Residues vs. SIR

SIR testing indicates how a product will perform in the field;
ion chromatography tells us why it will perform this way

Foresite Inc.

In determining whether an assembly should be considered as “acceptable”, there are two basic schools of thought:

- How clean is it?
- I don’t care what’s on it, does it work?

In the former case, someone is trying to determine the amount of ionic or organic material on a surface and use the assessment of ‘clean’ or ‘dirty’ to predict electrochemical reliability. In the latter case, someone is trying to determine, perhaps with environmental stress screening, whether a material system will last under harsh conditions, and does not care what the “cleanliness” of the item may be. This separation often comes into play when discussing ion chromatography data, which we frequently use, and the results from surface insulation resistance testing (SIR). Both camps are desirous of knowing how the two areas interact.

Tables 1 and 2 show the results of a small study we performed examining low solids flux residues by several methods, and relating them to SIR performance on identical samples. The IPC-B-24 test board was used as the test substrate. The boards had been coated with tin-lead by a standard HASL process.

Each test cell below represents the mean of five test samples:

Table 1. Residue Analysis

Ion Chromatography and Organic Analysis					**ROSE**
HASLed IPC B-24 boards (Values in mg/in^2)	**Rosin** (Abietic Acid)	**Chloride**	**Bromide**	**WOA** (weak organic acids)	**OM600R**
Bare Unprocessed Boards Standard Process	<0.1	5.79	0.37	<0.1	2.1
Bare Boards Cleaned in DI water/saponifier	<0.1	1.12	0.15	<0.1	1.1
No Clean Wave Soldered Standard Process	134	5.12	1.04	34.2	9.2
No Clean Wave Soldered DI water/saponifier Bare Board	153	0.89	1.13	31.4	13.1
RMA fluxed/Solvent Clean	2645	8.19	3.17	<0.1	8.3

Chloride, bromide and weak organic acids were deciphered and measured with ion chromatography (IPC-TM-650, method 2.3.28). The amount of residual rosin was determined by high pressure liquid chromatography (HPLC, method 2.3.27.1). The ROSE testing was performed in an Omegameter 600R at room temperature for 10 minutes.

The bare boards, by conventional ROSE standards, were quite clean. By ion chromatography, we considered them too high in chloride. Our recommended value is 2.00 for a HASLed board. Cleaning the bare boards with a saponifier prior to flux processing brought the bare boards down to what Foresite considers clean.

Note that for the no-clean processed boards, the chloride levels come through to the finished product, and if the boards were cleaned prior to processing, they stayed clean.
Table 2 shows the corresponding SIR performance for boards of these classes. The test method used was IPC-TM-650, method 2.6.3.3A, which is a seven day exposure to 85ºC/85% RH with a 50 volt bias.

Table 2. SIR Performance

SIR Electrical Assessment in ohms					
HASLed IPC B-24 boards (100volt test voltage)	**Initial Ambient**	**24 hour 85C/85%**	**96 hour 85C/85%**	**168 hour 85C/85%**	**Final Ambient**
Bare Unprocessed Boards Standard Process	2.3e10	**8.1e7**	**1.0e6**	**1.0e6**	**1.0e6**
Bare Boards Cleaned in DI water/saponifier	3.1e11	1.3e10	2.3e10	6.9e10	3.3e11
No Clean Wave Soldered Standard Process	1.7e11	1.1e8	**1.3e7**	**1.0e6**	**1.0e6**
No Clean Wave Soldered DI water/saponifier Bare Board	2.7e11	2.4e10	3.5e10	1.2e11	3.9e11
RMA fluxed/Solvent Clean	3.9e12	5.6e10	6.5e11	7.2e11	5.1e12

**1E+08 = 100 megohms*

On the unprocessed bare boards, which registered as “clean” by ROSE, we saw low resistance levels, corrosion and metal migration. This was also the case for the uncleaned bare boards processed with low solids fluxes. Conversely, the bare boards which were cleaned prior to processing did very well, as did the boards after processing with the low solids flux. An interesting comparison is to look at the residue levels for a classical RMA (high solids) processed board, cleaned with chlorinated solvent. These boards did not see any precleaning. The SIR response was very good due to the high level of abietic acid (residual rosin) retained on the board. The high levels acted almost like a microscopic conformal coating, armoring the surface against dendritic growth. This protection also served to protect the board against the high chloride residues present from the RMA fluxes. Space here does not permit us to go into all the other conclusions we have reached.