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White Residue on Finished Assemblies: Is it Good or Bad?

White residues, particularly on no-clean assemblies,
are often benign & insulative

Foresite Inc.

As has been published in this column before, when it comes to whether or not white residues on finished assemblies are good or bad, we say: "It depends." The reason is not based on whether the white residue is bad or good, but whether the other invisible residues below or in the flux residue are corrosive. Typically, white residues are flux residues, and based on our investigations, they act as good insulators. Many of today's low solids fluxes, pastes and cored solders can generate a white residue if the flux is partially cleaned and exposed to a small percentage of water. Often this residue is not corrosive, but may be conductive if not completely heat activated. These residues can be moisture absorbing and conductive, creating electrical leakage and stray voltage failures on sensitive circuits.



Figure 1: white residue from no clean flux hand soldering

In many of the cases we have seen, the white residue is primarily due to the reaction of moisture and flux residue. We have also seen dryfilm soldermask absorb cleaning chemistries and water to create a white hazy surface. In the first photo, you see a typical hand solder application with a low residue flux, this material is intended to be left on the assembly without cleaning. The area around the solder joint is shiny compared to the finish of the standard laminate. This may be a cosmetic issue that arises when some assemblers are trying to remove the evidence of flux residue with a standard benchtop cleaner or with alcohol and a brush, then rinsed with water. This reaction with water from rinsing a partially cleaned flux residue is typical. If the residue is from a water-soluble flux, many times this material contains activators that are very conductive, moisture absorbing and corrosive. These residues must be removed if they are water-soluble flux residues. The low solids do not need to be removed, but the bare board and components must be cleaned so that they do not contain surface residues that are corrosive or conductive (HASL flux and plating bath residues).

Tools such as Ion Chromatography (IC) have allowed Foresite to evaluate the residue and determine if the residues, visible and invisible, must be removed. Foresite was presented with a project to determine the nature of a heavy white residue on the bottom (wave solder) side of an assembly and evaluate if the residue could easily be removed. A corner of the board was analyzed to determine the nature of the material, and if there were any corrosive residues present. The data shows that the area with the white residue on a HASL finished board was only a low solid flux residue intended to not be cleaned. It turns out that this unit was exposed to the ROSE (Resistivity Of Solvent Extract) process control tester, which uses a 75% isopropyl alcohol and 25% deionized water solution, then air dried before being put back into inventory. This residue shows a heavy spray-fluxing pattern from the wave solder process typical of this type of material. After the first extraction, the board was then cleaned in a specific Saponifier at 5% concentration at 140°F wash and rinse water in a batch cleaning system and then analyzed (in a different area) by IC. The data shows that the cleaning reduced the visible flux residue and the corrosive residues from the incoming HASL board residues. After cleaning, the board is free of visible and ionic residues. The ionic residues are corrosive, while the no clean white flux residues are benign and pose no risk of electromigration.



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Data Table

Ion Chromatography data - in $\mu\text{g} / \text{in}^2$				
	Chloride	Bromide	Sulfate	Weak Organic Acid
Assembly with White Residue	12.94	3.98	0	614.32
Assembly after Cleaning with a saponifier	2.21	2.14	0	79.16