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Just Wash Your Troubles Away

Ensuring good cleaning processes & bare board cleanliness can save time, money and face

Foresite Inc.

Introduction

Many PCB fabricators find themselves "behind the eight ball" when it comes to meeting the cleaning challenges that today's new assembly processes and component technologies present. Many are not privy to the reliability risks that insufficient bare board cleaning creates for today's electronic assemblies. Some may be aware of the risks, but cannot justify the cost of purchasing new cleaning systems or upgrading existing ones. Some maintain that they already do meet customer-imposed bare-board cleanliness requirements. Regardless of the cleaning methods used, the industry's direction is clearly towards low-solids (no-clean) assembly processes, placing much of the cleanliness burden on the PCB fabricator. The following discussion provides a simple example of how water quality, one aspect of an effective cleaning regimen, impacts the levels of fabrication residues that eventually transfer to the assembly.

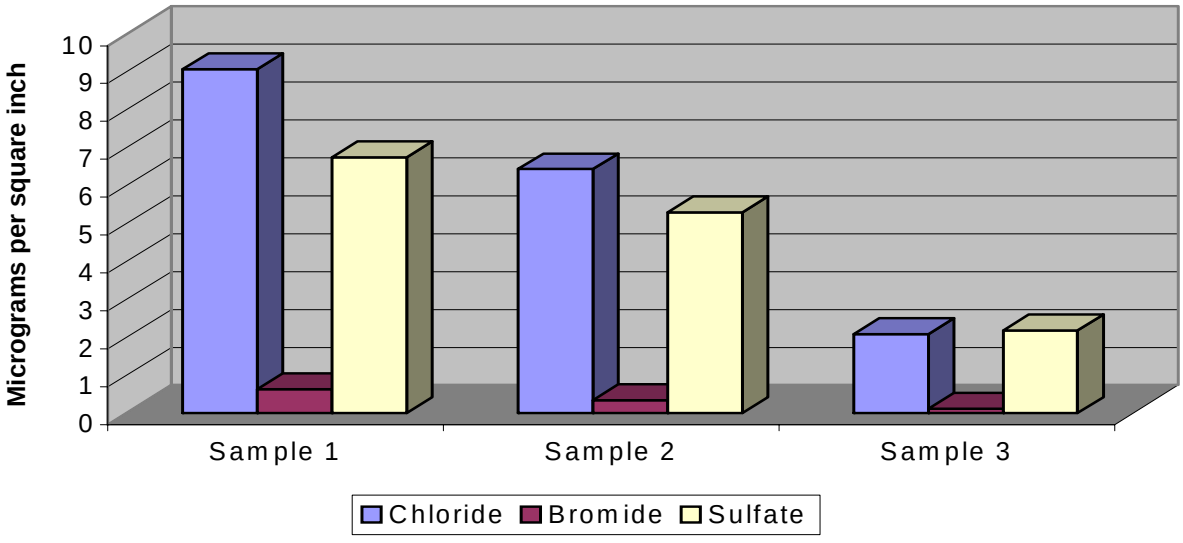
Making the Comparison

We were tasked to evaluate and compare the ionic cleanliness of bare boards from a large PCB fabricator. The fabricator provided a matrix of boards that represented various cleaning regimens. The boards consisted of FR-4 laminate with LPI solder mask and tin/lead HASL metallization. We subjected the PCBs to Ion Chromatography (IC) testing per IPC-TM-650, method 2.3.28. Table 1 and Figure 1 summarize the IC data, measured in units of $\mu g/in^2$.

TABLE 1. Bare Board Ion Chromatography Data

Sample #	Sample Description	Chloride	Bromide	Sulfate
1	No cleaning	9.07	0.63	6.74
2	Washed in recommended saponifier for 2 minutes @135°F and rinsed in city (tap) water	6.43	0.34	5.29
3	Washed in recommended saponifier for 2 minutes @135°F, rinsed in DI water, and air-dried	2.08	0.11	2.17

Figure 1. Bare Board Ion Chromatography Data



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Fabrication residues not sufficiently removed from bare boards can transfer to the assembly process, thereby creating a significant threat for electrochemical failures in finished assemblies. Water purity level is a huge contributing factor to the cleanliness of bare boards. Comparison analysis of the data presented in Table 1 and Figure 1 validates the impact that water purity has on the halide residue levels remaining on bare circuit boards. The sample cleaned in deionized (DI) water with saponifier exhibits the lowest overall halide levels. It also indicates a nearly 70% reduction in both chloride and bromide and nearly 60% reduction in sulfate. Tap water cleaning with saponifier did provide some reduction in halide levels relative to those observed on the uncleaned bare board. However, the chloride and sulfate levels are still above our recommended maximums. The bare board cleaned in tap water and, certainly, the uncleaned bare board are both at risk of electrochemical failures on finished assemblies.

Saponification?

In our example, we proved saponified water has a positive impact on the amount of hazardous residues remaining on bare boards. Why is saponified water versus water-only cleaning so effective? Although we will discuss the use of saponifiers in future articles as a means of improving a given cleaning process, a brief introduction is befitting here for those fabricators new to the concept. Cleaning in tap water or de-ionized water only is usually not enough to remove harmful process residues to suitable levels for assembly. An effective saponifier, added to the wash water in a fabrication cleaning process, has two important performance characteristics. First are the neutralizers that dissolve flux residues or other contaminants. Second are the surfactants that reduce the surface tension of water, thereby allowing penetration of tight geometries. Although they are not necessary in all situations, certain saponifiers can be particularly effective for the more tenacious cleaning challenge. A word of caution: saponifiers are not one in the same; most have their shortcomings.

Is It Worth the Risk?: Weighing Reliability Versus Cost

Our simple real-life example in this article shows the significant impact that water purity has on bare board cleanliness. DI water is indeed superior to cleaning with tap water only. It seems like an obvious choice for PCB fabricators to switch from marginal tap water cleaning to implementing processes using de-ionized water cleaning, that is until it comes to the purchase of new equipment. Moreover, the associated cost of conversion for the sake of reliability is a difficult task. In most cases, management does not take a proactive stance on improvements in their own processes, especially when it involves cost. However, they will often take a leap of faith with an existing or new customer, making the commitment to supply bare circuit boards while unaware that the customer is using a no-clean assembly process. Their PCB fabrication cleaning practices may not meet the requirements. The fabricator becomes painfully aware when the customer is in a crisis regarding the reliability and performance of their products. By this time, it is too late; the PCB fabricator's reputation for reliability is tainted. Ironically, the PCB fabricator usually ends up having to purchase new equipment anyway to save face and potential loss of existing or new business.

So, are marginal cleaning practices really worth the risk? The choice is clear (de-ionized water, of course) and even a little saponifier for good measure!