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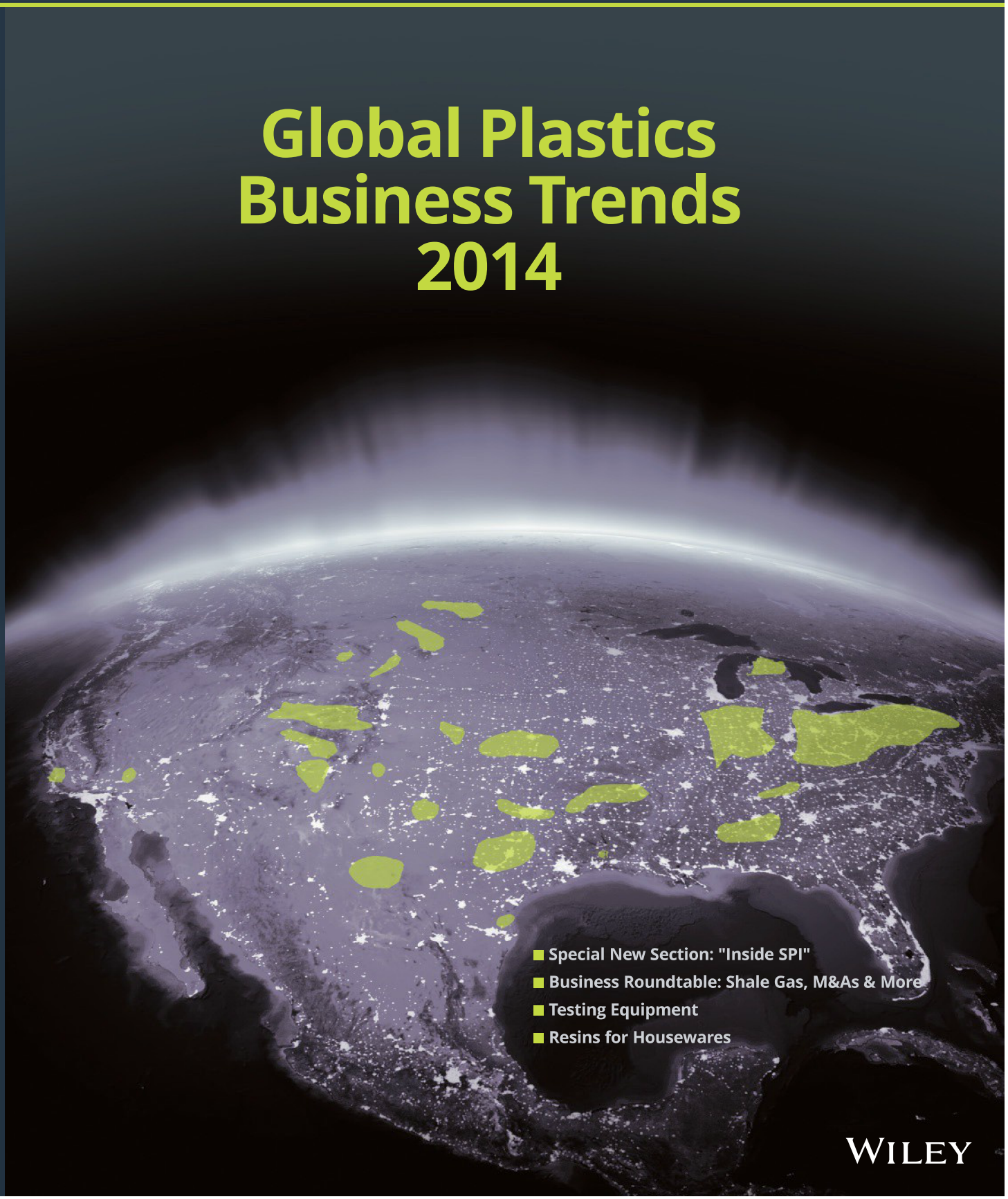

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User-Focused Testing

Plastics testing systems are becoming more automated, easier to use, and "solutions-oriented"

By Mike Verespej

A dramatic change is occurring in test equipment as manufacturers respond to the changing needs of plastics processors, compounders, resin manufacturers, and companies that use plastics and composite parts in their products.

In short, test equipment is becoming more user-focused, more automated, easier to use, and solutions-oriented—not just by providing data, but by interpreting results—all in response to more complex polymers, more composites materials, and fewer skilled technicians.

"New complex polyolefins are becoming standard in the market," creating a need for closer scrutiny and control to prevent losses from off-grade material, particularly since throughput capacity both of processing lines and of reactors has "grown significantly in the past few years," says Benjamin Monrabal, director of R&D and founder of Polymer Characterization, S.A. (Polymer Char) in Valencia, Spain.

Twenty-first-century analysis lab equipment is being redesigned for user-friendliness (photo courtesy of Polymer Char).

In addition, the lack of trained technicians means that "companies have to provide whole solutions, not just equipment, because a lot of the people using the equipment no longer have the background and education to analyze the data," says Kevin Menard, senior product specialist in thermal analysis for PerkinElmer Inc. in Waltham, Massachusetts, USA.

"In the past, the average user used to have a bachelor's of science degree and was often overseen by someone with a Ph.D.," he says. "But now it is more likely that the technician is someone with a high school education, so they don't have the skills they used to have."

Monrabal agrees. "There is a younger workforce with less skilled people than probably ten years ago." In addition, he says, "technicians have less time to understand the analytical process and want the results in a faster, more practical manner. Companies want test equipment that will solve the problem and provide the results in the most straightforward and transparent way."

Plus, "It is now expected that the equipment will do that work without any additional interpretation, and do it in the most efficient way without losing time," he says. "We have built our instrumentation around these expectations so that the machine gives you the answer, and lab technicians don't have to put so much effort into interpreting the results."

User-Friendliness

A case in point: the Crystex® QC instrument that Polymer Char introduced earlier in 2013 to help companies measure the amount of xylene solubles (the amorphous fraction) in polypropylene.

"You put a sample in a bottle, place it in an instrument, lower a handle to pierce the bottle with a needle that will inject the solvent, and push a button to start," says Monrabal. "It

Polymer Char's Crystex QC instrument reportedly helps users measure the the amorphous fraction of polypropylene quickly and without the need to handle solvents at high temperatures.

is a lot simpler, there is less handling of materials and solvents, and you get your answer in about two hours," as opposed to the typical six hours it takes using traditional gravimetric or wet chemistry methods.

In addition, Crystex eliminates the need to handle solvents at high temperatures, the need for weighing, and the need for external filtration or extraction devices. "It completely automates steps that previously were done manually." He said Polymer Char is developing similar type QC test equipment for intrinsic viscosity—which it expects to introduce soon—and also for molar mass and composition analysis.

That drive to develop equipment that provides solutions and is easier to use is also reflected in recent new products from testing companies such as PerkinElmer, Zwick USA, Dynisco Instruments, and Netzsch Instruments N.A.

At K 2013, Dynisco added to its LMI series the company's proprietary LaVA (Laboratory Viscosity Analyis) software that captures melt flow indexes, shear stress, shear rate, viscosity, and apparent melt density.

Netzsch's DSC 214 Polyma reportedly can achieve heating and cooling rates that are far closer to real processing conditions than other DSCs.

Dynisco says its LMI series records melt flow indexes, shear stress, shear rate, viscosity, and apparent melt density while simplifying the steps for testing and set-up.

"The LMI is Dynisco's approach to reinventing one of the most common pieces of equipment in any polymer lab," says Joe D'Orio, product manager. "We migrated from a vacuum fluorescent display to a backlit color touch screen that is larger, more functional, [and] easier to program and to read, and provides a direct printout of results for users," he adds.

"And with the new weight management system, changing the weight loads is as simple as moving a pin from one slot to the next, similar to what you do in a gym," he says. "You don't have to lift weights anymore or risk dropping them."

Equally as important, a new adjustable force packer option eliminates inconsistency that comes from packing samples manually, D'Orio says. "You get the same shot size packed the same way over and over again," as it provides a constant force regardless of who the operator may be. In addition, "We have taken and redesigned the software package from the ground up, making it simpler to use and with more graphics," he says. "You don't need a high-end operator, because it tells you when to do everything."

"The new LMI with the software package will provide you more consistent data and simplify the processing steps for testing and set-up," he says. "A lab manager can set up the machine and lock things in so the parameters can't be

changed. That minimizes the variability and the input prior to testing, and makes it easier to generate reports. You get a lot of flexibility and proof of validity."

Testing Processing

Other test equipment innovations are aimed at helping companies better simulate operating conditions.

For example, PerkinElmer's double-furnace differential scanning calorimeter, DSC 8500, with HyperDSC technology, reportedly permits rapid controlled heating at 750°C/min and ballistic cooling at 2100°C/min. "That allows companies to mimic what happens in real processes and know what the material will do when it comes out of an extruder," says Menard about the product, which was introduced in 2010. "It shortens test times, reduces the analysis time to less than three minutes, and doesn't require the operator to have much scientific background to analyze the results."

Similarly, Netzsch president Gilles Widawski calls the company's just-introduced compact desktop differential scanning calorimetry for polymer characterization "a revolution in DSC."

"We redesigned it to create the best optimization between the pan/crucible, the sample and the sensor, and so it could do more tests, be faster, and be easier to use," says Widawski about the DSC 214 Polyma, introduced in October at testXpo in Germany. "All other instruments that do this neglect the speed of the process, the heating rate and the cooling rate, and all of that has an impact on the performance of the polymer in both injection molding and extrusion," he says.

Rapid heating and cooling reportedly allows PerkinElmer's double-furnace DSC 8500 "to mimic what happens in real processes."

Specifically, the DSC 214 Polyma can achieve heating and cooling rates of up to 500K/min—which are far closer to real processing conditions than the cooling rates of 10 or 20 K/min of the common heat-flux DSC. "You can go all the way from sample preparation to final analysis with this, and it can be used with any kind of computer, tablet, or iPad," he says. "It enables a company to make a measurement and know in a few seconds what the material is without having to compare it to information in libraries or databases," adds Widawski.

"It is more powerful, more sensitive, has more processing capacity, [and] can do more tests in one day, and the technician does not need to stay by the machine—whether it is in the factory or in a lab. The instrument does the evaluation and technicians look at the data from a desk or from a hand-held device."

"A lot of the changes are on the user interface because there is a need to have that work in a simple way," says Widawski. "This is an industry trend. It offers simplicity, flexibility, and mobility with the equipment. This is completely market-driven. The functionality is being driven by plastic processors."

Ultrasonic Imaging

Mobility is also one of the advantages of the two-year-old AcoustoCam ultrasonic imaging camera from Imperium Inc. that allows companies to assess how well composite materials have bonded and to check potential internal damage to such parts.

"Anytime you bond two things together, or have damage in a sophisticated composite material, you have to be able to see inside," says Bob Lasser, owner and co-founder of the company in Maryland, USA. AcoustoCam gives companies "a real-time window" to inspect potential problems and also permits Imperium to perform remote diagnostic work for its customers. He said automotive, aerospace, and transportation companies use the cameras for service work and to inspect composite parts used in production.

"There is a lack of trained technicians, so the key is to make test equipment simple to use," he says. "Our device is like an ultrasonic camcorder, so the training is minimal, maybe a day or two."

User-Focused Testing

Composites Analysis

The increasing number of composites used overall, particularly fiber-reinforced composites, has spurred the development of equipment to analyze those types of materials. Zwick/Roell AG, for example, introduced its Allround-Line system for composites in 2012 which has 13 different fixtures and is capable of performing more than 20 different tests—including compression, tensile, and shear tests—on a single platform, enhancing lab throughput and providing greater efficiency.

Then this past October the company incorporated its testControl II measurement and control electronics into its zwickiLine systems that make measurements of carbon fibers used to make composites, and its ProLine systems that are designed to conduct functional tests on component parts. The added electronics and software gives users a high data transfer rate that provides benefits when doing rapid testing, and permits companies to perform testing independently of a PC, either directly from a display-equipped remote control or the user interface of the software.

Zwick/Roell systems come in a range of options for testing multiple mechanical properties of composites and related materials.

"We have developed a lot of new test equipment, fixtures and grips for the composite industry," says Florian Liebert, plastics industry manager for Zwick USA, Kennesaw, Georgia, USA. Both the automotive and aerospace industries are looking for stronger, lighter-weight materials such as advanced composites and carbon fibers. Liebert says the automotive industry is using the equipment for research and development and for production control, while aerospace is using it more for quality control.

"With all the new equipment, automation is a big part," he says. "Companies want to automate tests, have shorter test sequences and save money on the employee side. They also want to decrease the operator influence and reduce the potential for operator error." For example, its new x-flow series of plastometers that measure flow properties of thermoplastics used in extrusion offer "new electronics, improved temperature variability and improved handling of materials," says Liebert.

"Whether they are resin producers or plastics processors, companies have less time to make the test, and it is more difficult to get qualified operators, both here in the USA and in Europe," says Liebert. "So the important thing is to have simple test software that is not difficult for people to use."

"Hyphenated" Techniques

The other big push has been to develop equipment where two testing techniques are combined, such as pairing a thermogravimetric analyzer with gas chromatography mass spectrometry (TG-GC/S), says PerkinElmer's Menard. "That hypnenated technique lets you burn something and see what comes off" so a company can assess if any chemicals, for example, are leaching into food packaging, he says.

Polymer Char's Monrabal agrees. "It is not surprising that test instruments have evolved with the incorporation of more detectors or even hyphenated techniques. Just one example: the incorporation of infrared detection into gel permeation chromatography to provide a two-dimensional view—molar mass and composition—of new complex materials."

But beyond what companies need test equipment to be able to measure, the overriding theme today is simplicity, he says. "The software built into our instruments constantly monitors the system's running, automatically detects any malfunctions, and even allows us to do remote diagnostics for customers," says Monrabal. "The design of the equipment needs to adapt to the needs of the users... so that it requires less time and physical effort from the analyst [and provides] an analysis that [is] not only easier to perform, but more powerful in the results it delivers," he adds.