

Engineering Note: EN0095 & Hydro-Probe Aggregate Averaging

Summary: Configuring a Hydro-Probe Moisture Sensor for Batch Averaging of Aggregates

Products affected: HP02, HP04

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Summary

When a Hydro-Probe sensor has been installed underneath, or in an aggregate bin, the material will flow over the sensor when the discharge is commenced. For each batch of material the sensor will need to perform an average calculation of the moisture %. It is necessary to configure the sensor to average at the appropriate point to avoid an incorrect calculation. This engineering note explains the reasons why the Average/Hold delay is required and why the sensor should be configured to average the Raw Moisture/Unscaled.

This engineering note only details the measurement of free falling materials that are being batched. For continuous processes see the relevant user guide for the sensor in use.

Sensor setup

1 Average/Hold

To ensure the sensor is measuring flowing material it has to be configured to start averaging the moisture when the bin gate opens and to stop as soon as it shuts again. To automatically Start/Stop the averaging the PLC will need to send a start averaging signal. This can be achieved by applying 24vDC to Digital input 1 on the sensor (Yellow Wire).

The majority of batching systems will weigh up a proportion of the material, approximately 75%, in a single dose. The remainder of the required material is then released by jogging the feed gate. It is important that the averaging signal is only applied during the main dose. The average Moisture value should be read from the sensor at the end of the main dose only, any values calculated during the bin gate jogging will be incorrect and should be discarded.

To configure the sensor to accept the start/stop command digital input 1 must be set to Average/Hold (Figure 1) using Hydro-Com/Hydro-View.

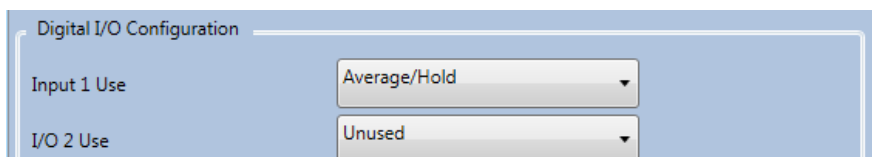


Figure 1: Average Hold

2 Average/Hold Delay

On the initiation of the material flow it will take a brief period of time for the material to reach the sensor and for the flow to stabilise, this period of time must not be included in the averaging of the material. If the averaging is started too soon the calculation will include unrepresentative values. To eliminate the irrelevant data from the averaging the sensor can be configured to delay the start of the calculation, this is called Average/Hold Delay. To calculate the length of delay required a Raw Unscaled log of the sensor should be performed using Hydro-Com/Hydro-View.

The following graph (Figure 2) shows a simplified log of a batch of sand. It can be seen that the signal is not stable until 1.5 seconds after the bin gate is opened. In this case the Average/Hold should be set to a minimum of 1.5 seconds. With the Average/Hold set to 1.5 seconds the total averaging time will be 8 seconds.

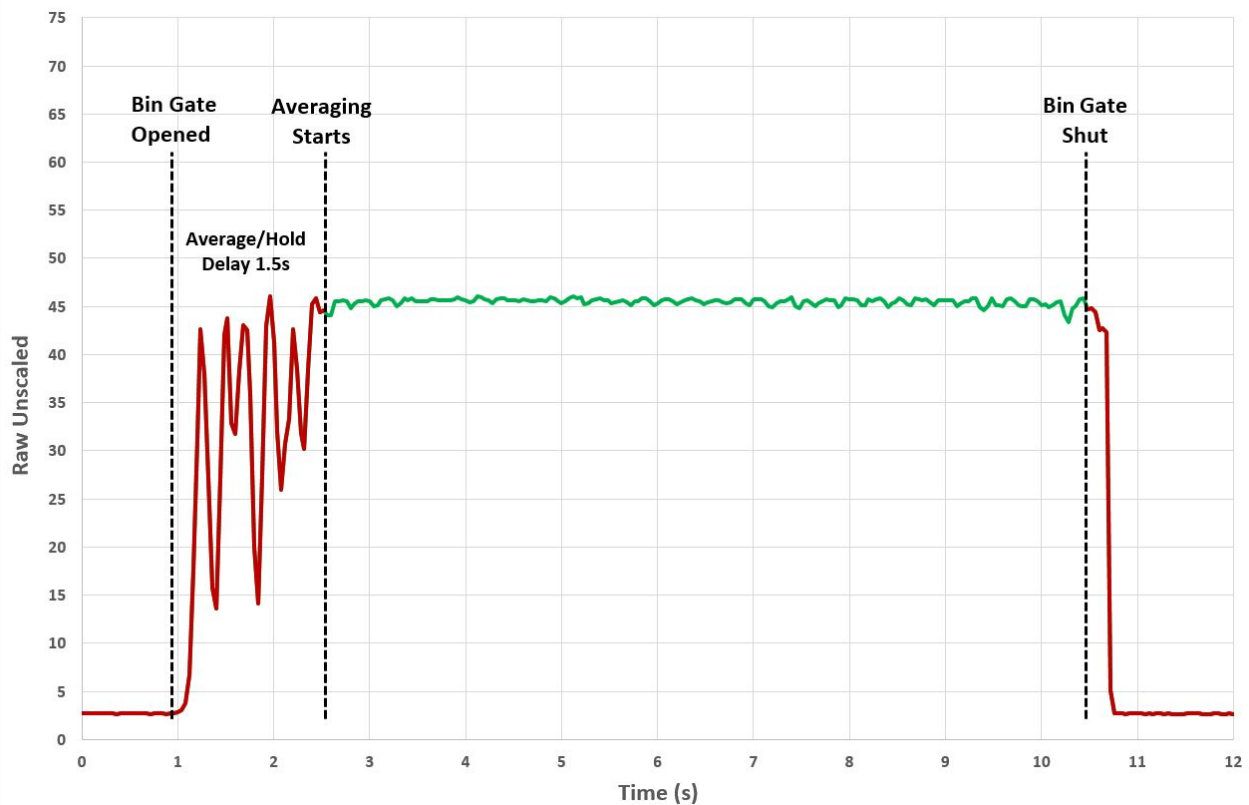


Figure 2: Calculate the Average/Hold Delay

The average/hold delay can be configured as required for the specific installation using Hydro-Com/Hydro-View (Figure 3).

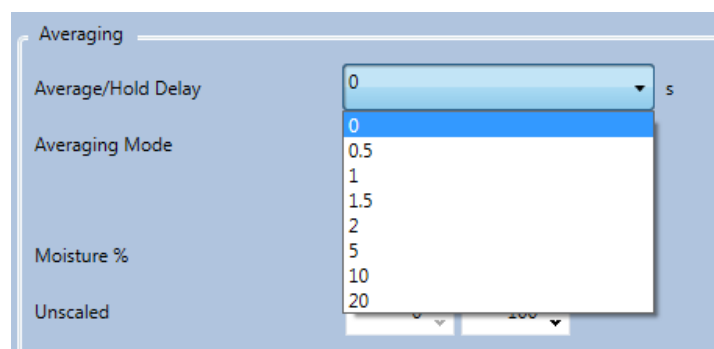


Figure 3: Hydro-Com Average/Hold Delay

With the sensor correctly configured the averaging will start when digital input 1 is high (after the Average/Hold delay) and stop once the input is low.

3 Averaging Mode

When averaging flowing material, such as sand, from a silo the discharge time is limited so it is important that as much data is recorded as possible. The sensor will average the reading 25 times a second and at the end of the batch will output the average moisture.

A typical sand batch will flow for roughly 5-10 seconds so it is important that the sensor signal stabilises rapidly, this is why the sensor must be set to average the Raw unfiltered output. The Raw output uses no signal filtering that can delay the sensor response. Filters applied to the signal will create a delay in the signal and this will, as a result, affect the amount of time available to average.

In the following graph (Figure 5) the Raw Moisture % and Filtered Moisture % have been recorded. It can be seen that the Raw Moisture % (Blue) responds to the material flow immediately and drops off rapidly once the bin gate is shut. However, when signal filtering is applied (Red), to smooth the signal, the moisture value increases slowly after the gate is opened and decreases slowly after the gate has shut. The filtering will reduce the amount of time the signal can be averaged.

If the batching period is very short the signal will not have the time to stabilise before the bin gate is closed so averaging will not be possible.

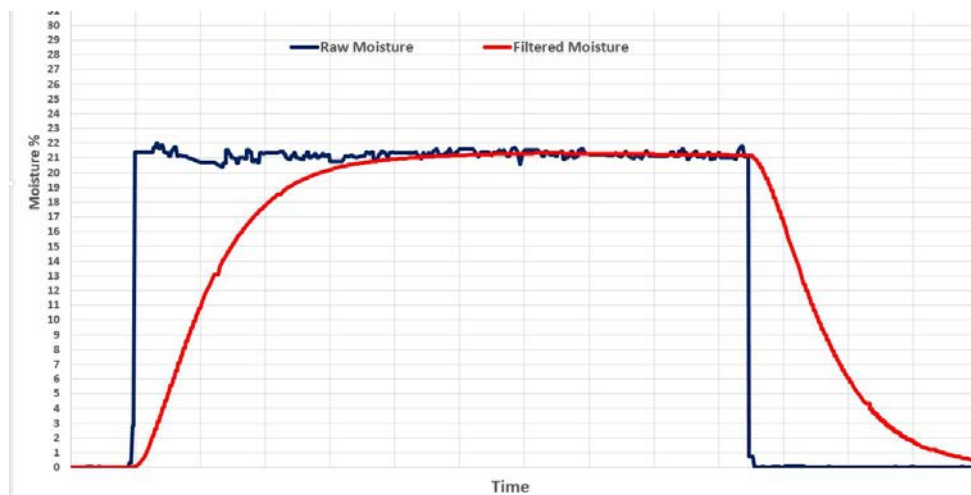


Figure 4: RAW vs Filtered

Excessive filtering, applied to the Raw Moisture, will result in the sensor signal never reaching a stable value before the material flow is ceased (Figure 6). Averaging the Filtered Moisture in this case would be completely unreliable.

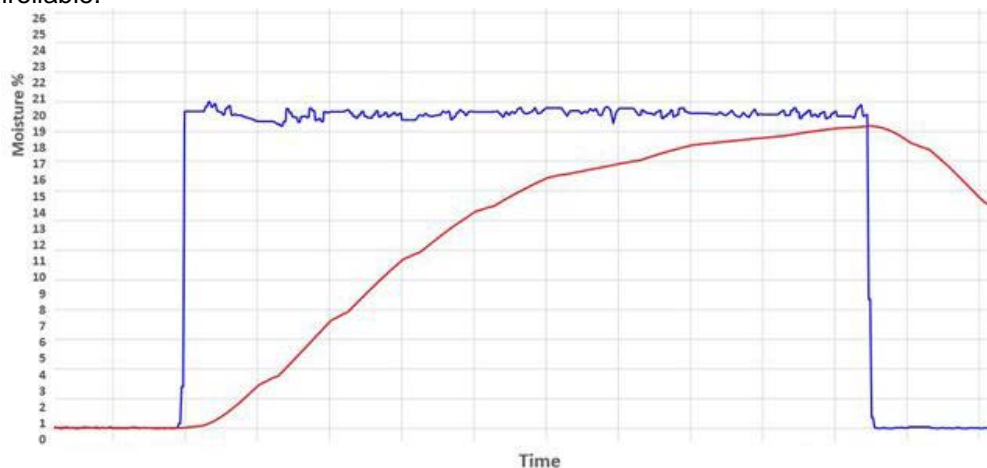


Figure 5: Increased Filtering

In the following graph (Figure 6) the averaging has been applied to both the Raw and Filtered Moisture sensor values. In this example the gate is opened and the averaging starts after a 1 second Average/Hold delay and continues until the bin gate is shut. When averaging the Raw Moisture% the averaging is only performed when the signal is stable and this produces a value of 21.2%. If the averaging is performed on the Filtered signal the averaging starts before the signal is stable and as a result the final Average moisture value is 20.17%, an error of over 1% moisture.

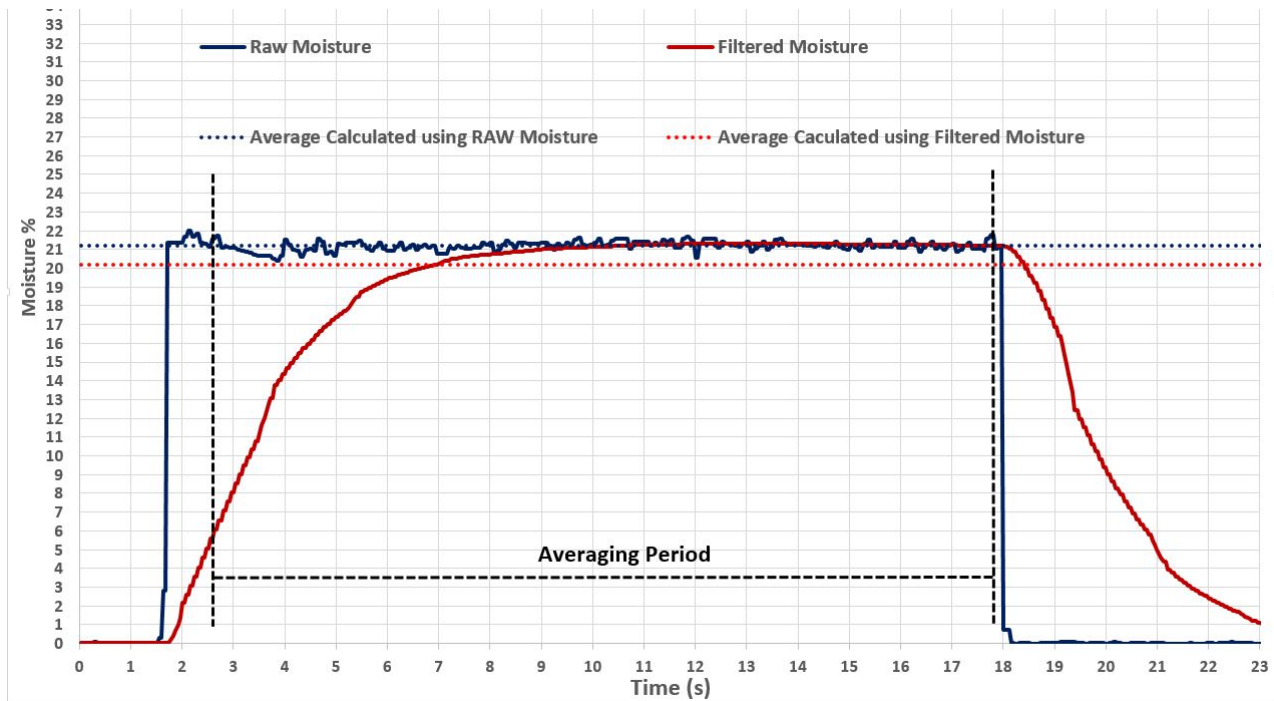


Figure 6: Calculated Average

The Averaging Mode for the sensor is configured in the Averaging section of Hydro-Com/Hydro-View (Figure 4).

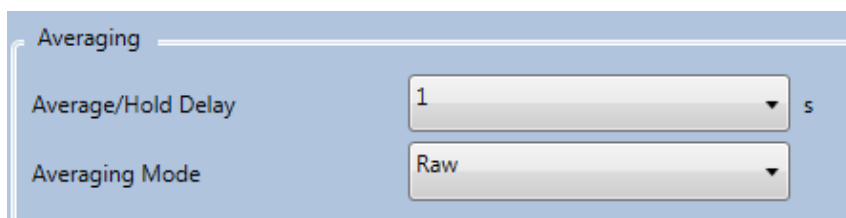


Figure 7: Hydro-Com Averaging Mode