MicroBGA Cleaning

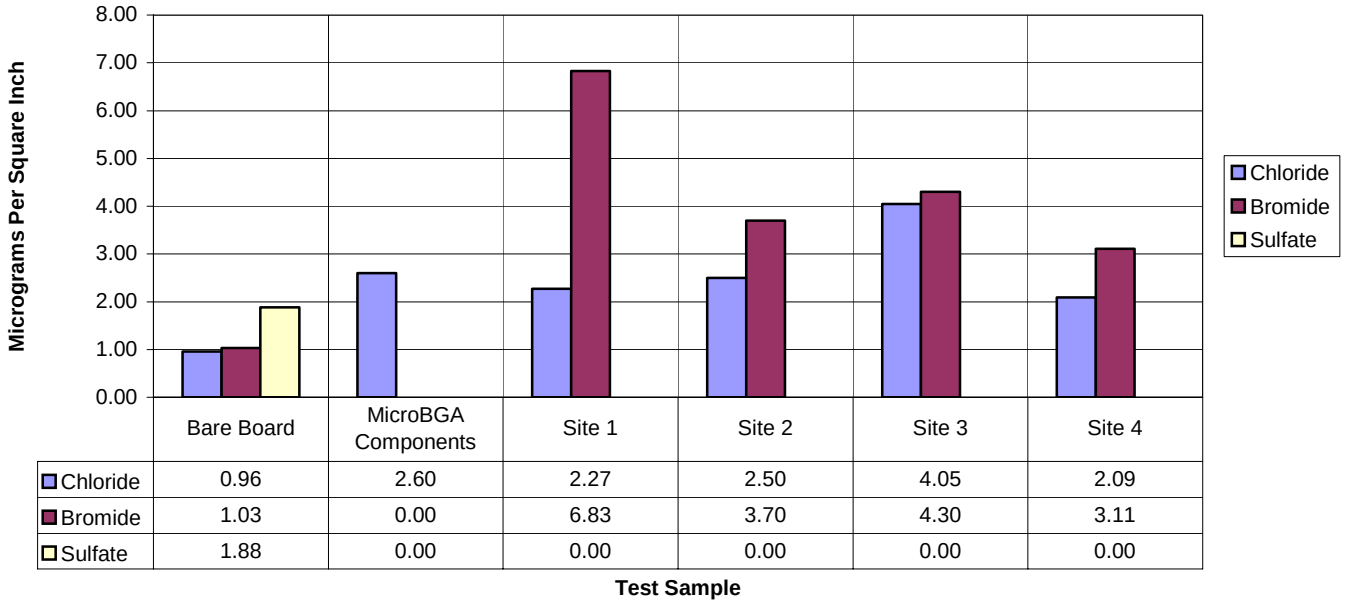
A high pressure cleaning approach is not the answer when dealing with sensitive components

Foresite Inc.

Micro ball grid arrays (μBGAs) have received a great deal of attention lately, so we thought we would dust off a case study where a client was examining the residue aspects (cleanliness) of micro-BGAs, when processed with aqueous cleaning. The push towards μBGAs means a decreased bump-to-bump spacing and generally lower standoffs. This generally equates to a greater sensitivity to contaminants and a greater cleaning challenge. The client wanted to do testing to make sure that the residues that were on the product would not result in unreliable performance.

The client used a custom test vehicle (see Figure 1) which contained four different test areas. Each site contained a different kind of μBGA device. Site 1 had no surrounding components to interfere with cleaning. Sites 2 and 3 had two closely spaced μBGA devices. Site 4 was surrounded with numerous components (non-μBGA) which could interfere with cleaning efficiency. After processing with the OA paste and cleaning, we cut out the segments from each test vehicle and analyzed the residues by ion chromatography. The OA paste used was halide-free, with predominantly weak organic acid (WOA) activators. We also examined the bare boards for two reasons: the more advanced the packaging, the greater the effect of bare board residues; and to assess the amount of end-item residues, it is useful to know the starting residue levels. For the same reasoning, we examined the residues on the micro-BGAs themselves. Charts 1 and 2 show typical results. The bromide residues were due solely to the fire retardant in the laminate and the thermal effects in processing. The sulfates were found only on the bare boards, either as sulfate from tap water rinsing or from residual acid from plating. In either case, the cleaning process removed the sulfate. Chloride and WOA residues were the interesting parts.

Micro BGA Cleaning - Chart 1



	Bare Board	MicroBGA Components	Site 1	Site 2	Site 3	Site 4
Chloride	0.96	2.60	2.27	2.50	4.05	2.09
Bromide	1.03	0.00	6.83	3.70	4.30	3.11
Sulfate	1.88	0.00	0.00	0.00	0.00	0.00

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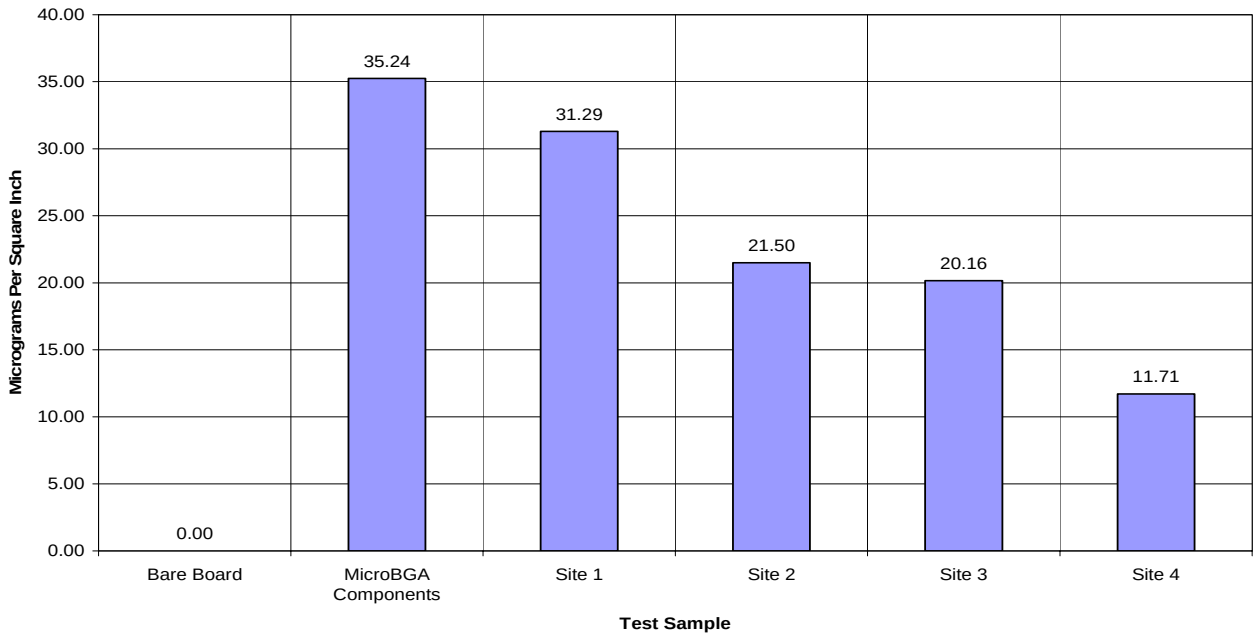
Micro BGA Cleaning - Chart 2
WOA Levels After Cleaning



The bare boards (nickel-gold metallization) were fairly clean in our estimation. We recommend approximately 1 microgram per square inch of chloride for a Ni-Au board. The micro-BGA devices had a surprisingly high level of chloride. Due to the sensitivity of these devices, we recommend a maximum chloride level of 0.6 $\mu g/in^2$. Both the chloride and the WOA residues on the μBGA devices were from the flux used during the bumping process. In our experience, awareness of component cleanliness is often minimal for many assemblers. The residues on the μBGAs carried through the manufacturing process, providing an additional residue challenge.

As a frame of reference for the residues in Sites 1-4, we recommend a maximum chloride level of 1.0 $\mu g/in^2$ for assembled boards with either μBGAs or hybrids. Using this guideline, we saw unacceptably high levels of chloride on the finished boards. Comparing sites 1-4 showed chloride levels that defied conventional wisdom. Site 4, as the greatest cleaning challenge, had the lowest chloride and the lowest WOA residues. In addition, sites 1-4 represented increasing cleaning challenges, but the WOA residue levels decreased as the site increase. This was puzzling until we started to examine the cleaning dynamics.

The cleaner used some fairly high wash and pressures (70-80 psi). In the areas where components did not “impede” the cleaning media, such as Site 1, the water had too much energy and bounced off the board, rather than clean under components. In the Site 4 area, the “shielding” components allowed the water more of a flushing action, flooding the area at a lower pressure. Such an action resulted in improved cleaning and reduced residue levels in Site 4. Sites 2 and 3 had adjacent μBGA devices that tended to block each other to some extent. The manufacturer converted the wash operation to a high flow flood at a lower pressure (30-35 psi), which has resulted in a cleaner assembly. The manufacturer is also precleaning the μBGA devices until the supplier can give a more consistently clean product.

Morals of the Story:

- For very sensitive components, like μBGAs and hybrids, don't assume they are clean as delivered
- A lower-pressure / high-flood cleaning may net better cleaning than a high pressure blast.

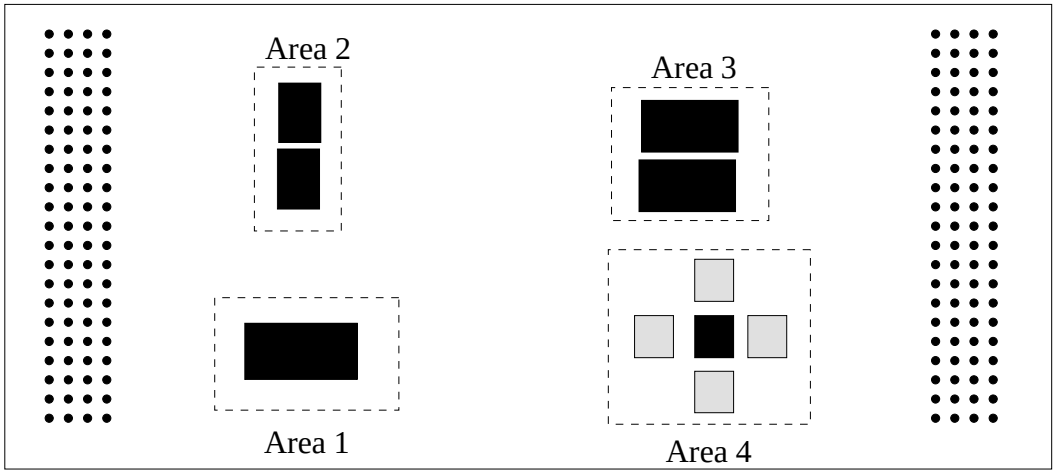


Figure 1.