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Accelerate product development testing
by digitalizing formulator knowledge



Elastomer testing industry

Compression stress relaxation testing:
Considerations in an era of ISO 17025 proficiency testing

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As an immediate, real time alternative, NIR moisture meters are the simplest and most economical type of filter-based device. Often, NIR moisture meters are used to inspect incoming raw materials. However, the meters can be used anywhere in the production process where achieving a specific moisture content is important. With the devices, reflected light is filtered to a narrow portion of the near-infrared light spectrum, usually at only one or two wavelengths.

Often, bulk polymerization as a process does not require much more than a moisture meter for testing, since the reaction proceeds without a solvent, diluent, etc. However, moisture meters can be utilized with more complex forms of polymer where the client may want to measure moisture anyway.

Bogart relates an example of a polymer manufacturer that uses an NIR moisture meter to successfully produce pellets for a medical device company. The medical device company creates products that are inserted into the body. For this application, the polymer manufacturer needs to have extremely low moisture in the pellets before using an injection mold to create the part. If the moisture level rises above a certain amount, the mold process does not work well, which increases the part failure risk.

“The polymer pellets must be precisely made and properly packaged with very little moisture; and the samples cannot be destroyed during verification,” says Bogart. “So, the manufacturer uses NIR moisture metering to cost-effectively ensure that 100% of polymer pellets safely meet the required criteria.”

Composition analyzers

Among filter-based devices, NIR composition analyzers are a step up in measuring capability, and usually can simultaneously measure a few different chemical components in the polymer, while being limited to about 6-7 wavelengths of light. In addition to moisture, the devices may also be used to measure residual oils or solvents, which can cause contamination issues if not detected and removed.

In the polymer industry, solution polymerization, which is conducted with an inert solvent and initiator, may find an NIR composition analyzer helpful for monitoring and adjusting the process.

Bogart points to another common use of such a device. “The industry often uses recycled plastic as a raw input, but does not always know where it originates. So, manufacturers may want to measure total oil and solvent, in addition to moisture, since any residual contaminants can disrupt the process and even cause a plant malfunction,” he says.

A third traditional use of this type of device is to measure coating thickness or film thickness. Both desktop and real time online process measurements can be provided in many cases. Generally, the price point of the NIR composition analyzer is substantially lower than alternative technologies.

Because polymers are so widely used in a variety of industries, Bogart notes that composition analyzers are often used

not only on incoming materials, but also on in-process materials, final products, and even on external product failures and returns to help determine the cause of the problem.

Full spectrum testing

In contrast to filter-based devices, NIR full spectrum devices may measure 500+ wavelengths to determine if certain substances or materials meet a wide range of criteria.

With full spectrum testing, the widest number of targeted factors can be measured in real time, once the device is specifically calibrated for their detection. In addition to moisture, for example, polymer manufacturers may often measure density, viscosity, melt flow rate (MFR) and functional groups.

Such testing is commonly utilized during emulsion polymerization, which is used to produce latexes and synthetic polymer colloids for paint, coating, rubber, binder and adhesive applications.

The testing is also helpful for successfully carrying out suspension polymerization processes, which are often used to produce polymer beads. Such processes generally involve an initiator and comonomers, with the final polymers suspended in an aqueous phase containing additives and residual monomer.

“For quality control, manufacturers may need to monitor many chemical reactions during the polymerization process to bring it to the desired endpoint,” says Bogart. “For instance, several different chemicals may cause a chemical reaction that transforms them into a blended product. In such cases, manufacturers can optimize the quality and speed of their process with NIR full spectrum testing to ensure that everything produced is a completely finished product with no residual chemicals left over.”

Traditional direct measurements of these parameters can take up to 24 to 48 hours for results. The tests are very complicated, since various substances must be broken down into their underlying chemical compositions. The tests require meticulous set-up and conducting to avoid errors. Other tests, such as viscosity and functional groups, may be carried out, as well, with each test requiring additional time and staff members.

In contrast, full spectrum NIR testing is instant and can produce results in real time without relying on laborious, error prone techniques. Such real time monitoring of the polymerization process can give the manufacturer the ability to make immediate adjustments to optimize the process, if necessary, when the process is starting to drift. This can result in dramatic improvements in batch-to-batch quality and consistency, as well as overall product yields and energy usage.

While polymer manufacturers are more familiar with traditional methods, for those concerned not only with quality, but also profitability, selecting the NIR approach that works best for the application, whether moisture meter, composition analyzer or full spectrum tester, can have a major impact on the bottom line. For more info, contact Kett U.S.: (800) 438-5388; email support@kett.com; or visit www.kett.com.