Process Doctor

Terry Munson

Understanding Selective Pallet Soldering Residue

Proper heating can eliminate flux concerns.

Needless to say, high reliability hardware becoming useless unexpectedly is a little unerving. One of our customers that makes sensing technology for use in safety products came to us when their hardware began suffering from field failures. Their sensitive circuits were exhibiting stray voltage failures on CEM 1 laminate processed with a water-based no-clean flux.

The company's product was processed at a contract manufacturer using selective wave soldering pallets and a heavy spray of low volatile organic compound (VOC) no-clean flux. They also used an extremely short wave solder system with inadequate heating. The sensitive circuits that failed were not in direct contact with the wave solder but were covered by the selective pallet next to the area of the wave soldering.

While selective pallet soldering is an effective way to wave solder a specific area of a board while thermally controlling the effects of the wave solder process in other areas, it does have an effect on processing residues. Heavy fluxing of a selective pallet can lead to areas with large amounts of partially heated flux residues.

To better understand the ionic and electrical effects of trapped flux residue, we used B-24 test coupons processed with selective pallet areas and direct wave solder areas processed on the customer's production line with the low VOC no-clean flux. After processing, each board was subjected to 85°C/85 relative humidity (RH) using standard IPC SIR protocol of 50 v bias and 100 v measurement. Instead of the standard 168-hour test, we tested for 500 hours.

The boards processed without a selective pallet performed well throughout the test. However, the boards processed with selective pallet soldering on hot-air solder leveled (HASL) boards exhibited electromigration and became thermally overstressed to the point of fire in just three or four days (Figure 1). The only ionic difference between the two groups was the weak organic acid (WOA) flux activators (Table 1).

With direct contact with the solder wave, proper thermal energy drove all of the flux carrier (water) off, which reduced the levels of WOA and water, and, thus reduced the moisture absorption properties and acidity of the residue. The boards processed with the selective pallet left residues that were moisture absorbing and, since the pH of the flux is 2, very corrosive.

The only source of corrosive residue on clean, bare boards is the unreacted flux. When properly heated, a low VOC no-clean flux leaves a benign, insulative residue. If not heated properly, stray voltage and electromigration failures can occur. Remember that no-clean flux does not mean no-residue, but, rather, that it is non-corrosive when properly processed.

To correct residue concerns, consider eliminating the use of selective pallets or creating a secondary heating fixture/process for all selective pallet wave soldered assemblies. You might also consider replacing current wave solder equipment with appropriate heating systems. ■

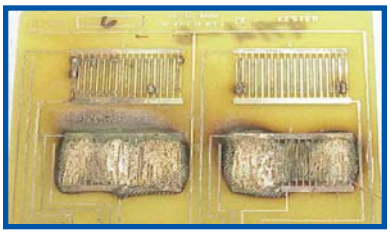

FIGURE 1: Thermally overstressed HASL boards processed with selective pallet soldering.

	---- Ion Chromatography ----				SIR test
Sample Description	**Cl-**	**Br-**	**SO42-**	**WOA**	**500 hrs**
HASL control unprocessed	2.89	0.44	0.27	0	Pass
HASL control unprocessed	2.37	0.42	0.22	0	Pass
HASL control unprocessed	2.59	0.48	0.28	0	Pass
HASL direct wave	1.90	1.27	0.21	122.4	Pass
HASL direct wave	1.86	1.39	0.18	104.8	Pass
HASL direct wave	1.72	1.29	0.19	111.3	Pass
HASL selective pallet	2.40	1.10	0.25	263.0	Failed
HASL selective pallet	2.43	1.06	0.24	279.2	Failed
HASL selective pallet	2.65	1.09	0.27	283.9	Failed

TABLE 1: The test results show the increased occurrence of WOAs with selective pallet soldering.

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