



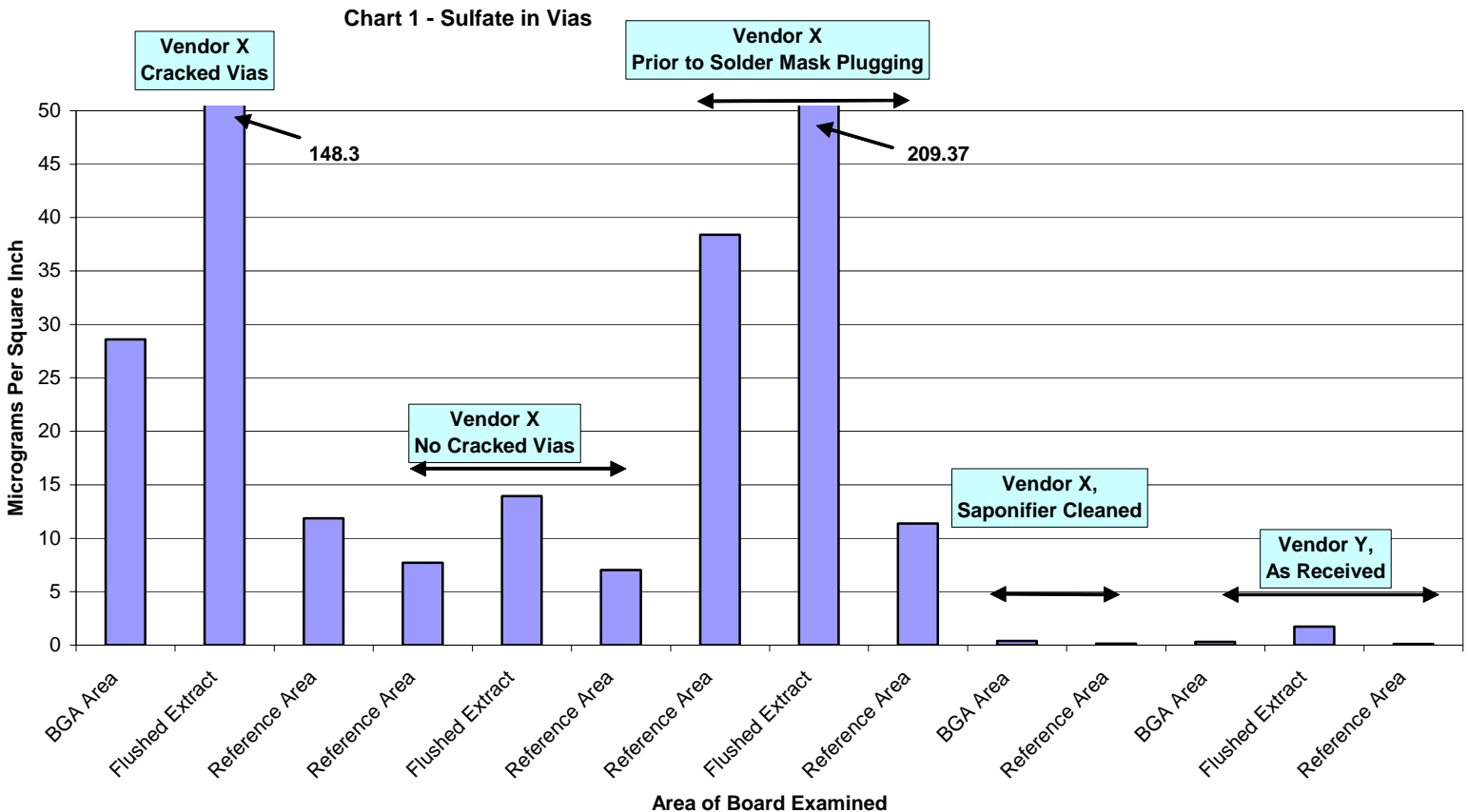
Sulfates in Vias

A Continuation of the case entitled *It Cracks Me Up*
Foresite Inc.

This is a follow on column to *It Cracks Me Up*. In that previous column, we examined the problem that an assembler was having with high levels of sulfate remaining in small diameter (less than 13 mils) vias. The high level of sulfate combined with the water from an aqueous cleaning process and subsequent reflow preheats to etch open the barrels of the holes in a circumferential manner. The sulfate had remained in the holes as a residue from an organic solder preservative (OSP) coating process, which contained sulfuric acid as a microetch agent. The problem had not surfaced until the hole diameters became very small relative to the depth of the via (large aspect ratio). As this goes to press, that assembler and fabricator were looking at different options, both for better cleaning and for examining vias that were not capped on one side. When viewing a phenomena such as this, we always wonder if the problem was specific to a fabricator, or was it a characteristic of the technology that has not been examined before.

The assembler had numerous fabrication sources for the various part numbers of bare boards, some of which contained the small diameter holes in a dense configuration (BGA). They had several fabricators ship us boards to examine the suspect areas. One of the other vendors (Vendor X) examined also had the via cracking problem on an intermittent basis. Vendor Y did not have such problems.

Chart #1 shows an examination of the Vendor X and Vendor Y boards. We examined the BGA via area by cutting that segment from the board prior to extraction. We took other samples and flushed 20 vias in the suspect areas with hot extract solution (isopropanol / DI water) and captured the extract. We also looked at segments of the bare boards where the via density was much lower.

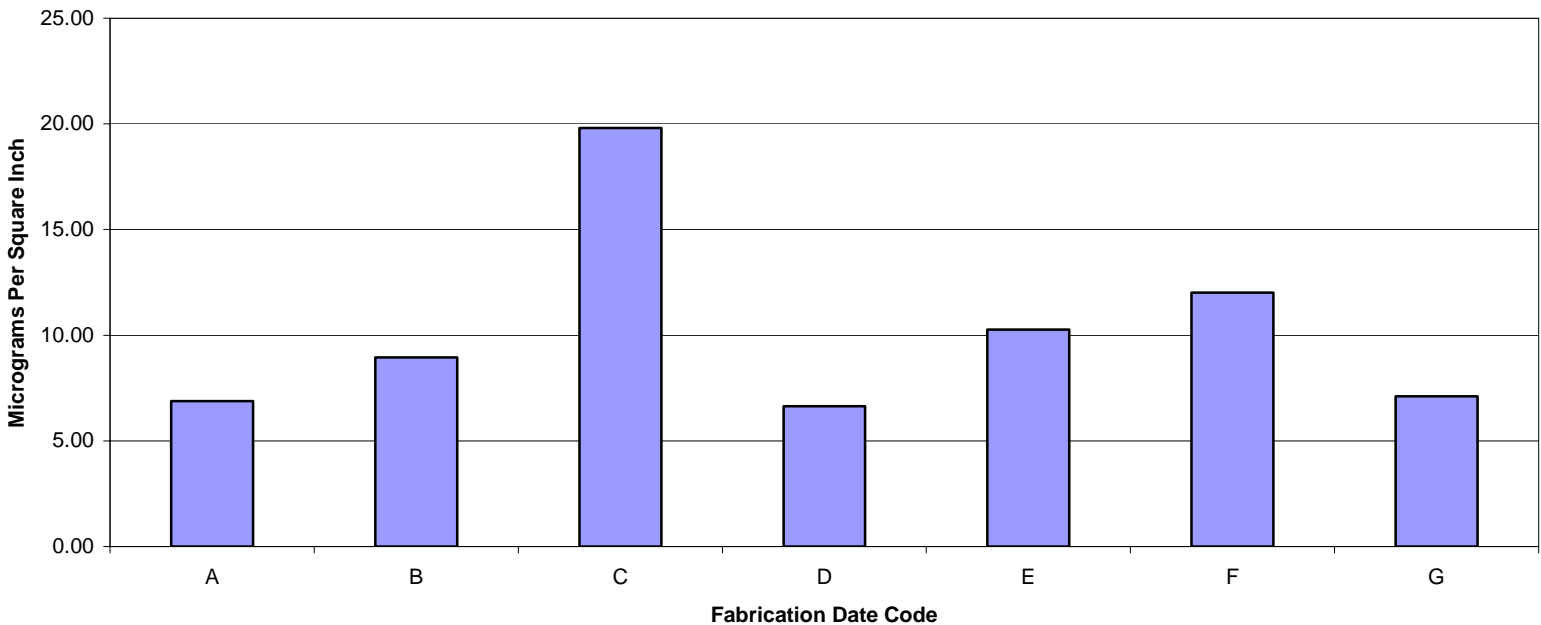




For the boards from lots corresponding with the cracked vias, we saw that the sulfate levels in the BGA areas were very high. As a guideline, Foresite recommends a maximum of 3.0 micrograms per square inch for sulfate. The levels of sulfates on boards from Vendor X, which did not correspond to a via cracking problem, were still above our recommended level, but significantly lower than the problem lots. In contrast, Vendor Y had acceptably low levels of sulfate for the same board configuration. We examined the suspect boards prior to the solder mask hole plugging operation and found sulfate levels even higher than before. The cleaning process used in fabrication lowered the amounts to some degree, but not enough. The fabricator cleaned some of their bare boards with a saponifier solution (140°F, 5% concentration, 5 minute soak) prior to the standard water cleaning. The saponifier surfactant package allowed the water to get into the vias and significantly reduce the sulfate residues. In general, sulfates are fairly water cleanable, provided you can get enough water to the residue with sufficient flow-through.

We examined Vendor X boards across several date codes as outlined in Chart 2, examining only the BGA area. The values shown are the averages of 3 samples. There was a high variability within each set of 3 samples. The sulfate levels varied week to week and appeared to be a consistent problem.

Chart 2 - Sulfate Levels Across Date Codes





We examined the Vendor X boards across a larger data sampling within a specific lot. The levels were consistently above what we recommend and fairly variable. Vendor X did some experimentation with saponified cleaning of the finished bare boards using the same process as before, with a dramatic improvement in via cleanliness, which can be seen in Chart 3.

The point of the study is not to incite panic or cause trouble with your fabricator, but to point out that residues can become entrapped in bare boards. This is true for acid residues as well as flux residues in HASL. As technology forces us to tighter and tighter vias, there is a cleaning threshold that is crossed. Normal cleaning needs to be bolstered in such cases. Designers need to be aware of this potential problem in manufacturability.

Authors Note: No, we won't tell you who the fabricators or assemblers are, so don't ask.

Chart 3 - Sulfate Levels on Boards

