aw value measurement

Practical tips for measuring

Your a_w value measurement should be made as simple and quick as possible. For this reason we have put together an application sheet for you with practical tips for measuring the a_w value.

1. How can I get reliable measured results?
2. Influence of temperature on the a_w value
3. Duration of measurement
4. Filling height
5. Dependency of a_w value on size of sample
6. Requirement for a_w value measurement
7. Importance of a_w value measurement for food
8. Additional applications

1. How can I get reliable measured results?
An accurate a_w value measurement is guaranteed if the temperatures of the measurement chamber, sensor and product being measured are identical during and prior to the measurement (observe adaptation time in the case of temperature differences between sample and sensor). We recommend the measurement to be carried out at constant temperatures (e.g. 25°C).

2. Influence of temperature on the a_w value
A general statement on the influence of temperature on the a_w value cannot be made. The influence of temperature on the a_w value depends on the type of product being measured. In some samples the a_w value increases when the temperature rises (e.g. flour) while in others (e.g. milk sugar) the a_w value decreases when the temperature rises and then there are samples which do not have any temperature dependency.

3. Duration of measurement
The duration of the measurement depends on the product being measured. The a_w value measurement is complete once there are no changes within a defined time. These values can be input in the main menu under Special-a_w value (see Instruction manual on a_w value measurement). We recommend the following standard setting in the instrument: change 1% after 5 minutes. In test measurements on meat and sausage meat the setting, change 1% after 2 minutes, proved to be ideal.

4. Filling height
We recommend that the measuring chamber is made at least half full.

5. Dependency of a_w value on size of sample
Extensive tests in our company have shown that the size of a sample does not have any effect on the measured result. The deviations of the results measured for coarse, whole and fine samples of the same product were always in the fluctuation range of our reference probe.

With products made up of many different components (e.g. biscuits) it is recommended to chop the sample into small pieces or to cut into slices. The preparation method of a sample should always be the same so you always have reproducible results.

6. Requirement for a_w value measurement
The a_w value can be measured if the product to be measured is hygroscopic. Substances which absorb or release water in humid air with a relative air humidity of <100% are known as hygroscopic. For example, sand cannot absorb water. It is therefore not hygroscopic. An a_w value measurement is therefore not possible.

7. Importance of aw value measurement for food
Water activity is a measure of the life of a product in relation to the many different forms of decomposition. Unlike water level, water activity is more suitable for the assessment of possible decomposition because it is a measure of the availability of the water in the reaction medium of a product and does not just provide information on the mass level of the water. In every food a part of the total water level is free, the other part is strongly bonded. The level of free water influences the aw value. This free water is very important for the growth of microorganisms and their toxin development. However there are limits under which growth or toxin development is not possible.

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Water activity, water level and food decomposition (Mossel 1982)

a_w range	Lowest range value of inhibited organisms	Examples of food and solutions
1- 0.95	Gram-negative rods, bacteria spores, several yeasts	Food with 40% saccharose or 7% NaCl, e.g.: many boiling sausages, milk, meat, eggs, vegetables, fruits, fruit juices
0.95 – 0.91	Gram-positive cocci, lactic acid bacteria, vegetative cells of bacilli, several mould fungi	Food with approx. 55% saccharose or 12% NaCl*, e.g. dry ham, “mature” cheese
0.91 – 0.87	Most yeasts	Food with approx. 65% saccharose (= saturated) or approx. 15% NaCl, e.g. salami, “old” cheese
0.87 – 0.80	Most mould fungi; staphylococcus aureus	Flour, rice, pulses with 15 to 17% water, sugared condensed milk (a_w : approx. 0.83)
0.80 – 0.75	Most halophilic bacteria (halophilic: high tolerance of salt concentrations)	Food with 26% NaCl (saturated), e.g.: “old” hungarian salami, marzipan with 15 to 17% water, marmelades
0.75 – 0.65	Xerophilic mould fungi (xerophilic: high tolerance of dryness)	Oat flakes with approx. 10% water
0.65 – 0.60	Osmophilic yeasts (osmophilic: high tolerance of sugar concentrations)	Dried fruits with 15 to 20% wasser, caramel sweets with approx. 8% water
0.50	Microbial growth no longer possible	Noodles with approx. 12% water, Vegetables with approx.10% water
0.40		Egg powder with approx. 5% water
0.30		Baked goods with 3-5% water
0.20		Full-cream milk powder with 2-3% water, Dry vegetables with approx. 5% water, Air moisture in deserts

* The % data for the dissolved substances refer to the aqueous phase in food with more than traces of fat.

It can generally be said that the growth of microorganisms or mould fungi is not possible below an aw value of 0.60. Foodstuffs which are in this range are therefore microbiologically stable.

8. Additional applications

In addition to applications in the food and pharmaceutical branch our measuring system was tested on additional applications. The aw value is an important topic wherever the remaining moisture in a product sample is an important characteristic for the product quality. However in this case it is often not the aw value which is measured but the water level in weight percentage. For a given product there is a direct relation between the aw value and water level in weight percentage: sorption isotherms. These can be displayed as a curve or in table form. At a given constant temperature, a sorption isotherm shows the corresponding water level of this material for every moisture value. We have a collection of sorption isotherms which we gathered from the literature available. You will find a list of isotherms in the appendix.

aw value measurement of different plastic granules and motor oil

We carried aw value measurements on different hygroscopic plastic granules and motor oil in our research department. Reproducible results were measured with our measuring system in both cases. The respective aw value measured can be used to directly calculate the water level using the corresponding isotherms.

Dear Customer:

We welcome all practical tips on aw value measurement..

Acetate	**J**ute	Rusk
Active coal		Rye (→Grain)
Adhesive	**K**aolin	
Asbestos		**S**and-lime fly ash stone
Asbestos paper	**L**arge cop	Sand-lime lightweight
	Latex	refractory brick
Barley (→Grain)	Leather	Sawdust
Beans	Lime cast	Sea weed mat
	Lime mortar	Sheep leather
Cane sugar	Linen	Silica gel
Casein		Silk
Cement	**M**acaroni	Sintered pumice
Cement mortar	Maize starch	stone concrete
Charcoal	Manila paper	Slag concrete
Clay brick	Metallurgical coke	Soap
Clinker		Soda pulp
Collagen	**N**ewspaper	Sodium pectate II
Corkwood	Nylon	Sodium pectate III
Cotton	Nylon film	Starch
		Straw mat
Feathers Filter paper	**O**ats (→Grain) Offset paper	**T**obacco
Flax	Oil substances	Triolein
Foundry coke		
Fragmented concrete	**P**laster	**W**heat (→Grain)
	Polyamide powder	Wood-20°C
Gelatine	Polyethylene	Wood-40°C
Glassine	Polypropylene	Wood-60°C
Glass wool	Polystyrene	Wood-80°C
Gold beater´s skin	Polyvinyl chloride	Wool
Grain	Potatoes	Woollen cloth
Ground wood pulp	Pressboard	Writing paper
	Pumice slag brick	
Hay		**Y**ton
	Rice	
Infusorial earth	Roof tile	
	Rope paper	
	Rubber	

The following formula applies to the sorption isotherms:

Water level in weight % = (mf - mtr) x 100 / mtr

or: Water level in weight % = mw x 100 / mtr

mtr = dry mass
mf = moist mass
mw = water mass

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