How Clean Is Clean?

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The leading manufacturer of cleaning and cleanliness testing products.

Over the past several years, post-reflow defluxing of circuit assemblies has gained in popularity. Microminiaturization of components and boards, combined with higher expected reliability and increased product liability, have contributed to the prominence of defluxing. Lead-free solder paste - with its higher reflow temperatures and negative effects on flux - increase the likelihood of post-reflow defluxing to increase a product's reliability and aesthetic appearance.

With ever-growing attention to cleaning comes equal attention to cleanliness. With the increasing assimilation of lead-free soldering, one must pay extra attention to the defluxing process. The techniques, profiles, recipes, chemicals, and equipment used in the past may require review and possible updating.

The life of an automated defluxing system may be 10 years or more. In many cases, the chemicals, processes, and procedures deemed appropriate several years ago are no longer relevant. Defluxing equipment and all associated processes need to be verified to ensure conventional relevance.

Determining Cleanliness

There are several methods to determine the cleanliness of a circuit assembly. The most common, and least effective, is visual inspection. Visually inspecting assemblies, although partially effective, does not guarantee the absence of flux or other harmful substances from an assembly. What the eye can see, even under extreme magnification, is only a small percentage of potentially hazardous substances.

The three basic technologies available to determine board cleanliness include:

- Surface insulation resistance (SIR)
- Resistivity of solvent extract (ROSE)
- Ion chromatography (IC)

For SIR testing, test coupons incorporating track-comb patterns are used to model the assembly. During SIR testing, measuring the electrical resistance between metallic conductors on a substrate's surface is monitored as voltage is applied. These results give a measure of the estimated reliability of the circuit product in the field. SIR testing, although accurate on the test coupon, generally is considered anecdotal as it is commonly applied to test coupons that emulate a production board.

ROSE testing uses a calibrated mixture of isopropanol (IPA) and deionized (DI) water to remove soluble contaminants from a sample printed circuit assembly. The change in the resistivity of the test solution used to wash the assembly provides a measure of the average ionic contamination present on the board. ROSE determines the total volume of contamination on an assembly, but does not show the distribution of contamination. The

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advantage of a ROSE tester is its ability to quantify the total volume of ionic contamination present on an assembly quickly and accurately.

Many automatic ROSE testers perform basic calculations that factor the assembly's surface area and express cleanliness results based on the assembly's size (i.e. X micrograms NaCl/in2). The determination of an assembly's surface area provides a perspective in determining specific pass/fail results.

Like ROSE testing, IC testing uses an extraction process to remove contamination from an assembly's surface. Unlike ROSE testing, however, IC testing subjects the extracted media to analytical analysis - identifying specific ionic species such as chlorides, bromides, sulfates, phosphates, nitrates, and weak organic acids. IC testing has the ability to identify and quantify specific types of contamination. Like ROSE testing, however, assemblies are fully immersed in the extraction solution. This provides the user with the volume and identity of the contamination, but does not show the distribution of contamination.

The major disadvantage of IC testing is price. The cost-complex operation of IC test equipment generally is prohibitive to most assemblers. Analytical laboratories normally perform IC testing. As a result, a panel of IC tests may cost $2,000-$3,000.

Conclusion

The recent emergence of new technologies provide the user with the best of both worlds. A new ionic tester offers the ability to provide localized ionic extraction. By extracting contamination from specific targeted sections of an assembly, one can successfully identify problem areas. For example, one can inject and extract test solution under a BGA - a likely source of trapped residues. Within a matter of minutes, the tester will determine if the target area is clean. If it is determined that the targeted area contains excess ionic contamination, the user can send the collected sample to the manufacturer's laboratory for IC testing, which will offer information on contamination type and volume.

Because the user extracted the contamination, and not the laboratory, the cost for IC testing is greatly reduced. With conventional cleanliness-testing equipment, one may no longer ponder: "How clean is clean?"

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