Welcome to Hydronix

Defining the Standard for Microwave Moisture Measurement
An Introduction to Hydronix

- Hydronix design, manufacture and sell microwave moisture measurement and control equipment
- Industry leader of digital sensors, controls and service
- First company to develop microwave technique in 1982
- Focus on sensor technology and service
- Over 65,000 installations world wide
- Global network of trained resellers that speak your language
- Continually investing in research
- Customer Focus – Your satisfaction, guaranteed!
A Sensor for All Materials

- Hydronix has a range of sensors specifically designed to measure moisture in most types of flowing materials
- Exterior made from stainless steel to withstand the harshest environments
- Easy to install in a variety of different locations
- A choice of measurement modes for optimising sensor performance in a variety of applications and materials
- Not affected by dust or colour
Moisture Control - Benefits

• Cost Savings / Increased Profitability
  • Reduced material and/or product wastage
  • Increased production
  • Water content control

• Time Savings
  • Automation usually increases production rates
  • Reduced laboratory time
  • Feed-in data

• Consistent Production
  • Quality Control
  • On-line, automated moisture control
  • Easy adjustment to varying moisture contents
Typical Moisture Variations

- Fine Sand 0-20%
- Coarse Sand 0-12%
- 6mm Aggregate 0-10%
- 20mm Aggregate 0-4%
- Pulverised Fuel Ash 0-33%
- Clay Tile Mixes 0-20%
- Animal Feed 0-20%
- Grain 5-30%
- Your Material ??
Equipment Overview

• Moisture Sensors for Flowing Materials

**Hydro-Probe**
Sensor for use in flowing mineral type applications such as concrete, aggregates and asphalt

**Hydro-Probe XT**
Sensor for use in flowing organic type applications such as animal feed, grain and biomass materials
Equipment Overview

- Moisture Sensors for Mixers, Conveyors, Chutes and Ducting

Hydro-Mix
Flush mounted Sensor

Hydro-Probe Orbiter
Rotating Sensor for Mixers
Equipment Overview

- Digital sensor for measuring moisture or dissolved solids in liquids

Hydro-Probe SE
Equipment Overview

- Water Control
  - Hydro-Control VI
    - Precision Water Controller

- Moisture Display
  - Hydro-View IV
    - Display unit for Calibration and Configuration of Hydronix Sensors
Supported By . . .

- Optional comprehensive 4 year warranty
- Immediate exchange units
- Full service commitment from Hydronix
- Local support in your own language
Hydronix Sensor Technology
Hydronix Sensor Technology

- Robust, reliable, simple
- Linear output
- Digitally, factory configured to be identical
- 0-20mA, 0-10V or 4-20mA linear outputs
- RS485/232, USB & Ethernet
- Network up to 16 sensors
- 25 readings per second
- Contact Sensors

- Temperature output available
- On-board functionality & alarms
- Configurable input / outputs
- Power +15Vdc to +30Vdc
- Automatic temperature compensation
Water Molecule

- Water is a polarised molecule and will align itself with an electromagnetic field.
- It stores energy as it aligns itself and also dissipates energy as it interferes with adjacent molecules.
- This combined effect is known as Relative Permittivity and in water this is very high compared with most other materials.
How Microwave Technology Works

• Hydronix measures the dielectric properties of materials

• Resonant frequency shifts have a linear relationship with moisture variation in many non-metallic materials

For ease of use:

\[ f_{\text{air}} = 0 \text{ unscaled} \]

\[ f_{\text{water}} = 100 \text{ unscaled} \]
Microwave Resonator – The Resonant Frequency Response

- Old legacy “Analogue” sensors measure only at f1 and output A1, A2, A3 and A4 – a non-linear response
- Hydronix digital sensors output f1 to f4 Normalised so that f1=0 and f4=100 “unscaled” units – a linear response

- $f_1 = \text{air}$
- $f_2 = \text{dry material}$
- $f_3 = \text{wet material}$
- $f_4 = \text{water}$

**Vacuum / Air Relative Permittivity = 1**

**Water Relative Permittivity = 80**

**$\varepsilon'$ affects the resonant frequency shift**

**$\varepsilon''$ affects the amplitude shift**
Calibration
The Theoretical Calibration Line

- Every material has a theoretically perfect calibration line. By calibrating the sensor we are trying to identify this perfect line. If correctly calibrated with 2 points (A and B below) it is possible to determine any exact moisture value along the line from any unscaled value measured by the sensor.
Possible Error – Not Enough Spread

- It is recommended that calibration points are taken over the full working moisture range of the material. If points are taken too close together the actual calibration line calculated may not lie on the on top of the theoretically correct line as shown below.

If the working range drops:

From 2.5 to 4.0%
To 1.0 to 3.5%

this may result in an error of approximately 1% moisture.

1% in 1m³ of concrete is approximately 20 litres of water.
Possible Error – Good Spread

• With two points taken over a much wider moisture range the adverse effects of the same 0.3% error are dramatically reduced.
Calibration Data – Good or Bad?

- A good spread is essential (2-3%)
- Representative Sampling
- Accurate moisture content determination
Storing Calibration Data

- There are two ways of storing the material calibration data

- Firstly - In the Sensor

  Advantages
  - Calibration using Hydro-Com
  - Control system does not need modification to calibrate the sensor
  - Ability to use Hydronix known calibration data for different materials
  - Calibrations can be transferred between sensors

\[
\text{Moisture} = B \times (U/S) + C - SSD
\]
Storing Calibration Data

• Secondly - In the Control System

Advantages

• Direct calibration without the need for an additional computer or RS485 adapter
• No need to learn how to use additional software
• If it is necessary to replace the sensor, a replacement can be connected and valid results obtained immediately without the need to connect to a PC to update the material calibration
• Calibrations can be switched between sensors easily
System Accuracy

- Resolution of electronics +/- 0.13 unscaled units (0-100 range) (equivalent to +/- 0.04% moisture in sand)
- System accuracy in practice, depends on:
  - Sampling of material being measured
  - Accuracy of laboratory test
- In practice, for sand and aggregates +/- 0.2% moisture (effectively…. as accurately as the user can calibrate)
- System accuracy for measurement in mixers: Within +/- 0.1%
Reliable Repeatability

• Results of 10 sets of 3 batches
Hydro-Probe

Moisture Sensor for Flowing Material
Hydro-Probe

- Easy to use
- Extremely robust – stainless steel body and ceramic sensing face
- Ideal for use under or inside silos, on conveyors or anywhere in your process where there is a consistent, smooth flow of material
- Shape designed to achieve best results
- Temperature rated 0-60°C (32-140°F)
- Quick and flexible connectivity
- Unscaled units allow immediate replacement without recalibrating
- The Hydro-Probe has become the industry standard for moisture measurement equipment
Hydro-Probe Positioning

Flow A or Flow B should be in line with the material flow

Typical hopper or silo installations

Typical Conveyor Installation

Material Flow

30°

Flow A

Flow B
Hydro-Probe - Sensor Connectivity

• All sensor models connect similarly

- Power supply
  +15V - 30v DC, 1A min

- 2 x Analogue outputs
  0-20mA, 4-20mA, 0-10v

- Digital input / outputs

- RS485 serial communications

• External Converters

RS485, RS232
USB Interface
Ethernet Adapter
Hydro-Probe Accessories
Hydro-Probe Accessories

- Mounting Sleeves – Standard and Extension
- Clamp Ring (for use with Flanged Mounting Sleeve)
- Flanged Mounting Sleeve for vertical mounting
Hydro-Mix

Flush Mounted Sensor
Hydro-Mix

• Easy to use with flat ceramic sensing face to achieve best results
• Extremely robust – stainless steel body and ceramic sensor face
• Designed specifically for use in static pan, horizontal shaft mixers, screw conveyors and ducting systems
• Quick and flexible connectivity including connection to Control System, PC or Hydro-Control VI
• Temperature rated 0-60°C (32-140°F)
• Replaceable ceramic sensing face
• The Hydro-Mix has become the industry standard for flush mounted moisture sensors
Hydro-Mix Positioning

Turbo and Planetary Mixers

Single Horizontal and Twin Shaft Mixers

Augers and Screw Conveyors

Conveyor Belts

Ducting Systems
Hydro-Mix Installation

• For installations in flat surfaces the top of the sensor must be flush with the floor of the mixer

• For curved installations the centre of the ceramic must be flush with the radius of the mixer wall

• In all installations, it is recommended that the sensor is fitted in an area where it is away from any possible collection of ‘sitting’ water
Hydro-Mix Installation

127mm hole for fixing plate

Fill gap with sand or silicon sealant

Mixer floor or wall

Adjustable Clamp Ring
Typical Hydro-Mix Installation
Hydro-Mix Installation

- For installation in applications that use ducting, for example grain, Hydronix has a ducting system designed to measure a portion of the flow of material using a Hydro-Mix sensor.

- The Hydronix Ducting System can be installed into square or round ducting, in either vertical or angled systems.
Hydro-Mix Installation

- Hydronix Grain Ducting System

Measuring moisture in grain using a Hydro-Mix moisture sensor
Hydro-Probe Orbiter

Rotating Sensor for Mixers
Hydro-Probe Orbiter

- Easy to use with 4 different arm lengths to suit your mixer
- Extremely robust – stainless steel body, ceramic sensing face, and replaceable wear sleeves
- Designed specifically for use in rotating pan and planetary mixers
- Permanently in the material for faster, more accurate measurement
- Small sensing arm for minimum mixing interference
- Temperature rated 0-60°C (32-140°F) or optional high temperature sensor arm 0-120°C (32-248°F)
- Easy and flexible connectivity including connection to Control System, PC or Hydro-Control VI
- The Hydro-Probe Orbiter is the only proven solution for rotating moisture measurement sensors
Hydro-Probe Orbiter Components

Easily replaceable Sensing Arm with Wear Sleeve and Wear Rings

Ceramic head for high wear applications
Hydro-Probe Orbiter Positioning

Planetary Mixer

Rotating Pan Mixer

Rotating Connector

Sensor Cable

Moisture & Temperature Outputs

Terminal Box

24V DC

Static Pan Mixer

RS485
2 Analogue Outputs

Rotating Pan Mixer

Sensor Cable

Moisture & Temperature Outputs

Terminal Box

Static Sensor

RS485
2 Analogue Outputs

24V DC
Hydro-Probe Orbiter Typical Installation

- Couvrot Planetary Mixer
Hydro-Probe Orbiter Typical Installation

- Couvrot Planetary Mixer
Hydro-Probe Orbiter Typical Installation

- Eirich Mixers

- The Hydro-Probe Orbiter dramatically reduced wastage upon installation in a roof tile manufacturing plant
Hydro-Probe Orbiter Typical Installation

- OMG Mixers
Hydro-Probe Orbiter Typical Installation

- Rapid Turbo Mixers
Hydro-Probe Orbiter Typical Installation

- Teka Turbo Mixers
Hydro-Probe Orbiter Accessories
Hydro-Probe Orbiter Accessories

- Wear Rings (Ceramic or Stainless Steel Options)
- Wear Sleeves
- Rotating Connector
- Replaceable Arm
- High Temperature Arm
Hydro-Probe SE

Digital Sensor for Liquids
Hydro-Probe SE

- High temperature sensor for use in liquids, concentrates or dissolved solids
- Operating temperature range: 0 to 125°C
- Extremely robust – stainless steel body and ceramic sensing face
- Manufactured from materials that are safe for food contact
- Designed for pressurised environments up to 6 Bar gauge
- Ideal for use in evaporators or pipelines
- Shape designed to achieve best results
- Quick and flexible connectivity
Hydro-Probe SE Installation

- The Hydro-Probe SE can be mounted into a vessel or pipeline
- Material flows easily around the sensor
Typical Hydro-Probe SE Applications

- Concentrated Measurement
- Calandria
- Spray Drying
- Powered Food – Drinks, Soups etc
- Alcohol
- Organic Oils – Olive, Nut, Vegetable
- Biological Waste
Hydro-Com Software

Diagnostic and Configuration Software
Hydro-Com Software

• Read, configure and diagnose up to 16 sensors

• Easy, quick to use software allows you to start measuring moisture straight away

• Windows compatible

• Free software – download at www.hydronix.com
Hydro-Com Scalable Solution

From a Single User with One Plant

To a Global Producer with Multiple Plants

Head Office

West Regional Office

Site A

Site B

East Regional Office

Site C

Site D
Hydro-Com Sensor Configuration

• Sensor Live Display and Trending
  • Up to 16 sensors may be networked
  • Log data over time including moisture, temperature…
  • User configurable sensor value display pages
Hydro-Com Sensor Configuration

• Configuration Tab
  • Change Probe Name / Address
  • Select output variable
  • Configure Input / Outputs
  • Average hold / delay
  • Scaling of Analogue
  • Alarms (bin empty, temperature)
  • Calibrate the Sensor Air and Water
Hydro-Com Sensor Configuration

- Diagnostics Tab
  - Hardware Test
    - Analogue output test
  - Sensor Event Log
  - Temperature records
Hydro-Com Sensor Configuration

- Calibration Tab
  - Store multiple material calibrations for each sensor
  - Easy to start averaging a batch with remote averaging
  - Graphical display of calibration points and calculated coefficients
Hydro-Com Sensor Calibration

- Quick start calibration (for aggregates) – one point technique

<table>
<thead>
<tr>
<th>Aggregate size (mm)</th>
<th>Coefficient B (slope)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>0.1515</td>
</tr>
<tr>
<td>0-4</td>
<td>0.2186</td>
</tr>
<tr>
<td>0-8</td>
<td>0.2857</td>
</tr>
</tbody>
</table>

- Multi-point calibration (Recommended )

![Graph showing multi-point calibration data]
Water Control Units

Hydro-Control VI
Hydro-Control VI

- Produce consistent, high quality batches
- Automatic or manual operation
- 3 water addition modes to reach moisture target
- Control fine and coarse valves for accurate control of moisture in mixer
- Stores up to 32,000 recipes
- Graphical display of moisture throughout the batch
- Repeatable batches +/- 0.1% moisture
- Calibrate recipe to a previous ‘good’ batch
- Records batch history of previous 1,000 batches
Hydro-Control VI Integration

- Hydro-Control VI connects to sensor digitally
- One sensor per Hydro-Control VI unit
- Connection of Hydro-Control VI to control system allows remote recipe selection and batch control
Hydro-Control VI Connections

• On board voltage selectable opto-relays: (24Vdc, 110Vac etc)
  • For connection to water valves and control system for automatic control
    • 7 Digital Outputs
    • 5 Digital Inputs
    • Optional expansion board that allows connection for digital remote recipe selection, weighed water

• RS232 Port:
  • For sending recipe and control information including
    • Recipe number
    • Live recipe batch weights

• RS485 Port:
  • Connection to Hydronix sensor for moisture and temperature readings and sensor diagnostics
Hydro-Control VI Water Modes

• 3 modes for adding water
  • Pre-Set
    • Adds a fixed amount of water set in the recipe. No moisture sensor required
  • Auto
    • Dribble feed method using advanced PID algorithm, progressively adds water until target moisture is reached
  • Calc
    • Calculates the water required to reach target moisture and adds in one shot
Hydro-Control VI Auto Mode

• Advantages
  • Independent of batch weight
  • No need to wait for a stable signal in the dry mix
  • Easy to calibrate recipe

• Disadvantages
  • PID algorithm needs to be tuned as the moisture signal is related to the mixer efficiency
  • Can be slow where mixing action of the mixer is slow
  • Cannot be used where water pressure is variable
Hydro-Control VI Calc Mode

• Advantages
  • Faster mixing times achievable in mixers with poor mixing efficiency
  • Independent of water pressure variations

• Disadvantages
  • Requires a suitable dry mixing time to produce a stable signal for water calculation
Multi-Function Touch Screen Display

Hydro-View IV
Hydro-View

• Easy to use touch screen, multi language interface
• Displays measurements for up to 4 sensors
• Configurable display for each sensor
• Trend graph or numeric display
• Communicates with up to 16 sensors
• Simple material calibration using multiple points
• Easily configure sensor parameters
• USB backup and restore
Hydro-View Interface

- The Hydro-View IV can be easily configured to display:
  - Multiple parameters from the same sensor
  - Measurements from up to 4 sensors
  - Simple multi-point calibration
Thank you