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RoHS Regulation: Challenges in the Measurement of Substances of Concern in Industrial Products by Different Analytical Techniques

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Abstract: The European Union's as well as India's reduction of hazardous materials (RoHS) directives state that producers of certain categories of electrical and electronic equipments will not be able to offer for sale any product that contains any of hazardous substances: Cd, Pb, Hg, Cr6?, polybrominated biphenyls (PBB), polybrominated diphenyl ethers (PBDE), bis(2-ethylhexyl) phthalate (DEHP), butyl benzyl phthalate (BBP), dibutyl phthalate (DBP) and diisobutyl phthalate (DIBP) beyond the specified limits. Allowable concentration levels in any homogeneous material contained within a product are extremely low: 0.01% for Cd and 0.1% for other substances by weight. These substances when present in quantities in excess of the permissible limits are considered hazardous and damaging to the environment and human health. With the introduction of the RoHS Directive many manufacturing companies in the world are pursuing chemical testing as a means to identify and quantify these hazardous substances. This article presents various testing methods that are currently available to the manufacturing firms who need to generate data to prove that their products are compliant to the RoHS directive. The utility of portable X-ray fluorescence spectrometer (XRF) and also the potential of laser-induced breakdown spectrometer (LIBS) for rapid screening applications is described. For quantitative determination of Pb, Cd, Hg and Cr, the role of instrumental analytical techniques such as atomic absorption spectrometry, XRF, instrumental neutron activation analysis, inductively coupled plasma optical emission spectrometry, the inductively coupled plasma mass spectrometry (ICP-MS), LIBS and the potential of the new analytical technique, microwave plasma atomic emission spectrometry is discussed. Applicability of hyphenated techniques such as HPLC-ICP-MS for Cr6?, GC–MS for the determination of PBB, PBDE and phthalates, and the importance of certified reference materials, challenges and future trends are presented.

Keywords: RoHS; Hexavalent chromium (Cr6?); ED-XRF screening; UV–vis spectrophotometry; ICP-MS; ICP-OES; MP-AES; PBB; PBDE; FT-IR; Ion Chromatography; GC–MS; HPLC; CRMs