The case for precision in online moisture measurement for the wood pellet manufacturing process

Made to measure

Moisture measurement in the production process of wood pellets for bioenergy is an important parameter for a number of reasons. Firstly, it allows for the production process to be optimised through energy saving during the drying stage, and by reducing waste. Secondly, knowing the right moisture content at each step avoids damage to production equipment (presses) and stablises the entire production process.

The right moisture content of the end product is obviously important for product transportability as well as for pellet quality (burning efficiency). Moisture measurement is prescribed in various norms (i.e. EN 14961-2). Online moisture measurement is recommended for process control.

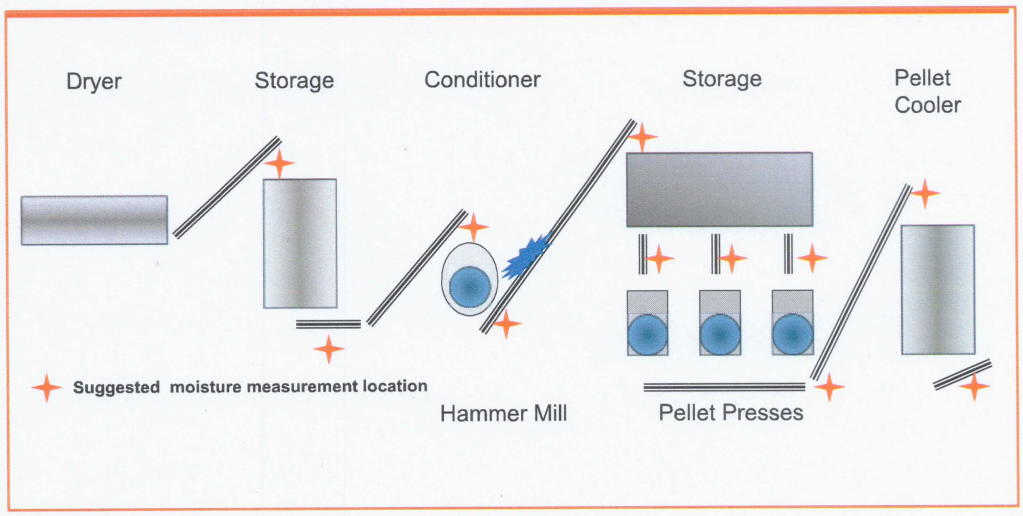


Figure 1: + = typical moisture measurement points in pellet production process

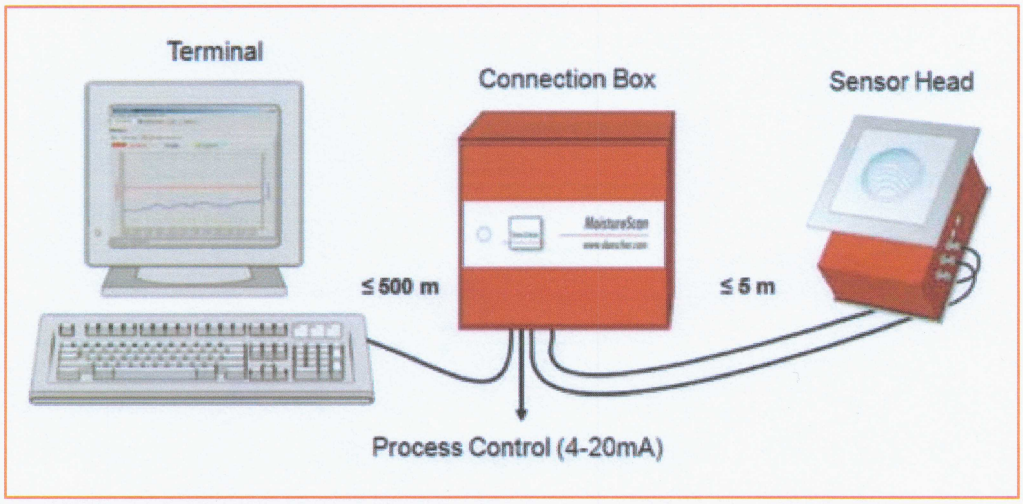
As a general rule online moisture measurement is best achieved in homogenous product flow conditions. There are many factors which can degrade homogeneity, including excessive dryer speed variations, particle size mix and variation, and short storage dwell times. The more homogenous the product the more accurately moisture will be measured.

Some of the best and most meaningful moisture measurement locations in the production process are indicated in the below general process flow diagram (figure 1).

Conventional moisture measurement technologies

Traditionally, one of three methods is employed to

2-PMR moisture sensors installed in chain conveyors downstream of dryer



Typical 2-PMR moisture measurement system configuration

measure moisture online: near-infrared, microwave, or capacitance. Their respective pluses and minuses are summerised as follows:

- Capacitance: product functions as the dielectric of a capacitor. The measurement accuracy is thus sensitive to variations in temperature, conductivity (salt content) and density.
- Near-infrared: measures the reflection of near-infrared light off the product surface. It is a non-contact measurement. However, moisture is measured primarily on the surface and not through the entire core. The accuracy is influenced by colour, surface structure and product surface contamination.
- Single-parameter microwaves: sets water molecules – contained inside the product sample – into oscillations. Electro-magnetic field energy loss is measured and becomes a proxy for water content. The accuracy is dependent on product temperature as well as product density.

> Moisture control optimises the wood pellet production process by saving energy

Further development in measurement technology

A 2-Parameter Microwave Resonance (2-PMR) method (as opposed to the above mentioned single-parameter method) was introduced in order to eliminate or reduce the negative influences of temperature and density variations. The 2-PMR technology works as follows: water molecules (inside the product) are dipoles and thus follow polarity changes of an applied alternating electro-magnetic field. These polarity changes require energy, which is drawn from the electromagnetic field. This loss of energy, which depends on the number of water molecules, is detected. Furthermore, variations in density (via product compression or differing product material densities) lead to changes in the propagation speed of the electromagnetic waves. This change in propagation speed is also detected and compensated for. The 2-PMR measuring technique allows for the determination of the moisture content of materials independent of their density.

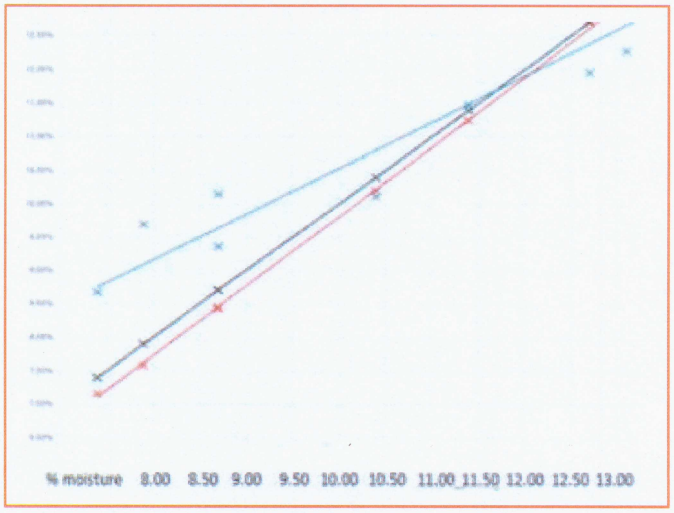


Figure 2 - Legend: all straight lines: average values — black: reference method/blue: near infrared/red: 2-PMR microwave/ X X X = actual measurements/vertical: gauge readings

A practical example

A US-based wood pellet manufacturer with focus on the export pellet market experienced unreliable readings in their moisture values during their production process. Their existing online moisture measurement method (NIR = near infrared) was tested against the above described 2-Parameter Microwave Resonance technology (2-PMR). The 2-PMR method proved to measure tighter (= less scatter) and with better precision across the entire moisture range. A summary of the results can be viewed in figure 2.

Installation and system configuration

2-PMR moisture meters are installed in chutes, chain conveyors, screw conveyors, silos and similar, typically at angled surfaces to ensure a constant product flow covering the entire sensor surface.

In summary

Moisture control optimises the wood pellet production process by saving energy. Live moisture values also protect production equipment and avoid waste. The 2-Parameter Microwave Resonance technology applied to on-line measurement in wood pellet manufacturing is a proven method for increased reliability in moisture control. As a key feature to ensure accuracy it is able to compensate for density variations. Moisture of up to approximately 20% can be detected with a precision comparable to drying ovens. With a measurement rate of up to 600+Hz, moisture values are available without the delays involved in laboratory settings.

For more information:
This article was written by Claus Huebel, North America representative at Doescher Microwave Systems.
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