What A Difference A Little Soap Makes

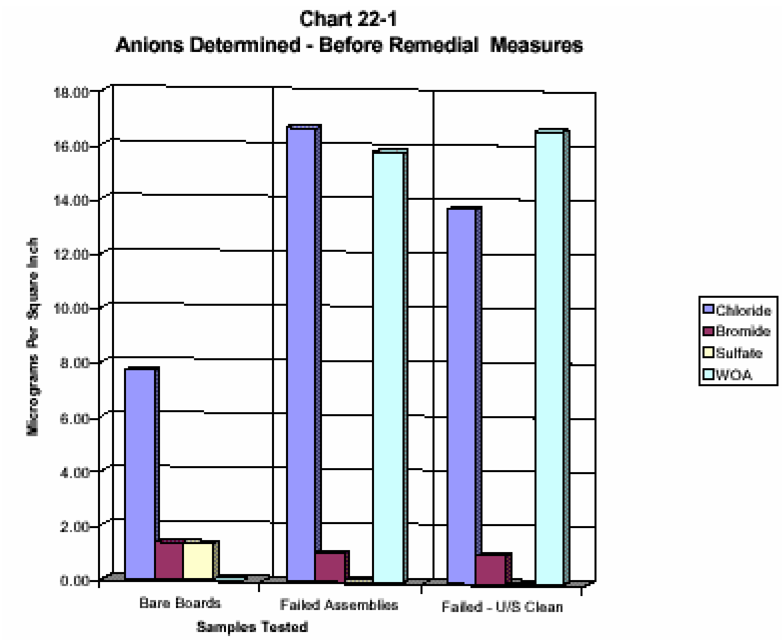
Tap Water cleaning doesn't hold up against tough residues

Foresite Inc.

Anyone who has small children can tell you that if you want to get the kids clean after a day of playing, water alone will not do it. You need to add a little soap (or a lot of soap in my sons' case). It is the same way with printed circuit assemblies. Minor cleaning can be accomplished with tap water. A slightly greater contamination might require hot deionized water. A really tenacious contamination problem means the addition of a saponifier (a fancy word for soap).

In this case study, we look at a serious contamination problem and how it was dealt with. The problem involved excessive electrical leakage, which caused the assembly to fail impedance testing. The high-impedance assembly operated at high frequencies and plugged into a standard desktop computer. The mixed-technology bare board was FR-4, LPI solder masked, with gold-over-nickel surface metalization. The assembly process made use of a low-halide water soluble solder paste and a high-halide water soluble flux. Cleaning was done in tap water (140F) with DI water rinsing.

Chart 22-1 shows the residue levels on bare boards and assemblies which had failed the impedance testing. An attempt to clean the assemblies using deionized water and ultrasonic agitation was also made, but the assemblies still failed impedance testing. The anions found included chloride, bromide, sulfate, and weak organic acid. These residues are fairly common. Bromide in the 0-7 $\mu g/in^2$ range is normal for FR-4 flame retardant, so bromide was not the problem. Sulfate appeared only on the bare boards as a result of tap water rinsing. The assembly processing removed this residue. With some minor exceptions, weak organic acids (WOAs) are benign materials (insulators) and were likewise not a contributor to the problem. The problem was the high chloride levels on the bare boards and assemblies. The bare boards had mean chloride levels of 7-8 $\mu g/in^2$. For HASLed boards, we recommend chloride levels of under 2.0 $\mu g/in^2$. For nickel-gold boards, which use a much cleaner fabrication process, we recommend chloride levels under 1.0 $\mu g/in^2$. By this standard, the nickel-gold bare boards were very dirty.



The assemblies had even higher levels of chloride which was an indication that the tap water cleaning was not removing enough of the high halide water soluble flux from the wave solder operation. Hot DI water cleaning, even with ultrasonics, was not up to the task of reducing these residues. For assemblies processed with water soluble fluxes, we recommend chloride levels of under 5.0 $\mu g/in^2$.

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The assembler implemented a change in the cleaning process by converting to deionized water throughout and adding a small amount (5%) of a saponifier which we have found to be effective against chloride residues. All other cleaning parameters stayed the same. Until the fabricator's cleaning process was improved, the assembler cleaned the incoming bare boards with the new cleaning process prior to the boards' entry into the assembly process. The new cleaning process was also used for the post-reflow cleaning. A chart of the residue levels on the pre-cleaned bare boards and the cleaned assemblies is shown in 22-2. Note the difference in scales. The boards and assemblies are now "squeaky clean" and the impedance failures have gone away.