Innovative Microwave Resonance Technology

Moisture and Bulk Density Measurement for the Food and Feed Industry

Production Optimisation and Cost Savings

- Improve yield and reduce waste
- Save energy through precise dryer control
- Enhance your productivity
- Increase your product quality
- Amortisation within less than one year
Dear Costumer,

TEWS Elektronik GmbH & Co. KG was founded in 1970 in Hamburg, Germany as an owner-managed company. Since the late eighties it has focused its principal activities on developing, producing and selling its patented state-of-the-art microwave moisture and density measuring systems. The company is now headed by the second generation of the family, Mr. Andre Tews, accompanied by Dr. Tim Richter as CFO.

With around 50 employees in research, development and production, TEWS Elektronik provides customised online process systems and laboratory units for a large variety of applications in every corner of the world. More than 6000 measuring systems are already in operation worldwide, and a truly global service team is available around the clock for application support and customer services. Forward-looking TEWS Elektronik is prepared to respond to the most exacting requirements from its global customer-base.
TEWS develops and manufactures microwave measuring systems specifically designed for the food and feed industry. It keeps close professional ties with leading small and large companies from the industry, including end customers and machinery makers. The products to be measured can take on a variety of shapes and sizes (e.g. powder, wafers, granules, pellets, etc.) that can all be covered with different types of sensors for installation in pipes and chutes, both at-line as well as in laboratories. As a matter of course, food safety requirements are also fully complied with.

Due to continuous monitoring during the production process, the moisture can be adjusted accordingly very quickly and always kept at an optimum level in order to assure highest product quality and avoid fungal infection. Thus, there is no need to wait for test results from a remote laboratory. Shorter drying times enable a higher throughput and avoid overdrying of the product and hence wasting energy. Furthermore, a higher degree of automation leads to lower personnel costs. Another important aspect is the fact that optimum product moisture leads to increased shelf life of the product.

**Characteristics of Microwave Resonance Method**

- **High accuracy**
  - Surface and core moisture
  - Independent of density, color, surface structure
- **High speed**
  - Direct measurement in product flow
  - Online capacity
- **Easy operation**
  - Free of wear and tear, low-maintenance
  - No sample preparation
  - Non-destructive
Applications

TEWS Elektronik has vast experience in developing and manufacturing microwave measuring systems that are successfully used by various customers around the world for many different applications. Among others these include:

**FOOD APPLICATIONS**

- Caramel paste
- Cereals
- Cocoa beans and nibs
- Dried herbs, fruits and spices
- Gelatine
- Green coffee beans, roasted and ground coffee
- Hop umbels
- Marzipan, almond paste
- Milk cream
- Nuts
- Oil seeds like soya, rapeseed, sunflower
- Pasta
- Potato chips and crisps
- Soft candy
- Soup powder
- Sugar
- Wafer, cracker and crisp bread

**FEED AND SEED APPLICATIONS**

TEWS sensors can be used at locations where competitive measuring technology like capacitive and optical methods may fail. We produce robust measuring systems that deliver accurate and stable measurements even under harsh environmental conditions in many different feed and seed applications, e.g.:

- Aqua feed
- Compound feed
- Feed pellets
- Grain
- Oil seeds, press cake, flakes and meal
- Pet food
- Pet treats & snacks
- Seeds
Moisture and Density Sensors

The food and feed industry faces many challenges in order to ensure consistent product quality and maximum production efficiency. TEWS’s wide product range therefore includes a broad variety of sensors that can cope with many different applications in various industries. At the required point of measurement the product may be transferred from one conveyor belt to the next or flow inside a chute or into a silo. Ambient process conditions such as temperature and bulk density are likely to change as well. Specifically engineered and customized sensor solutions are available in order to cope with these often harsh conditions.

- Diverse sizes for use at specific locations in the production process
- Special sensors available for ATEX requirement and high temperature applications
- Moisture measurements down to 0.05% for very homogenous products
- Robust and durable design for industrial usage
- IP65 protection and partly CIP approved

Tubular sensors
- Bypass and laboratory use for
  - Powder
  - Granules
  - Pellets

Planar sensors
- Inline use for
  - Powder
  - Granules
  - Pellets

Fork sensors
- Inline and at-line use for
  - Foils / Sheets
  - Wafer
  - Crisp bread

- Powder
- Granules
- Pellets

- Foils / Sheets
- Wafer
- Crisp bread
Typical Measuring Points

Moisture Measuring in Process Systems

1. **Hand-held for portable measurement**
   For quick moisture measurement during goods receipt inspection, or in storage. MW 1100.

2. **Sensor installation in the silo hopper**
   Online measurement: Directly in the exhaust hopper. MW 4200, MW 4260 or MW 4270 with planar sensor.

3. **Sensor installation at ejection location**
   Sensor installation at the drop-off point at the end of a conveyor. MW 4200, MW 4260 or MW 4270 with planar sensor.

4. **Laboratory sensors for measurement of samples**
   For quality control and for ensuring quality, for product development or goods receipt inspection. MW 1150 for routine measurements, MW 4300 / MW 4310 for sophisticated laboratory applications.

5. **Vibrating conveyor system**
   Installation of the planar sensor directly in a vibrating conveyor. MW 4260 or MW 4270 with planar sensor and special cable set.

6. **Sensor installation in a bypass of main product flow**
   Installation of a tubular sensor in a tube for free-flowing and non-adhesive products for semi-automated inline measurement. MW 4260 or MW 4270 with bypass sensor.

7. **Sensor installation in the wall on the buffer silo**
   Online measurement: Directly at the outlet of the buffer silo. MW 4200, MW 4260 or MW 4270 with planar sensor.
Quality Assurance in the Laboratory

MW 4300 / MW 4310
Accurate, fast and easy to operate

The laboratory testers MW 4300 and MW 4310 stand for the high-quality laboratory measurement of moisture and/or bulk density. The MW 4300 features an integrated 10.4” touch TFT LCD that enables a vast range of configuration, calibration and data analysis options. It is mainly used as a replacement for time-consuming methods such as drying oven or KF. The MW 4310 requires a commercially available monitor and PC keyboard.

Key features

- Measuring results obtained within seconds to avoid process delays
- No preparation of samples (e.g. grinding or weighing) required
- Up to 200 product calibrations can be set up inside
- Measurements can be stored on external PC via network or USB
- Sensors for sample volumes of 1 ml – 2000 ml available
- MW 4310 as cost-efficient alternative requires external monitor, keyboard and mouse
- Up to 2 laboratory sensors can be connected
MW 1150
Ideal for Routine Measurement

The MW 1150 is designed as a compact laboratory instrument that can also easily be used at-line. The display is directly attached to the sensor for optimised space conditions. The MW 1150 is set up and calibrated via a PC connection. It enables frequent microwave moisture measurements at a reasonable cost.

Key features
- Configuration, calibration and data analysis related to applications
- Data transfer via industry standard 4-20mA interface
- Results are displayed on 5.7" LCD monitor in less than 1 second
- 250 readings can be stored internally for 25 different products
- Printer and USB port for PC connection available
- Equipment for sample volumes of 1 ml – 2000 ml available
- Convenient communication via TMV Lite software
TEWS understands the specific requirements that customers have and provides a variety of process systems. The top range MW 4270 features an integrated touch TFT screen for highest convenience and ease of use. The MW 4260 has a single line analogue display. All versions can be connected to a PC and controlled using the TMV software.

• Measuring results within a fraction of a second with up to 3,500 measurements/s
• Long-term stability and low installation cost
• Easy integration into closed-loop control systems
• IP65 protection for industrial use
• ATEX protection possible

MW 4200
Compact Version – Higher Flexibility

The MW 4200 is the perfect alternative for specific purposes:

• Applications where the distance between the sensor and the display needs to be longer (up to 8 m)
• Applications where traversing is essential to get accurate results
Moisture and Density Sensors

Planar Sensors for Inline Moisture Measurement
Planar sensors can be installed along a conveyor belt, in a chute, a vibrating conveyor or a silo for the inline moisture measurement of bulk material. The product to be measured moves over the sensor with direct contact. Extra hard stainless steel and ceramics are used to make the sensors very robust and durable so they can be used for abrasive products and can withstand product temperatures of up to 120°C.

Tubular Sensors for Moisture & Bulk Density Measurement
Bypass sensors are automatically filled and emptied with the product to be measured in order to provide a semi-automated inline analysis. They can also be used for the measurement of bulk density.

Fork Sensors for Measurement of Flat Products
This special type of sensor can be applied for the measurement of flat products including wafer or crisp bread. Fork sensors are made up of two semi-cylinders that generate the microwave field between them. The measurement is contactless and the product can flow freely through the sensor.
Standard Configuration of an MW 42x0 Process Unit

**Remote access**

- **PC**
  - TEWS Hamburg
  - Team Viewer

- **PLC**
  - (e.g. Siemens S7)

- **PC**
  - TMW
  - (Team Viewer)

- **Analyser MW42X0**
  - 2.6% 89°C

**Complete set of standard interfaces**
- Analogue output 4-20mA
- Network connection (Modbus/TCP)
- Analogue & digital I/Os
- Profibus and other fieldbus on request (option)
- Remote support via TeamViewer

**Connections**
- Standard ethernet connection cable
- Multi-wired shielded cable for analogue and digital inputs and outputs (Option: Profibus DP)
- Microwave and sensor cables. Maximum length: 4m
- Option: IR temp.

Configuration via operating software TMV
PC can be used as RPC server (or any other PC in the LAN)
Selection Criteria of Planar Sensor Locations

Planar sensors are most often used for inline applications. They can be easily integrated into the process at various positions, which provides a very high degree of flexibility for the user. In order to find the optimum solution, a number of things have to be taken into account:

- The product has to be in direct contact to the sensor and is moving
- Varying coverage of the sensor or a discontinuous product flow is no problem as the measurement is independent of the bulk density resp. mass-flow
- It is essential to have access to the sensor for cleaning, servicing and sampling

A few examples of planar sensor installation into the process

- Drop-off point at the end of a conveyor belt
- Plates to cover the sensor surface
- Installation in a chute from round to square
- Swing device for easy installation and maintenance
- Outside installation in hopper
- Sensor inside the wall of a buffer silo or a drop shaft
Microwave Transmission System

The transmission measuring system MW-T is designed for non-contact moisture measuring, specifically in large bales or boxes. The instrument is, for example, used for herbs, spices and tea. The sensor field passes completely through the sample being analyzed so that moisture is measured right to the core. Moisture measuring using MW-T is carried out irrespective of the product density, meaning that densities or masses do not have to be determined separately. MW-T is a robust measuring unit: Results are neither influenced by the distance between sensors nor the exact adjustment of the sample.

Consulting & Services

• Support in selecting the optimum sensor location
• Commissioning of TEWS microwave moisture measuring systems
• Training of operators
• Regular maintenance visits
• Training courses at our headquarters in Germany or on site
• Remote support via TeamViewer
• Testing of samples and assisting in setting-up calibrations
• Development of customised sensors
• Service centres in Hamburg, USA, Thailand and China
The TEWS Moisture View software TMV is based on the experience of more than 20 years in the food and feed industry. It is particularly simple and straightforward to use in order to ensure easy operation. Furthermore, it comes free of charge with every measuring system and can be quickly installed on external PCs for remote data monitoring and configuration.

- Statistics and trend diagram functions for analysis and display
- User administration includes log-in function and log files
- Personal set-up and user profile memory
- Multiple language selection

**Accessories**

**For laboratory use**
- Thermo printer P 1150
- Pt100 temperature sensors
- Infrared temperature sensor
- Hoppers, brushes, dishes
- Spare beakers

**For process systems**
- Infrared temperature sensors
- Analogue remote display
- Welding flanges
- Mounting plates and swing devices
- Profibus and other field bus interfaces
Advantages of TEWS’s dual Parameter Microwave Measurement

• Non-destructive measurement in original product shape
• Independent of color, surface structure and density
• Very fast and user-friendly as no sample preparation necessary
• Reference samples can be reused
• Measurement takes place right into the sample core
• Very high measuring rate for accurate laboratory and inline use
• Calibrations can easily be set-up by user and transferred to new instrument

Water molecules are one of the smallest molecules that have a positive and a negative side. The moisture sensor generates a low-energy electro-magnetic field, which interacts with these water molecules inside the product sample. Since the microwave field penetrates a number of centimeters into the sample, water is not only detected at the surface but also in the product’s core.

The product sample reduces the propagation speed of the microwave field, and the water molecules in the sample perpetually align to the electromagnetic field, thus depriving it of energy. The moisture meter continuously measures these two effects which are referred to as the dual parameter method.

A moisture value is calculated on the basis of the resonance parameters. This is independent of the sample’s bulk density or the thickness of the product layer on top of the sensor. For every product the moisture meter is calibrated with the aid of a laboratory method (e.g. LOD method or Karl Fischer Titration), so that the product’s moisture content is displayed, stored or processed as a percentage value.

In some cases the microwave resonance method can also be used to measure bulk density, sample mass or a sample’s weight per area.
# Comparison of Inline Moisture Measuring Methods

<table>
<thead>
<tr>
<th>MEASURING METHOD</th>
<th>Near Infrared (NIR)</th>
<th>Capacitive</th>
<th>TEWS-Microwave Resonance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode of operation</td>
<td>Analysis of optical spectral lines</td>
<td>Measurement of permittivity</td>
<td>Measurement of resonance shift and attenuation</td>
</tr>
<tr>
<td>What can be measured</td>
<td>Moisture, fat, protein, sugar etc.</td>
<td>Moisture</td>
<td>Moisture</td>
</tr>
<tr>
<td>Contact with product</td>
<td>Non-touching</td>
<td>Touching</td>
<td>Touching</td>
</tr>
<tr>
<td>Depth of penetration</td>
<td>Surface only</td>
<td>Core</td>
<td>Core</td>
</tr>
<tr>
<td>Calibration</td>
<td>Complex (modelling)</td>
<td>Simple</td>
<td>Simple</td>
</tr>
<tr>
<td>Moisture range</td>
<td>Limited, depending on product</td>
<td>Limited, depending on product</td>
<td>Limited, depending on product</td>
</tr>
</tbody>
</table>

| INTERFERING FACTORS               |                     |            |                          |
| Contactless measurement           |                     |            |                          |
| Varying sensor filling level      |                     |            |                          |
| Independent of salt content of product |     |            |                          |
| Varying product density           |                     |            |                          |
| Independent of small changes in composition and natural changes | | | |
| Varying product color             |                     |            |                          |
| Varying product surface structure |                     |            |                          |
| Varying temperature               |                     |            | * Compensation possible |
| Dust / dirty atmosphere           |                     |            |                          |
| Black product (light absorbing)   |                     |            |                          |
| Ambient light                     |                     |            |                          |

- Not affected
- Potentially problematic
- * Compensation possible
Other Industry Applications

Wood and Paper Industry
TEWS systems measure the moisture of wood chips and pellets, fibres and boards, paper sheets, webs and rolls and even the bulk density of wood pellets. The measuring results are unaffected by varying colors, densities or board and paper thicknesses.

Pharmaceutical and Chemical Industry
Microwave measuring instruments measure the mass, density and moisture in production processes as well as in the laboratory. Application areas include gelatine capsules and tablets, powders and granules, fertilizer and washing powder.

Tobacco Processing Industry
TEWS Elektronik offers a wide range of instruments for quality control of the entire production process: from incoming bales to outgoing cigarettes. Sensors and analyzers are available for inline, at-line and laboratory measurement of green leaf and cut tobacco, cigarettes/cigars and filter rods.
## Overview of Instruments and Sensors

### FOR LABORATORY AND AT-LINE

<table>
<thead>
<tr>
<th>Model</th>
<th>Display</th>
<th>Density display</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLE-10</td>
<td>5.7&quot;</td>
<td>No</td>
<td>240x70x170*</td>
</tr>
<tr>
<td>SLE-10B</td>
<td>10.4&quot;</td>
<td>Yes</td>
<td>350x220x435*</td>
</tr>
<tr>
<td>SLE-16</td>
<td>No</td>
<td>Yes</td>
<td>255x265x280</td>
</tr>
<tr>
<td>SLE-20B</td>
<td>50/80</td>
<td>Bypass</td>
<td>365x205x275</td>
</tr>
<tr>
<td>SLE-40B</td>
<td>Powder, granules</td>
<td>14/18/22</td>
<td>255x150x280</td>
</tr>
<tr>
<td>SLE-46</td>
<td>Powder, granules</td>
<td>80</td>
<td>255x305x280</td>
</tr>
<tr>
<td>SLE-50B</td>
<td>Paste like, bulk material</td>
<td>90</td>
<td>365x205x275</td>
</tr>
<tr>
<td>SLE-75B</td>
<td>Beans, bulk material</td>
<td>375</td>
<td>365x390x410</td>
</tr>
<tr>
<td>SLE-96</td>
<td>Beans, bulk material</td>
<td>1600</td>
<td>365x390x410</td>
</tr>
</tbody>
</table>

### FOR PROCESS INSTALLATION

<table>
<thead>
<tr>
<th>Model</th>
<th>Display</th>
<th>Density display</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW 1150</td>
<td>5.7&quot;</td>
<td>No</td>
<td>240x70x170*</td>
</tr>
<tr>
<td>MW 4300</td>
<td>10.4&quot;</td>
<td>Yes</td>
<td>350x220x435*</td>
</tr>
<tr>
<td>MW 4310</td>
<td>No</td>
<td>Yes</td>
<td>255x265x280</td>
</tr>
<tr>
<td>MW 4200</td>
<td>Numerical</td>
<td>No</td>
<td>370x250x160</td>
</tr>
<tr>
<td>MW 4260</td>
<td>5.7&quot;</td>
<td>Yes</td>
<td>415x530x240</td>
</tr>
<tr>
<td>MW 4270</td>
<td>10.4&quot;</td>
<td>Yes</td>
<td>415x530x240</td>
</tr>
</tbody>
</table>

* plus sensors

### OVERVIEW OF SENSORS

<table>
<thead>
<tr>
<th>Model</th>
<th>Typical product</th>
<th>Volume (ml)</th>
<th>Size* WxHxD (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLE-10</td>
<td>Powder</td>
<td>9</td>
<td>255x265x280</td>
</tr>
<tr>
<td>SLE-10B</td>
<td>Powder, granules</td>
<td>5</td>
<td>255x105x270</td>
</tr>
<tr>
<td>SLE-16</td>
<td>Powder, granules</td>
<td>14/18/22</td>
<td>255x150x280</td>
</tr>
<tr>
<td>SLE-26</td>
<td>Powder, granules</td>
<td>80</td>
<td>255x305x280</td>
</tr>
<tr>
<td>SLE-40B</td>
<td>Paste like, bulk material</td>
<td>60/160</td>
<td>365x205x275</td>
</tr>
<tr>
<td>SLE-46</td>
<td>Beans, bulk material</td>
<td>350</td>
<td>365x390x280</td>
</tr>
<tr>
<td>SLE-50B</td>
<td>Paste like, bulk material</td>
<td>90</td>
<td>365x205x275</td>
</tr>
<tr>
<td>SLE-75B</td>
<td>Beans, bulk material</td>
<td>375</td>
<td>365x390x410</td>
</tr>
<tr>
<td>SLE-96</td>
<td>Beans, bulk material</td>
<td>1600</td>
<td>365x390x410</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Typical product</th>
<th>Volume (ml)</th>
<th>Form factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPP-080-0xx</td>
<td>Pet food, gelatine, oil seeds</td>
<td>–</td>
<td>Small planar</td>
</tr>
<tr>
<td>SPP-160-xxx</td>
<td>All kinds of food and feed</td>
<td>–</td>
<td>Planar</td>
</tr>
<tr>
<td>SPP-4200-xxx</td>
<td>All kinds of food and feed</td>
<td>–</td>
<td>Planar</td>
</tr>
<tr>
<td>SPE-20/26</td>
<td>Powder</td>
<td>50/80</td>
<td>Bypass</td>
</tr>
<tr>
<td>SPH-46</td>
<td>Granules, beans, bulk material</td>
<td>500</td>
<td>Bypass</td>
</tr>
<tr>
<td>SPH-96</td>
<td>Beans, bulk material</td>
<td>2000</td>
<td>Bypass</td>
</tr>
<tr>
<td>SPF-60-16</td>
<td>Wafer, crisp bread, flat material</td>
<td>–</td>
<td>Fork</td>
</tr>
</tbody>
</table>

For additional technical information regarding installation, calibration, network connections and closed-loop control please consult the respective manuals.
Innovative Microwave Resonance Technology

Food and Feed Industry

TEWS Elektronik is an international company with a large number of sales partners all over the world. For an up-to-date list of agencies visit our website: www.tews-elektronik.com