

Analysis of Hazardous Substances and Products for WEEE/RoHS Compliance by EDXRF

ARL QUANT'X High Performance Energy Dispersive X-Ray Fluorescence Spectrometer

Key Words

- ARL QUANT'X
- EDXRF
- RoHS
- WEEE

Introduction

RoHS stands for the European Union (EU) Directive on the Restriction of certain Hazardous Substances. This bans the use of certain substances in electrical and electronic equipment products after July 2006.

WEEE stands for the Waste from Electrical and Electronic Equipment. This deals with the recovery, sorting and treatment of non-compliant products effective from August 2005.

Elements and compounds concerned

Elements and compounds covered under these WEEE/RoHS directives are:

Cadmium (Cd), mercury (Hg), hexavalent chromium (Cr (VI)), polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs) as well as lead (Pb).

These directives are introduced to reduce the damage to both the environment in terms of pollution as well as to human health from occupational exposure and exposure following disposal.

The allowed limits of concentrations for each element/compound are listed in Table 1.

Lead	Pb	(1,000ppm)
Mercury	Hg	(1,000ppm)
Cadmium	Cd	(100ppm)
Hexavalent Chromium	Cr(VI)	(1,000ppm)
Polybromobiphenyls	PBB	(1,000ppm)
Polybromodiphenylethers	PBDE	(1,000ppm)

Table 1: Allowed limits of concentrations for each element/compound

People or organizations concerned

The people or organizations concerned by WEEE/RoHS directives are anybody who:

- Manufactures and sells electrical and electronic equipment within the specified categories
- Sells equipment produced by other suppliers under their own brand
- Imports (or exports) affected equipment into European Union (EU) member states

It is expected that from August 2005, such producers will be responsible for financing the collection of waste electrical and electronic equipment from central points, specialist treatment, and meeting targets for re-use, recycling and recovery.

ARL QUANT'X and its capabilities to meet WEEE-RoHS compliance

The Thermo Scientific ARL QUANT'X is a high performance Energy Dispersive XRF system.

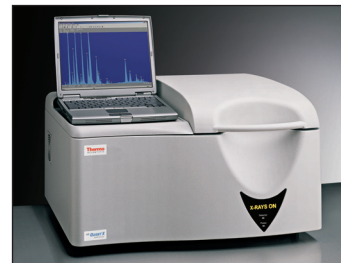
Benefits of XRF screening:

- Non destructive testing
- Little/no sample preparation
- Easy to use with minimal operator training

Notes: XRF is an elemental technique and is not compound specific; thus, it provides results on total Cr and total Br levels, so additional testing must be done to determine the specific levels of hexavalent Cr (Cr+6), and PBB and PBDE.

The key features of ARL QUANT'X are:

- Bench top laboratory EDXRF
- Element coverage: Sodium to Uranium
- Various sample types:
 - Solids or liquids samples
 - Bulk sample or thin films
- Wide dynamic range ppm-%
- Multi-matrix
- Multi-element
- Choice of detectors
 - Peltier cooled Si(Li)
 - LN cooled Si(Li)
 - PIN Diode
- Transportable for field analyses



In addition, it has the performance of a high end EDXRF without the need for complicated instrumentation.

For example, ARL QUANT'X has the following technical features which are very attractive, useful and provide added value to the analyst:

- Digital Pulse Processing for optimal throughput
- Ethernet connectivity
- Flexible sample handling from 1mm diameter onwards
- Mechanically simple: Only 1 moving part
- Installation in less than 30 minutes
- Fully customizable on-site
- Field-portable and rugged for mobile use
- Lowest running and maintenance cost

The high flexibility of ARL QUANT'X comes also from the following outstanding analytical features:

- Unlimited number of analytes
- Multiple calibration options
 - Theoretical and empirical models
 - Pure element standards
 - Type or custom standards
- Full Semi-Quantitative or "standardless analysis" capability
- Auto-intensity adjustment for samples of different composition or thickness
- Thickness analysis

A qualitative scan followed by quantitative analysis is done in a few minutes to determine whether the sample tested is WEEE-RoHS compliant or not. An example of two samples: one failed and one passed is showed in Figure 1.

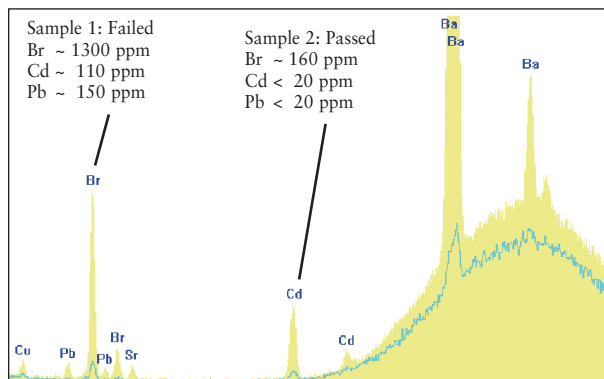
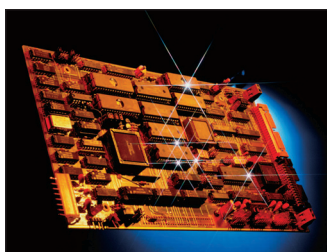


Figure 1: In a few minutes, the ARL QUANT'X determines whether the sample tested is WEEE/RoHS compliant or not

Since most of the materials analyzed are polymer or plastic based, it is of interest to check the typical performance in terms of limits of detection and precision of ARL QUANT'X for various elements.

Table 2 lists the elements and their LODs with a repeatability test.

ARL QUANT'X PERFORMANCE

ATOMIC#	ELEMENT	LOD IN PLASTIC (PPM)
24	Cr	2.0
35	Br	1.0
48	Cd	1.5
80	Hg	1.3
82	Pb	1.3

Table 2: LOD with repeatability test for each element

Products concerned

The products concerned by WEEE/RoHS directives are:

- Large household appliances (eg. fridges, washing machines, electric ovens)
- Small household appliances (eg. vacuum cleaners, toasters, irons, clocks, scales)
- IT and telecommunication equipment (eg. computers, photocopiers, telephones)
- Consumer equipment (eg. televisions, video recorders, hi-fi equipment)
- Lighting equipment (eg. fluorescent lamps, discharge lamps)
- Electrical and electronic tools (eg. drills, sewing machines, lawnmowers)
- Toys, leisure and sports equipment (eg. video games and consoles, train sets)
- Medical equipment systems (eg. radiotherapy equipment, pulmonary ventilators) - WEEE only
- Monitoring and control equipment (eg. thermostats, control panels) - WEEE only
- Automatic dispensers (eg. drinks machines)
- Electric light bulbs - RoHS only
- Luminaries in households - RoHS only

Some typical uses for these substances in electrical and electronic equipment are:

- Mercury: Thermostats, sensors, relays in switches and discharge lamps.
- Lead: Soldering of printed circuit boards, glass for cathode ray tubes and light bulbs.
- Cadmium: Switches, springs, connectors, housings and printed circuit boards. (see below for more details)
- Hexavalent Chromium: Metal coatings for corrosion protection and wear resistance.
- Polybrominated biphenyls and diphenyl ethers: Flame retardants in printed circuit boards, connectors and plastic covers.
- Cadmium is used by industry for a number of purposes, including:
 - As an anti-binding agent (cadmium-plated parts have good lubricity)
 - As an anti-corrosive agent (particularly to protect connectors and fixings in salt-spray conditions where electromagnetic compatibility (EMC) is a critical issue).
 - As pigments and stabilisers in paints and plastics
 - As solders

Conclusion

The ARL QUANT'X EDXRF spectrometer provides ppm level measurements of Pb, Cd, Hg, Cr and Br, all in a single test. The ARL QUANT'X is ideal for laboratories where fast turnaround time for samples is required with high performance. The unique Peltier cooled detector eliminates the need for liquid nitrogen cooling, thereby simplifying operation and lowering operating costs. To know more on Thermo's latest improvements on WEEE/RoHS, visit our WEB site: www.thermo.com/rohs.

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