The Crystalline Entity

Too many challenges, Too little cleaning

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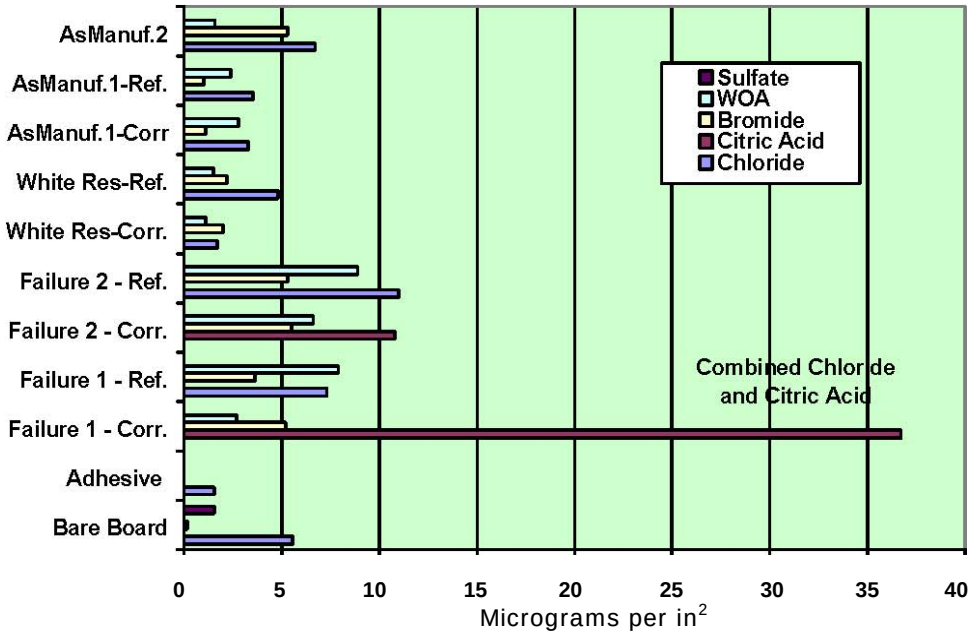
In this case study, we examine detrimental residues present in a water-soluble flux assembly process. The assembler used a mainstream combination of water-soluble fluxes and water-soluble pastes. The liquid flux contained citric acid as one of the active elements. The aqueous cleaning used tap water. The units had not failed electrically, but the processed assemblies showed a white residue and visible corrosion on the leads of fine-pitch surface mount devices. Contained within the white residue were small crystal formations. Several assemblies were analyzed. Some field assemblies contained residue, no corrosion, and no crystals. Assemblies were also analyzed which had seen no field service. A test for ionic contamination at the end of the assembly process showed these assemblies to have readings anywhere between 4.0 and 12.0 micrograms of NaCl equivalence per square inch. Figure 1 shows the residue levels detectable by ion chromatography and shows one past problem with ion chromatography. The analyzed assemblies Failure 1 and Failure 2 contained both Chloride and Citric Acid, and at the time it was difficult to separate the two. Research completed after this study yielded a new method to separate these ionic species.

Figure 1 - Ion Chromatography Results



- The bare boards had high chloride and sulfate. The sulfate does, however, disappear by the completion of the assembly process. The chloride contributed to corrosion.
- The backside of the assembly was covered with an adhesive-backed plastic sheet to provide some protection to the circuit. The adhesive was chloride-bearing and contributed to the corrosion.
- All assemblies had the white residue around and under the fine pitch SMT devices. The white residue was residual resin/rosin from the WSF paste, which turned white after exposure to the aqueous cleaning. The surface tension of the tap water and the cleaning parameters resulted in incomplete cleaning leaving the white residue.
- The corrosion was found only where the crystalline material was noted. Citric acid was found wherever the crystals were found. We found that the technicians added the wave solder flux that contained the citric acid to the fine pitch device leads during touch up soldering. The crystals were citric acid that became embedded into the white rosin residue making it much harder to clean.

Conclusion

The corrosion was the result of throwing too many cleaning challenges at an inadequate cleaning process. The assembler made the following changes, which solved the corrosion problem and improved assembly reliability.

- The tap water was converted to deionized water with a 3-5% solution of a saponifier, which included a surfactant agent. This allowed the cleaning solution to overcome the water tension problem get at low standoff areas and clean residual rosin.
- Technicians were given another flux that was much more favorable for touch up soldering. The touch-up flux did not contain citric acid.
- The assembler stopped using the chloride adhesive and worked with the fabricator to provide cleaner bare boards.