Case Study #17 - Just Call Me Fireproof

How much bromide is a hazard? The assembler was a high volume manufacturer of industrial control electronics. The products often went into hot, humid, and hostile environments. The application was a mixed-technology high-impedance device. The bare boards were FR-4, solder masked with an LPI, with tin-lead (HASL) metalization. The assembler specified an incoming cleanliness level of 5.0 μg of NaCl equivalence/in^2 on bare boards. The incoming bare boards consistently met this requirement (2.8-3.0 μg of NaCl equiv./in^2). The assembly process was a true no-clean process using halide-free solder pastes and fluxes. Reasonable handling procedures were used. No post-solder cleaning was performed.

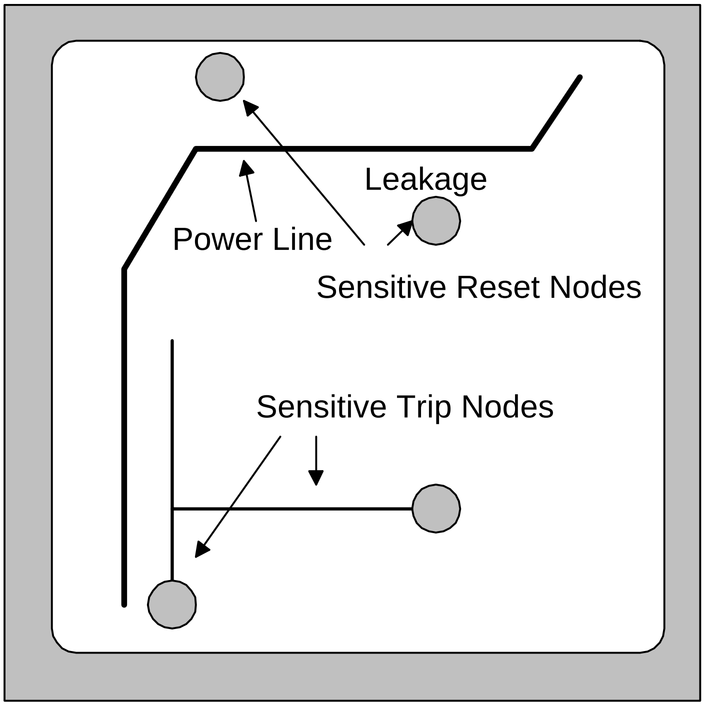


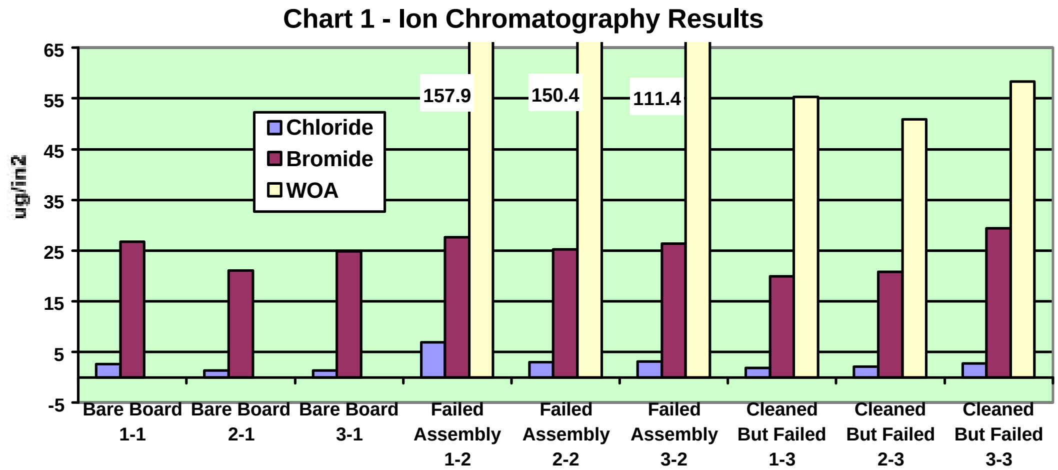
Figure 1.

The finished product was exposed to a temperature-humidity profile of 60^{o}C / 95% RH. In this exposure, excessive leakage between traces caused excessive “Resets” and “Triggers” (see Figure 1). The effect was widespread for this application. In the initial analyses, we examined bare boards, no-clean assemblies that exhibited the fault, and assemblies that had been cleaned, but still exhibited the fault. Chart 1 shows the residues present on these samples. The chloride levels were low enough and deemed a contributor to the problem but not the primary cause. The weak organic acid (WOA) levels on the no-clean assemblies were high indicating a liberal (spray) application of flux. The cleaned assemblies had markedly reduced WOA levels. The most common thread was the high level of bromide found on the bare boards and assemblies.

Most electronics grade laminates and solder masks contain some amount of bromide, added as a fire-retarding agent. We find that bromide, complexed as an internal fire retardant, is non-hazardous. Bromide as a surface flux residue can be corrosive and promote electrical leakage. In ion chromatography (IC), the extraction method removes both kinds of bromide (surface and subsurface). In our experience, bromide levels of 0-7 μg/in^2 can be attributed to laminate fire retardant, with levels up to 12 μg/in^2 if the laminate has been subjected to many

Contamination Studies Laboratories
201 E. Defenbaugh
Kokomo Indiana 46902
(765) 457-8095
residues.com

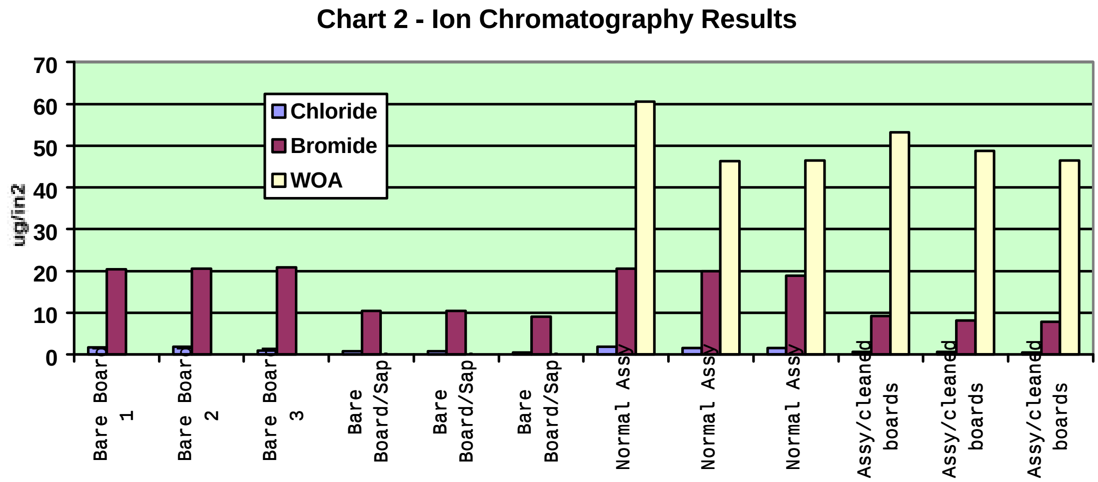
reflow operations. Above 15 µg/in^2, we look for a brominated flux somewhere in



the process.

The board fabricator used a high volume HASL process that used a hydrobromic acid activated HASL flux. The cleaning process was tap water with a deionized water rinse at a relatively high belt speed in the cleaner. Bromide levels above 23 µg/in^2 were common. Assemblies with these levels of bromide failed the test.

The assembler worked with the fabricator (a generally good relationship). The fabricator made some improvements to the cleaning process after HASL. In addition, some bare boards were cleaned with a saponifier solution that we know to be effective against halide residues. Assemblies were made with boards from both the standard HASL process and those cleaned with saponifier. Chart 2 shows the residue levels on the bare boards and on the assemblies made with those boards. The bromide levels were dropped to levels under 20 µg/in^2.



All of the assemblies, both standard-cleaned and saponifier-cleaned, passed the 60^{o}C / 95% RH burn-in test. The assembler has set an ion chromatography pass / fail limit of 20 µg/in^2 of bromide. This has solved the problem. The saponifier cleaning process was not absolutely necessary, although it was kept to give a greater margin of safety.