TEWS Elektronik

Measuring Moisture by Microwave Resonance

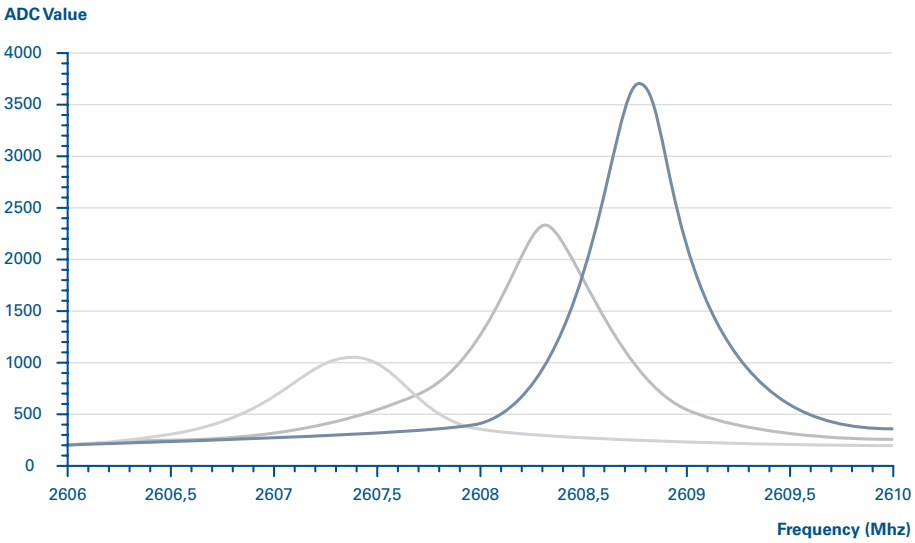
The Patented „TEWS Method“

Moisture

Moisture is defined as the percentage of water contained in the total mass of a solid substance. Other terms are used synonymously - such as humidity, material moisture, absolute moisture, moisture content, gravimetric water content etc., these words must be clearly distinguished from all expressions referring to the share of steam in gases such as humidity, relative humidity, water vapor content etc. The ATRO moisture details only refers to the water content in the dry mass of the substance.

Water molecules and resonant microwave field

Water molecules residing on the surface or in the pores of solid substances align themselves with electromagnetic fields while drawing energy from the field. One practical example of using this effect is a microwave oven where oscillating water molecules generate heat. The interaction between microwavefields and water molecules are also measured and, thus, put to technical use. Since microwaves will penetrate deeply into the product, the technique will detect water both inside and on the surface of an object or substance.



Typical resonance plot of different moisture contents

Microwave resonance

The TEWS moisture measuring method uses a sensor to generate a low-powered microwave field resonating characteristically within well-defined parameters. Filling or covering the sensor with a product – e.g. a powder or granules – will change the position and strength of the resonance. These changes largely depend on how much water the product contains. The resonance readings are proportional to moisture. The effects of the product density variations or sensor load are compensated for. The TEWS‘ method allows several dozen, or even several thousand, readings to be taken and shown every second.

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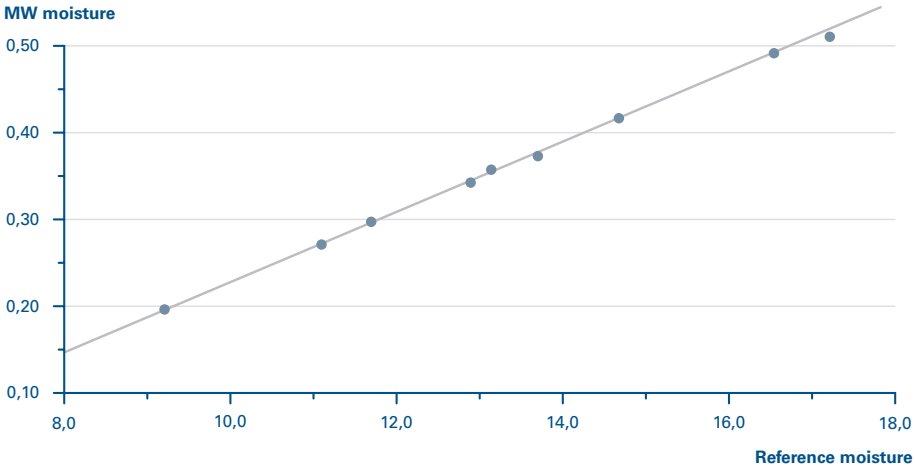
Calibration

For the moisture content to be shown as a percentage, the instrument first needs to be calibrated. This is done by collecting samples of the product with different moisture contents, which cover a typical range of applications. Moisture in the sample is then measured using both a suitable laboratory method and the microwave resonance method. In the drying process (drying kiln, drying balance), the sample moisture is determined mainly by the amount of weight lost. A chemical method, such as the Karl Fischer titration, can also be applied occasionally to determine the water content.

The system uses the pairs of values obtained from the microwave and laboratory measurements to calculate a calibration curve, which is then used to convert the measured microwave readings into moisture percentages. Under certain circumstances, the instruments can also be calibrated for measuring densities. Calibration is required only once for every product.



Example of a calibration graph
Number of samples measured: 9, Correlation: 0.99,
Mean deviation: +/- 0.1%, Lab reference method: drying kiln

MEASURING METHOD BENEFITS:

- Very fast results, also suitable for measuring online
- High accuracy of results
- Measuring independent of product density or product load
- No impact of optical factors on measuring, such as color changes, product surface structure, dust
- Measuring of moisture at product surface and core
- Non-destructive measuring
- No consumables, such as reagents, etc.
- Testers are maintenance-free and easy to use

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