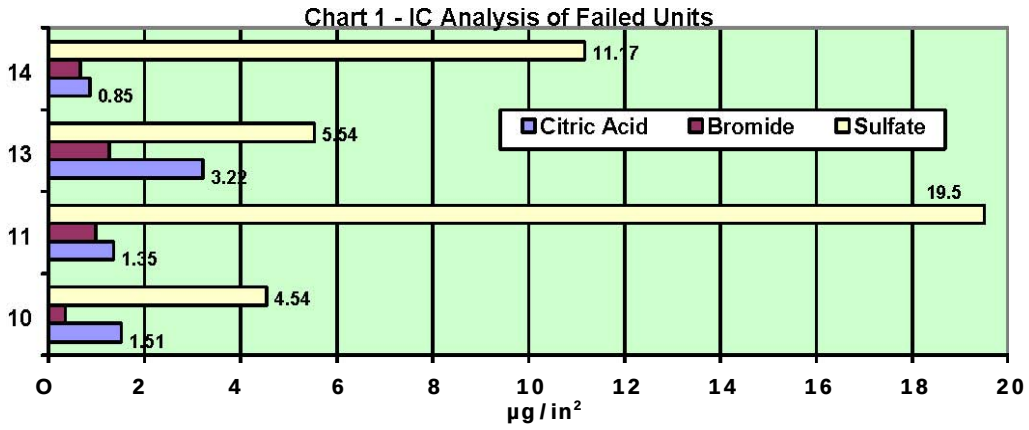
I Could Solder to Concrete
Use flux for its intended purposes
Foresite Inc.

What can happen when you use an active flux totally outside of the manufacturer recommendations? The assembly in question contained a large aluminum heat sink, making reflow more difficult. Component leads passed through the heat sink to the circuit board. The assembler (low volume, high mix) would immerse the assembly in a citric-acid activated flux and then bake the assembly. The assembly was then wave soldered. Good solder joints were the result. Following wave soldering, the assemblies were manually cleaned using a spray wand and heated deionized water. The assembler had difficulty in consistently passing in-circuit testing. Following environmental stress testing, a white crystalline material was found on the component leads, on the holes in the heat sink, and on the components themselves in the form of black spots. The material was not found on the circuit boards, only on the component leads. When the corroded parts were replaced, the assemblies passed in-circuit testing.

Chart 1 shows the residues detected by ion chromatography. Some of the pure flux was also analyzed as a baseline. The flux contained primarily citric acid with an organic surfactant compound. The sulfate residues were attributed to the heat sink. The anodizing process often leaves sulfate residues on heat sinks. The bromide was from the circuit board fire retardant and was of no consequence here.



All of the units tested had failed the original in-circuit testing and all showed the white crystals and other evidence of corrosion. Unit 10 failed in-circuit testing and had no remedial cleaning. Unit 11 passed in-circuit testing after removal of the corroded parts and after cleaning with an effective saponifier solution. Unit 13 passed in-circuit testing after removal of the corroded parts, but with no environmental stress. Unit 14 passed in-circuit testing with original components after cleaning with an effective saponifier solution.

After some additional testing, we determined that the white crystals were dried citric acid. Citric acid is highly corrosive when exposed to moisture. The black residues were corrosion products formed in environmental testing by the citric acid. When the assembler dipped the assembly into the liquid flux, and then baked it on, the flux carrier and surfactant were driven off, leaving the most corrosive residue. In environmental testing, where water vapor is plentiful, the citric acid crystal re-hydrolyzed, making some locally concentrated acid. The corrosion ensued.

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When the assembler ceased the practice of baking on the flux, and when they implemented saponifier cleaning, the problems ceased. The citric acid was no longer concentrated and more of it was rinsed away. The problem occurred in the first place because the only criteria of judgment was the ability to form good solder joints, without considering the resulting residues or their effects.

Lest we snicker up our sleeves at this assembler, similar things may be happening in your facility during touch-up soldering. Many operators keep a little squeeze bottle of uncut OA flux (probably from your wave solder supply) hidden away for problem joints but would swear, upon asking, of never having seen that bottle before! Many fluxes are designed to be applied in a specific way, and in limited amounts. Using them outside of the recommended methods and amounts means you are on your own.