

Making the World Healthier, Cleaner and Safer

Screening for Toxic Heavy Metals in Packaging



Overview

With growing concerns in the manufacturing, recycling and environmental industries regarding toxic elements in consumer products, the need to be environmentally responsible and to assure adherence to regulations requires a strong verification program at all stages of a product's life cycle. Nineteen U.S. states have toxics in packaging laws that prohibit the sale or distribution of packaging containing intentionally added cadmium, lead, mercury, and hexavalent chromium, and limit the incidental concentration of these materials allowed in packaging. Additionally, the European Union Directive 94/62/EC calls for Member States to enforce similar standards. These laws are necessary to prevent toxic metals from discarded packaging materials from entering landfills, recycling streams, and ultimately, the environment.

The Toxics in Packaging Clearinghouse (TPCH), a national organization that coordinates testing and implementation of legislation on behalf of its member states and serves as a single point of contact for manufacturers and retailers seeking information, also conducts testing programs for toxic heavy metals in packaging. Companies found to be noncompliant with toxics in packaging laws are subject to investigation by their state agencies and potential monetary penalties.

With funding from the U.S. Environmental Protection Agency, TPCH conducted the first comprehensive test program of packaging in the U.S., screening 355 packaging samples between October 2005 and February 2006 for the presence of the four restricted metals using a handheld NITON x-ray fluorescence (XRF) analyzer from Thermo Fisher Scientific. The packaging samples tested were selected to represent a variety of different materials (aluminum, glass, paper, plastic,

and steel) and product types, mostly in the retail sector.

Thermo Scientific NITON Analyzers

Testing was performed using a handheld, nondestructive NITON XLt 797 analyzer. The ease of operation, speed and portability of these instruments make them ideal tools for quality control and rapid testing of packaging materials wherever needed – in a warehouse, on the assembly line, or in the back of a truck. With the simple pull of a trigger, quantitative analysis of cadmium, lead, mercury, and total chromium – as well as additional elemental constituents – is obtained in less than one minute, with little or no sample preparation required.

Methodology

The concentration of the four metals (cadmium, lead, mercury, and chromium) was evaluated as pass (< 100 ppm) or fail (> 100 ppm), taking into consideration the reported range of uncertainty for each metal. Samples were either measured directly or mechanically prepared to meet a minimum sample thickness of 5 mm. All samples were analyzed for 120 seconds, and at least two analyses were taken for each packaging component. The results reported for each metal are the average of the measurements taken of each packaging component.

The test results were compiled and analyzed for trends in compliance and non-compliance with state toxics in packaging laws, including percentage of samples that passed and failed the screening test and the characteristics of failed samples, including product sector, material types and which restricted metals were detected above the screening threshold.

16% of the packaging components tested exceeded the allowed concentration of 100 ppm of one or more of the restricted heavy metals, and may



Thermo's NITON XLT easily tests various areas of packaging directly

be in violation of state toxics in packaging laws. Cadmium and lead were the most frequently detected of the four regulated metals. There were two types of packaging that had a particularly high rate of failure: flexible polyvinylchloride (PVC) packages, and inks and colorants used on plastic shopping/mailling bags. The packages with elevated levels of the restricted metals appear to be largely imported from Asia, where solvent-based inks that contain these heavy metals are often still used.

Follow-Up

Companies whose products were not in compliance with state toxics in packaging laws were contacted by TPCH and asked to verify or refute the test results. Only 15% of the companies contacted acknowledged that their packages were not in compliance with state toxics in packaging requirements. Most companies claimed compliance and submitted supporting documentation for almost 70% of the packages that failed the TPCH screening tests. Companies that did not respond to the requests were referred to member states for appropriate action, including enforcement.

There are several possible explanations for the discrepancy between the TPCH test results and company compliance claims. First, suppliers or raw materials may have changed since the time that TPCH obtained a given package. Second, TPCH suspects that conventional laboratory preparation methods are not sufficient to adequately digest the packaging sample, resulting only in the quantification of recoverable metals rather than a true total concentration of the restricted metals.

XRF vs Traditional Laboratory Methods

After receiving numerous analytic test results from companies that refuted TPCH XRF measurements indicating violations of state laws, TPCH sent several samples to the California Department of Toxic Substance Control's (DTSC) analytical laboratory for further testing. California DTSC analyzed the samples using XRF technology, as well as Inductively Coupled Plasma-Atomic

Emission Spectroscopy (ICP-AES), a common analytical laboratory technique for determining metals concentration in soil samples. The XRF measurements obtained by TPCH and DTSC, using three different XRF instrument models manufactured by two companies, all indicated that the packages are in violation of state laws. The ICP-AES test results obtained by California DTSC, however, were significantly lower than the collective XRF results. If TPCH had relied on ICP-AES results instead of XRF, most of the failing samples would have passed the compliance test.

Given the results obtained using conventional laboratory test methods, it is not surprising that many of the companies that received failure notifications from TPCH claimed compliance based on independent laboratory test results. TPCH suspects that conventional laboratory sample preparation methods insufficiently digest polymer samples, so that test results for the regulated metals appear significantly lower. The California DTSC is designing a follow-up study to further compare different sample preparation and test methods for determining total concentration of the restricted metals in packaging materials.

*"TPCH and its member states support the use of XRF technology to screen packages and packaging materials for compliance with state requirements."*¹ (p. 23)

Conclusions

This study conducted by TPCH clearly demonstrates that toxic heavy metals in packaging are still present in the U.S. above the levels allowed by state toxics in packaging laws, with the majority of violations found in packages of imported products. As a result, toxic heavy metals are continuously being fed into the solid waste and recycling streams, eventually being released into the environment. With more and more of the products sold on U.S. shelves being imported from other countries, companies selling or distributing packaging materials and packaged products need to perform verification testing on packaging components before they reach store shelves.

Be ready for the task at hand with Thermo Scientific NITON XRF analyzers, the ideal tools for ensuring that toxics in packaging regulations are followed and the risks to consumers, the environment and legal compliance are minimized.

References

1. An Assessment of Heavy Metals in Packaging: Screening Results Using a Portable X-Ray Fluorescence Analyzer. The Toxics in Packaging Clearinghouse. June 20, 2007.

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