NEW ASTM International Committee F40 on Declarable Substances

BY TIM McGRADY

ASTM International Committee F40 on Declarable Substances in Materials was organized on Jan. 13 by an international group representing manufacturers of appliances, medical devices, toys, electrical and power products, electronic goods, chemicals and materials, lighting equipment, analytical instruments, and parts and component suppliers to finished-good sectors. Other participants include representatives of mining interests, independent laboratories, trade associations, government, and consulting firms.

The new committee's goal is to assist global industry with issues surrounding compliance with legislation involving the regulation of substances in materials. Committee F40 will help make sense out of myriad regulations and will serve as a resource for any interested party to draw upon when material compliance issues arise. But F40 will not dictate courses of action to industry; rather, when industry asks for help, the committee will assist in standards development. Judging by the number of products affected by new regulations, many new standards and modifications to existing standards will be required.

THE GLOBAL REGULATORY ENVIRONMENT

Manufacturers are under increasing pressure from legislators to remove hazardous substances from the materials comprising their products. The most notable legislation has come from the European Union in the form of Directives 2002/95/EC on Restriction of Certain Hazardous Substances in Electrical and Electronic Equipment, 2000/53/EC on End-of-Life Vehicles and 94/62/EC on Packaging and Packaging Waste. Taken together with EU directives such as 76/769/EEC on Restrictions on the Marketing and Use of Certain Dangerous Substances and Preparations, these laws regulate practically every material used to construct every product. This type of legislation has tended to propagate rather quickly, as evidenced by laws and pending legislation in Canada, China, Japan, the United States and other countries.

In a recent documentary aired on the Discovery Times channel, three-time Pulitzer Prize-winning journalist Thomas L. Friedman said that "the EU is now completely revising its rules regarding thousands of potentially dangerous chemicals found in virtually every consumer product imaginable." The same program included an interview with Mike Walls of the American Chemistry Council, who stated that the European Commission will set the rules for "not just chemicals per se, but all the products that are made with chemicals. You can't make a computer chip without chemicals, you can't make a car without chemicals; we're talking about sweeping regulation." Walls further said that "it will increase cost to producers globally, it will increase cost to consumers as a result, and ultimately may have an effect on jobs."

The goals of these legislative efforts are the protection of human health and the environment through waste management and the reduction of hazards via the Sixth Community Environmental Action Program, which targets batteries, packaging, vehicles, and electrical and electronic products as priority hazardous waste streams. The primary means of waste management are prevention and reduction of landfilling through collection, recovery and recycling. Approaches are also aimed at product life-cycle management, which includes the re-engineering of products so they can be more easily and completely reclaimed. The landfilling of manufactured goods at the end of their useful lives is to be considered the absolute last means of dealing with waste.

In order to build the infrastructure necessary to implement collection, recovery, and recycling of prod-

ucts, the EU depends on the principle of "the producer pays," which places the financial cost on the owners of the brand names of the finished goods. The brand name owner could be a manufacturer or a non-manufacturing re-brander of a product.

The plan to reduce the hazard potential of products has been focused on eliminating dangerous and hazardous substances from materials to minimize exposure to production workers, consumers, recycling personnel, and the environment. The EU has defined dangerous substances as those that pose a known, imminent threat to human health and/or the environment; hazardous substances are those that may pose a threat to human health and/or the environment, though that threat may not be immediate. Recent materials regulations have cited mercury, cadmium, lead, hexavalent chromium, polybrominated biphenyls, and polybrominated diphenyl ethers as hazardous substances that need to be removed from consumer goods. Of the latter two, PBBs are no longer manufactured or used in products and PBDEs are used as part of flame retardant systems in various plastic formulations.

Much debate has focused on the excessive costs associated with this sweeping legislation; one charge is that it includes no consideration of cost-benefit analysis. Another concern is that, because not much technical assistance is offered to help industry comply with the regulations, confusion may ensue, causing the administrative and testing costs associated with compliance to multiply geometrically. The Economics Department of the Organization for Economic Coordination and Development has stated that "the effective coordination of environmental policy across sectors requires assessment of the economic effects of environmental policies, to ensure cost minimization."

In a speech to Harvard Medical School about the EU Proposal on the Registration, Evaluation, Authorization and Restriction of Chemicals, now-former EU Commissioner for the Environment Margot Wallström stated, "Industry on both sides of the Atlantic has squealed at the alleged costs of REACH. But I sincerely believe that the benefits to health brought about by REACH will far outweigh the costs." Although this statement was concerned with REACH, it represents a common position the European Union has taken with regard to environmental legislation.

THE SPECIFICS

European Union Directive 2002/95/EC on the Restriction of Certain Hazardous Substances in Electrical and Electronic Equipment (known as RoHS, and pronounced "ross"), was published in the Official Journal of the European Union in February 2003. RoHS restricts the use of cadmium, mercury, lead, hexavalent chromium, PBBs and PBDEs in electrical and electronic equipment, known as EEE, put on the European market after July 1, 2006. Those restrictions are added to existing regulations, such as the 47 categories of dangerous substances restricted for use in nearly every product by EU Directive 76/769/EEC and its numerous amendments. EEE is defined as devices that are dependent on electric current or electromagnetic fields to work properly, including equipment used to generate, transfer, or measure such currents or fields. The definition of EEE for RoHS is limited to those devices operating on a maximum 1,000 volts alternating current or 1,500 volts direct current. The products covered by RoHS are listed in categories 1 through 7 and 10 in Annex IA to Directive 2002/96/EC on Waste Electrical and Electronic Equipment. Those categories are:

1. Large household appliances;
2. Small household appliances;
3. IT and telecommunications equipment;
4. Consumer equipment;
5. Lighting equipment;
6. Electrical and electronic tools (except large-scale stationary and industrial tools);
7. Toys, leisure and sports equipment; and
10. Automatic dispensers.

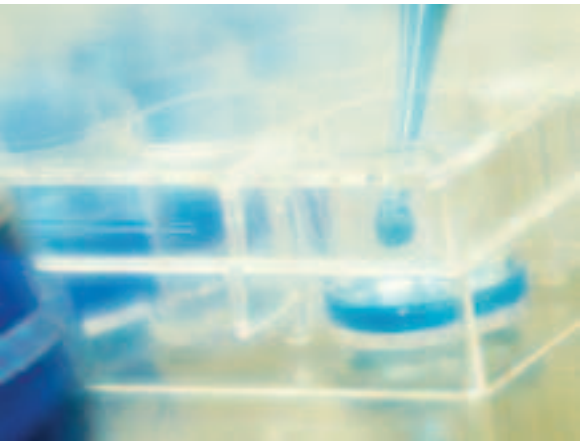
Categories 8 and 9, which cover medical devices and measuring and control instruments, are exempt from RoHS requirements until the European Commission includes them (estimates are that this will occur in 2008 or 2009). There are some exemptions, which are listed in the annex to RoHS; further exemptions are being discussed by the Commission and the Technical Adaptation Committee and may be included in an amendment.

HOMOGENEOUS MATERIALS

In order to more fully grasp the scope of RoHS, an understanding of the term "homogeneous material" is required. The word "homogeneous" is understood as "of uniform composition throughout." Examples of "homogeneous materials" are individual types of plastics, ceramics, glass, metals, alloys, paper, board, resins, and coatings. Further, a "homogeneous material" cannot be mechanically disjointed into different materials. The term "mechanically disjointed" means that the materials can be, in principle, separated by mechanical actions. This means that an insulated wire is considered as two homogeneous mate-

rials: the metal wire and the plastic insulating material. Prior to testing for compliance, the wire would have to be separated into its two materials; each material would then have to be tested separately. In the proposed RoHS amendment, it has been made clear that RoHS compliance is based on homogeneous materials, and not the devices made from those materials. Also established are maximum concentration values, or MCVs, for the six restricted substance categories: 0.1 percent by weight maximum for lead, mercury, hexavalent chromium, PBBs and PBDEs, and 0.01 percent by weight maximum for cadmium.

The definitions and limits above are not in accordance with international standards for several reasons. Individual plating and coating layers



are considered homogeneous materials. Plating and coatings are not typically removed from substrates by mechanical actions, but by chemical means; individual International Organization for Standardization (ISO) standards and standards such as ASTM International's B 767, Guide for Determining Mass Per Unit Area of Electrodeposited and Related Coatings by Gravimetric and Other Chemical Analysis Procedures, offer many methods for the chemical removal of plating and coatings from substrates. In addition, the standard for the determination of hexavalent chromium in coatings is ISO 3613, Chromate conversion coatings on zinc, cadmium, aluminum-zinc alloys and zinc-aluminum alloys – Test methods, which states that the units for measurement of hexavalent chromium are micrograms per square centimeter ($\mu g/cm^2$) and not percent by weight. In fact, because hexavalent chromium conversion coatings are relatively thin (on the order of several hundred nanometers) and because the coating mass changes over time, it is not feasible to determine total coating mass, particularly if mechanical action is required to remove the coating from the substrate. Furthermore, the term "weight" is not in keeping with the International System of Units, which specifies "mass" as the correct term.

A more subtle but critically important issue with RoHS limits is the fact that the method of determining conformance with the MCVs is left unresolved. Per ASTM International's E 29, Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications, there are two equally acceptable methods of evaluating the conformance of test results to specified limits: the rounding and absolute methods. ASTM International's E 29 says that unqualified conformance limits such as 0.1 percent cannot "be regarded as carrying a definite operational meaning" without stating which assessment method is to be used. The reason this is such an important issue is that if the rounding method is used to assess conformity, a different assessment of conformance may be made than if the absolute method were employed.

THE NEED FOR STANDARDS

Laws cannot be enforced nor can compliance be assessed without the proper standards in place. In most manufacturing sectors, typical supply chain practice involves ordering materials and parts to specification. Standard material specifications include all the necessary information about the part or material; it is useful to use such a specification in a purchase order so that the detailed information does not have to be reproduced. This greatly facilitates communication between buyer and seller and allows clear and consistent descriptions of requirements.

Where chemical, physical, structural, or performance criteria are required, standard test methods allow both the buyer and seller to assess whether the material or part is within required parameters, that is, whether the purchase order (contract) was or will be properly satisfied. Certified reference materials are used to validate test methods and to compare results obtained from one or more methods. When coupled with laws, regulations or codes, the system as described above is a basis of legal metrology. This is the basic framework needed by industry to ensure compliance with legislated regulations. Such a framework allows fair competition, facilitates fair trade, and permits execution of legally defensible contracts.

Very few standards have ever been developed in conjunction with legislation on hazardous substance restrictions. Even though the EU directives cover the restriction of substances in materials, conformity assessment tests that would presumably be used to determine product or material compliance are virtually nonexistent. Few certified reference materials exist for use in the validation of test methods or comparison of results (see the article on page XX). Standard material specifications detailing acceptable material compositions are conspicuously absent, though end-product manufacturers have compiled long lists of restricted substances not allowed in materials of construction.

Much superfluous testing is being requested because material declarations sent from original equipment manufacturers to their first-tier suppliers include long lists of restricted items and there is little guidance concerning which substance to test in what material. For example, some suppliers have requested that steel be tested for banned brominated flame retardants; this is unnecessary, because there is practically no risk of those substances being present in steel.

A PRIME OPPORTUNITY

Herein lies a prime opportunity to reduce testing costs associated

with regulatory compliance: there is no need to "prove the negative" by testing materials for substances that cannot be present either as ingredients or as contaminants.

Consider the hypothetical example where peanut butter is restricted for use in stainless steel. The stainless steel producer should be able to assess the ingredients used in the formula, the production process, and the substances used in the production process and conclude, without testing, that peanut butter is not a constituent of the stainless steel. The basis of this conclusion is that peanut butter is not an ingredient in the stainless steel, it is not a process material or chemical, there is no possibility that peanut butter may be produced by reaction of the ingredients, there is no possibility that peanut butter is a contaminant in the ingredients, and peanut butter could not survive the temperatures required to produce the finished product. The producer of the stainless steel should be able to declare that the stainless steel does not contain peanut butter, and this declaration should be acceptable to all further users of that material.

But it is very important to note that only the producer of the stainless steel or experts in the production and composition of stainless steel should make such an assessment, and such an assessment should not be made by or required of users further along the supply chain. This is one example of how ASTM International Committee F40 can help all members of all industries avoid unnecessary costs associated with regulatory compliance.

Industry needs standards well in advance of the effective date of legislation, since typical product change cycles can be 18 months or more. Research and development is needed to replace critical materials, such as tin/lead solder. Retooling is required where the use of alternate materials causes processing parameters to change. Product redesign is often necessary. Administrative costs are high due to the number of parts being reconfigured or renumbered and the amount of paperwork required for demonstrating compliance. Without standards, there is an enormous amount of duplicate effort, particularly in the conformity assessment testing of materials. In the case of RoHS compliance, some key members of industry have unwittingly caused much of this unnecessary testing by placing the burden of compliance on their immediate suppliers.

These parts and components suppliers often do not have much knowledge of the chemical composition of the materials they use, and many of these smaller companies do not have the power to demand compliance information from their materials suppliers, who tend to be large corporations. Caught in the middle between large OEMs and large materials suppliers, these companies seek testing from independent laboratories. Because these suppliers see regulatory compliance as a competitive advantage and because they bear the cost of the testing, they do not share information with other companies within their supply sector. These suppliers represent the largest contingent of companies within the supply chain and these companies also have the largest number of items that must comply with regulations (10,000 part numbers per company is not unusual).

Many parts may be made from one lot of material and those parts may be distributed widely among many companies. Thus, the same lot of material may be tested over and over, perhaps hundreds or thousands of times. It is easy to see why RoHS compliance testing has ballooned to incredible proportions.

But there are ways to alleviate the burden on the parts and components suppliers; instead of placing the primary burden of testing on them, the overall cost to industry would be dramatically lower if testing were done at the raw and manufactured materials level of the supply chains, the results of which could be shared throughout entire industries. The testing burden for parts and components suppliers and OEMs would then be limited to infrequent monitoring of supplier conformance. The testing by the materials suppliers would also be held to a minimum, because self-assessments could eliminate most of the superfluous testing. This is the common model of material certification and auditing used within most industries. For certain industries, the material management infrastructure needs to be built, but for the majority all that is needed is modification of the existing compliance schemes. The potential economic benefit to world manufacturing would be significant and almost certainly would total many billions of dollars.

This is a key reason why ASTM International Committee F40 was formed: to save time, effort, and money. This can only be accomplished through the cooperation of companies throughout all manufacturing sectors. And there are ancillary benefits to taking a holistic approach to regulatory compliance issues: once the material management infrastructures are built or modified, they may be adjusted with relative ease as new regulations are born, and the chaos and confusion endemic to the current RoHS compliance mess could be greatly diminished if not completely eliminated. Harmonization of standards will also save a good deal of duplicate efforts, and would benefit manufacturing and regulators alike. However, the development of needed standards takes time; it is hoped that governments establishing regulations on substances in materials will recognize this fact in the future and allow industry sufficient time to adjust their materials compliance schemes. //

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