Determination of hazardous substances according to RoHS

Energy-dispersive X-ray Fluorescence Spectrometer

Energy-dispersive X-ray fluorescence is a fast and simple analytical method for the determination of compounds which are addressed under the RoHS (“Restriction of the use of certain Hazardous Substances”) directive. This directive on the limited use of certain hazardous compounds has been integrated into national legislation by the European Union member states. The new legislature will come into effect on July 1, 2006 and will restrict the use of lead, mercury, cadmium, hexavalent chromium and two brominated flame retardants which are used in the manufacture of electrical and electronic equipment.

Shimadzu, one of the world leaders in analytical instrumentation, offers within its wide product range numerous systems which are able to detect the lowest concentration levels of hazardous compounds. For instance, in the analysis of cadmium, concentrations as low as 0.1 µg/L can be detected using atomic absorption spectrometry in the flame atomization mode while the digital graphite furnace mode with electrothermal atomization can detect concentrations even as low as 0.1 µg/L. For the determination of hexavalent chromium it is recommended to use UV-VIS spectrometry. This is implemented quickly and easily in the routine laboratory using the UVmin-1240. Polybrominated biphenyls as well as polybrominated dibenyl ethers are analyzed by FTIR spectrometry using the IRPrepstein-21 or the GCMS-QP2010 systems.

Development of a routine analysis method

In the context of a research cooperation with the ERA Technology Ltd. Research Institute in Leatherhead, U.K., Shimadzu EDX-700HS energy-dispersive X-ray fluorescence spectrometer was used for RoHS determination of hazardous substances with the goal of developing a routine RoHS compliant analytical method for conventional construction parts such as circuit boards, cables and electronic parts. Furthermore, it should be possible to position the sample directly in the sample compartment for a non destructive measurement.

The results confirm that energy-dispersive X-ray fluorescence is a high-performance and flexible analytical method. However, it was also apparent that depending on the sample material, the choice of system parameters played an important role in obtaining the correct result. The EDX-700HS with its flexible system configuration guarantees the highest possible reliability of the analytical data.

The research results were presented on October 21, 2004 during the international “Lead-free Conference” in Frankfurt, Germany, by Dr. Chris Robertson, ERA Technology Ltd., Leatherhead, under the following title: “A case study of energy-dispersive X-ray fluorescence as a tool for RoHS compliance analysis.” A special reprint of the publication is available upon request.

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INFO 288

Figure 3: The fully automatic atomic absorption spectrometer AA-6800

Figure 2: The FTIR Spectrometer IRPrepstein-21

Figure 1: The UV-VIS Spectrometer UV-2401PC

Enjoyment without consequences

Spectroscopy in Food Analysis

The press regularly reports about exceeding contamination levels or even scandals in foods and drinks based on residues, accumulation or illegal application of substances.

There is a big variety of spectroscopic methods for residue analysis and quality control. The method and type of instrumentation used are determined by the composition and formulation of the samples to be measured. Spectroscopy is the method of choice if quick and simple information about the sample material is required, both qualitatively and quantitatively. The optimum spectroscopic method is determined by the sample characteristics.

UV-VIS Spectrometry

The widest application range is covered by the UV-VIS spectrometers such as the UV-2401PC (Figure 1), which are ideal for the quantitative and qualitative analysis of samples in absorption, transmission and reflection measurement modes. Sensitive determinations of trace and ultra trace elements in aqueous and organic solutions can be determined using atomic absorption spectrometers.

FTIR Spectrometry

FTIR Spectrometers covering the near to the far IR region allow the specific identification of substances. They can be used in combination with a range of accessories, including microscope, each accessory being selected according to the sample material and properties. Fluorescence spectrometers capable of highly sensitive quantitative analysis complete the range of spectroscopic methods suitable for the analysis of food stuffs.

Atomic Absorption Spectrometry

Even though quantitation of substances in food is a typical spectroscopic application, the determination of trace elements is the favourite subject of atomic absorption spectrometers. The drinking water as one of the most important ingredients of all foodstuffs has to be strictly controlled according to the paragraphs 5 to 7 of the new European drinking water regulations (2003). The concentration levels of the essential and toxic elements are tightly controlled so that a constant water quality can be maintained. Elements like mercury, cadmium and lead are included in the list of contaminants and must not exceed their maximum contaminant levels according to EPA.

Other elements, like platinum, palladium and rhodium actually are not straight in the focus of the public interest, even though, these platinum elements are not directly accumulated in our environment and found in significant concentrations in our food chain. The analytical procedures for the determination of low level platinum metals is described using the Shimadzu atomic absorption spectrometer AA-6800 with electrothermal atomization and background compensation methods for solving spectral interferences (Deuterium- and High Speed Self Reversal Method).

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INFO 289