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Electronics Manufacturing Insights from ACI Technologies, Inc.

A Systematic Approach to RoHS Analysis

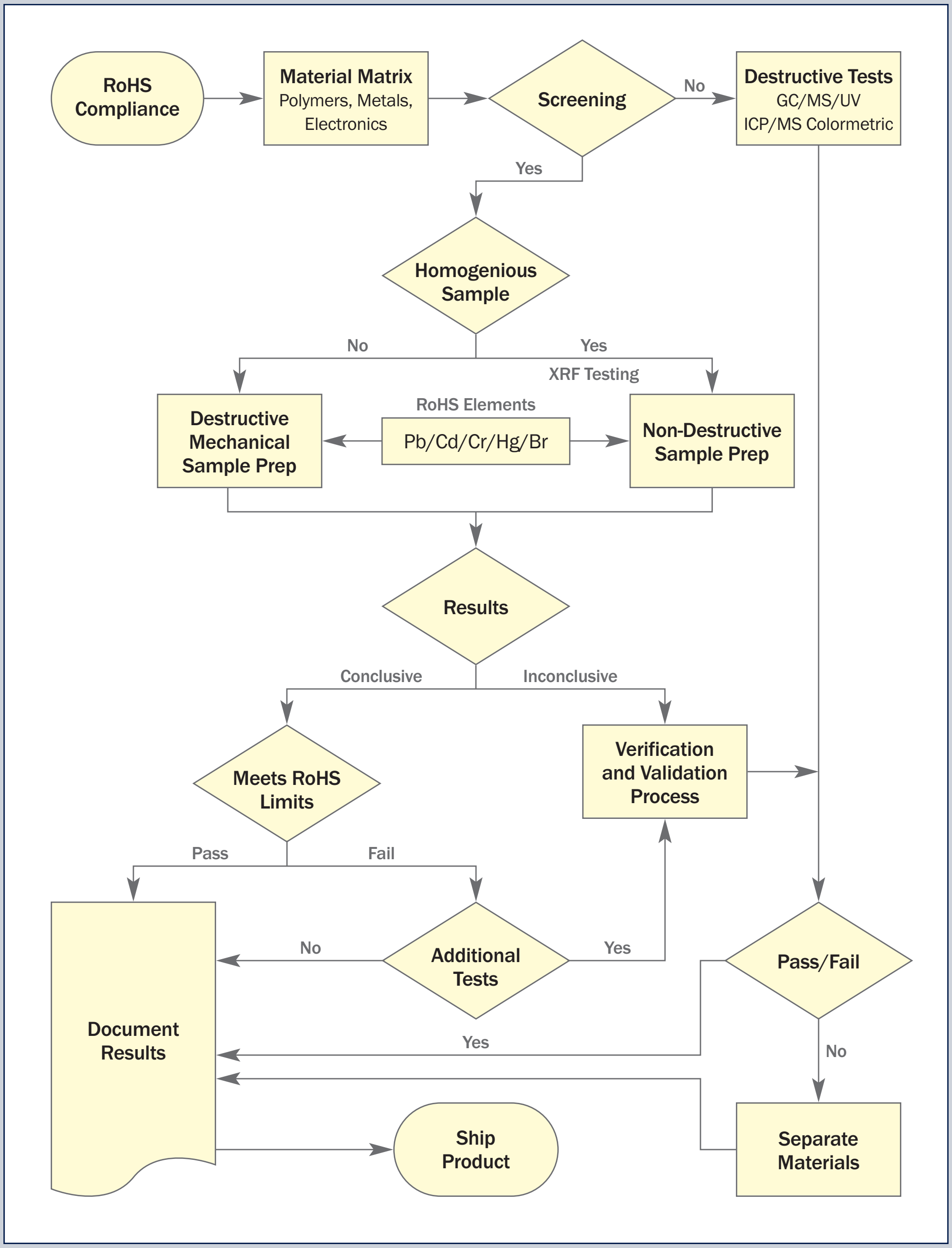

Figure 1: Roadmap selection process for the analysis of the restricted constituents outlined by the RoHS directive.

One of the most frequently asked questions of ACI Technologies (ACI) is how to qualify and verify that the electronic systems shipped by their respective companies are Restriction of Hazardous Substances (RoHS) compliant.

The RoHS directive has been implemented since July of 2006, and the preoccupation with what constitutes a compliant product continues to confuse the electronic industry. ACI receives countless inquiries regarding how to qualify and verify that the electronic systems shipped by their respective companies are RoHS compliant. The approach to proving compliancy requires a sequential analytical process that utilizes a decision flow chart.

There is a progressive course of action which can be initiated, that will help a strategic company exercise due diligence regarding efforts toward RoHS compliancy. The foundation to sustain a robust position of stewardship with trading partners, vendors, customers, and regulatory agencies should include the following.

I Quality Audit

This is done to ensure that your facility has implemented a control plan to address the prevention of lead (Pb) into the product stream. The audit contains some of the following elements:

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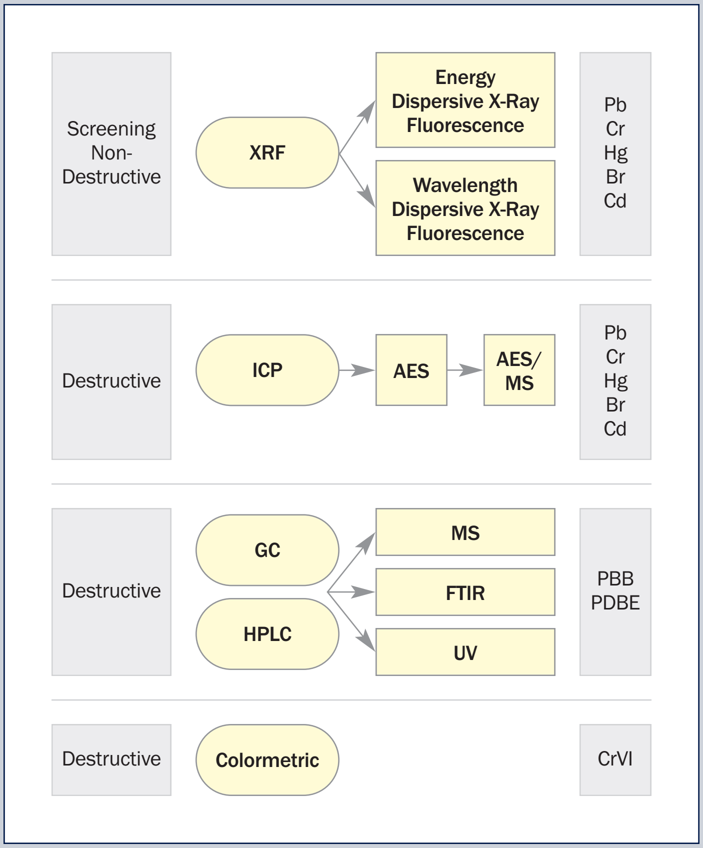

Figure 2: Analytical techniques that can be used to determine RoHS restricted materials.

1 Verification and testing for RoHS compliance
   a. component
   b. printed circuit board (PCB)
   c. other materials

2 Separation of tin-lead and lead-free processes and materials
   a. labeling
   b. component storage
   c. solder materials
   d. surface mount production lines
   e. hand soldering
   f. wave soldering
   g. assembly storage and transportation

3 Documentation related to RoHS, for example:
   a. Certificate of compliance
   b. X-ray fluorescence (XRF) testing records

4 Awareness and training of employees
   a. RoHS experience
   b. procedures
   c. training
   d. awareness

II Analytical Screening Process

The analytical screen process is a very fundamental and usually non-destructive method of screening lead (Pb), cadmium (Cd), mercury (Hg), chromium (Cr) (total), and bromine (Br). Please note that hexavalent Cr requires a destructive analytical approach, and that the isomers of Br, polybrominated biphenyls and polybrominated diphenyl ethers (PBB and PBDE), cannot be detected in the screening process.

The chart in Figure 1 illustrates a roadmap selection process intended to address the analysis of the restricted constituents outlined by the RoHS directive.

The flow chart gives guidance on the appropriate course of actions to:

- minimize unnecessary analytical activities that can be resolved with non-destructive screening
- provide a logical analytical sequence that can be used for documenting the screening results, and subsequent testing when analytical uncertainties arise

The material matrix plays a pivotal role in determining what the analytical threshold limits are for the various instruments used to detect the constituents of interest. The matrices that surround or sequester the restricted substances are analytically defined as polymeric, metallic, and electronic. Instruments such as energy dispersive X-ray fluorescence (EDXRF) can be used as a screening technique to detect the presence of Pb and other elements. However, depending on the geometry and matrix of the samples, a quantitative analysis approaching the allowable upper limits, as defined by RoHS, can be difficult and often inconclusive. A statistically valid data set requires a minimum of seven measurements to determine a viable three sigma value. It is suggested that if the three sigma value added to the average reading exceeds the upper limit, additional testing is warranted. This may require a destructive test method, and more sensitive analytical techniques. As a point of interest, the ACI analytical lab has found that grinding or pulverizing the sample can render a more accurate XRF (or other) analysis. Though this is a destructive test, the additional sample preparation can preclude the necessity of more expensive analytical verification.

III Material Verification Testing

As a subsequent step, it is often required that if uncertainties exist in the screening analysis, a more thorough and sensitive analytical technique be used. Figure 2 outlines a series of analytical techniques that can be used to determine the various RoHS restricted materials.

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As stated previously, the matrix surrounding the RoHS constituent will determine the proper instrumental conditions, sample preparation, and calibration standards required to avoid overlapping spectral interferences. This is especially true of spectroscopic techniques where samples requiring acidic decomposition or alkali digestion may recombine, precipitate, or attach ligands that can produce interfering emissions, or prevent atomization. Sample preparation can take a number of forms:

- acid decomposition
- alkali digestion
- microwave digestion
- solvent extraction
- elution

ACI has helped a number of companies clarify the confusion surrounding RoHS by offering analytical services and assisting in the preparation of Pb-free compliance through our Pb-free auditing services. For more information please contact the Helpline at 610.362.1320 or email helpline@aciusa.org.

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