FAQ – HydroTracer HT3

What is the definition of moisture?

There is no universal definition for the term moisture. Commonly, the physical measuring principle used for the moisture measurement determines its definition. So, it is necessary to distinguish between "moisture" and "water content".

The **moisture** of a material includes all those substances that volatilize during heating. In addition to water these are e.g.

- Evaporating organic solvents
- Alcohols
- Greases, oils, aromatic components
- Plasticizers
- Decomposition and combustion products

Systems that measure exclusively the **water content** of a material can be called as **water-specific** ones. Here, other evaporating substances as mentioned above do not influence the readings.

Especially in the field of plastic drying and proceeding where very low water contents must be detected a water-specific method is highly recommended. It ensures reliable readings about the actual water content of the polymers.

Which measuring method is used?

The HydroTracer determines the water content of the sample by chemical-analytic method. It is based on the calcium hydride method and the chemical reaction that occurs is as follows:

$$CaH_2 + 2\,H_2O \rightarrow Ca(OH)_2 + 2\,H_2$$

The introduced sample is heated in the reactor, only the evaporated water is converted into hydrogen and the hydrogen content is detected by a hydrogen-sensitive gas sensor. This patented measuring method specifically measures the water content, other volatile ingredients are not detected.

Which substances can be measured with the HydroTracer?

Liquids are not possible to measure. The measuring capability is limited to solids only, whereby the materials can be in the form of granules, powders or flakes. Foils, fibres or thin-walled injection moulded parts can also be measured.

In which industrial sector is the HydroTracer mainly used?

The main application is in the plastics processing industry. In particular the injection moulding and extrusion industries where the water content is checked and monitored during the incoming goods and drying process. Our moisture analyser is also used successfully in related areas such as raw material manufacturers and compounders as well as for research, development and teaching at universities and research institutes.

Is the device suitable for all plastics?

Yes, for all engineering and high-performance plastics in the field of injection molding or extrusion. No false measurements are known to us. There are only 2 exceptions:

- PVC - here the thermal stability has to be considered as in case of decomposition, side reactions may affect the readings of the HydroTracer
- Polymers containing blowing agents e.g., thermoplastic or elastomeric foams

Comparison: HydroTracer and Thermogravimetric Balance (Weight-Loss-Method)

A thermogravimetric moisture analyzer consists of a scale with an overhead heating source e.g., infrared, halogen or microwave based. The sample is heated on the scale, the weight loss is postulated as moisture content. This simple method is practical for the determination of high moisture contents, e.g., in food or agricultural industry, when the proportion of water is very high compared to other contained volatiles.

Disadvantages: Only a weight loss is measured, the cause of the weight loss cannot be determined. It can be water or caused by other volatile substances such as plasticizers, paraffin's, fire inhibitors, etc.

A frequent sales argument for thermogravimetry is the hypothesis that at a low heating temperature - for example, 110 °C - the proportion of the other volatiles can be neglected. On the other hand, at these temperatures in the presence of atmospheric moisture, the water only partially escapes from a hygroscopic test material until a state of equilibrium with the water content of the air is reached.

A further disadvantage is the heating source: Contrary to the statements of the manufacturers, it is not possible to heat a plastic granulate evenly by means of heat radiation. The surface will absorb more heat than the core. This accelerates the thermal degradation of the plastic (and therefore an additional weight loss). This is clearly visible in the case of translucent material on the basis of the discoloration.

Comparison: HydroTracer and Karl-Fischer Titration

Since decades the Karl-Fischer Titration it is the reference method for detecting the water content in many substances. It is a chemical-analytical method based on the oxidation of sulfur dioxide in methanolic-basic solution by iodine. As **water-specific** method it measures the **water content** down to the single-digit ppm (0.0001%) range.

These systems are used in many industries, but mainly in laboratories. Because of its complexity regarding peripheral equipment (aging & toxic reagent, carrier gas supply) and preparation of testing (blank value determination, shut-off criterion), users must be trained or need to have a specialized knowledge to proper operate these devices.

This is where the HydroTracer comes in. When developing the HydroTracer, the focus was always on providing an easy-to-use and cost-effective water content analyzer without sacrificing the analysis quality of an expensive and complex laboratory device. Many comparative measurements with the Karl Fischer titration prove the comparability of the systems with regard to the absolute measured value and repeatability.

What is the measurement accuracy?

The measuring range is between 0 mg and 25 mg of water.
The measurement accuracy is 0.14 mg in a range from 0 mg to 5 mg of water, 0.24 mg in a range of 5.1 and 15 mg of water, 0.34 mg in a range of 15.1 and 20 mg of water and 0.64 mg in a range of 20.01 and 25 mg of water.

How to determine the tolerance on the indicated % or ppm reading?

Here, we must consider the absolute accuracy valid in the respective measuring range. To determine the relative water content of the sample material, the water mass of the sample is divided by the weight of the sample. This will be illustrated using 3 typical use cases:

Example 1*: After 4 hours of drying at 80°C a 10 g specimen of Polyamide 6 GF 30 is measured*

A water content of 2 mg is determined during a measurement, the sample mass was 10 g. The average error according to the calibration certificate is 0.14 mg. The relative water content is thus: 2 mg / 10.000 mg = 0.0002 = 0.02% = 200 ppm. Neglecting the weighing error, the average error of the relative water content is 0.02% x (± 0.14 mg / 1 mg) = ± 0.0014 % and ± 14 ppm, respectively.

Example 2: *Crystallized and dried PET granules for PET-preform production*

A water content of 1 mg is determined during a measurement and the sample mass is 30 g. The average error according to the calibration certificate is 0.14 mg. The relative water content is thus: 1 mg / 30000 mg = 0.000033 = 0.0033% = 33 ppm. Neglecting the weighing error, the average error of the relative water content is 0.0033% x (± 0.14 mg / 1 mg) = ± 0.00047% and ± 4.7 ppm, respectively

Example 3: *PA6.6 injection moulded part conditioned in a 65°C water bath for 24 hours*

A water content of 20 mg is determined during a measurement and the sample mass is 1 g. The average error according to the calibration certificate is 0.34 mg. The relative water content is thus: 20 mg / 1000 mg = 0.02 = 2.00% = 20.000 ppm. Neglecting the weighing error, the average error of the relative water content is 2.00% x (± 0.34 mg / 20 mg) = ± 0.034% and ± 340 ppm, respectively.

These examples illustrate the great importance of the sample quantity to the accuracy of the measurement result.

What procedure is used to calibrate the HydroTracer?

A calibration is included in the initial delivery. The measurement accuracy can be checked by the customer, but we recommend the maintenance and calibration by aboni or an authorized service partner on a regular basis every 1-2 years.

The calibration is based on a method described in DIN EN ISO 15512:2019 PLASTICS - DETERMINATION OF WATER CONTENT.

A defined amount of an analytical salt is heated to 175 °C in the closed reactor, thereby ensuring complete evaporation of the entrapped water. The salt used is sodium molybdate dihydrate with analytical grade, the crystal water content of it is 14.89 mass%.

The salt is weighed with an analytical balance, the resolution of the scale is 0.01 mg, the accuracy +/- 0.03 mg, so the accuracy of the water weighed is 0.03 mg x 0.1489 = 0.005 mg.

The traceability of this method is based on a tested scale with which the calibration salt is weighed.

The average results must be within a tolerance range and the allowed values are:

0.14 mg in a range of from 0 mg to 5 mg of water,

0.24 mg in a range of 5.01 to 15 mg of water,

0.34 mg in a range of 15.01 to 20 mg of water and

0.64 mg in a range of 20.01 to 25 mg

Why do I have to specify the material density?

The material density is required to calculate the sample volume together with the sample weight. The volume of the empty test chamber is already known. By subtracting the sample volume from the chamber volume, the free volume is obtained – this is the space that the surrounding air occupies.

During the preparation of a measurement, this surrounding air enters the test chamber. The HydroTracer continuously monitors the air pressure, temperature, and relative humidity. This makes it possible to accurately calculate the amount of water that enters the test chamber with the surrounding air. This water content is then automatically taken into account in the final measurement result.

How much sample material should I use for a test?

For most applications, a sample weight of **5–10 g** is ideal to cover a moisture range of **0.01–0.5%** (or **100–5000 ppm**). In special cases, it may be necessary to analyze either very moist materials (> 1%) or extremely dry samples (< 0.005%).

The following guidelines can be used as a reference:

A) Very dry material with < 50 ppm residual moisture → **20–30 g**
B) Typical application range (0.01–0.5%) → **5–10 g**
C) Very moist samples (> 1–3%) → **0.5–2.5 g**

Rule of thumb: The higher the moisture content, the smaller the sample amount — and vice versa.