

## Innovative Microwave Resonance Technology Process and Laboratory Moisture and Density Measuring



## Research and Development, Production and Sales

# TEWS Elektronik



## Research and Development, Production and Sales

# 47 Years of TEWS Elektronik

### TEWS ELEKTRONIK GMBH & CO. KG

**47 years of industrial experience**  
**27 years of experience in microwave resonance technology for moisture and density measurement**

**6000 systems employed for 750 customers**

**Approximately 75% of the equipment are installed and maintained overseas**

**50 employees in research, development and production**

**Sales and service throughout the world**

**Made in Germany**





## Physics and Methods

# Moisture Measuring Procedures



## **Moisture Measuring for Quality Assurance and Process Control**

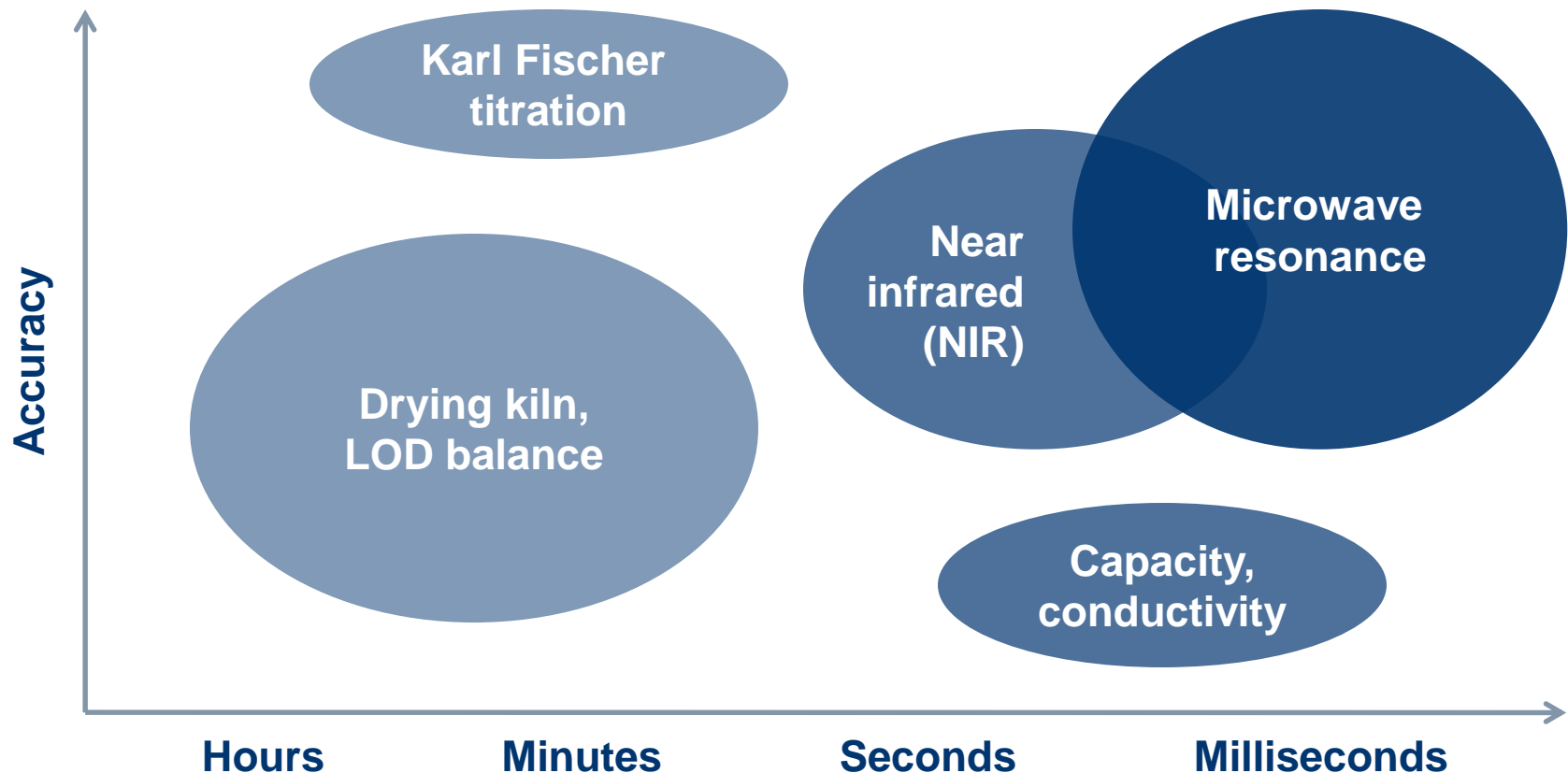
### **Why measure the Water Content?**

- **Water content as cost factor (valuable product, cheap water)**
- **Optimization of process steps (e.g. time and energy during drying)**
- **Mechanical processability (e.g. stability, proportioning)**
- **Product shelf life (e.g. moldiness, chemical reactions)**
- **Safety (e.g. risk of explosion, spontaneous combustion)**
- **Legal and contract conditions**

**>> require reliable, accurate and fast moisture measuring**

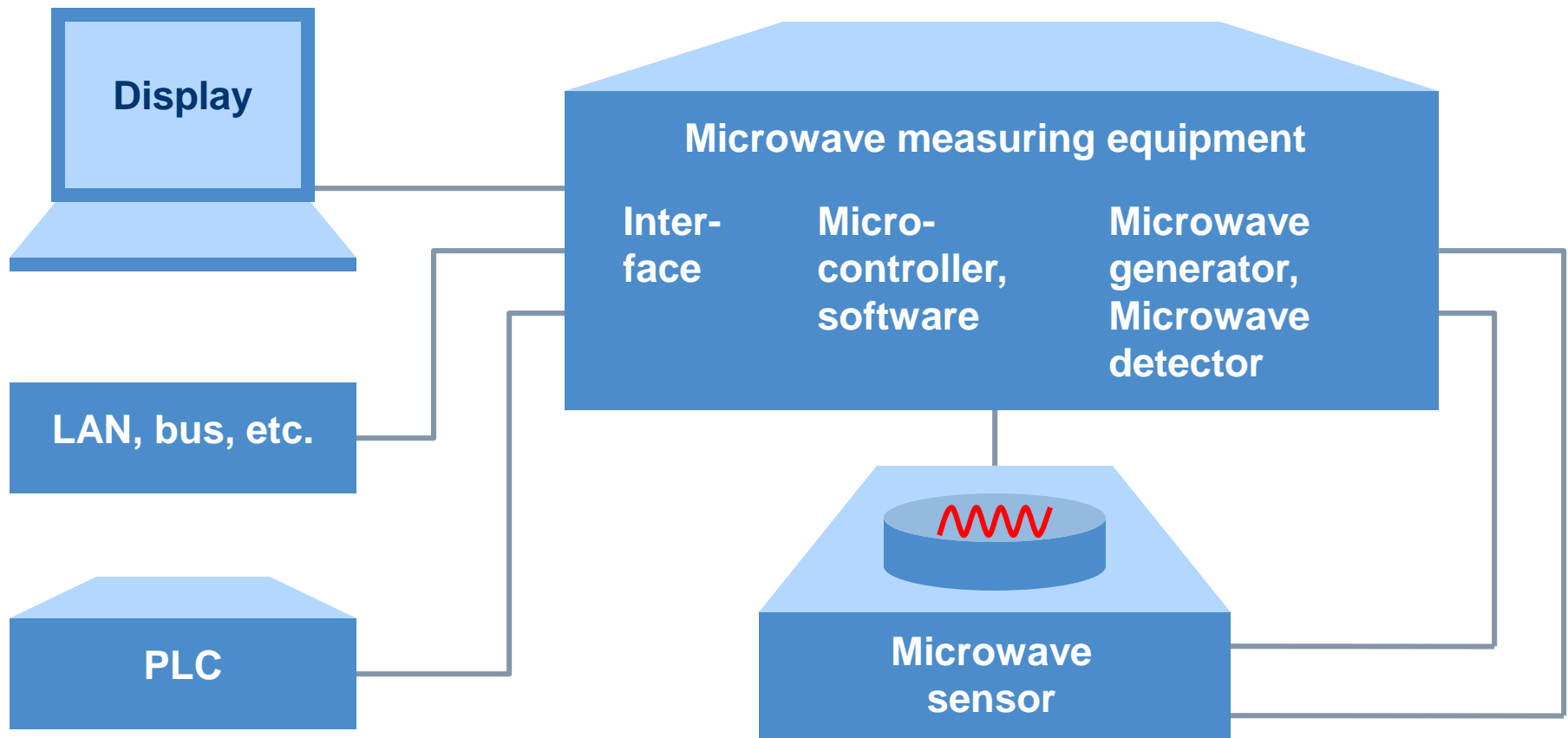
## Direct and Indirect Methods

# Industrial Moisture Measuring Procedures



## Construction and Components

# Microwave Resonance Measuring System

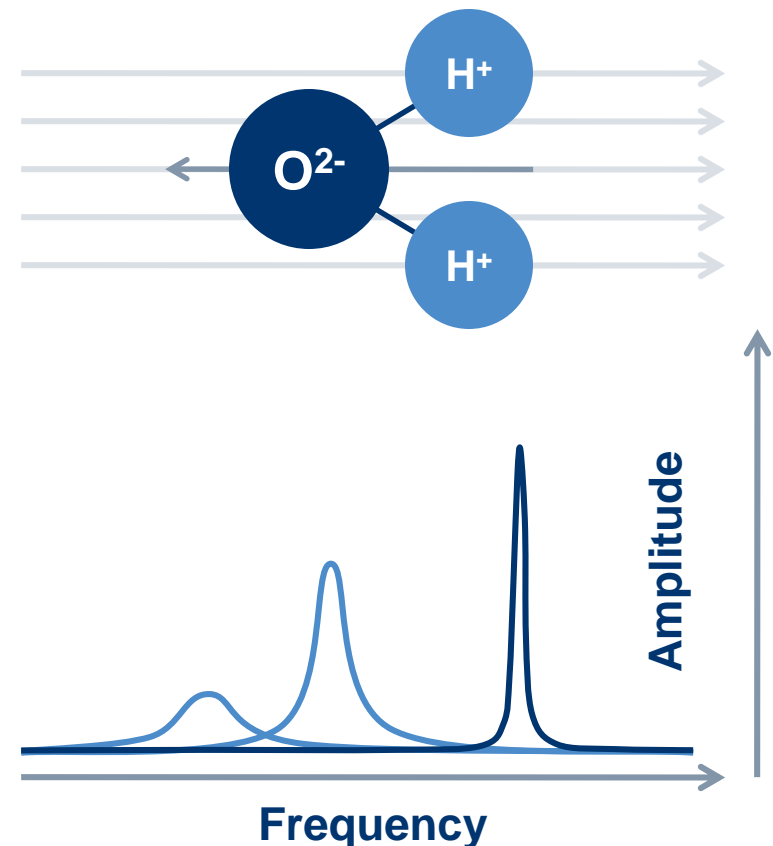


## Electromagnetic Field Measurement

### Interactions between Water and Microwaves

- Low-powered microwave field
- Selective interactions between field and polar water molecules
- Resonance is sensor-specific
- Water molecules in the product change the resonance frequency and amplitude
- Measurements of moisture and density or mass

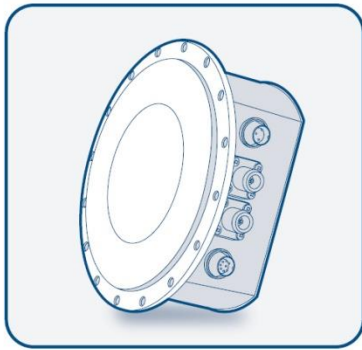
#### The Microwave Resonance Technique





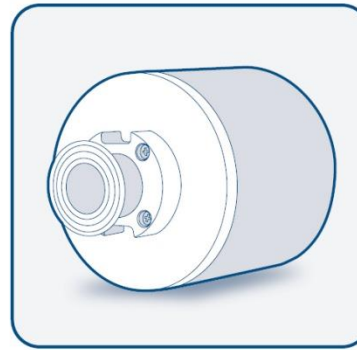
## Adjusted to Product and Application

# Forms of Microwave Resonators



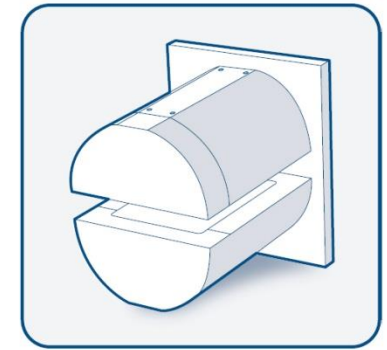
### Planar sensors

- Powder
- Granules
- Pellets
- Fibers
- Boards



### Tubular sensors

- Powder
- Granules
- Pellets
- Fibers (atline)

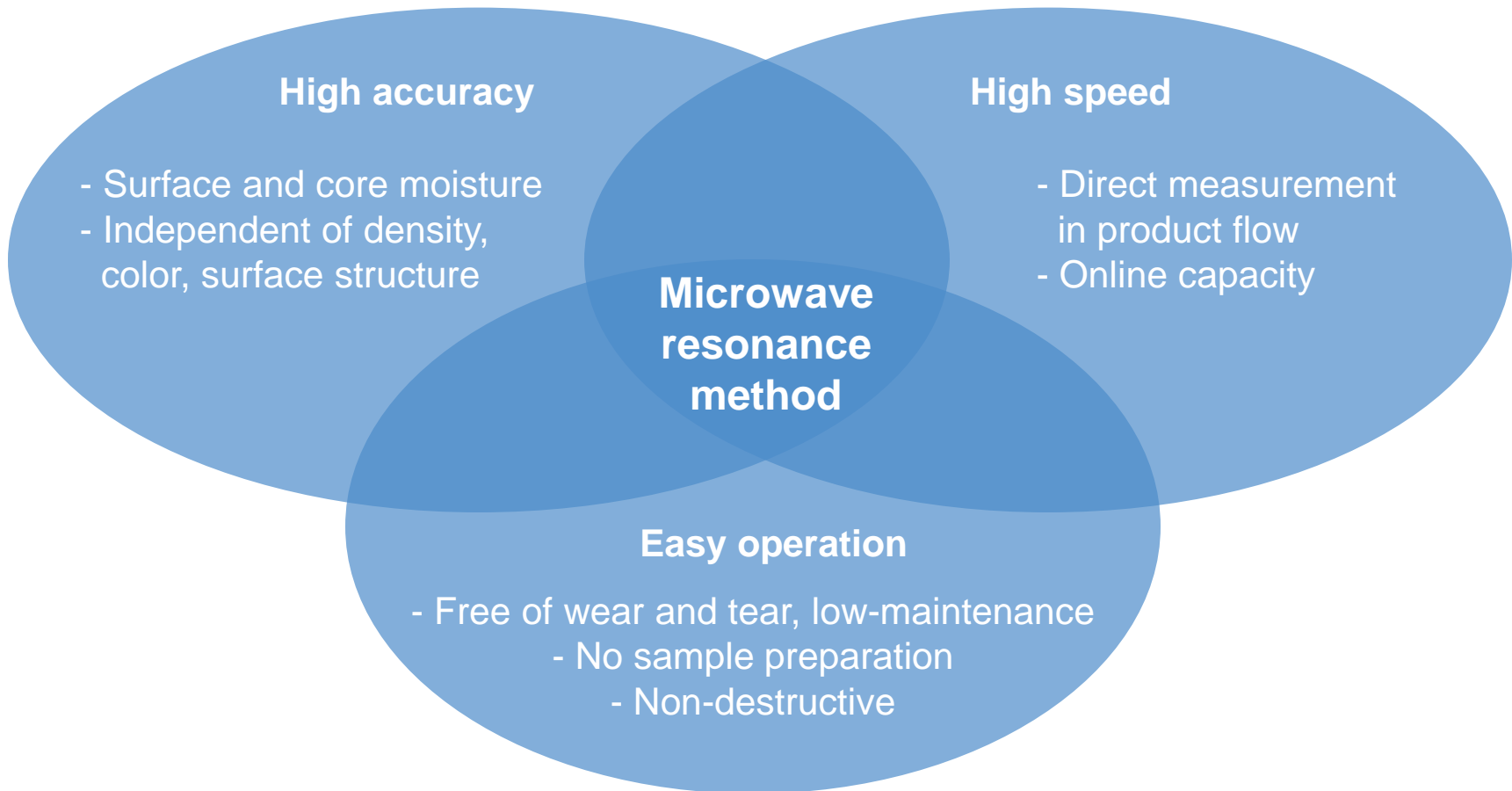


### Fork sensors

- Foils
- Strips
- Sheets
- Fleece
- Paper

**For High-quality Industrial Application**

## **Characteristics of the Microwave Resonance Method**



**TEWS Elektronik Blueline ®**

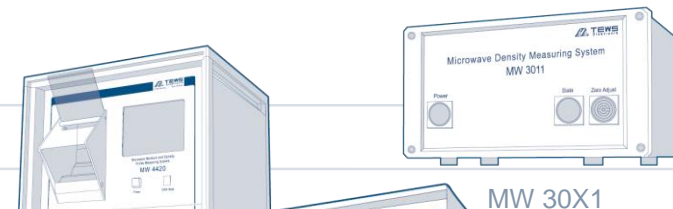
## Measuring Instruments to meet your Demands



## TEWS Elektronik Blueline ®

# The Instrument Program

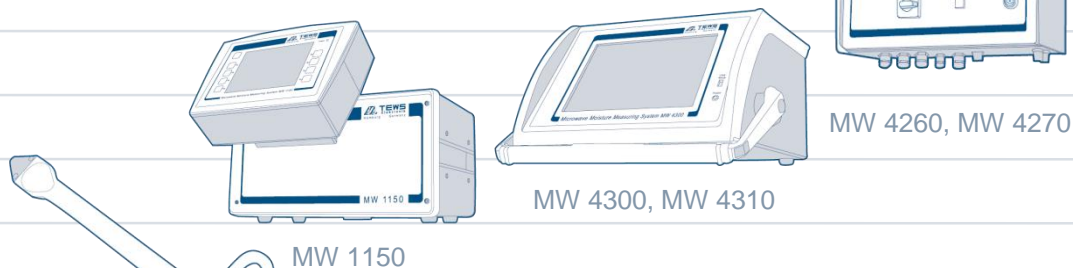
### Special solutions



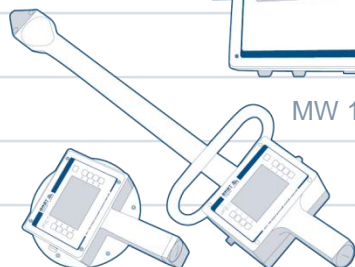
### Process facilities



### Laboratory/ atline instruments



### Handheld instruments



Measuring rate

1/sec

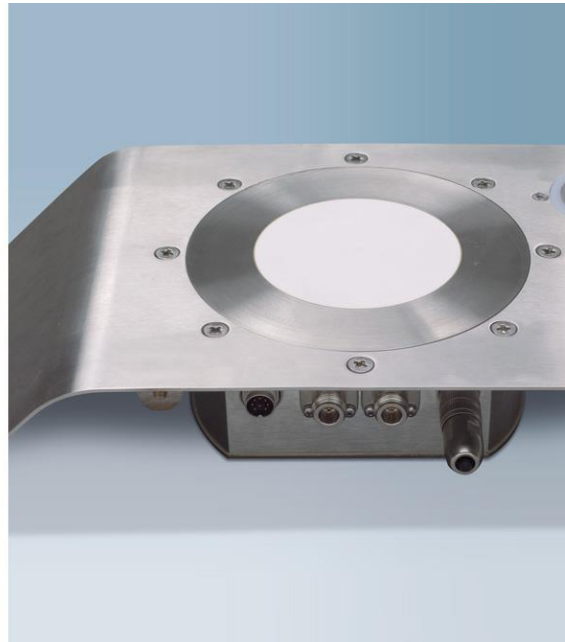
100/sec

10,000/sec

## Process Instruments MW 4260 and MW 4270

# Online Measurement of Material Moisture & Density

- Sensors directly within the product stream
- Continuous measurement transfer to process control
- Special implementations and ATEX protection are possible





## Moisture Measuring Instruments MW 4300 and MW 4310

### Quality Assurance in the Laboratory

- For high-quality laboratory measurements of moisture / density
- Many configuration, calibration and data analysis options
- Sensors for sample volumes of 1 ml – 2000 ml are available



## Moisture Measuring Instrument MW 1150

### Atline routine Measurements

- For frequent routine measurements accompanying production
- Configuration, calibration and data analysis related to applications
- Equipment for sample volumes of 1 ml – 2000 ml are available



## Handheld Instruments MW 1100 and MW 1100S

### Transportable, precise, applicable in a Variety of Ways

- Measuring by pressing on bulk material or insertion in bales, etc.
- Storage of measurements and data exchange via USB
- Application under industrial conditions





## Special Instruments for the Tobacco Industry

### Density and Moisture Measurement

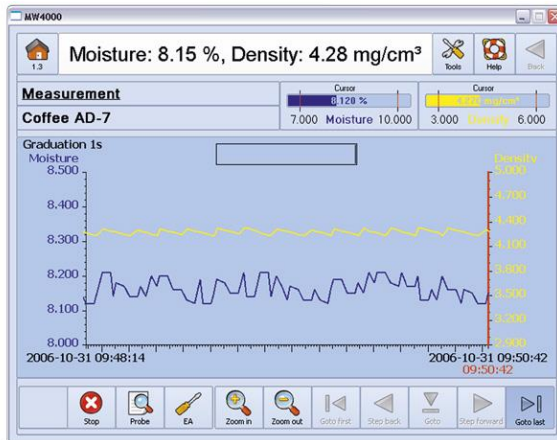
- **MW 3011:** Measuring the initial tobacco weight in cigarette rods (10,000 / sec)
- **MW-T:** Non-contact measurement of bales and cartons
- **MW 4420:** Moisture and density profiles of cigarettes and cigars



## Software TEWS Moisture View TMV ©

### Display, Analysis, Documentation

- Simple operation, configuration and calibration of the measuring instruments
- Statistics and graphics functions for the measured data analysis
- Integrated software for all applications



No.	Name	Remark	MC	CC	Cal. link	Off. moisture	Off. de
1	Coffee AD-7	TEWS Elekt.	100	50	self	0	
2	Coffee AD-8	TEWS Elekt.	0	0	41	0	
3	Cigarettes...		50	10	self	0	
4	41 REFEREN		0	2000	self	0	

**Product properties**

No.  Cal. no.  Offset moisture

Name  Offset density

Remark  Memory

Sensor mode

Buttons: Apply, Cancel, Help



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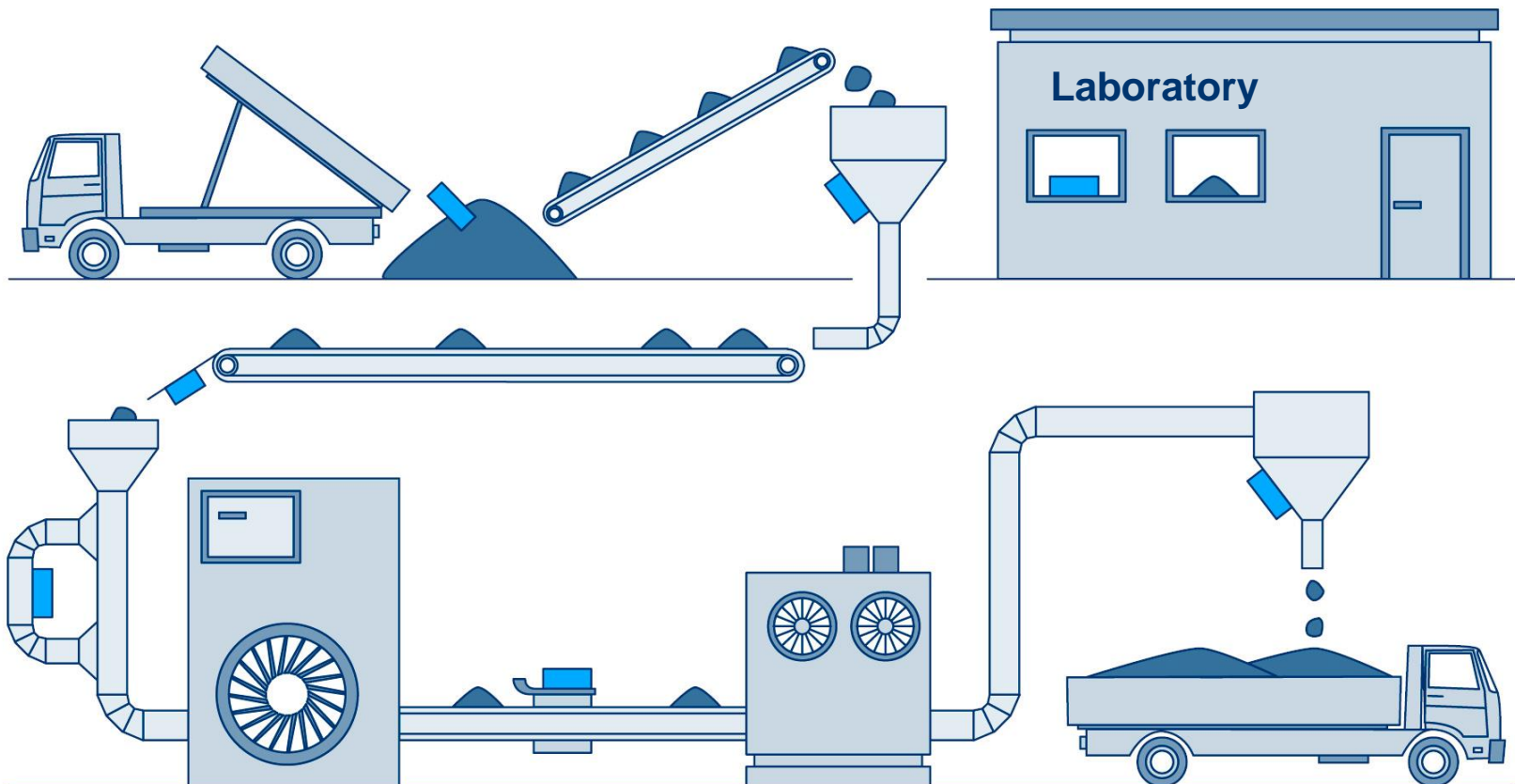
Sensor mode

Buttons: Apply, Cancel, Help



## Typical Measuring Sites

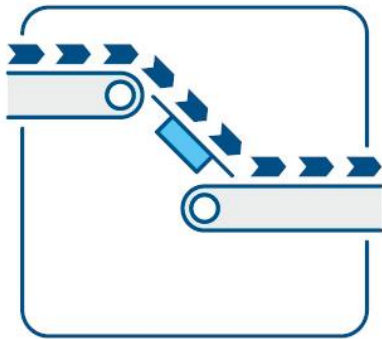
# Moisture Measuring at Production Facilities



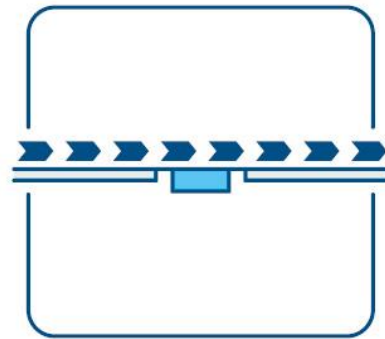
**As Diverse as the Demands**

## Sensor Installation at Process Facilities

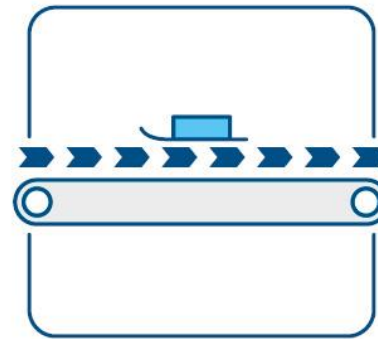
**Conveyor  
transfer point**



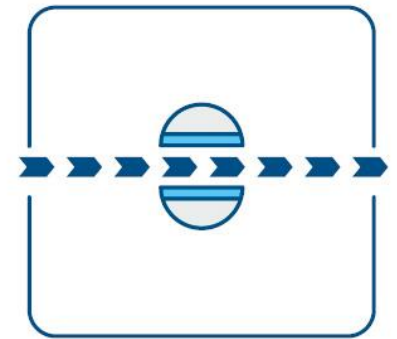
**Vibro  
conveyor**



**Sliding  
block above  
conveyor belt**



**Fork sensor on  
production line**

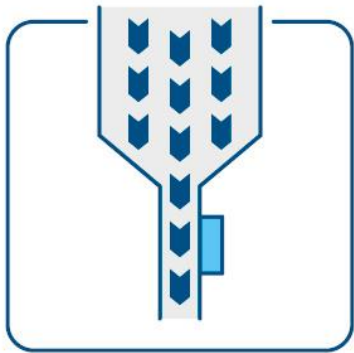


 Sensor  
 Product Flow

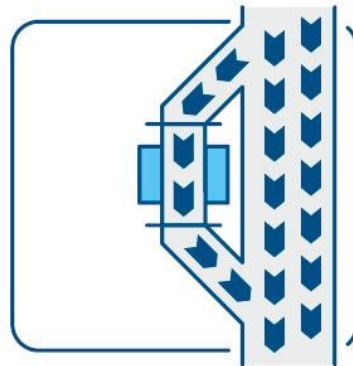
**As Diverse as the Demands**

## Sensor Installation at Process Facilities

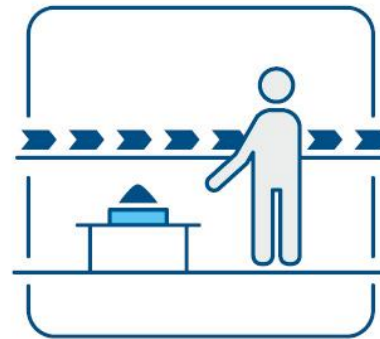
**Drop shaft,  
silo, chute**



**Bypass**



**Measuring next  
to conveyor belt**



**Mobile  
instruments**



■ Sensor  
➤ Product Flow

**Exposition on Process Installations**

## Industrial Applications

# Powder, Granules, Pellets, Fibers, Boards, Bales, Webs





## Accurate and Fast Measuring Saves Time and Money

### Food and Feedstuff Industries

- Microwave measuring is rarely influenced by natural variation of grain sizes, color, mineral content
- Detection of surface and core moisture



#### APPLICATION EXAMPLES

Wheat flour	5 – 13 %
Soybeans	8 – 13 %
Feed pellets	6 – 16 %
Noodles	10 – 16 %
Dried herbs	1 – 7.5 %
Nuts, almonds	5 – 10 %
Lucerne (alfalfa)	6 – 14 %



## From whole Beans to Powder

### Coffee Industry

- Accurate adherence of moisture limits in coffee
- Prevention of excessive drying
- Process measuring of whole, freshly roasted beans



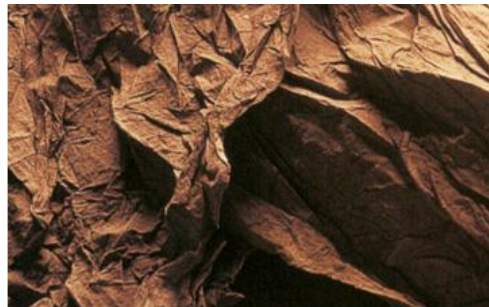
#### APPLICATION EXAMPLES

Raw coffee	8 – 15 %
Roasted coffee beans	3 – 6 %
Ground coffee	3 – 6 %
Instant coffee	2 – 6 %
Ground coffee	Density measuring

## Process Moisture Precisely Calculated

### Tobacco Industry

- Measuring systems for all tobacco processing stages from raw tobacco to the final product
- High-speed measuring of initial tobacco weight in cigarette rods



#### APPLICATION EXAMPLES

Raw tobacco	7 – 25 %
Leaf and cut tobacco	11 – 16 %
Expanded out tobacco	5 – 17 %
Cut stems	18 – 35 %
Cigarettes	Density profile
Cigars	Density profile

## From Powder to 100% Control

# Pharmaceutical and Chemical Industries

- Measuring on driers, mixers, conditioners
- Moisture and density determination on tablets and capsules



## APPLICATION EXAMPLES

Gelatine capsules	5 – 15 %
Tablets	2 – 5 %
Fertilizers	0.15 – 0.5 %
Silicic acid	2 – 5 %
Washing powder	5 – 15 %
Plastic granule	0.1 – 1 %



## Chips, Fibers, Boards, Pellets

### Wood Industry

- Moisture control for quality assurance in board production
- Moisture measuring for process optimization of pelletization and briquetting to meet the industry's quality standard



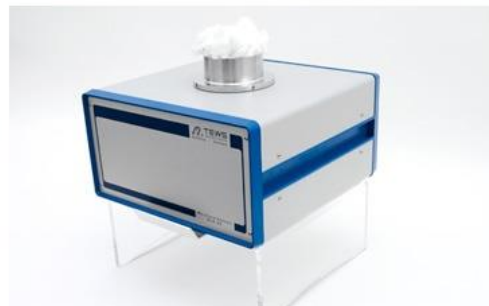
#### APPLICATION EXAMPLES

<b>MDF fibers</b>	<b>5 – 15 %</b>
<b>Wood particles</b>	<b>2 – 5 %</b>
<b>Fiber boards</b>	<b>3 – 8 %</b>
<b>Particle boards</b>	<b>3 – 8 %</b>
<b>Oriented strand boards</b>	<b>3 – 8 %</b>
<b>Wood pellets</b>	<b>6 – 14 %</b>
<b>Wood chip</b>	<b>25 – 40 %</b>

## Also Sub-Surface Measuring

## Paper and Textile Industries

- Moisture determination in paper and textiles on the running web
- Calibration on the basis weight is possible
- Independent of variations in color and thickness



### APPLICATION EXAMPLES

Viscose PE fleece	0.2 – 1 %
Cotton fleece	5 – 10 %
Paper	4 – 8 %
Tissue paper	4 – 8 %
Adhesive films	2 – 5 %
Yarn	Mass



## **Our Service**

# **Qualified Support**



## Our Service

### Qualified Support

- Project support from initial consultation to commissioning
- After sales service
- Support for customers throughout the world in many languages



## OVERVIEW OF SERVICE

Application laboratory for test measurements

Customer-specific solutions

Qualified maintenance and  
instructions to users

Application-specific calibration

Support provided by  
engineers via telephone and modem

Upgrading service

## Service and Sales

# Representing TEWS Elektronik international



## Enterprise and Technology

# TEWS Elektronik – your competent Partner

## TEWS Elektronik

- The specialist for microwave resonance measuring
- 24 years of experience in material moisture and density measurement
- Research and development, production, sales and service
- Customer-specific solutions in many branches throughout the world

## Microwave resonance measuring

- High accuracy
- High measuring speed
- Easy to operate

## **TEWS Elektronik – Industrial Moisture and Density Measuring Technology**

### **Thank you very much for your Interest!**

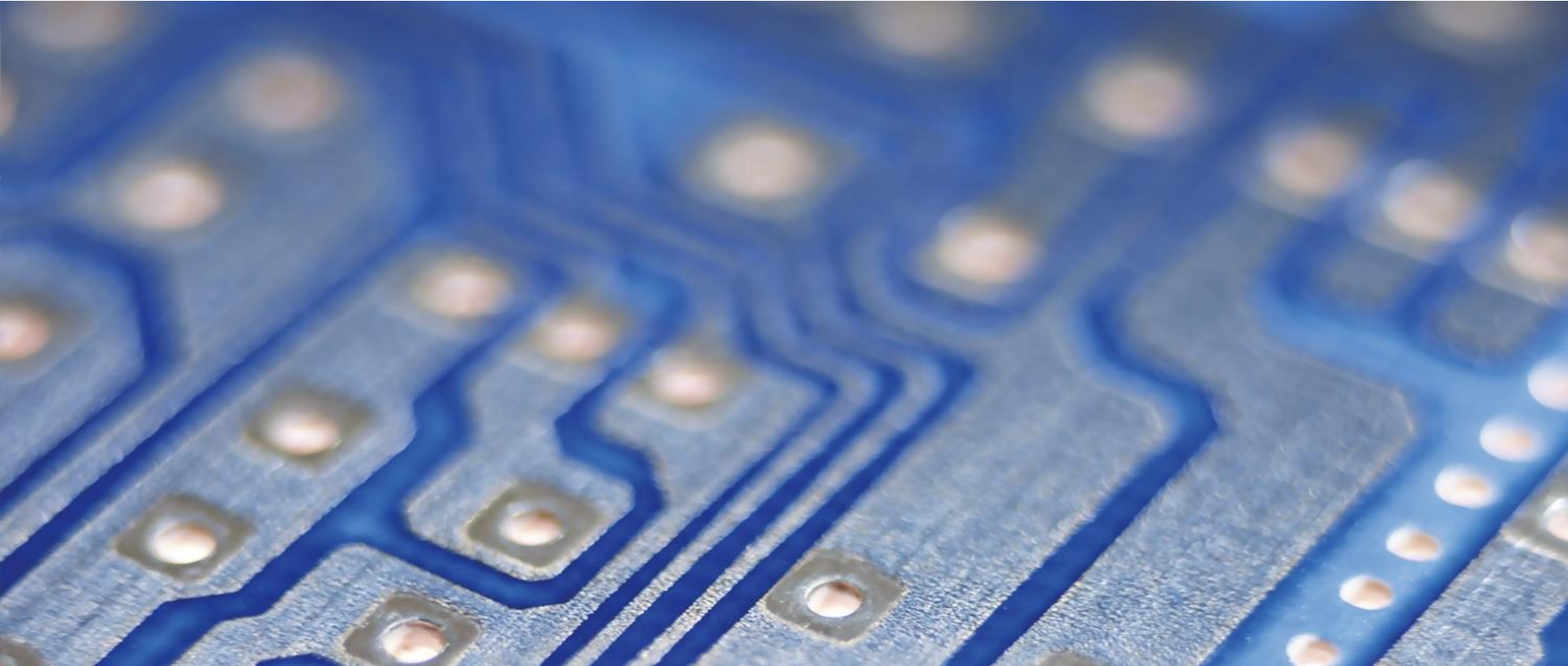


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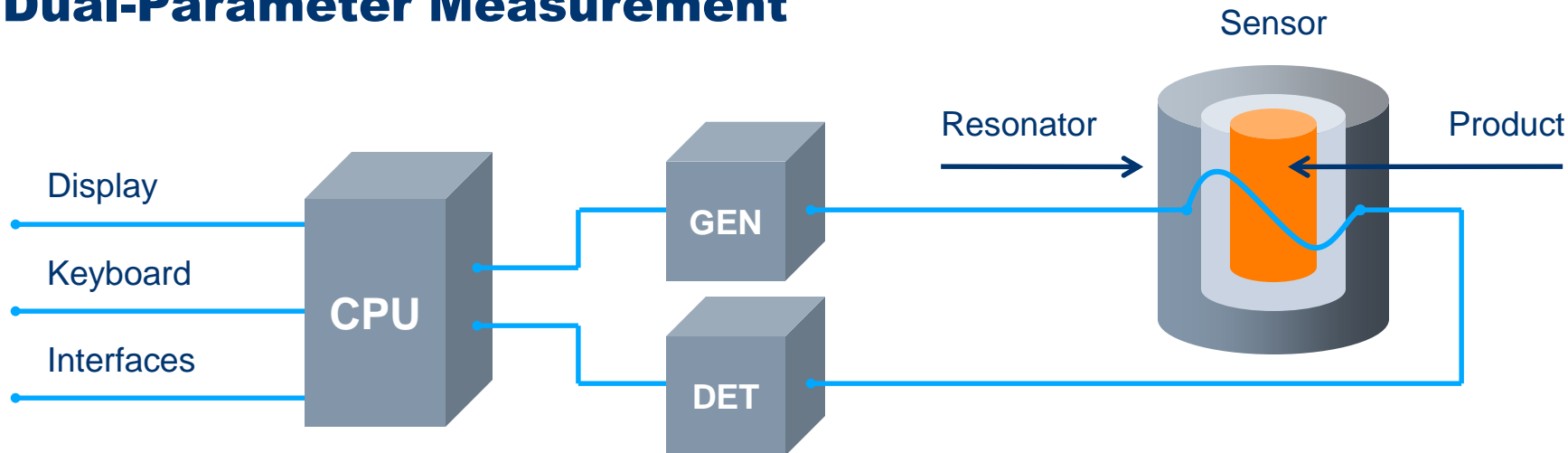


## **Process and Laboratory Moisture and Density Measuring Exposition on Microwave Resonance Procedures**



## Exposition on Microwave Resonance Procedures

### Dual-Parameter Measurement



#### Processor

- Generator control
- Detector read-out
- Moisture and density calculation
- Peripheral connection (e.g. PC)

#### Generator/Detector

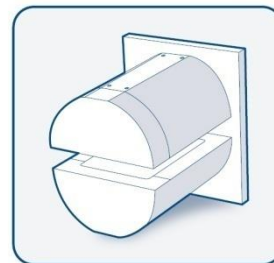
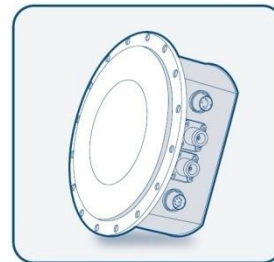
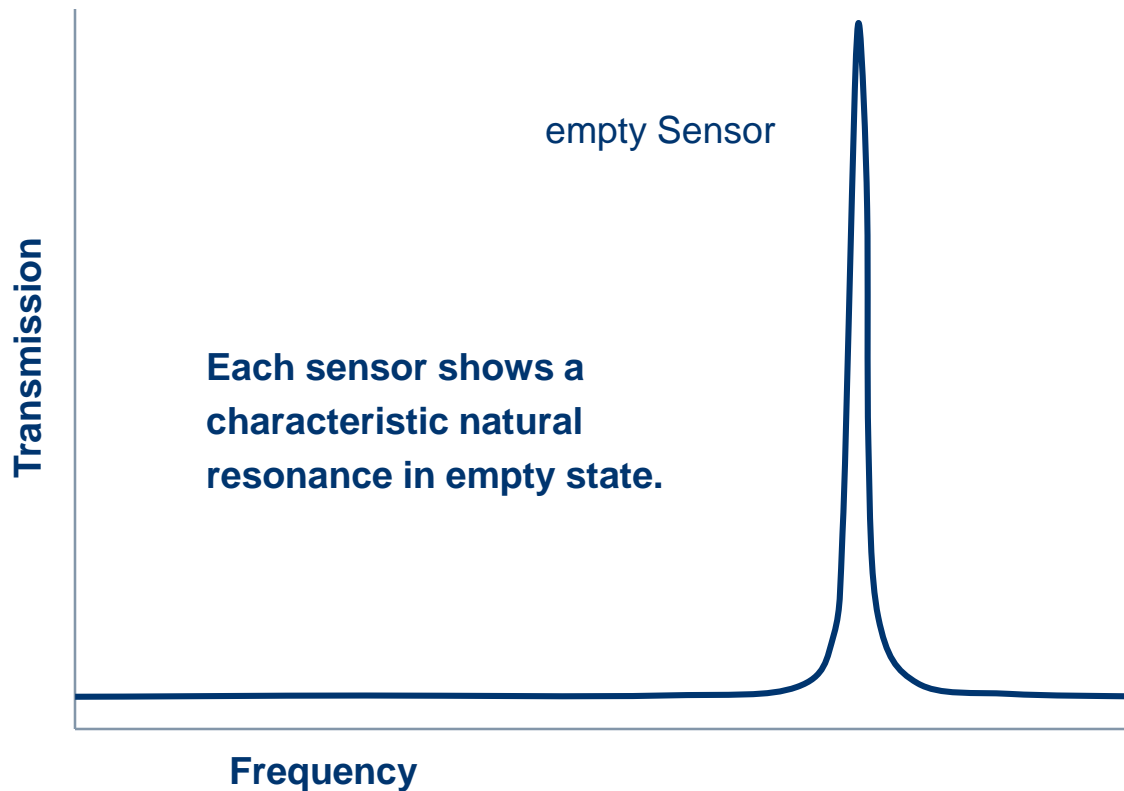
- Microwave generation in the gigahertz range
- Sensor input
- Microwaves changed by the product are received
- Transmission of the measuring signal to the CPU

#### Product/Sensor

- Build-up of a resonating microwave field
- Product changes the field in the sensor
- Measuring the signal by antenna at the detector

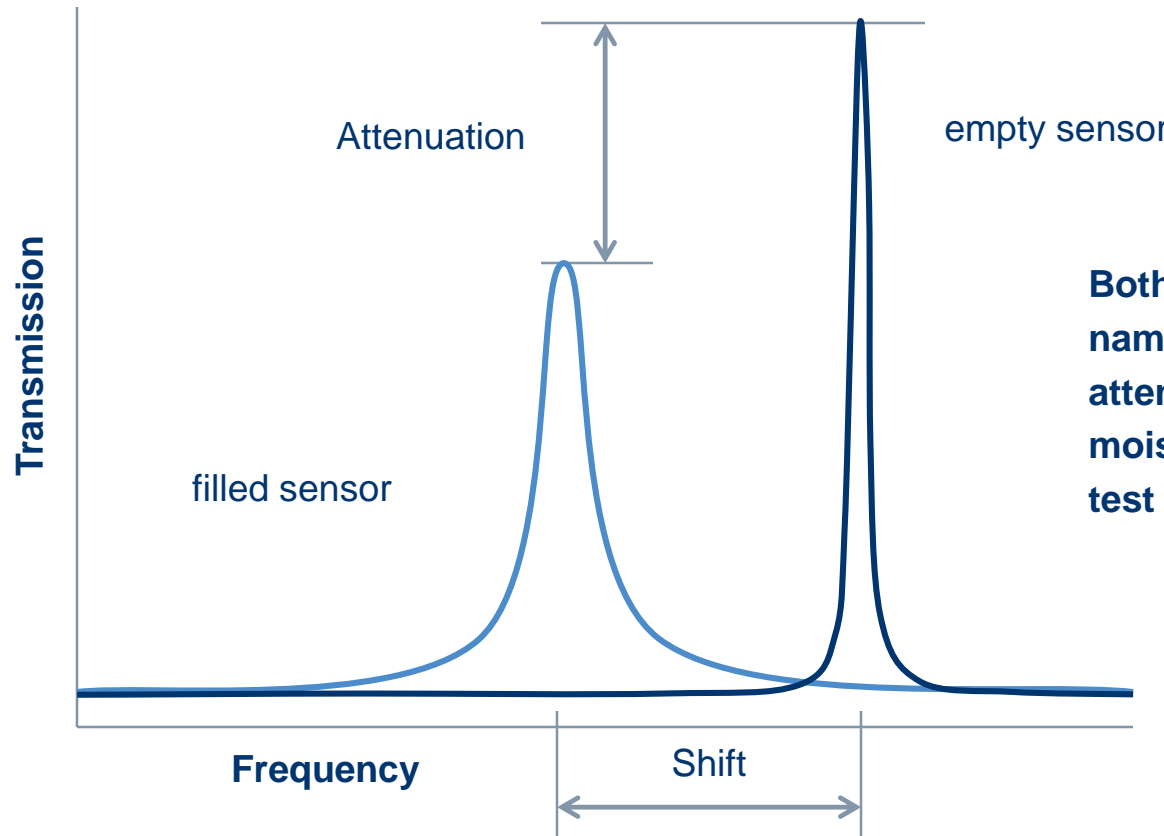
## Exposition on Microwave Resonance Procedures

### Dual-Parameter Measurement



## Exposition on Microwave Resonance Procedures

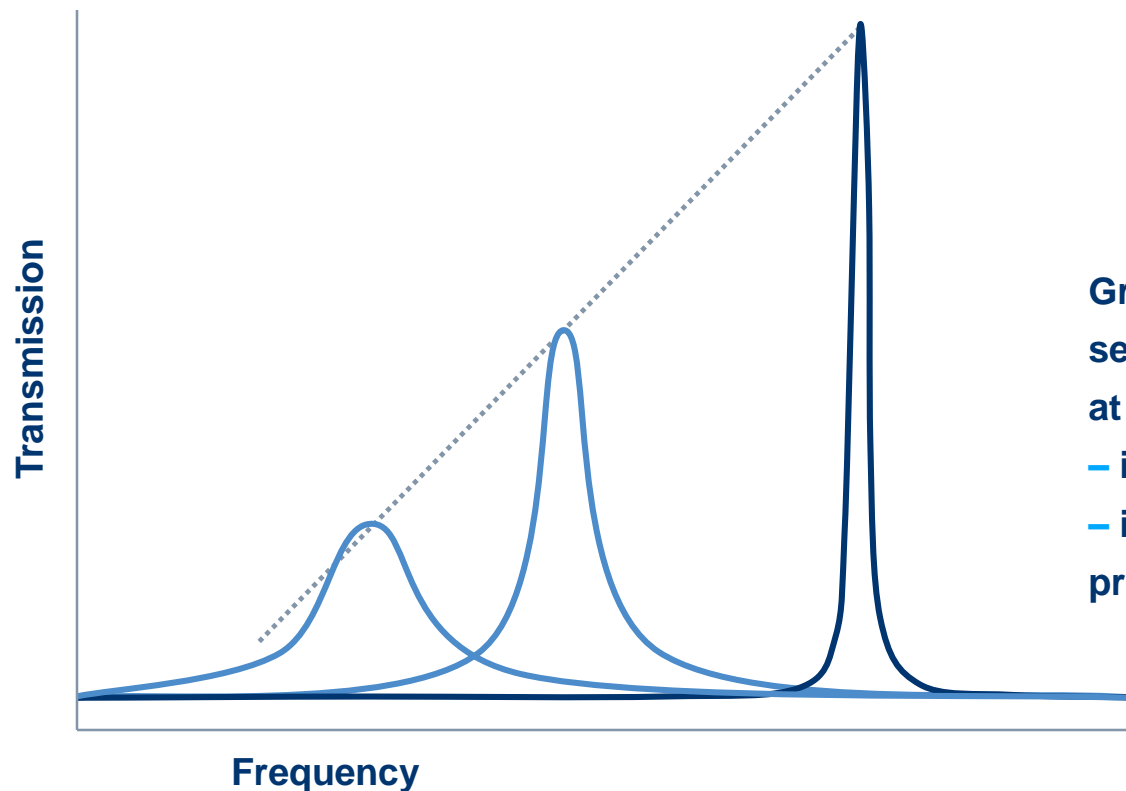
### Dual-Parameter Measurement



**Both the resonance parameters, namely shift displacement and attenuation, are typical for moisture and density of the test sample in the sensor.**

## Exposition on Microwave Resonance Procedures

### Dual-Parameter Measurement



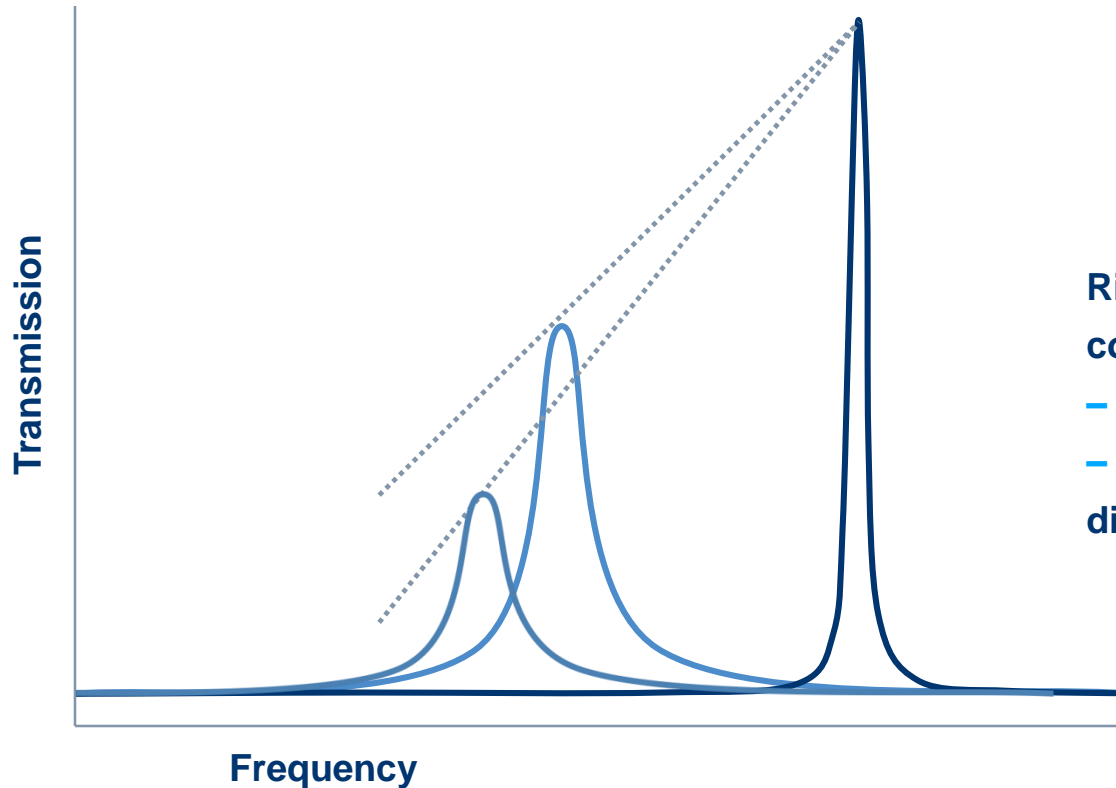
**Gradual charging of the sensor or product compaction at constant moisture**

- increases the resonance shift
- increases the resonance attenuation proportionately



## Exposition on Microwave Resonance Procedures

### Dual-Parameter Measurement

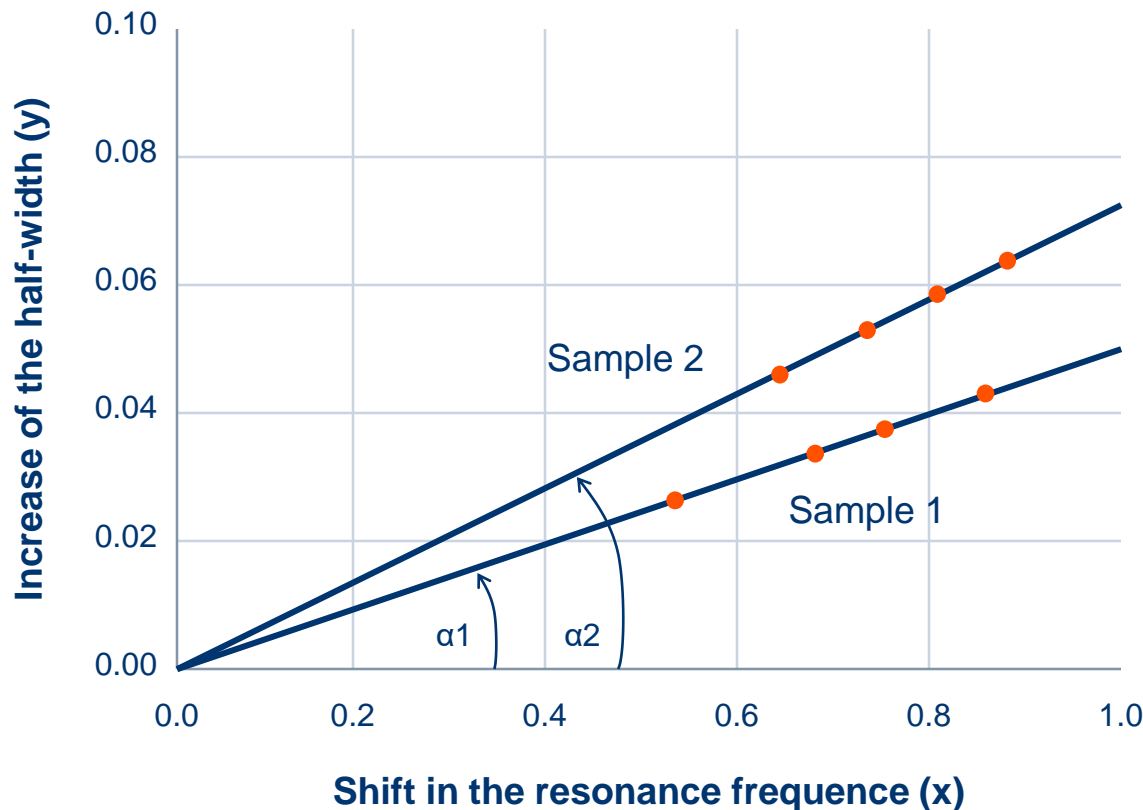


**Rising product moisture at constant density**

- increases the resonance shift
- increases the resonance attenuation disproportionately

## Exposition on Microwave Resonance Procedures

### Separation of Moisture and Density



#### Diagram

- x-axis: Frequency shift
- y-axis: Change of amplitude

#### Different lines

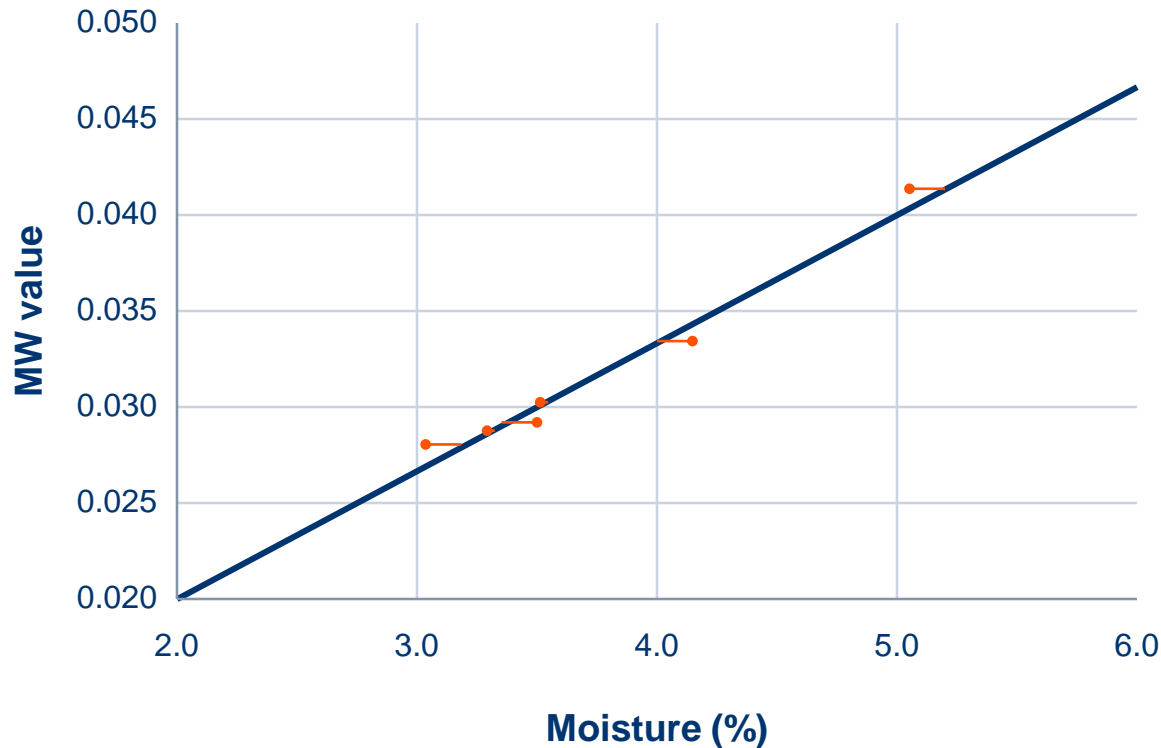
- Line 1: dry product
- Line 2: moist product
- Values on one regression line: different densities but same moisture

#### Angle

- The " $\alpha$ " angle only depends on moisture
- The angle determines the MW value
- The density only determines the position on the regression line

## Exposition on Microwave Resonance Procedures

### Calibration



#### Diagram

- x-axis: Moisture reference (e.g. LOD loss on drying)
- y-axis: MW-value

#### Regression

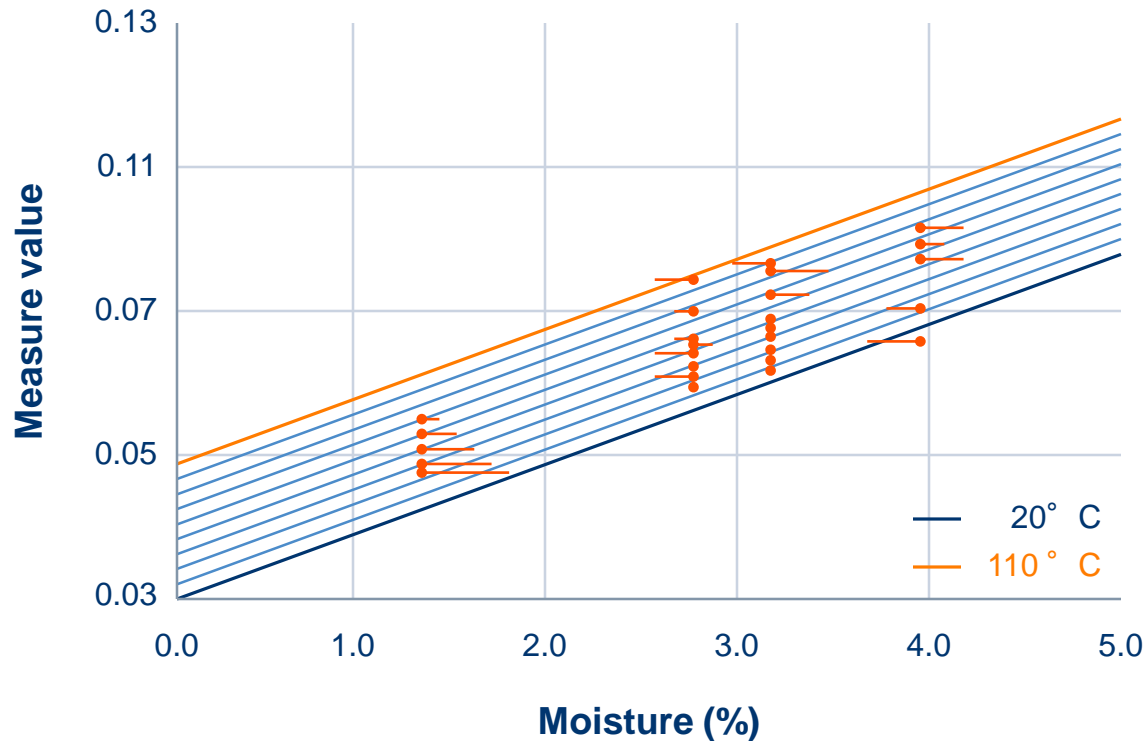
- Calculation of a calibration line
- Measuring in the application-specific moisture range
- Correlation and mean deviation are calculated

#### Number of calibrations

- Several calibrations can be stored
- For up to 200 products (optional)

## Exposition on Microwave Resonance Procedures

### Temperature Compensation



#### Increasing temperature

- Makes water molecules more mobile
- Increases microwave values

#### Temperature compensation lines

- For cold samples (blue)
- For hot samples (red)

#### Calculation

- Recommended for temperature variations > 10° C
- Compensation can be activated by user

## Exposition on Microwave Resonance Procedures

### Display and Storage of Measurements (1)

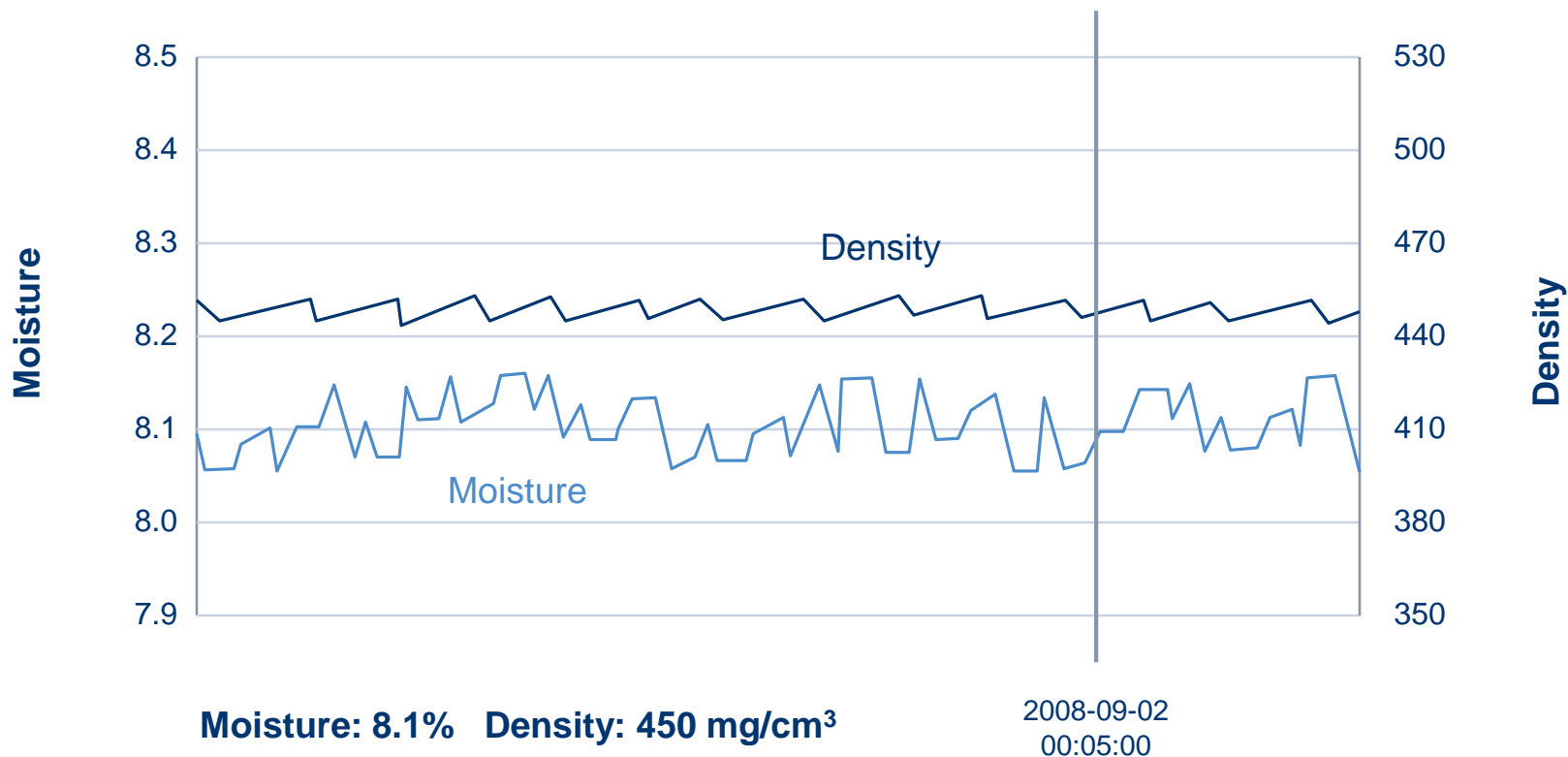
Number	Date	Hour	Moisture	Density	Temperature
1	01.09.2008	23:45	7,8	492	22°
2	01.09.2008	23:50	8,1	489	23°
3	01.09.2008	23:55	7,9	503	22°
4	02.09.2008	0:00	8,0	510	23°
5	02.09.2008	0:05	7,9	512	24°

**Moisture: 8.0    Density: 510    Temperature: 23° C**



## Exposition on Microwave Resonance Procedures

### Display and Storage of Measurements (2)



## Exposition on Microwave Resonance Procedures

# Summary: Advantages and Benefits

### Advantages

- **ACCURATE** – due to high water selectivity
- **FAST** – the results are available within milliseconds
- **INDEPENDENT** – the moisture determination is independent of density, surface structure and color of the sample
- **FREE OF MAINTENANCE** – no consumables, no aging, no wear

### BENEFITS FOR THE USER

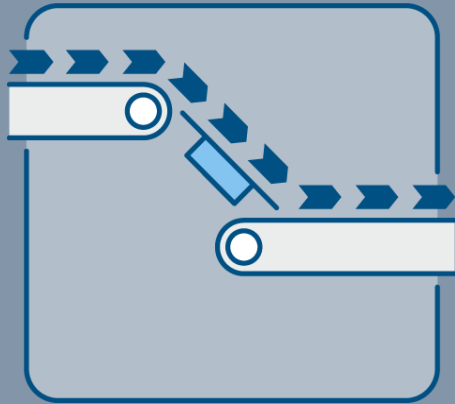
- Fast amortization
- Energy-saving
- Optimization of production process
- Increase in product quality

## **Process and Laboratory Moisture and Density Measuring Exposition on Process Installations**



## Sensor Installation at Process Facilities

### Planar Sensor at a Conveyor Belt (1)





## Sensor Installation at Process Facilities

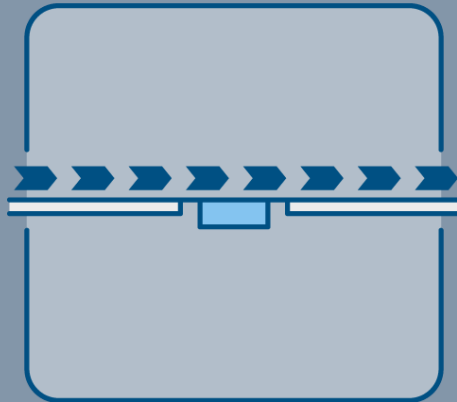
### Planar Sensor at a Conveyor Belt (2)





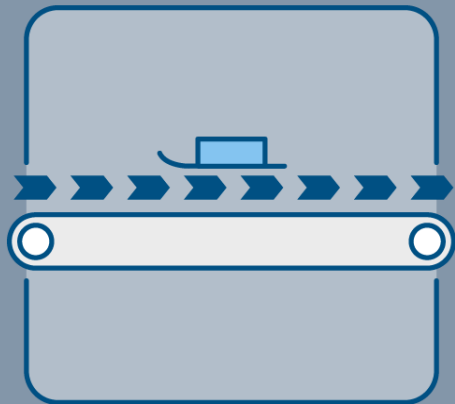
## Sensor Installation at Process Facilities

### Planar Sensor in a Vibro Conveyor



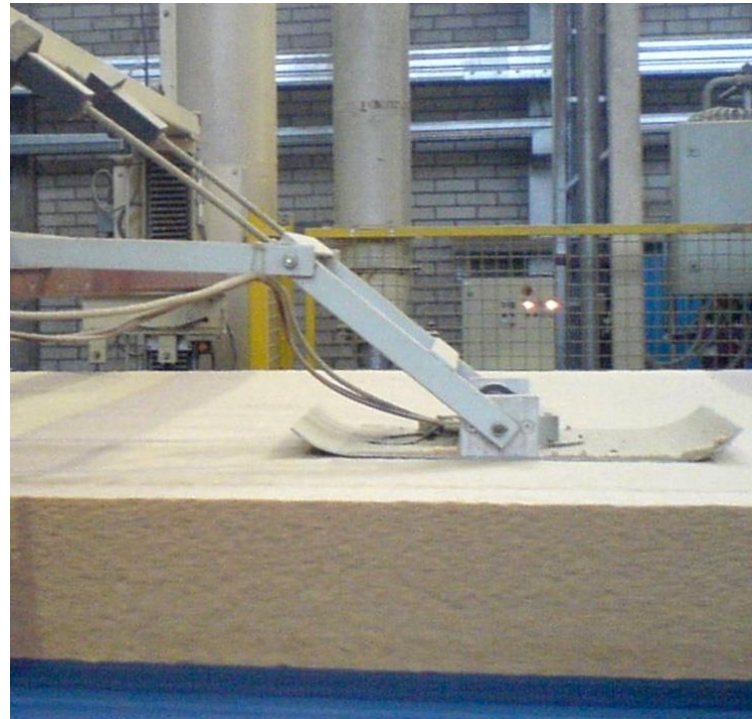
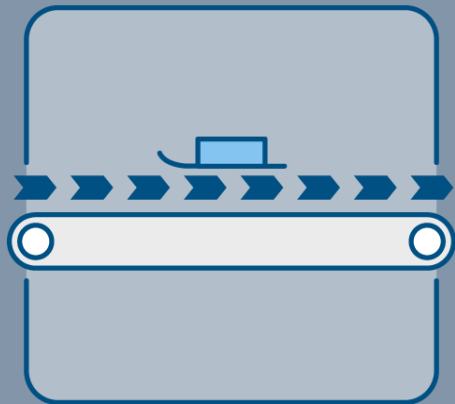
## Sensor Installation at Process Facilities

### Planar Sensor in Sliding Block above Belt Conveyor (1)



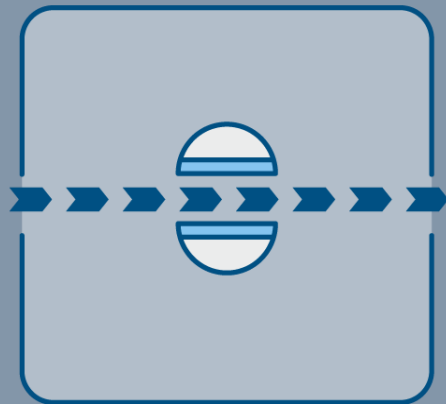
## Sensor Installation at Process Facilities

### Planar Sensor in Sliding Block above Belt Conveyor (2)



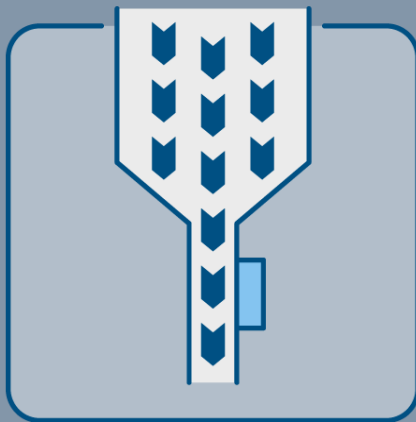
## Sensor Installation at Process Facilities

### Fork Sensor Over Product Web



## Sensor Installation at Process Facilities

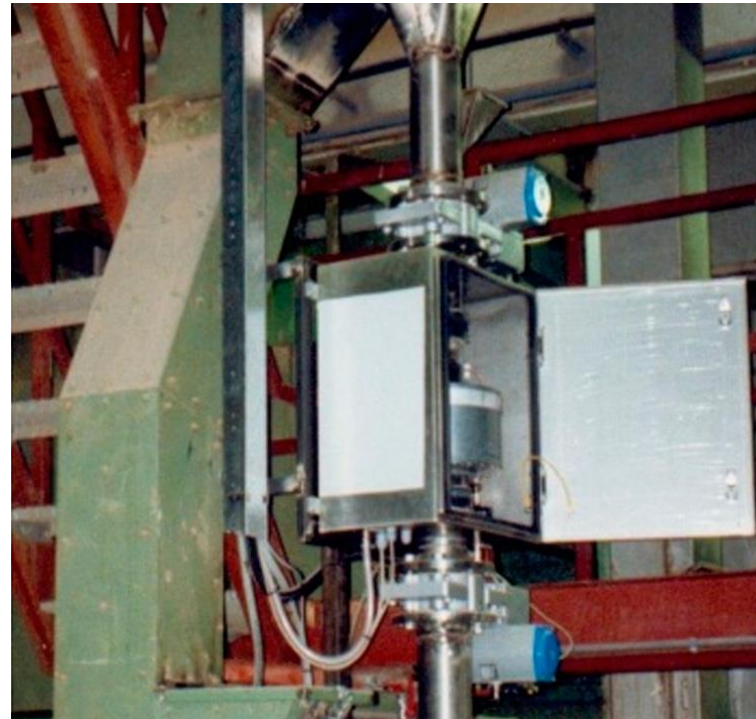
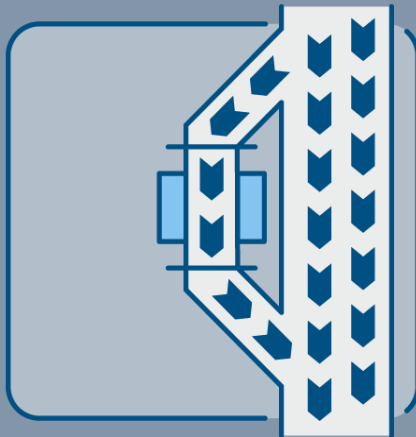
### Planar Sensor in Silo Wall





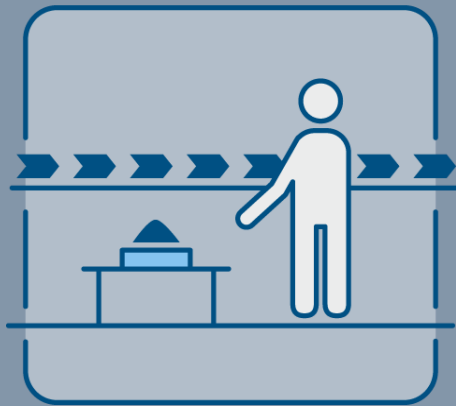
## Sensor Installation at Process Facilities

### Tubular Sensor in Bypass



## Sensor Installation at Process Facilities

### Planar Sensor for Atline Use



## Mobile Use of Moisture Measuring Instruments

# Handheld Measuring Instruments on Boards & Bulk Material

