# New Moisture Management Technology by Hydronix

The benefits of accurate moisture management are now widely accepted to clearly outweigh the investment and onward cost for producers of animal feed. Monitoring the moisture in the raw materials, controlling water addition during the mixing and drying processes and finally checking the moisture of the materials in their finished form brings substantial benefits. Product yields may be maximised, ingredients efficiently utilised, energy consumption reduced and a quality finished product ensured.

For these reasons it is more common for producers to examine the business case for such installations, and therefore look for solutions that offer the best accuracy and flexibility at the most competitive price.

With over 25 years experience using low power microwaves to measure moisture, Hydronix has become the industry leader in the field of microwave moisture measurement technology. The sensor's microwaves penetrate into the materials being measured and they are not affected by dusty environments or colour changes. Due to the high volume of sensors produced, Hydronix has reduced the cost of measuring moisture in-line, making it more widely available to all producers.

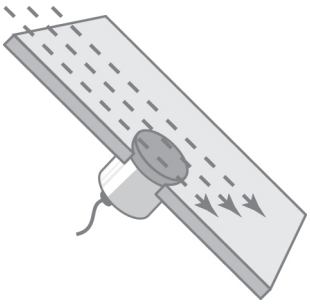


**Figure 1: Material Flow over a Moisture Sensor**

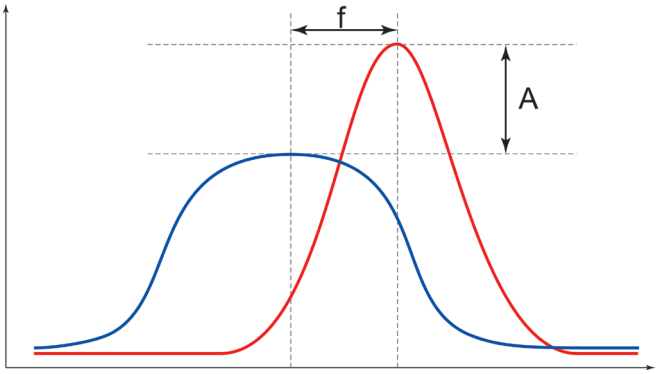
Building on the success of previous sensors, Hydronix will soon be releasing the new Hydro-Mix VII sensor into the market. This new sensor is particularly relevant to the animal feed industry. The sensor may be installed onto screw conveyors, chutes and holding hoppers. The key to a successful installation is to ensure that the sensor is located such that the material flows smoothly across the sensor's flat ceramic face.

The latest improvement in sensor technology lends itself to the feed industry for a number of reasons.

## Measurement Technique

In the past, an analogue microwave sensor would measure moisture through a combination of frequency shift and amplitude attenuation (see Figure 2). This combination was measured as a single analogue response and therefore frequency shift and attenuation could not be separated. It is widely known that the frequency shift component of the measurement relates directly to changes in moisture and that the amplitude relates, to some degree, to the density of the material. Hydronix went on to break new ground in the 1980's with the introduction of an innovative digital microwave sensor whereby the frequency shift could be accurately measured using precise digital techniques. This development resulted in two significant improvements in the sensors, an improvement in accuracy and also a very significant extension of the moisture range for which the sensor would give a true linear response as moisture levels increased.

**Figure 2: Moisture causes a change in the dielectric property of a material resulting in a frequency shift and amplitude attenuation**

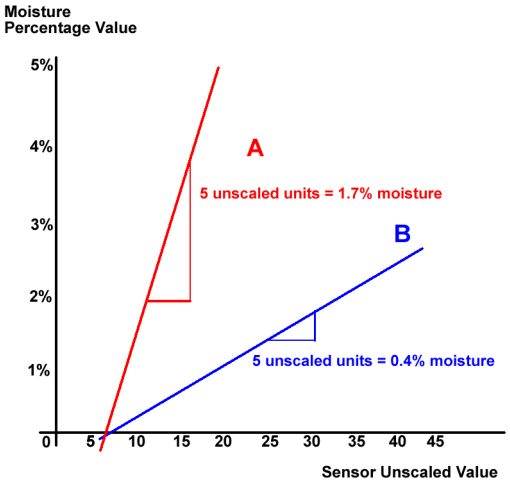



The latest breakthrough allows the sensor to measure, with digital accuracy, both the frequency and the amplitude responses of the microwave signal. These two measurements are then precisely combined using mathematical formulae to offer the user a choice of measurement modes. In practice, the user may now select from either Standard Mode (frequency shift technique) or two new modes that may be selected dependent on the material to give the best possible results.

All sensors available on the market will output an unscaled value that is either linear or non-linear. This value is then calibrated to give a moisture percentage for the material being measured.

When measuring in any material it is beneficial that a large change in unscaled sensor readings equates to a small change in moisture levels. This will give the most stable and precise calibrated moisture reading (see Figure 3). This assumes that the sensor is capable of measuring across the full moisture range required. In organic products the relationship between unscaled values and moisture means that a smaller change in unscaled values gives a large change in the moisture value which is undesirable. If this were plotted with moisture on the Y axis and unscaled values on the X axis, the calibration line is very

**Figure 3: Effects on sensor of differing calibration line gradients**



steep (see line 'A', Figure 3). The ability to select the fundamental measurement technique allows the user to choose the technique that most flattens the relationship between unscaled values and moisture (see line 'B', Figure 3). The mathematical algorithms employed in the sensor have been specially devised to respond in a different manner dependent on the material. They will all give a stable linear output, however line 'B' in Figure 3 will give better accuracy and tighter precision.

The ability to select the best measurement mode is of particular interest to users measuring in organic materials. This is because different organic materials have their own distinct dielectric property behaviour and will therefore respond differently to each of the underlying measurement modes. These response differences between the modes are also applicable to variables in the application itself. The best mode may now be selected for the material and the application to best account for the temperature range, precision required and bulk density changes over time.

Currently the new measurement technique will be offered as part of the new Hydro-Mix VII sensor. However it is also expected to be included with the new generation of the Hydro-Probe Orbiter sensor range later in the year, which offers the option to measure moisture in high temperature locations.

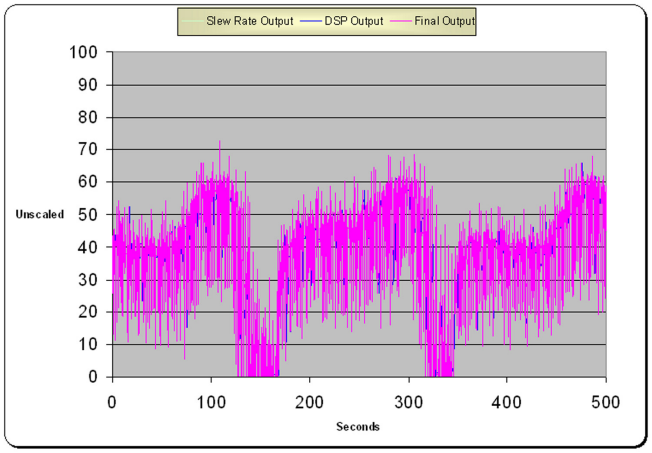
**Figure 4: Hydro-Mix VII Sensor**

## New Signal Processing

Digital microwave sensors have on-board electronics that allow results to be immediately processed, averaged and treated before they are used by the plant's operator or automated control. Filters using moving averages and rate of change rules have been used on Hydronix sensors for many years allowing the treatment of data on-board the sensor. As the quantity of air in a material increases (and its density reduces) filters gain importance as they are required to remove 'noise' from a signal and only use valid data.

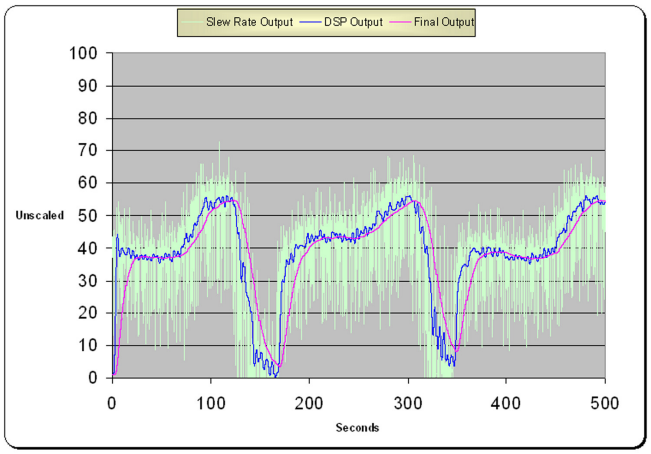
New Hydronix technology now allows the use of advanced Digital Signal Processing (DSP) filters. When used in combination with existing filtering parameters these allow the user to obtain a smoother signal with reduced data loss further improving sensor performance.

**Figure 5: Raw signal from a sensor**




***" … Monitoring the moisture in the raw materials, controlling water addition during the mixing and drying processes and finally checking the moisture of the materials in their finished form brings substantial benefits … "***

**Figure 6: The effect of DSP filters (dark blue) and the final output with 7.5s smoothing (purple)**




## Temperature Stability

When measuring in organic products with a potentially steep calibration line, a small change in unscaled readings will lead to a large change in moisture readings. For this reason it is vital that the unscaled readings of any sensor used remain stable with changes in temperature.

The Hydro-Mix VII sensor electronic hardware is designed, just like the bimetallic strip in a mechanical Swiss watch, to remain indifferent to changes in temperature. In addition, a software compensation algorithm measures the temperature of the electronics and finely adjusts the sensor for any further compensation if it is required. Each sensor has a unique software algorithm calculated during the production stage which is stored in the sensors memory ensuring maximum stability for each individual unit.

## Connectivity

The new Hydro-Mix VII sensor may be networked using RS485, RS232 and has USB and Ethernet options. The sensor also has two on-board analogue outputs allowing the user to simultaneously output a variety of filtered readings, readings from two different measurement modes or moisture and material temperature simultaneously.

## Buying Decision and Happy Customers

When choosing moisture measurement equipment, the ease of use and quality of after sales service (and advice) given by the supplier should also be an important part of the purchasing decision process.

The Hydronix range of sensors may be configured using the Hydro-Com software from a PC with a simple USB connection. They are supported in over 65 countries worldwide and our team of engineers is backed-up by our free global exchange program.

If you would like to know more about measuring moisture at your feed plant, or using the latest microwave moisture measurement technology, contact Hydronix: David Serra, International Sales Manager

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