SHIMADZU

Application News

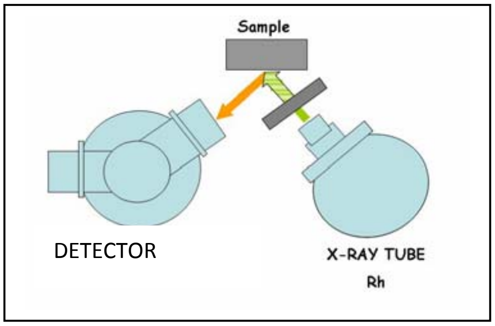
Energy Dispersive X-Ray Fluorescence Spectroscopy

"Getting the Lead Out"
Energy Dispersive X-Ray's Role in Uncovering Dangerous Toys

Everyone is becoming more aware of the influx of dangerous substances, specifically lead, being found in our everyday articles. Lead has been found in paints, plastics, and metal commonly used in toys. Compounding the problem even further is the difficulty in identifying which items contain harmful substances and which do not. This article investigates Energy Dispersive X-Ray's ability to identify lead in common constituents of toys, specifically in paints, resins, and metal.

There are two main areas of concern for contamination, the surface followed by the substrate. The surface finish can be a variety of materials, paint, resin, or metal. The surface is the first area of concern because this part has the most direct contact with the user. Contamination in the surface has the highest possibility of exposure or transfer to its user, with oral exposure being of particular concern. The second area of concern is the substrate. Over time the surface will wear off, exposing the user to the substrate and any contamination therein.

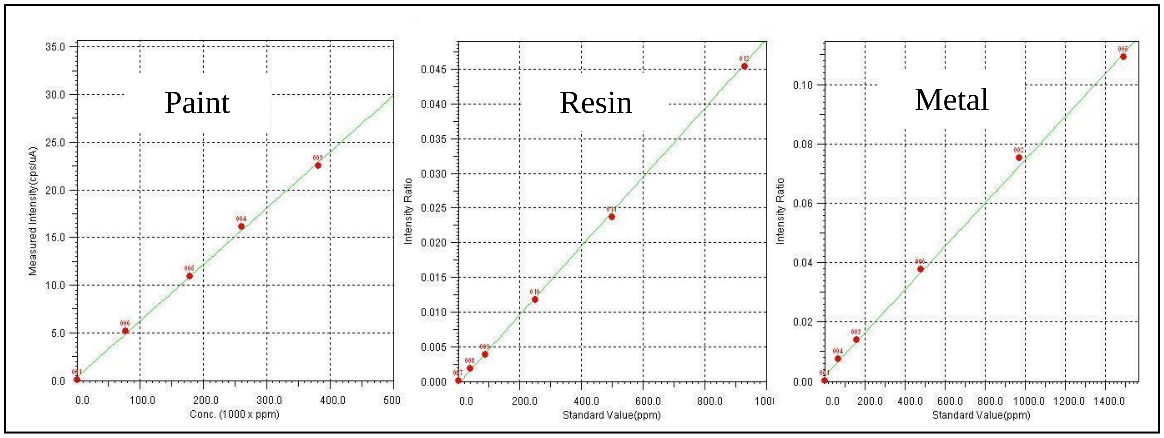
There are many techniques that can be used to identify and quantify harmful substances such as lead. Two very popular and commonly used techniques are Inductively Coupled Plasma (ICP) or Atomic Absorption (AA). Because both of these techniques usually require the sample to be in an aqueous form, intensive sample prep can be required. For samples containing plastics or metal this can be a daunting task requiring a lot of time and dangerous chemicals. Additionally, ICP and AA are both destructive measurements.



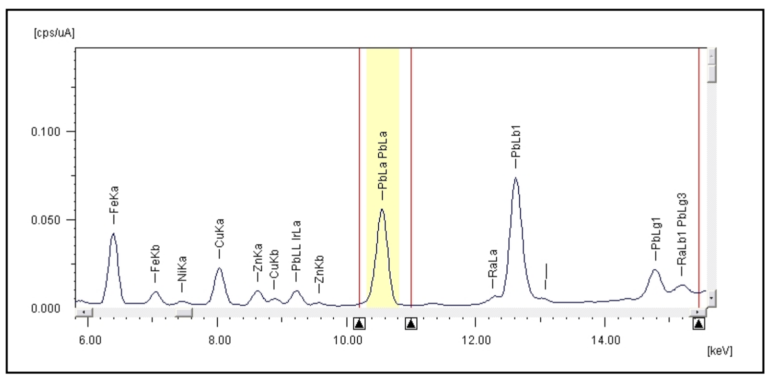
Another technique growing in commonality is X-Ray. There are three X-Ray techniques: Energy Dispersive X-Ray (EDX), X-Ray Diffraction, and Wavelength Dispersive X-Ray. Energy Dispersive is the easiest of the techniques and the most cost effective for a screening tool. EDX allows for a non-destructive rapid measurement of elements from Sodium (Na) to Uranium (U) in a variety of sample forms such as metals, resins, powders, and liquids. The functionality of EDX allows it to be easily integrated into any stage in a product's production, from the individual components to the final assembly.

EDX works by a simple process whereby a sample is irradiated by an incidental X-Ray. The sample absorbs the incidental X-Ray and emits characteristic X-Rays for the elements that make up its composition. After analysis the sample is not radioactive or altered in any way.

One important note is the large effect matrix has on the intensity of an emitted X-Ray. The intensity of the characteristic X-Ray decreases with the density of the matrix. Three different matrixes were chosen based on the popularity of use in toy components: paint, resin, and metal. Different amounts of lead contamination in each matrix are used to establish a linear relation between the lead and the matrix.



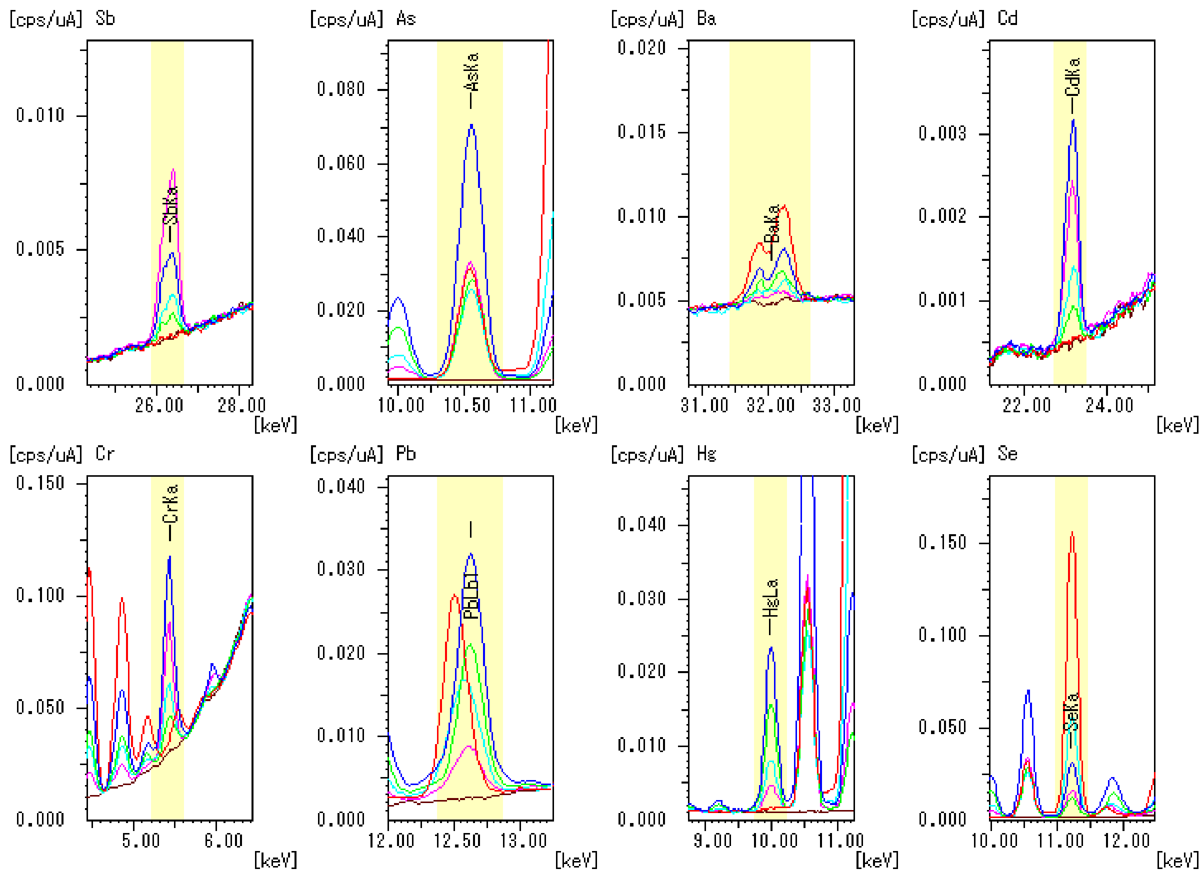
To the right, a metallic part of a toy is analyzed for lead. The lead peak is highlighted for emphasis. The peak is integrated and compared to a calibration curve to quantify the amount of lead.



Shimadzu's Commitment to and Support of the International Standards Organization Toy Safety Standard (EN71-3: 1994)

Shimadzu's EDX Series Energy Dispersive X-ray Spectrometer fully supports the International Standardization Organization (ISO) toy safety standard (EN71-3: 1994). Not only does the EDX easily detect the low concentrations that are demanded by the standard, Shimadzu also offers standards to calibrate all elements outlined in the guideline.

Element Name	Element Symbol	Maximum Concentration Allowed, parts per million
Cadmium	Cd	75
Lead	Pb	90
Mercury	Hg	60
Chromium	Cr	60
Bromine	Br	1000
Antimony	Sb	60
Arsenic	As	25
Barium	Ba	1000
Selenium	Se	500



Conclusion

EDX is a good technique for these types of analyses because it is a rapid, non-destructive analysis involving little to no prep work. The technique can be applied to a variety of materials, elements and matrixes, from levels of a few parts per million to percent levels.

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