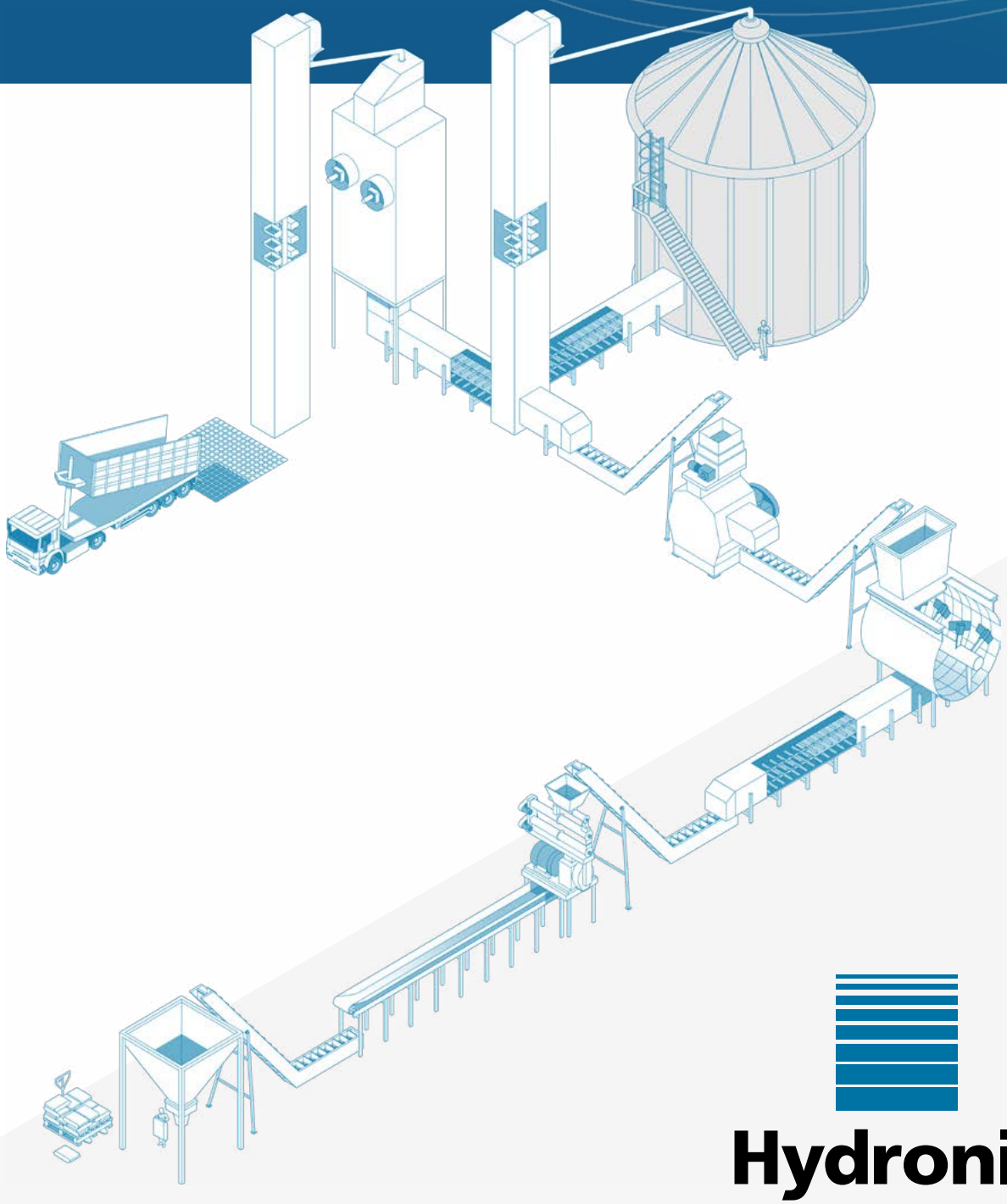
Precision in every Drop:
Moisture Measurement that transforms your Production



Hydronix

Contents

1. Introduction

This paper explores the critical role of moisture measurement in industrial processes and offers practical guidance on how to optimise sensor placement for accurate and consistent results.

It begins by examining the most effective points within a production line to install moisture sensors.

Next, the paper outlines the key factors that determine a suitable installation location, recognising that not all points in the process are fit for purpose.

Sensor accuracy, material flow, and environmental conditions all play a role in achieving reliable measurements.

Equally important is sensor connectivity. Modern moisture sensors are no longer stand-alone instruments—they are connected, data-driven tools that provide real-time feedback to control systems. Robust connectivity ensures seamless integration into existing plant infrastructure, enabling automated adjustments that improve efficiency, reduce energy consumption, and minimise waste.

Hydronix sensors can measure a wide range of materials including grains, aggregates, powders, biomass, wood products, pet food, and more—whether in mixers, conveyors, silos, or chutes. To illustrate these concepts, the paper presents real-world examples of successful sensor integration and the measurable benefits experienced by manufacturers across various industries. A key advantage is the ability to maintain consistent product quality while significantly reducing over-drying and the associated energy costs.

To assist with identifying the best installation points, the paper includes a **Moisture Sensor Installation Assessment Sheet.** This practical tool guides users through the key criteria that affect sensor performance, such as material flow consistency, environmental conditions, mechanical suitability, and connectivity options.

By systematically evaluating each potential location, engineers and plant operators can ensure that sensors are installed where they will deliver the most accurate, stable, and actionable moisture data — ultimately leading to better control and process optimisation.

2. Benefits of Moisture Measurement

Moisture measurement offers a wide range of benefits across many industries. Whether dealing with food, aggregates, biomass, animal feed, wood, or pharmaceuticals, the key benefits are clear:

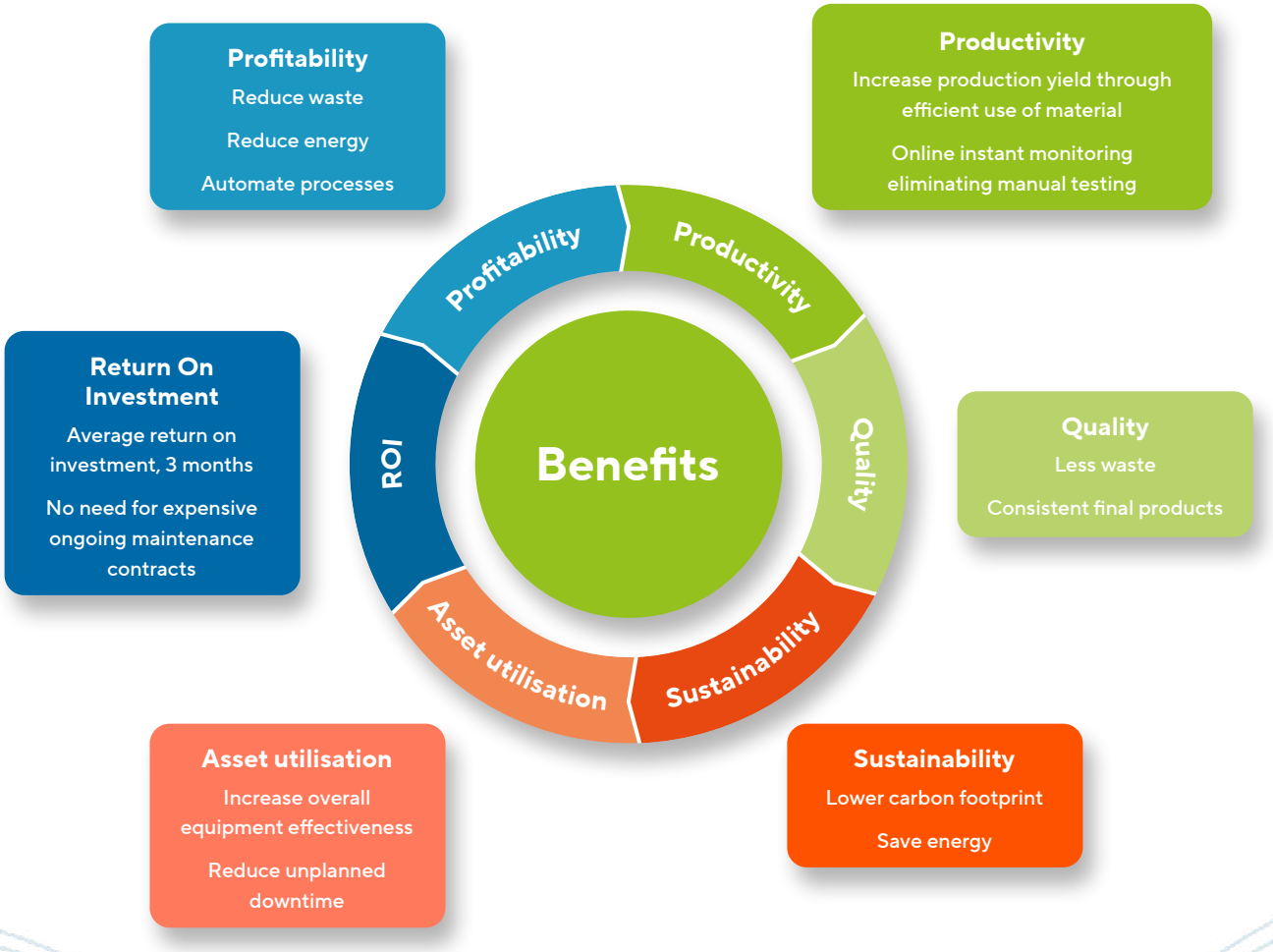


Figure 1: Moisture measurement benefit wheel

3. Which Material Can Be Measured

Moisture sensors can measure moisture in a wide range of materials, if there is a consistent material flow and direct contact with the sensor.

This section highlights several industries although there are many other industries that use similar materials and processes that would be suitable for moisture measurement and control. Some real-world examples of successful sensor integration and the measurable benefits experienced by manufacturers across various industries are explored in this chapter.

3.1. Agriculture & Animal Feed

- Grains (wheat, maize, barley, rice, oats)
- Oilseeds (soybeans, sunflower, rapeseed)
- Animal feed (mash, pellets, meal)
- Forage and silage
- Alfalfa

Animal feed production

One of the big challenges in the animal feed industry is the number of different formulations that can be produced by a single plant.

For each batch, it is essential to ensure that the quality of the product is correct so that the animals are fed a balanced nutritional diet optimised for their type and stage of development. Moisture control is a key factor in ensuring the final feed is palatable, retains its nutrients, and is consistent.

Read more

Cereal grain drying

Cereal grains are used to produce animal feeds, flours, cooking oils, fuels, alcohol products, packaging materials and much more.

Managing the moisture content of cereal grains is crucial to maximising storage times, maintaining nutritional value and taste, reducing costs and waste, and ensuring efficient use during further processing.

Read more

Corn/maize

Corn, also known as maize, is one of the world most cultivated crops. Corn can be used for human consumption, animal feed and fuel. It can be heavily processed to produce products such as flour and biodiesel or sold as whole grains.

Control of the moisture during corn processing and storage is vital to produce a final product suitable for its intended market.

Read more

Rice production

The introduction of affordable digital microwave moisture measurement into the process is revolutionising the rice industry.

It provides accurate moisture readings of the grain at important stages of the process enabling the producers to directly control the dryers in real-time. This leads to rice that has been dried to the correct moisture percentage for processing and has the direct effect of increasing the quality of the grains and therefore an increase in the producers' profitability.

Read more

Sugar beet pulp

The inclusion of a microwave moisture measurement system into the sugar beet drying process will not only achieve consistent quality products while reducing the number of spoilt materials but also provide instant savings and repay its capital expenditure in a short time.

Read more

3.2. Construction & Concrete

- Sand, gravel, and crushed stone
- Fly ash and gypsum
- Concrete mixes (in mixers or conveyors)
- Asphalt

Asphalt

Moisture control is critically important in asphalt production because it directly impacts energy efficiency, product quality, cost, and environmental compliance.

Read more

Brick production

Many brick manufacturers are now participating in quality management programmes as well as looking at ways to increase production levels while reducing costs.

The installation of a Hydronix microwave moisture control system can help them to achieve consistent, quality products while reducing costs in the reduction of wasted materials and potentially lower fuel costs.

Read more

Concrete slump

In modern concrete batching plants, the amounts of materials required for the recipe are typically weighed, and the recipe is calculated using the assumed 'dry' weight of the materials. When the aggregates are weighed in the batch plant, they are often not dry and so the weight of the water needs to be taken into account. If this is not done, then this will lead to inconsistencies in slump, strength, colour, and quality, resulting in an inferior product.

Read more

3.3. Wood & Biomass

- Wood chips
- Sawdust and shavings
- Bark
- Wood pellets
- MDF and particleboard feedstocks

Wood chips

The moisture in wood stockpiles varies constantly with local environmental conditions, both during harvesting and storage.

Working with the correct moisture of wood is important to prevent damage to process equipment, so measuring the moisture online with precision sensors ensures optimum efficiency.

Read more

3.4. Food Processing

- Flour, starches, and sugars
- Pasta
- Cocoa powder
- Coffee and tea
- Snack foods (cereals, nuts, crisps)
- Dry Pet food
- Bakery mixes

Almond processing

The moisture content is critical to ensure that packaged or stored almonds do not deteriorate and that processed almonds have minimum breakage or waste, ensuring that the final products are of the best quality.

Read more

Cocoa powder

When manufacturing powders, for example, dried drinking chocolate, it is common practice to concentrate a liquid before spray drying and this is typically done in an evaporator.

The material is then processed through the spray drier where the remaining moisture is evaporated leaving fine particles of powder. Measuring the precise level of solids in the liquid can achieve considerable savings in the reduction of waste materials and provides increased and consistent product quality.

Read more

Coffee

Getting the perfect cup of coffee has many steps before the rich aroma and taste can be enjoyed. Controlling the moisture whilst processing is essential to ensure the highest quality.

Read more

Food production

In the manufacture of foodstuffs, achieving the right moisture content is paramount. Too little moisture in the ingredients and the product might go stale too quickly or have an incorrect consistency. Too much moisture content and certain foods could develop moulds.

Texture, weight, colour, taste, and shelf life – can all be affected by incorrect moisture content, with the risk of costly product recalls and lost production time.

Read more

Food waste

Manufacturing waste is waste created during the production processes. This may be excess product, for example, trimmings, or by-product waste such as fat or bones.

Industrial waste is generated by the manufacturing process: it can be thought of as the “leftovers” after processing.

Most of these forms of waste may be reduced by better control of the moisture content throughout the process.

Read more

Rapeseed oil

The rapeseed oil extraction process benefits from moisture control for several reasons, including the correct moisture levels for the oil extraction process. It increases product control, reduces waste and spoilt product.

Read more

Wheat flour noodle

Noodles are made from wheat flour which are then dried, shaped, and packaged, for example, as instant noodles.

In the first steps, water is present and could lead to problems such as dough clogging the machines, quality issues, or, even worse, downtime for the plant.

Controlling the moisture becomes vital and provides instantaneous feedback to the control system to reach the correct moisture targets.

Read more

3.5. Chemicals & Pharmaceuticals

- Powders (e.g., detergents, pigments)
- Granules and flakes
- Fertilisers
- Pharmaceutical powders and blends

4. Where to Measure Moisture?

Moisture sensors can be mounted in many locations throughout the plant if there is a consistent flow of material over the sensor.

4.1. Ducts

For physical locations where the material is being transferred in vertical or angled ducts a ducting system can be installed to concentrate flow over the sensor whilst allowing excess material to overflow into the wider duct. This ensures consistent measurement independent of variations in overall flow.

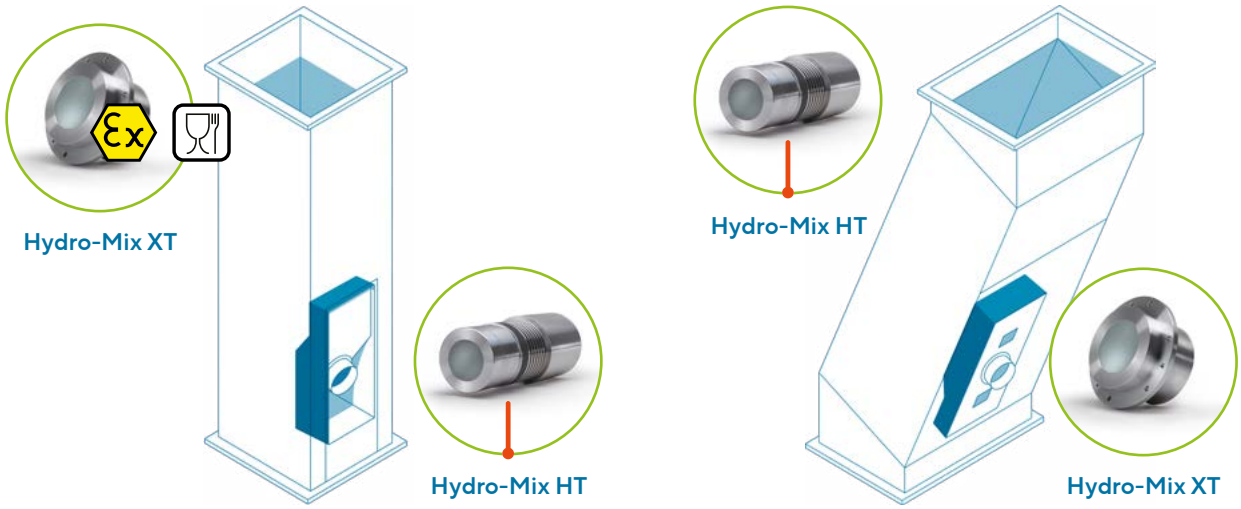


Figure 2: Sensor mounted in a duct

4.2. Chain Conveyors

Chain conveyors can have flush-mounted sensors installed in the floor.

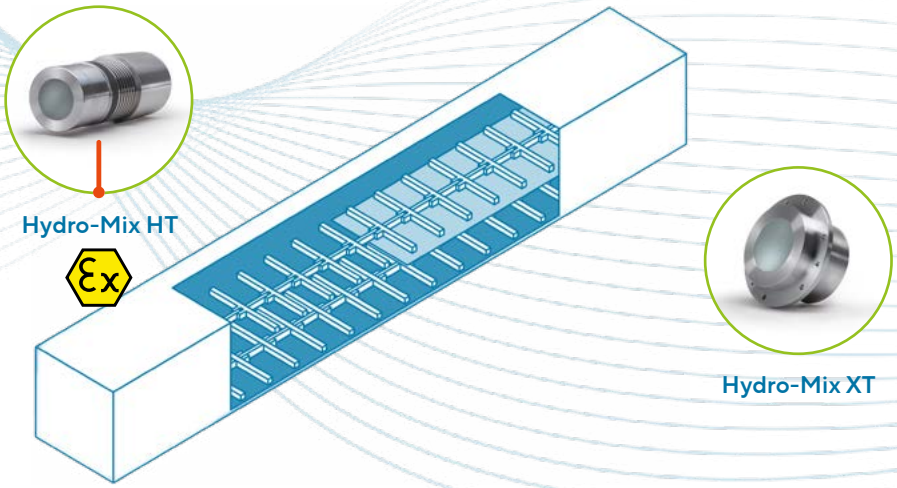


Figure 3: Sensor installed in the floor of a chain conveyor

4.3. Conveyor Belts

Sensors can be installed to measure material on conveyor belts or mounted on a skid where there is a minimum of 50mm material thickness.

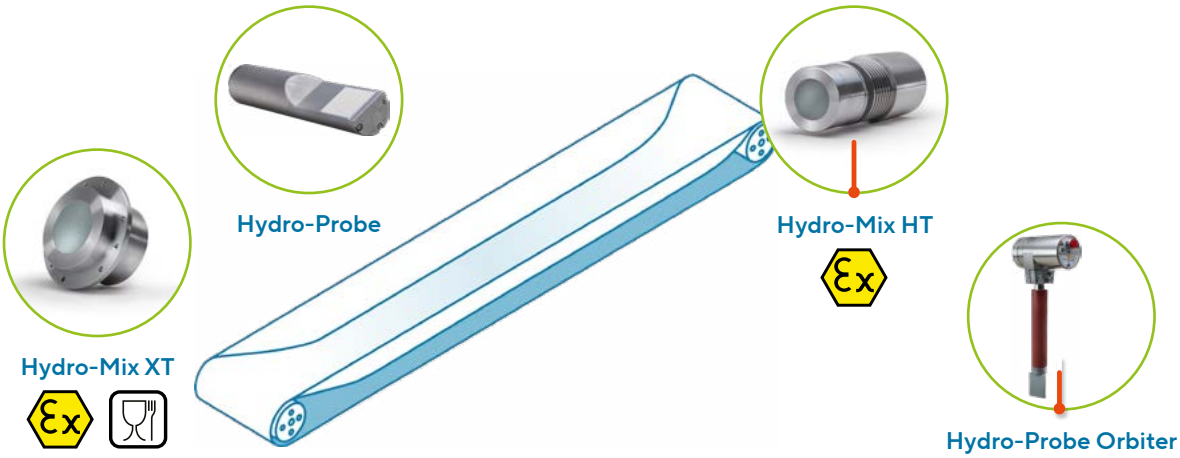


Figure 4: Sensor installed on a conveyor belt

4.4. Screw Conveyors

Screw conveyors can have sensors flush-mounted at 30° in the trough of the conveyor on the upstroke (carrying) side. In conveyors carrying powders, where buildup can occur flight edging can be used to ensure the measuring area has fresh material.

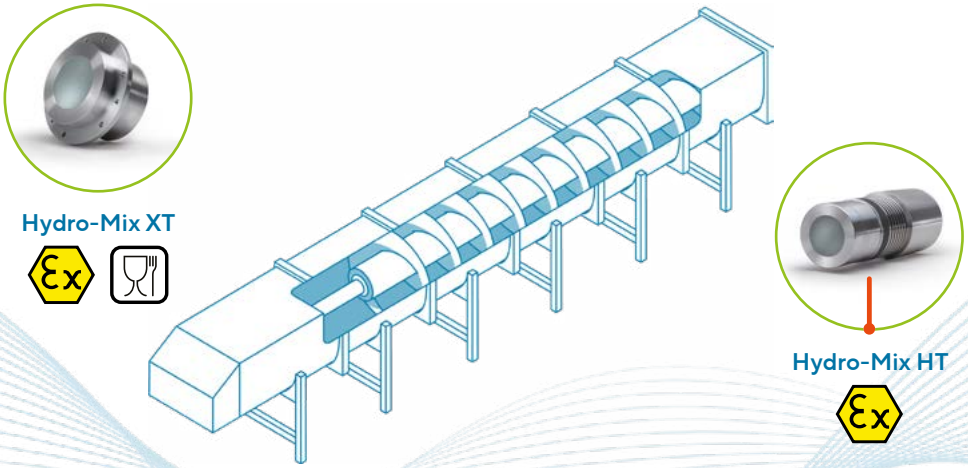


Figure 5: Sensor installed in a screw conveyor

4.5. Mixers

Sensors can be mounted in the belly or end wall of mixers. The exact location will depend on where the clean spots or scrapers are located.

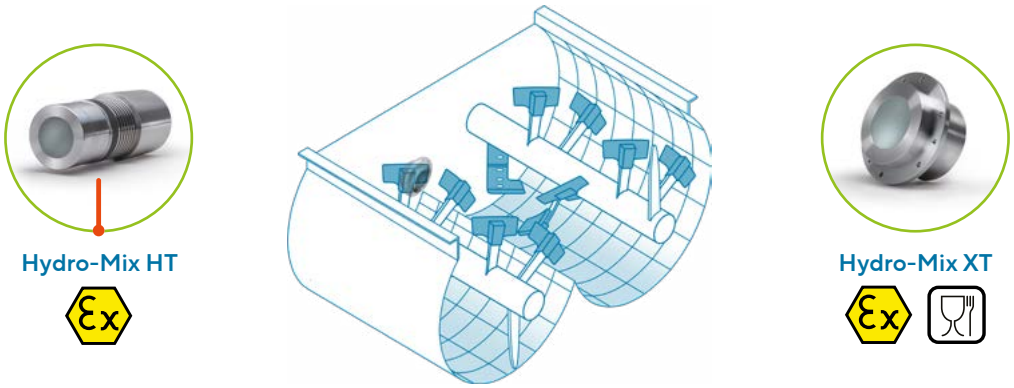


Figure 6: Sensor installed in a twin shaft mixer

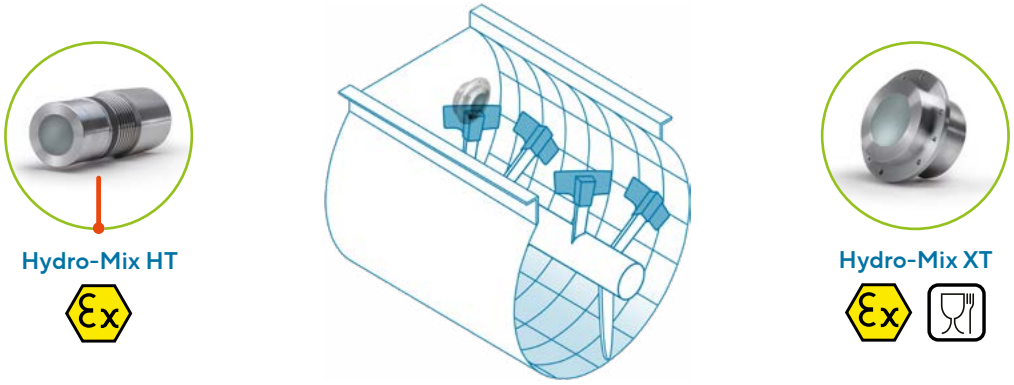


Figure 7: Sensor installed in a single shaft mixer

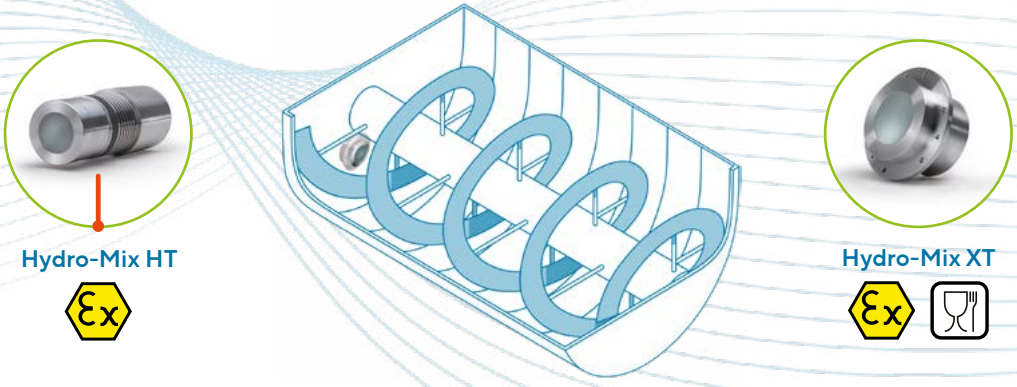


Figure 8: Sensor mounted in a ribbon mixer

4.6. Bin, Silos and Hoppers

Sensors can be mounted in or under the outlet of bins, silos, or hoppers.

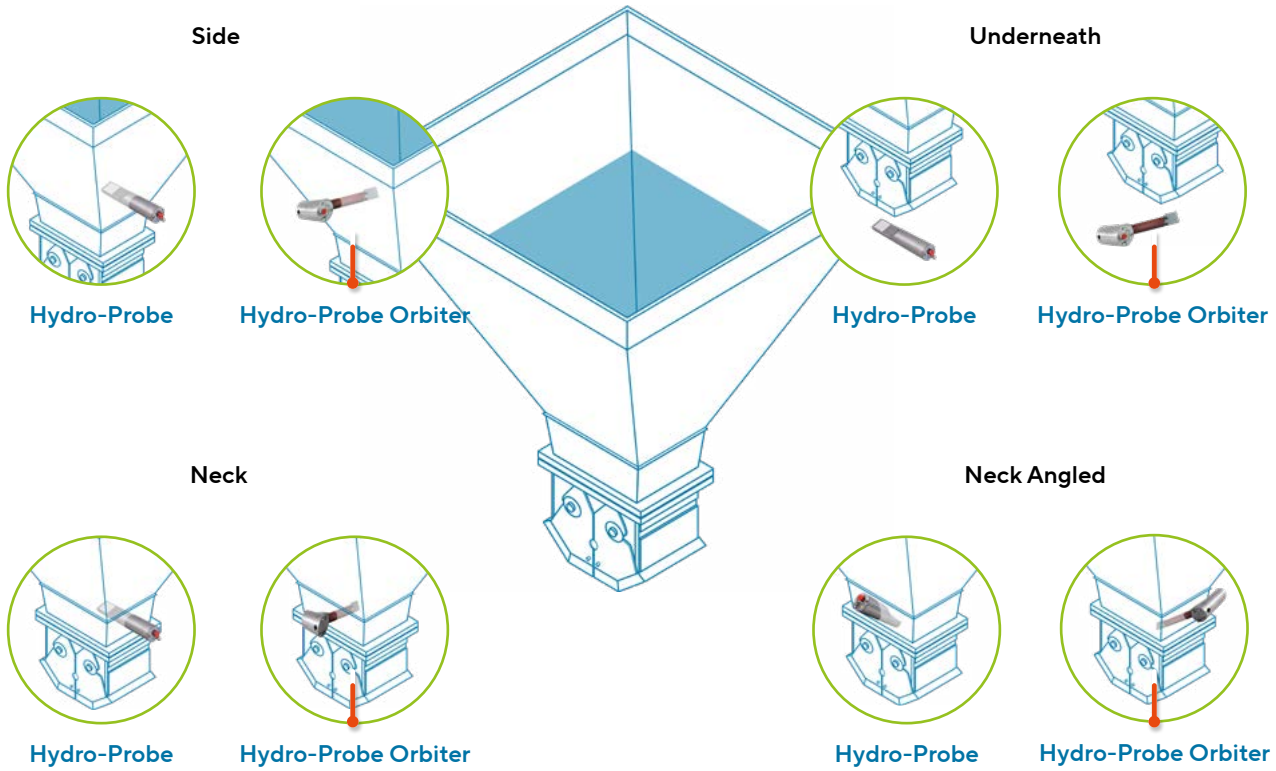


Figure 9: Sensor mounting options in a bin/hopper

5. Key Criteria for a Good Moisture Sensor Location

5.1. Sensor Locations

When selecting a location to install a moisture sensor, several practical and environmental factors must be considered to ensure accurate, repeatable measurements and long-term sensor reliability.

5.1.1. Stable, Fixed-Speed Material Flow

A consistent flow ensures that the sensor captures representative readings of the material. Variable speeds or pulsating flow can lead to erratic data or calibration issues.

5.1.2. Accessible for Sampling and Maintenance

The installation point should allow for easy manual sampling for calibration or validation purposes. It should also be reachable for cleaning, inspection, and any required maintenance.

5.1.3. Process Temperature Below 120°C

Most sensors are rated 0 to 60°C. There are high temperature options up to 120°C. Higher temperatures may require cooling options or limit sensor lifespan and accuracy.

5.1.4. Minimal Material Build-Up

The sensor should be installed in a location where material does not easily accumulate or cake, as this can lead to measurement of static, built up material rather than the desired flowing process material. See 2.4 for more details on mechanical cleaning.

5.1.5. Continuous Contact with Material

The sensor must have reliable, direct contact with the material during operation. Inconsistent flow, or bridging will negatively affect measurement accuracy.

5.1.6. Consistent Material Presentation

Ideally, the material should pass evenly across the sensor face (e.g., in a screw conveyor, chute, or mixer). Turbulent or uneven flows can reduce measurement quality which may require heavier filtering, limiting responsivity.

5.1.7. Single or Controlled Proportion of Mixed Material

Moisture measurement is most accurate when the sensor is exposed to a consistent blend or a single material stream. If materials are mixing (e.g. multiple ingredients or recycled product), in batch processes the sensor can be used to detect homogenisation.

In continuous processes the sensor should be installed after homogenisation or at a point where the mixture is well-proportioned. Avoid measuring where large, uneven clumps or unmixed ingredients pass the sensor.

5.1.8. No Interference from External Factors

Avoid locations affected by vibration, electromagnetic interference, or significant rapid changes in ambient conditions.

6. Modifying Locations to Improve Sensor Installation Conditions

Not every process line has a perfect location straight out of the box. In many cases, minor modifications can significantly improve conditions and make a previously unsuitable locations viable for moisture measurement. Here are some common solutions:

6.1. Ducting Systems

Redirects some material flow to a controlled environment, where the flow is stabilised and material presents consistently to the sensor.

Ideal for fast-moving conveyors or open belt systems where exposure is inconsistent or affected by dust and airflow.

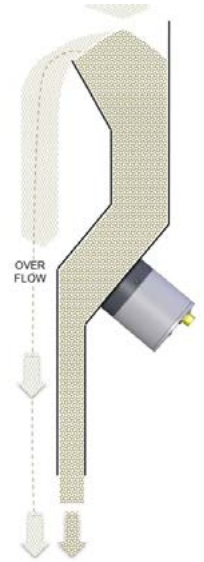


Figure 10: Hydro-Mix in a Vertical Ducting system

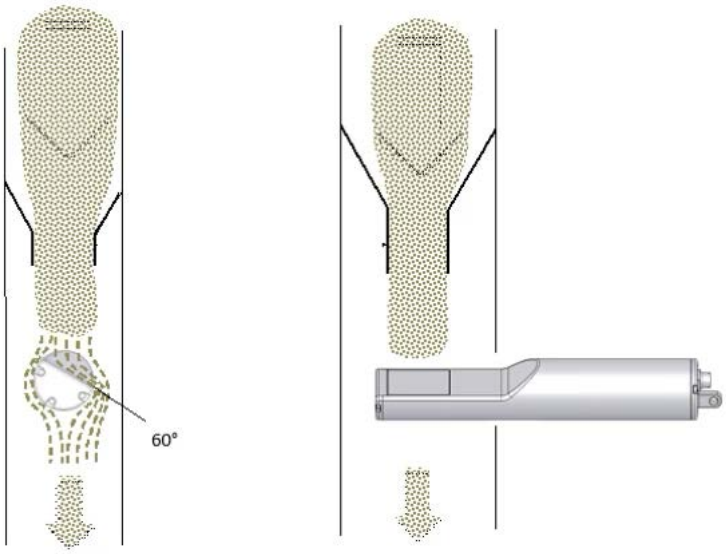


Figure 11: Hydro-Probe used with a ducting system

6.2. Bypass Systems

Divert a portion of the main product flow through a secondary smaller channel with ideal flow and environmental conditions. The flow can often be regulated at the output of the secondary channel with a rotary valve.

Useful in high-speed or high-temperature applications where the main line is too harsh or fast for direct sensor use.

6.3. Forced Cooling

In processes where the temperature exceeds 120°C, cooling jackets or air-cooling systems can be fitted to keep the sensor within its operational range.

This enables installation closer to heat-intensive zones such as dryers, kilns, or ovens without compromising the sensor.

6.4. Mechanical Cleaning Systems

Automated or semi-automated cleaning devices (e.g., scraper arms, air blades, rotating brushes, flight edging) help prevent build-up on the sensor face in sticky or dusty applications.

This maintains measurement accuracy and reduces the need for frequent manual cleaning.

7. Sensor Connectivity and Its Importance

Effective moisture measurement is not just about placing sensors in the right locations—it also depends on reliable connectivity and integration with the control system.

Hydronix sensors offer a highly flexible communication architecture that allows seamless data exchange across various platforms.

As shown in the diagram, Hydronix moisture sensors can be connected via RS485 using the Hydro-Link protocol, enabling up to 16 sensors to operate within the same network. This scalability makes it easy to monitor multiple stages of a process simultaneously, ensuring moisture is controlled from raw material intake to final packaging.

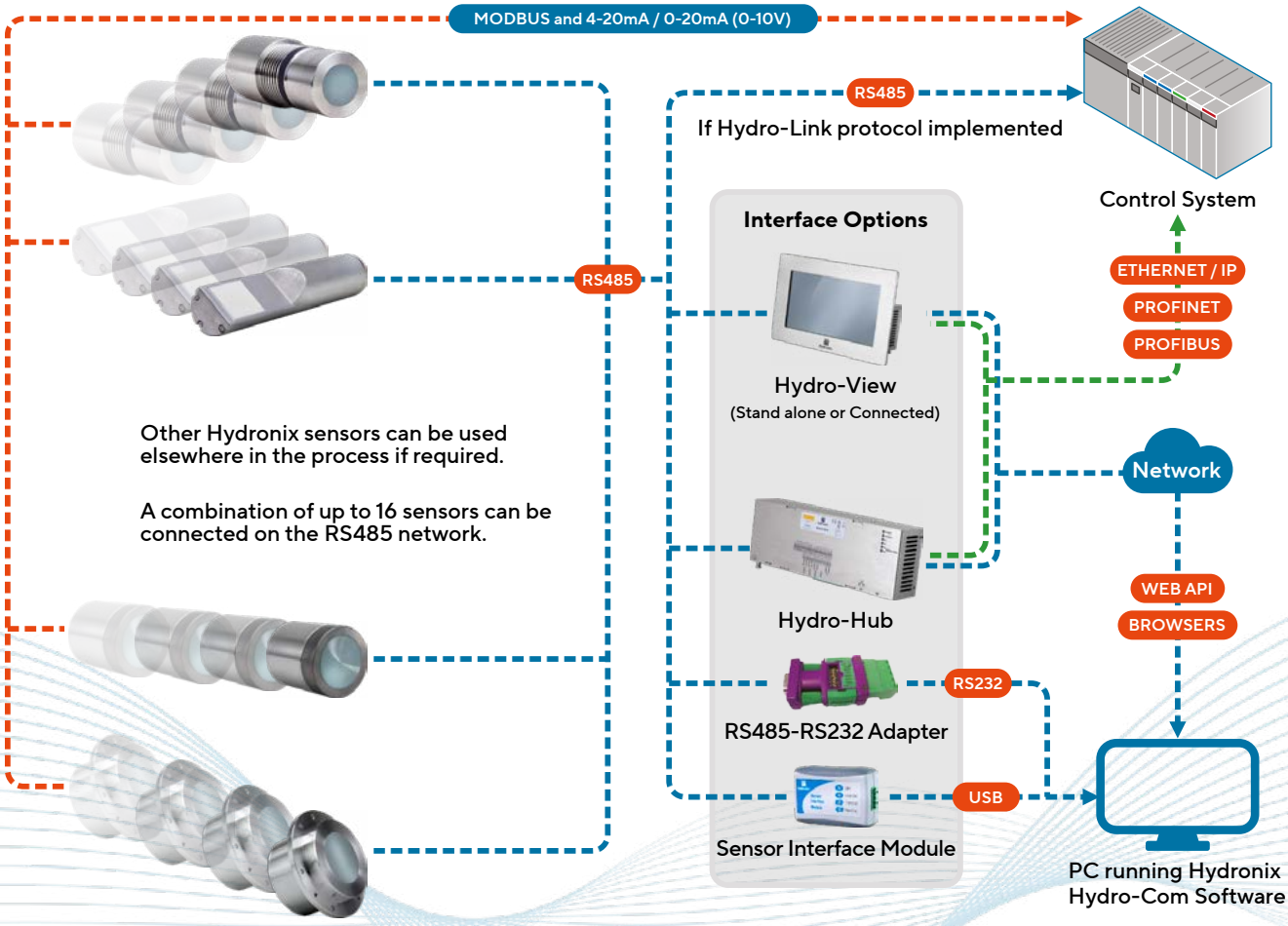


Figure 12: Sensor connectivity

Data can be transmitted to control systems using industry-standard protocols such as:

- MODBUS (with 4–20mA, 0–20mA, or 0–10V analogue output),
- Ethernet/IP, PROFINET, and PROFIBUS through integration with network gateways.

Operators and engineers can also access sensor data in real-time using:

- Hydronix's Hydro-Com software (via USB),
- Hydro-Hub, Hydro-View and, Hydro-Control units Web APIs and browser interfaces, offering powerful monitoring and diagnostics tools from virtually any location.

This flexible connectivity allows for:

- Real-time moisture control and closed-loop feedback to automated systems,
- Remote configuration and diagnostics, reducing downtime and maintenance costs,
- Centralised data collection, enabling smarter decision-making across the production line.

In short, robust sensor connectivity is not just convenient, it is essential for ensuring accurate, responsive, and efficient moisture management in modern industrial environments.

8. About Hydronix

8.1. Who are Hydronix?

Established in 1982, Hydronix specialises in the research, development, and manufacture of digital microwave moisture measurement systems.

Hydronix takes great pride in offering personal and responsive customer support. This is achieved through a network of resellers worldwide.

All Hydronix partners are experienced and fully trained in all aspects of the equipment, including installation, training, and support.

8.2. The Hydronix Unique Approach to Digital Moisture Measurement

Hydronix has developed its own proprietary digital microwave measurement technology, continuously refined over the years to deliver exceptional precision, consistency, and stability.

Hydronix sensors capture moisture levels digitally, providing a direct, linear response to the water content in the material as it flows across the sensor faceplate. This ensures fast, accurate readings with minimal drift, critical for real-time process control.

Hydronix sensors offer a range of advanced, fully configurable features, including:

- Built-in Digital signal processing
- Temperature compensation
- Alarms and threshold triggers
- Multiple communication interfaces

With a measurement speed of 25 measurements per second, our sensors can detect even the smallest fluctuations in moisture content, even in fast-moving or dynamic material flows.

Unlike systems that rely on standard, off-the-shelf components, Hydronix uses custom-designed hardware tailored for moisture measurement. This means the sensor can operate at an optimal microwave frequency, maximising sensitivity and ensuring high accuracy.

Hydronix sensors have multiple sensing modes, giving users the flexibility to fine-tune sensor performance across various materials and processes.

Hydronix is founded on four core values:

- **Commitment to excellence –** A commitment to excellence and quality covers every aspect of the business
- **Technology –** Sensors use a Hydronix patented digital measurement technique
- **Worldwide Expert Network –** Commitment to delivering excellent service through a network of local experts
- **Solution Focussed –** Partnering with customers to develop a working and effective solution.

8.3. Hydronix Moisture Sensors

Hydronix offers a range of digital microwave sensors for use in the processing of bulk solids or liquid materials.

There is a choice of installation and temperature options, enabling a sensor to be positioned in many locations where moisture, Brix or the concentration of liquid solutions needs to be measured.

8.3.1. Process Temperature up to 60°C

Hydro-Probe XT

- Mount in or underneath bins/silos or hoppers
- Mount above a belt conveyor

Hydro-Mix XT

- Flush mount for mixers, screw and chain conveyors
- Mounting options for ducting and belt conveyors

8.3.2. Process Temperature up to 120°C

Hydro-Mix HT

- Process temperature range up to 120°C
- Flush mount for mixers & screw conveyors
- Mounting options for ducting

Hydro-Probe Orbiter

- Process temperature range up to 100°C
- Mount in or underneath bins/silos or hoppers
- Mount above a belt conveyor

8.3.3. Explosive Dust Atmosphere

Hydro-Mix XT-EX

- Flush mount for mixers & screw conveyors
- Suitable for explosive dust environments

Hydro-Mix HT-EX

- Process temperature range up to 120°C
- Flush mount for mixers & screw conveyors
- Suitable for explosive dust environments

8.3.4. Food Safe

Hydro-Mix XT-FS (Food Safe)

- Flush mount for mixers & screw conveyors
- Food Safe compliant with EN 1935/2004

8.3.5. Brix Measurement

Hydro-Probe BX (Brix)

- Process temperature range up to 120°C
- Suitable for mounting in pressurised vessels
- Brix or moisture calibration available
- Self-cleaning option

Find out more at hydronix.com

9. Moisture Sensor Installation Assessment Sheet

9.1. Location Information

Plant / Site Name:	
Production Line / Process Area:	
Material Type:	
Sensor Model (if known):	

9.2. Material Flow Conditions

Criteria	Yes	No	Notes
Is the material flowing consistently across the sensor face?			
Is there sufficient material depth (not trickling)?			
Is the material well mixed and representative at this point?			
Is the flow neither pulsing nor intermittent?			

9.3. Material Considerations

Criteria	Yes	No	Notes
Is there easy physical access for installation and maintenance?			
Is the sensor protected from impact or mechanical damage?			
Is vibration or movement in the mounting area minimal?			
Can the sensor be mounted flush with the material flow?			

9.4. Environmental Factors

Criteria	Yes	No	Notes
Is the temperature within the sensor's rated operating range?			
Is the sensor protected from excessive dust, moisture, or chemicals?			
Is the area non-hazardous (or certified for ATEX/IECEx if required)?			
Is cleaning or washdown likely in this area?			

9.5. Electrical and Data Connectivity

Criteria	Yes	No	Notes
Is a power supply available nearby?			
Can the sensor cable be routed safely to a control unit or PLC using only data cable trays?			
Is there any machinery close by that could create interference (i.e. Industrial Microwave Ovens, High power transmitters)?			
Is real-time data required for process control?			

9.6. Process Relevance

Criteria	Yes	No	Notes
Is moisture control critical at this stage in the process?			
Will data from this point help optimise the process?			
Is this a single material stream or a mixed material point?			

9.7. Assessment Summary

Criteria	
Is the location suitable for installation?	Yes / Yes, with environmental modifications / No
Recommended Actions / Notes:	

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