy
- Pharmaceutical products
- Cosmetics
- Pasta
- Meat (fresh and processed) and fish
- Bakery products
- Cheese, milk and dairy products
- Food processing and dried products
- Pet food
- Tobacco
- and many more

Where water activity is measured, is process and user specific. Most of the measurement point(s) in existing applications are at quality inspection of incoming goods (educts), for monitoring of process progress or to qualify product quality at final inspection.

To produce a stable product, yet one that still appeals to the senses of taste & texture, then monitoring during the production according to the HACCP regulations should be performed, where the a_w -value measurement forms part of this control and international regulation.

Indirect water content determination

To get still an information about the water content of a sample, the new water activity instrument of Novasina offers the determination of the water content via the so-called "sorption isotherm" as well. The sorption isotherm shows the relation between water content and water activity at a given temperature and has to be recorded manually. For this reason there is a real, efficient and non-destructive alternative to well-established water content measurements.