Feature

Making the most out of moisture measurement

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In the pulp and paper industry, measuring and controlling moisture content can impact product quality, production throughput, and processing efficiency, as well as the purchase price of wood chips, pulp, and converted paper products, not to mention shipping costs.

As paper is made from pulp wood fibers that are boiled, bleached, strained, flattened, dried into continuous webs, and then converted into various paper products, measuring and controlling moisture content is critical every step of the way. Whether producing air dry pulp, roll pulp or converting to newsprint, magazines, books, boxes, bags, labels or packaging materials, measuring precise moisture levels is essential.

A pulp or paper product's quality, drying efficiency, as well as transactions based on weight, can be adversely affected by improper moisture content. Furthermore, the satisfaction of strict international specifications can be a determining factor influencing a mill or converter to measure moisture content.

Until recently, conducting frequent moisture content tests throughout the process or in the field has been difficult. In many cases, the primary barrier has been the expertise and time required to conduct such tests. Often, sophisticated moisture measurement devices must be operated by trained personnel that can properly calibrate the equipment. Many also require meticulous sample preparation and disposal.

Fortunately, handheld devices are now available that allow even less-skilled personnel to take lab-quality moisture measurements. These "point-and-measure" options allow moisture readings to be quickly taken at any stage of the process, as well as at loading docks, on trucks, at suppliers, or in bins, vats or vessels.

By simplifying the process, pulp and paper producers and converters can increase the quality of their products from wood chip receipt and pulping to end product conversion and distribution.

The Many Benefits of Moisture Readings

Although the reasons for measuring the moisture content of pulp and paper products can vary, the primary motivation is to improve quality and the bottom line. As such, monitoring and controlling moisture content in all stages of production ensures the most efficient processing and resource use, while increasing the customer's satisfaction with the product.

In pulp milling, if there is too much water in wood chips, it can affect physical and chemical processing into wood pulp. If too much water is in paper pulp during a process, the paper can fall apart so measuring and achieving the correct moisture content is critical.

In terms of quality control, there are strict international specifications required for pulp by the paper industry. Failing to meet required standards can result in rejected product or even fines by customers and clients. Air dry pulp, for instance, which is usually delivered as sheeted bales, leaves about 10 per cent moisture in the pulp to minimize fiber to fiber bonding, while easing pulp dispersal in water for processing into paper. Roll pulp is typically dried to five-to-six per cent moisture content for easier processing.

To optimize quality and processing, it is also important to analyze continuous paper webs for wet streaks and uneven drying. Since all of a paper product's physical properties such as curl, porosity, permeability, opacity, smoothness, roughness, stiffness, breaking strength, compression strength, and tear resistance also depend on measuring and controlling moisture content, this is crucial. Other conversion processes such as calendering and printing also depend on working with the materials at specified levels of moisture.

While drying has been reported to account for 12-20 per cent of industrial energy consumption, drying processes can be particularly energy-intensive operations in the pulp and paper processing industries. As such, measuring moisture content in batch or continuous drying processes can help to optimize the process and significantly reduce energy costs.

Finally, since moisture content contributes significantly to the weight of pulp and paper, properly drying a product to acceptable limits before it is transported can significantly reduce shipping costs.

Simplifying Moisture Measurement

Although traditional laboratory and online based moisture measurement techniques are useful in the right settings, they have lacked the simplicity and flexibility required for frequent spot checks.

One common test is Loss on Drying, which measures the total material weight change after drying. However, such tests typically require a sample to be prepared and brought back to the lab. The test takes at least 15 minutes to several hours to perform, which is too slow when more immediate measurements are required. It also requires the sample to be altered or destroyed.

The other common test is a Karl Fischer (KF) test. This procedure calls for chemical reagents to be added to the sample to separate the water from the remaining product and is normally used on liquid samples. The water removed is then compared with the initial mass or volume. Samples are generally small, making the assumption that a large batch is homogenous. Also, since the chemical reagents need to be used, skilled personnel are required to determine the initial parameters, confirm that the system is properly calibrated and maintained and, at times, required to actually conduct the tests. Disposal of the reagents and waste can be subject to substantial documentation and costly handling.

As a result, secondary test methods have typically been used to deliver faster results. This type of test uses an indirect method and a single conversion to achieve accurate results. Secondary measurement techniques are routinely accepted as equal to the gold standard method. Examples are speedometers, common infrared and liquid thermometers and most pressure gauges. If there is a disadvantage, it is that the instrument must first be calibrated to ensure accurate results. In some cases, calibration could only be performed by trained staff familiar with the equipment.

In response, industry innovators have developed a simplified approach that allows even less-trained personnel to take portable, instant moisture reading spot checks of pulp and paper industry inputs, in-process conditions, or finished products as needed. This can be used for measuring wood chips and incoming fiber before the "value-add" of the mill begins. It can include checking pulp sheets before pulp mill processing, analyzing the web for wet streaks and uneven drying before or after dryer cans, inspecting incoming roll stock before conversion, and of course at end product quality checks.

The approach involves moisture meters that utilize Near-Infrared

(NIR) light, a highly accurate, non-contact, secondary measurement method that can deliver immediate, laboratory quality moisture readings.

“NIR moisture meters allow very accurate instant measurement of solids, pastes, slurries, and liquids without contact or sample preparation, so there is no contamination in handheld and online models,” says John Bogart, Managing Director of Kett USA, a manufacturer of a full range of moisture and organic composition analyzers. “Once the meter has been calibrated against the lab or production standard, the calibration is stored in the device so no calibration is required in the field. Measurements are fully traceable to the original measurement method.”

In addition, because the process is non-destructive, samples remain unaltered so they can be used for additional tests or put back into the product stream.

“NIR moisture meters follow the principle that water absorbs certain wavelengths of light,” says Bogart. “The meter reflects light off the sample, measures how much light has been absorbed, and the result is automatically converted into a moisture content reading.”

Unlike complex laboratory equipment, portable NIR equipment is designed for ease of use. For example, with Kett’s KJT130 Handheld Portable Instant Moisture Meter, the user simply points the instrument at the product and the moisture content is instantly shown on a digital display, with results accurate to 0.01 per cent in a 0-100 per cent measurement range.

Because no direct contact or sample alteration is required, particle size variation and unusual textures are not an issue. This can be important when used with a range of inputs, processes, or end products in different settings.

For ease of use, the unit is operated via user friendly menu commands. The unit, which is the size of a camcorder, is designed for frequent spot checks wherever necessary, on both stationary and moving (process line) products. Moisture measurement data may be stored in the instrument, downloaded continuously, or manually recorded.

“The goal is for any staff member to be able to successfully use the moisture meter wherever it is needed, with minimal required training,” says Bogart. “This allows pulp and paper industry processors and converters to have the certainty that what they are producing is of the highest quality.

The same technology is also available for online/inline systems that allow instant, moisture measurement on pulp and paper production lines. Such continuous monitoring can help to eliminate costly batch waste and provide superior data to optimize the process. Instant desktop options are available as well for settings where producers want to remove a sample, test it, and then replace it.

“The key is to cost-effectively conduct as much testing as required, with full confidence in the results, each and every time,” says Bogart.

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