

# Moisture sensors for the concrete industry

The right moisture sensor  
for every application



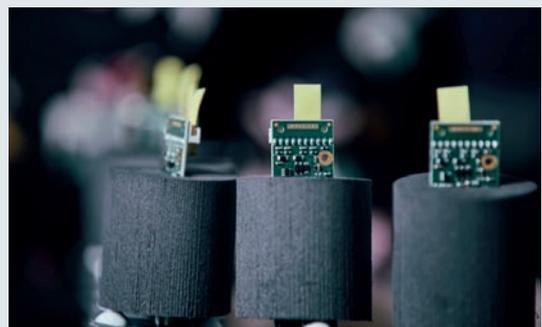
Moisture Sensor Experts



## History



- ➔ Founded in 1984 as an engineering firm, IMKO GmbH has been working on moisture measurement for over 30 years now.
- ➔ Based on the unique TRIME-TDR technology, IMKO experts developed sensors for science and meteorology in the early 90s. A few years later, the product range was extended with solutions for measuring moisture in grain, primarily for applications in the agricultural sector.
- ➔ Since the introduction of the SONO series in 2010, IMKO GmbH now offers a product portfolio that enables moisture measurement in any material, even for detection of just a few drops of water in solids, for example.
- ➔ Today, we are an innovative and motivated team of around 20 employees and, since October 2017, we have been a subsidiary of the Endress+Hauser Group. IMKO GmbH continues to develop and produce products with the "Made in Germany" quality mark at its original location in Ettlingen.



# IMKO – Application fields

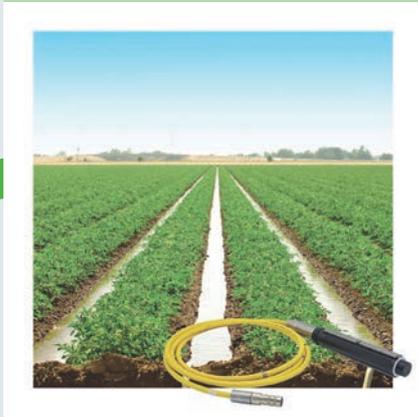
**Bulk solids**



**Concrete**



**Flooring**



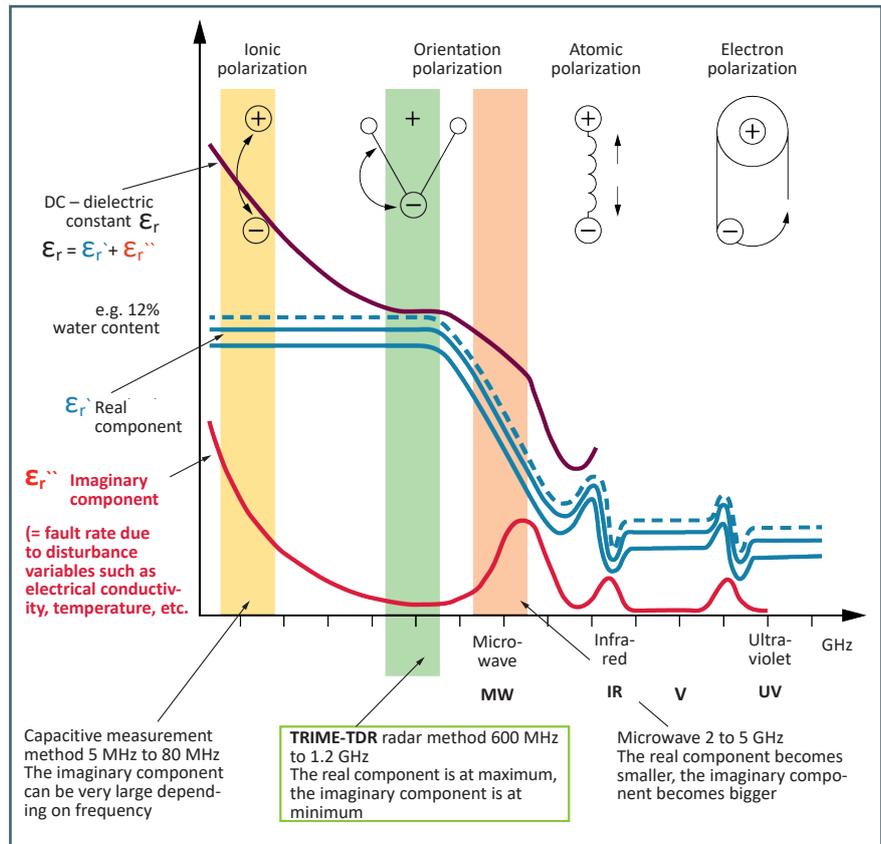
# The IMKO TRIME-TDR measurement method

The sensors developed by IMKO are based on measurement with **Time Domain Reflectometry**, or TDR for short.

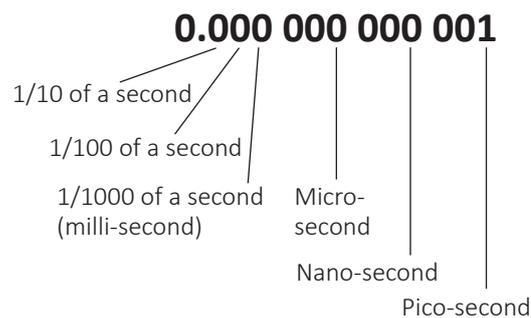
In principle, this measurement method is suitable for a range of applications, such as cable break detection or even measurement of fill levels.

When applied specifically for measuring moisture in bulk solids and liquids, the physical effect is used, which correlates the propagation speed of electromagnetic waves with the dielectric properties of the material to be measured.

Since water has a significantly higher dielectric constant than the materials to be measured, such as sand, grain or even oil, it is possible to determine the water content with a high degree of accuracy.

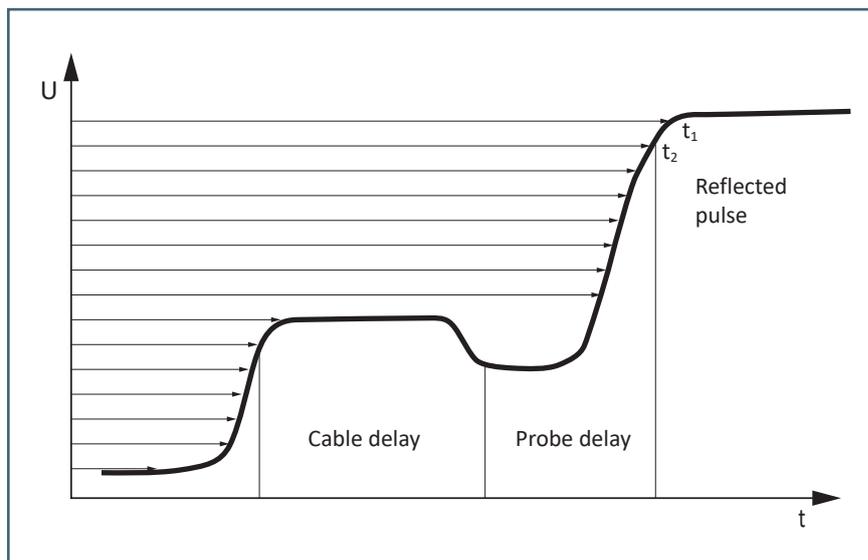


Time resolution of the IMKO sensory mechanism

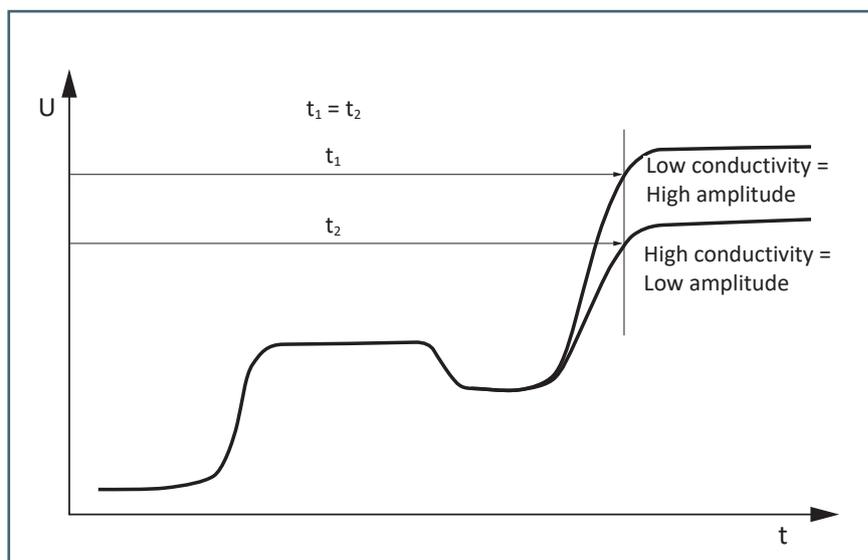


## TDR measurement with the patented TRIME method

Implementing a TDR measurement is usually associated with significant technical effort. Very accurate pulses must be generated and the measurement requires the utmost in precision. Therefore, for a long time, TDR technology remained a laboratory measurement method kept back for science. Measuring devices based on TDR were not only very expensive, but also large and unsuitable for field use. The TDR technology optimized by IMKO specifically for material moisture measurement, the **TRIME method** (Time Domain Reflectometry with Intelligent Micromodule Elements), is a robust measurement technology, which enables a compact and industry-compatible design with a very good price/performance ratio.



One of the biggest interference influences in all kinds of moisture measurement is the electrical conductivity of the medium to be measured. Electrical conductivity influences the measurement result. Even in tap water, the mineral content fluctuates over the year by up to 50% compared to the annual average. TDR technology is very robust as far as the electrical conductivity of the medium is concerned too. Intelligent signal analysis compensates for this disturbance variable and, if necessary, the analyzed signal can even be used to record the enrichment or discharge of minerals.



### TRIME®-TDR – Winner of multiple awards

Innovation awards, such as the Bauma Innovation Award 2016 and DLG Approved certification from the German Agricultural Society (DLG – 2018), show how successful the high-tech potential of TRIME-TDR technology has proven in practice. Countless industrial and scientific projects have demonstrated the advantages of TRIME technology.





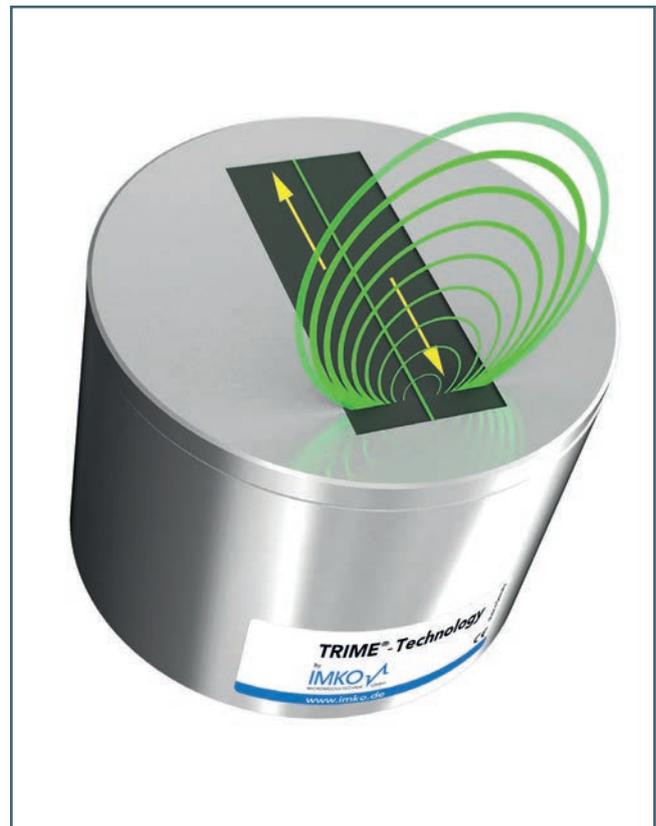
## The SONO probe as a "moisture tomograph"

The guided radar wave (in green) propagates at approximately the speed of light. The sensor measures the material layer by layer discoidally and transverse to the sensor surface, as is familiar from a computer tomograph, for example.

This method results in a sensor with an exactly defined measurement field, which can measure without errors even in the event of fluctuating fines or varying grain size. By measuring transverse to the sensor surface, the mechanical condition of the sensor surface does not represent a disturbance variable, i.e. the iterative wear of the sensor surface does not falsify the measured value.

The defined measurement field also enables accurate measurement for applications in which the material coverage is too low or fluctuates. This results in a high degree of flexibility in terms of mechanical integration in the application.

The IMKO sensor portfolio allows you to choose a suitable sensor design, enabling you to find the ideal solution for your application, always taking into account the framework conditions, such as moisture range, electrical conductivity, wear and mechanical installation.



# SONO process moisture probes for the bulk solids industry

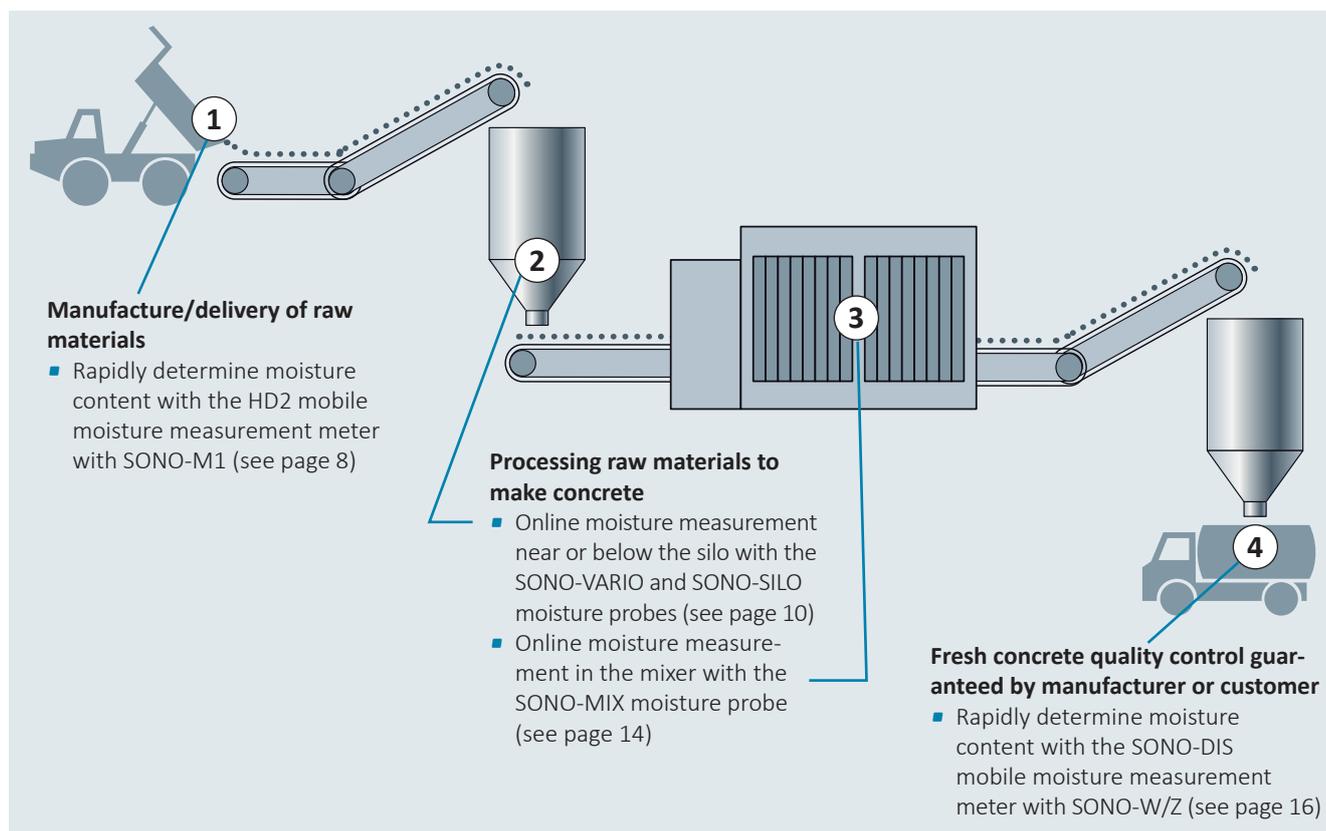
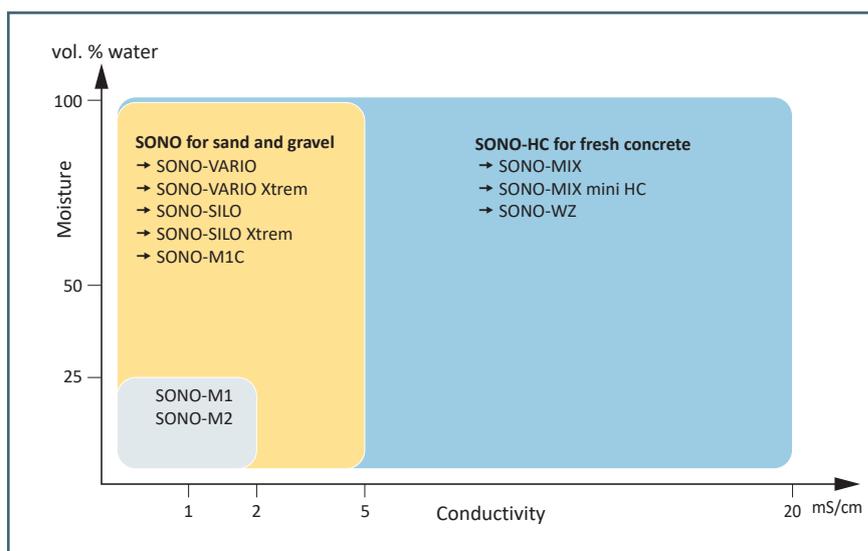
## Increase your plant safety and save time with resources as well as innovative sensor technologies

All aggregates and bulk solids contain a proportion of water. In addition to the quality of the final product, moisture also determines the weight and the price. Legal requirements lay down the framework. With material moisture measurement, you can determine the water content in your aggregates and bulk solids. IMKO is presenting a new generation of moisture probes in the form of its SONO probes. These were specifically developed for applications in the construction industry, as well as the chemical and pharmaceutical industries, but can be used in other industries too.

### SONO sensor applications

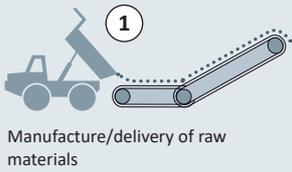
Depending on the group, IMKO sensors differ in resolution and measuring range. The higher the conductivity range of a sensor, the lower the resolution or performance characteristics.

Use the following diagram to help you choose your IMKO sensor. The IMKO application team would also be pleased to provide assistance.



# Mobile moisture measurement in sand and gravel

**Guarantee quality throughout the entire process, whether on delivery, during processing or directly on the construction site**



- Sand, gravel and crushed stone up to 32mm and other aggregates such as expanded clay can be measured easily.
- Calibrations for all conventional aggregates are preinstalled. Individual calibration based on your specific materials is possible.
- Possibility of checking the agreed maximum moisture on delivery, in real time and without the need for a laboratory.
- Aggregates not measured in the process (in the absence of online measurement), such as gravel and crushed stone and, where necessary, sand can be measured quickly and easily and considered in the recipe.
- Minimum maintenance and maximum reliability, as the TDR technology is characterized by long-term strength and stability.
- Safe handling, even under difficult environmental conditions, guaranteed by the robust and waterproof design.
- The sensors can be connected to a PC for data acquisition and advanced configuration using optional accessories.

## Quick and simple determination of the moisture content

With the HD2 set, you can measure the moisture in your aggregates quickly and easily, whether in sand, gravel, grit or even expanded clay. You will know the water content in less than a minute. This not only saves you time and laboratory capacity, but enables you to record the entire process more quickly and to make it more transparent. The measurement process is simple and can be carried out directly in the laboratory or on the sandbox. Just one bucket of sand is sufficient and the process yields an accurate measured value within a few seconds. A measurement volume of >10 kg provides meaningful information for the user.

## Controlling process quality – online and efficiently

Today, there is a huge difference between demand and reality in concrete production; concrete technologists expect an accuracy of  $\pm 5 \text{ l/m}^3$  in the concrete formula.

In reality, however, it is usually the case that just one moisture probe is installed for the sand measurement and all gravel is processed with fixed values. Since many of these sand probes are not installed correctly or outdated technologies are used, these are often deactivated, making the process completely non-transparent.

If we imagine that around 1800 kg sand and gravel is processed in  $1\text{m}^3$  concrete and this can contain an average of 0 to 5% water in natural raw materials, it soon becomes clear that this corresponds to a water volume of 0 to  $90 \text{ l/m}^3$  or  $\pm 45 \text{ l/m}^3$ , a convincing argument that demonstrates that this should be taken seriously.

This situation is easy to rectify by using the HD2 set to monitor the gravel values 2-3 times a day, make adjustments in the controller and regularly check installed sand probes.

We generally recommend our SONO series for online measurement, as this is a critical point when it comes to quality.



## Mobile moisture measuring probe for sand, gravel, crushed stone and other materials

### Description



#### Complete HD2 measurement carrying case set with SONO-M1

The set comprises:

- HD2 display unit
- SONO-M1 moisture probe
- AC adapter (12 V/2 A)
- Travel plug adapter for various countries



The accuracy of the measuring systems is 0.1–0.2%, while products from competitors only achieve 0.5%.



#### HD2

Robust, battery-operated mobile display unit for various probes: SONO-M1,-M1C,-M2.



#### SONO-M1

Mobile moisture probe for [sand](#), [gravel](#), [crushed stone](#) and [expanded clay](#) with integrated TDR electronics. The probe has a diameter of 64mm and uncoated rods with a rod length of 130mm.



#### SONO-M1C

Mobile moisture probe for conductive materials such as [coal](#), [iron oxide](#), [soils](#) and [sand containing clay](#), [fly ash](#), [sandstone](#), [furnace slag](#) and [other materials](#). Probe with integrated TDR electronics, 64mm diameter and coated rods with a rod length of 100mm.



#### SONO-M2

This particularly slim mobile moisture probe for [sand](#), [gravel](#) and [crushed stone](#) with integrated TDR electronics enables deeper penetration of the aggregate.

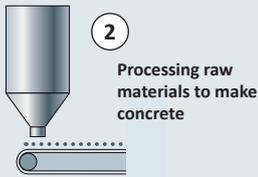


#### Telescopic extension for the SONO-M2

Pull-out telescopic extension of up to two meters.

*"Manufacturers of mobile sand moisture measurement meters have previously failed to impress us. But the HD2 from IMKO has exceeded our expectations. After several days of comparison measurements in the laboratory, we can confirm that the HD2 measuring device with the SONO-M1 probe delivers the highest degree of accuracy."*

Michael Ackermann, RAGANO Betonfertigteile



## Online moisture measurement in sand and gravel

Guarantee quality, directly in the process and in real time

- Sand, gravel and crushed stone up to 32mm and other aggregates such as expanded clay can be measured reliably.
- Calibrations for all conventional aggregates are preinstalled but it is also possible to carry out individual calibrations based on your specific materials.
- Simple commissioning with minimal calibration requirements.
- Minimum maintenance and maximum reliability, as the TDR technology is characterized by long-term robustness and stability.
- Wear does not require recalibration.
- Optional wear-resistant sensor head for cost-efficiency.
- Simple configuration and calibration with optional accessories (e.g. SONO-VIEW).

### Long-term stable online moisture measurement, batch by batch in your raw materials

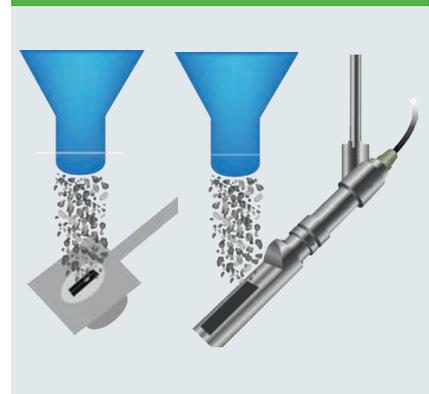
With the SONO sensors, you can measure the moisture in your aggregates quickly and easily and directly in the process, whether it's sand, gravel, crushed stone or even expanded clay. It only takes a few seconds of material flowing beneath the dosing gate or on the dosing belt to produce accurate results.

In conjunction with state-of-the-art control systems, the mixing water and therefore the W/Z value can be reliably checked in real time and per batch to guarantee optimum concrete quality. As it is also possible to measure gravel and crushed stone extremely accurately with the SONO sensors, continuously checking each individual batch is now a thing of the past, allowing you to focus on other, more important tasks associated with mixing process.

#### Moisture measurement in sand 0-4mm



#### Moisture measurement in gravel and crushed stone from 4 to 32mm



As well as using the right measurement technology, the efficient functioning of a moisture sensor relies on faultless mechanical integration.

In the past, sensors were often installed in the silo, for example, which caused significant problems, as deposits and compression when filling the silo can result in significant measuring errors.

Installing the sensors below the silo flap or above the dosing belt with a permanently installed slide as recommended by IMKO ensures reliable compaction of the sand, reliable cleaning and therefore ideal conditions for precise measurement.

# TDR sensors for robust measurements

## Conventional integration with simplified commissioning

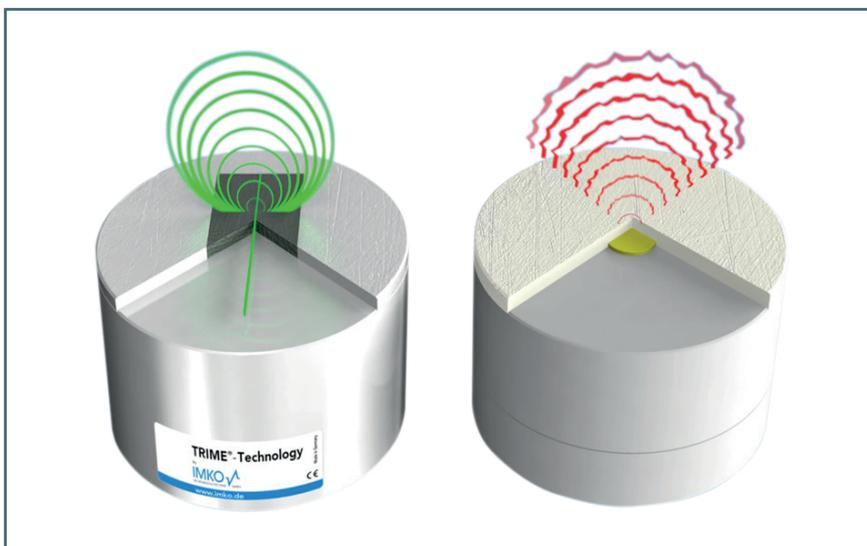
The technical integration of the SONO sensors is no different from other moisture measurement systems. The sensor is usually supplied via the system voltage and the measured value is sent to the controller via an analog signal. This means that the sensors can be integrated in the conventional way by your plant manufacturer.

Commissioning and adjustment are comparably easy, as the TDR sensors do not have to be laboriously adjusted to multiple points on individual products. The sensors can be calibrated as usual, whether via the controller or, provided the corresponding accessories are available, directly in the sensor.

## Intelligent probe head

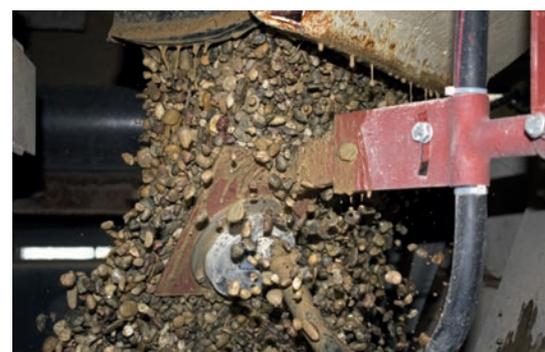
Once the probes are in operation, the TDR technology is characterized by its low maintenance requirements. The measurement technology is immune to variations in the grading curve and fine content and the design of the measuring head is completely new.

While conventional solutions require the measurement to take place through a solid ceramic layer, the signal conductor in the IMKO sensors lies between two ceramic plates and is in direct contact with the material to be measured. This design guarantees a long-term stable measurement, which does not have to be readjusted due to wear and also offers increased accuracy, as this direct contact with the material achieves maximum sensitivity.



*"Over the years we have tested a few moisture sensors, but none impressed us like the SONO probes. What really stood out for us was the extremely low level of maintenance required. Whereas previously we had to recalibrate the sensors every 10 days, now we can focus on the really important aspects of production."*

Friedel Kütemeier, Plant Manager at Peterbeton GmbH & Co. KG





## The ideal products

### Description



#### SONO-VARIO Standard

The SONO-VARIO Standard is ideal for measuring "normal" abrasive sand and gravel with a grain size of up to 8mm. The probe head consists of stainless steel with a rectangular ceramic window.



#### SONO-VARIO Xtrem

The SONO-VARIO Xtrem is ideal for measuring sand and gravel, as well as highly abrasive materials such as coarse gravel or crushed stone. The replaceable probe head consists of hardened steel with a rectangular window made from special ceramic.



#### SONO-SILO Standard

The SONO-SILO Standard is ideal for measuring "normal" abrasive sand and gravel with a grain size of up to 8mm. The probe head consists of stainless steel with a rectangular ceramic window.



#### SONO-SILO Xtrem

The SONO-SILO Xtrem is ideal for measuring sand and gravel, as well as highly abrasive materials such as coarse gravel or crushed stone. The replaceable probe head consists of hardened steel with a rectangular window made from special ceramic.



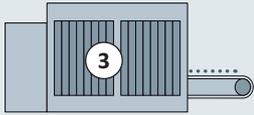
#### SONO-VIEW

The SONO-VIEW is a stand-alone display unit that can be used to visualize and configure up to 16 sensors. If necessary, the SONO-VIEW can act as an interface converter to enable access to the sensor via the free PC software.

## Satisfied customers



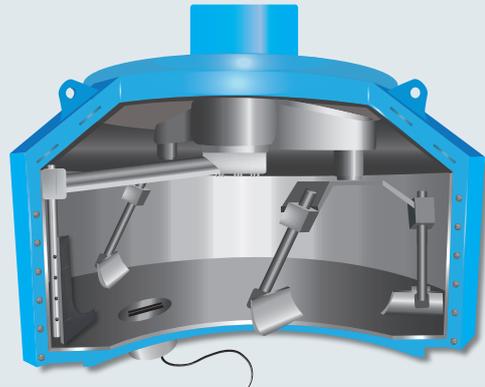
Processing raw materials to make concrete



## Online moisture measurement in concrete

Guarantee quality, directly in the mixer and in real time

- All conventional concretes, whether earth-moist or flowable, can be reliably measured.
- Suitable for all mixer types, e.g. turbine, counterflow, intensive or twin shaft mixers.
- Simple commissioning, minimum maintenance and maximum reliability thanks to TDR technology.
- Wear does not require recalibration.
- Optional wear-resistant sensor head (cost-efficient).
- Simple configuration and calibration with optional accessories (e.g. SONO-VIEW).



### Long-term stable online moisture measurement in your mixer

In the ready-mix concrete industry, measurement rarely takes place in the mixer because of the time pressure involved. The situation is different in precast plants and in particular in the production of concrete goods, where mixer probes are often used. This is partly because of the longer mixing times but also because of the different requirements for such applications. While only four to six different aggregates are used for ready-mix concrete, this figure easily exceeds 20 in the production of concrete goods, making the mixer the most efficient place to take measurements.

Some applications are also associated with very stringent requirements when it comes to accuracy, e.g. in pipe production or in the facing mixture in brick production just 1-2l/m<sup>3</sup> can determine the quality of the products.

SONO sensors can also make an important contribution to quality in these applications. As there are countless mixer types and both electrical and mechanical integration play a critical role here, the IMKO application team will be happy to support you in selecting the correct sensors and integrating them into your process.





## The ideal products

### Description



#### **SONO-MIX**

The toughest mixer probe for use in pan mixers, turbine mixers, planetary and twin shaft mixers. The replaceable probe head consists of steel and a solid carbide plate with a rectangular window made from special ceramic.



#### **SONO-MIX mini HC**

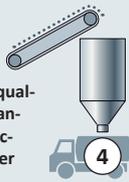
Thanks to its extremely compact dimensions, this robust mixer probe is ideal for integration in the scraper of intensive mixers, for example, but also for applications in which space is restricted, for example laboratory mixers. The probe head consists of stainless steel and a rectangular window made from special ceramic.



#### **SONO-VIEW**

The SONO-VIEW is a stand-alone display unit that can be used to visualize and configure up to 16 sensors. If necessary, the SONO-VIEW can act as an interface converter to enable access to the sensor via the free PC software.

Fresh concrete quality control guaranteed by manufacturer or customer



## Mobile moisture measurement in fresh concrete

Guarantee quality from the concrete plant to the construction site

- All conventional and flowable concretes can be reliably checked for water content.
- Simple measurement in the shortest time, without laboratory equipment.
- The measured value is available before the truck mixer has even unloaded.
- Simple handling, minimum maintenance and maximum reliability thanks to TDR technology.
- Wear does not require recalibration.

### Quality control on site

Even after the concrete has left the plant for the construction site, further controls are both sensible and necessary. Various factors can affect the quality of the concrete and its water content.

Was the truck mixer really completely empty after it was last cleaned or was there residual water in the mixing drum? Has there been heavy rainfall or has the vehicle been stuck in traffic? Something may have been added to make the consistency less stiff.

This is where the SONO-WZ system becomes the ideal addition to day-to-day operations. A concrete sample can be measured in no time at all and the water content checked, whether in the concrete plant or later before installation on the construction site. Even the recipe composition can be checked in its consistency by the sensor signal attenuation.

With the SONO-WZ, you can now determine the water content of the concrete before the fresh concrete is applied rather than finding out 30 minutes later, after it has dried, that the concrete you applied was too moist.



## The ideal products

	Description
	<p><b>SONO-DIS</b> Robust battery-powered mobile display unit for the SONO-W/Z and SONO-M1 moisture probes. Strong, weather-resistant IP67 aluminum housing. Size: 150 x 64 x 36mm</p>
	<p><b>SONO-W/Z</b> Robust mobile moisture probe for measuring water content in fresh concrete. Sensor: 154 x 60mm (length x width)</p>
	<p><b>SONO-M1</b> Mobile moisture probe for <a href="#">sand</a>, <a href="#">gravel</a>, <a href="#">crushed stone</a> and <a href="#">expanded clay</a>. Probe with integrated TDR electronics. The probe has a diameter of 64mm and uncoated rods with a rod length of 130mm.</p>
	<p>Complete SONO-DIS measurement carrying case set with SONO-W/Z The set comprises:</p> <ul style="list-style-type: none"> <li>• SONO-DIS display unit</li> <li>• SONO-W/Z moisture probe</li> <li>• AC adapter (12 V/2 A)</li> <li>• Travel plug adapter for various countries</li> </ul>
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Accredited testing  
laboratory  
according to DIN EN  
ISO/IEC 17025

*"After taking more than 150 measurements, we have become so confident in the results produced by the SONO-WZ that, unless otherwise explicitly prescribed by the standard, we no longer carry out comparative Darr tests within the scope of our FPC. The use of the SONO-WZ has simplified our work considerably and is saving us a significant amount of time."*

Vladimir Naumann, Test Center Manager,  
mbl Mineral- und Betonlabor GmbH, Germany

## B | A | S Research & Technology

A renowned research and information institute for the construction sector specializing in concrete and the asphalt industry has subjected our products to intensive examinations:

*"With a specialization in concrete and state-of-the-art laboratories, we tested the SONO-WZ in the most diverse range of concrete types with different cement types, whereby successful tests were also carried out at both low and high concrete temperatures. In order to work around errors in a Darr test, we created all mixtures with dry aggregates. We were impressed by the consistency with the wz values of our concrete formula, which were measured with the SONO-WZ by way of comparison."*

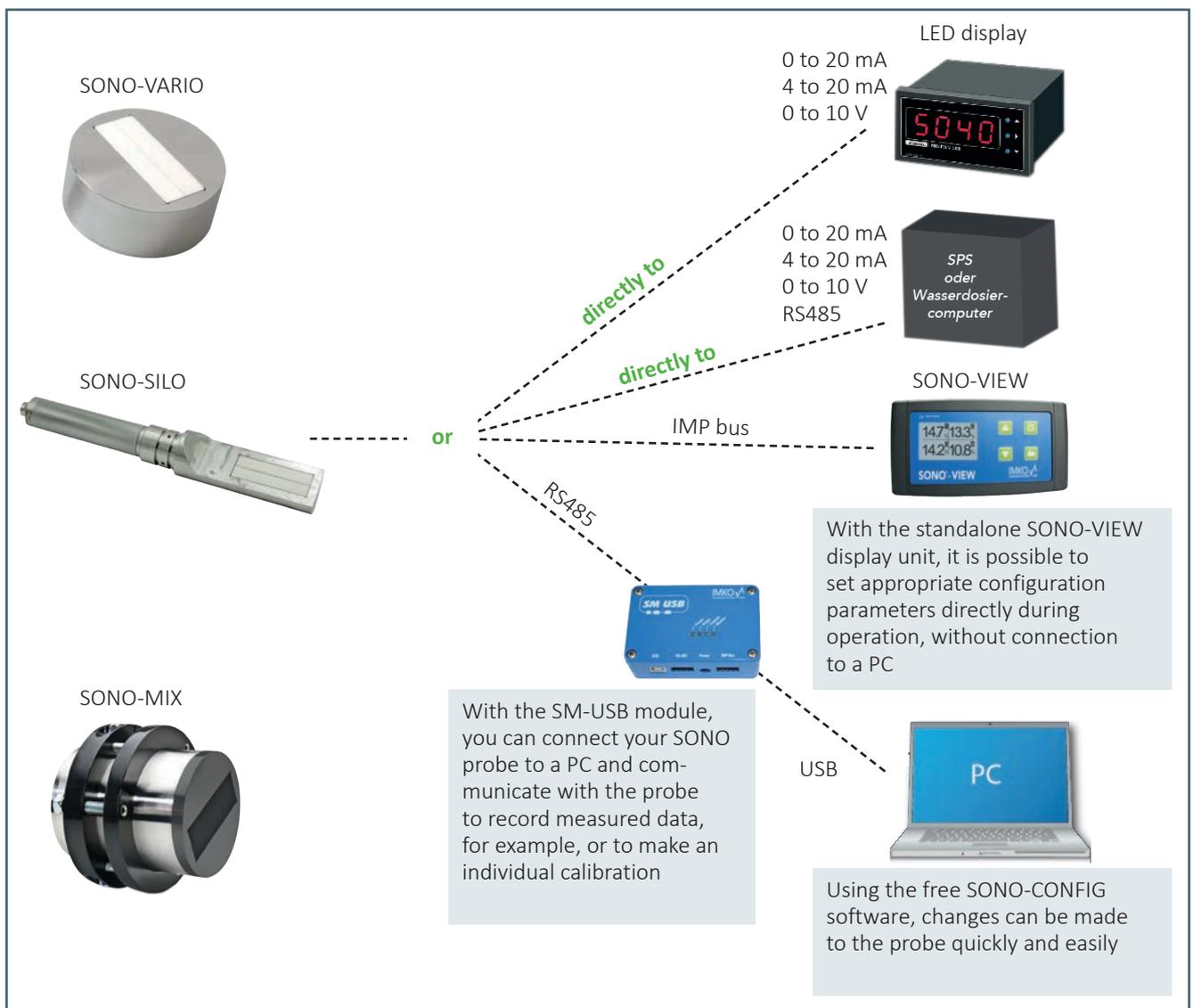
Wilko van der Meer, Managing Director  
B I A S Research & Technology, Netherlands



# Predictive sensor networking through intelligent device communication

## SONO probes enable easy and user-friendly sensor networking

Standard RS485 interfaces often pose significant challenges. They are not galvanically isolated and there is always the risk of ground loops or interference pulses, which can result in significant safety problems. For long cable lengths in particular, a shielded and twisted cable must be used. Depending on the wiring plan (topology), a 100 Ohm terminating resistor must be installed at sensitive locations in the RS485 network when there are individual spurs. In practice, this means significant effort for the plant operator. With SONO-VIEW, up to sixteen SONO probes can be connected via the SONO-internal IMP bus. The robust IMP bus guarantees safety.



Predictive sensor networking through intelligent device communication ensures smooth processes in the application. The IMP bus does not transmit its data packets as voltage pulses, but as current pulses. Thus, the process works even with long cable lengths on existing and already laid lines. A shielded cable is not required and even spurs in wide-ranging network topologies are not a problem.

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