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Simplifying Moisture Measurement to Optimize Chemical Qualit...

Description

In the chemical industry, measuring and controlling moisture content can impact product quality, production throughput, and processing efficiency, as well as the purchase price of feedstock and shipping costs.

Whether converting feedstock into products such as synthetic rubber, plastics, polymers, pigments, resins, salts, acids, additives, fertilizers, cleaners, cosmetics, or pharmaceuticals, the amount of moisture in the deliverables can have a wide range of effects.

A chemical compound or final product's quality, drying efficiency, as well as transactions based on weight, can be adversely affected by improper moisture contents. Furthermore, the satisfaction of legal requirements can be a determining factor influencing a company to measure moisture content, which can impact effectiveness.

However, 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, chemical producers can increase the quality of their products from feedstock receipt, formulation, and processing to end product manufacturing and distribution.

The Many Benefits of Moisture Readings

Although the reasons for measuring the moisture content of chemical products can vary, the primary motivation is to improve quality and the bottom line.

Monitoring and controlling moisture content in all stages of production ensures the most efficient processing, and can increase the customer's satisfaction with the product. From measurement of incoming feed materials to mid- process measurement, the optimization of product quality and plant resources will be ensured.

Substance interaction can be affected by the presence of moisture. For example, if the moisture content in paint is too high, the adhesion and drying principles of the product will be adversely affected, causing cracking to occur after it dries. If the moisture level is insufficient, premature drying will occur.

Establishing the moisture content is also very important when mixing two substances together. If the mixing is not done at the proper moisture levels, the way the two products react can be affected. This includes chemical reactions that take place, the way the two are blended together, or the amount one substance is able to be dissolved into another.

It is also important to know the precise moisture content in any feedstock prior to beginning the manufacturing process. Otherwise, its time in the dryer, the dryer temperature, the conveyor belt speed, and many other factors must be modified each time a new shipment is introduced.

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

Another benefit of frequent moisture measurement is for chemical products sold based on regulated moisture content, which could affect product effectiveness. Prescribed percentages must be met in order to comply with these specifications. In certain industries, heavy fines could be levied, while in others, the product or substance will not be accepted by the regulating agency. These industries can include pharmaceutical, agrochemical, and consumer products, among others.

There may even be legal ramifications, if the acceptable moisture content of a product is decided prior to purchase or shipping. Fees can be levied on companies that do not ship at the agreed moisture level or the product could be rejected outright.

Finally, since moisture content contributes significantly to the weight of such materials, properly drying a substance to acceptable limits before it is transported can dramatically reduce shipping and disposal 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. 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 readings of chemical industry feedstock, in-process formulations, or end products as needed.

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, and liquids without contact or sample preparation, so there is no contamination in handheld and online models," says John Bogart, Managing Director of Kett US, 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 .01% in a 0-100% 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 feedstocks, formulations, 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 chemical industry processors to have the certainty that what they are producing is of the highest quality.

"The key is to cost-effectively be able to conduct as much testing as required, with full confidence in the results, each and every time," adds Bogart.

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