Screening of Electronic Products with a "Small-Spot", Hand-Held XRF Analyzer for Compliance with RoHS Directive

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Abstract

July 1, 2006 marks the beginning of the industry's full compliance with the RoHS[(1)], WEEE[(2)] and ELV Directives implemented within the European Union. Undoubtedly, testing products, components and even raw materials for the presence of restricted substances is the key to assessing compliance with regulations. Given the sheer diversity of products, and the amount of testing required, one can easily conclude that the effectiveness of inspections depends on the availability of proven, reliable and fast-testing tools and methods. It is also reasonable to expect that the great deal of testing will be performed not under laboratory conditions, but in the field, and by floor personnel. Therefore, desirable instruments must be simple to operate and rugged enough to withstand floor plant environments.

X-ray Fluorescence Spectrometry (XRF) is one of a few, if not the only, instrumental analytical methods well-suited for field and industrial applications. Small, lightweight, and portable x-ray fluorescence analyzers have established themselves as indispensable analytical tools in metals and metal recycling industries, as well as in the screening and analysis of soil for heavy metals. We recently[(3)] reported on the successful extension of the XRF method to the analysis of metals in polymers and products made of those polymers using a hand-held XRF analyzer. However, the minimum sample size required for reliable analysis by a typical portable XRF analyzer is about 1 by 1 cm., which is inadequate to inspect ever smaller electronic components used by the electronics industry today. To meet this challenge, we have designed an improved version of the portable XRF analyzer which allows for selective analysis of objects as small as 3 mm in diameter.

In this paper, we will describe the new analyzer and its performance. We will compare the performance of the new, "small spot" design with that of the older, conventional "broad beam" version. We will show that both analyzers can achieve minimum detection limits way below threshold levels for RoHS regulated substances in polymers and solders. We will also show that the hand-held XRF analyzer can be used for the rapid screening of plastics and resins for the presence of brominated flame retardants. Further, that its "small-spot" version is capable of quantitative screening on a populated PC board individual components such as surface mounted capacitor or resistors, or an individual leaded solder joint amongst other joints of lead-free solder.

Major manufacturers of consumer electronics products are using hand-held portable XRF analyzers as first level screening tools in their multi-level compliance programs, the best evidence of the industry's acceptance of this technique.

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1) European Parliament and Council Directive 2002/95/EC of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS). Official Journal L 37, 13/2/2003 P. 0019 – 0023.

2) European Parliament and Council Directive 2002/96/EC of 27 January 2003 on waste electrical and electronic equipment (WEEE). Official Journal L 37, 13/2/2003 P. 0024 – 0038.

3) S. Piorek – "Portable X-Ray Fluorescence Analyzer for the First Level Screening of Materials for Prohibited Substances", Keynote paper in Proceedings of the 2005 IEEE International Conference on Asian Green Electronics, March 15-18, 2005, Shanghai, China, pp 7 – 13.