Optimizing Mixed Metal Manufacturing

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Just because the official RoHS compliance deadline officially hit on July 1, 2006 doesn't mean that every manufacturer has switched to a lead-free process. In fact, many firms haven't – and won't – make that switch anytime soon, if ever. The exemptions under the RoHS legislation are many – products for automotive, aerospace, medical – and, consequently, tin-lead manufacturing is alive and well. Or is it?

Though many manufacturers are still using SnPb, their suppliers are not. Printed circuit board (PCB) and component suppliers have completely transitioned or are quickly migrating their products to lead-free. Sometimes changes in plating are not identified, boards may have different finishes on the same PCB and components may be supplied with a diversity of lead finishes such as pure Sn, SnBi or AuPdNi. Because tin-lead finished board and component availability is dwindling – and fast – those firms that must still use SnPb processes have no choice but to use lead-free devices within their otherwise tin-lead manufacturing operations. Attempting to reflow a lead-free device with a tin-lead optimized profile simply may not work. The result can be incomplete wetting, which causes defects such as voiding and opens. Conversely, trying to force tin-lead solder paste through a higher temperature profile isn't ideal either, as the elevated temperatures exceed the capability of most tin-lead pastes and, again, incomplete wetting is the result.

With standard leaded devices, the most common issue with mixed metal manufacturing is improper wetting. But much more catastrophic problems exist when using lead-free bumped array devices within a SnPb process. SnPb solder pastes achieve liquidus at 183°C but the Pb-free SAC alloys used to bump array devices most often require a temperature of 217°C. If the lead-free BGA and CSP bumps are processed at lower, tin-lead temperatures, incomplete bump melting or collapsing occurs. Ideally, the goal is to promote even distribution of lead (Pb) from the tin-lead paste throughout the solder joint but, if the lead-free bump doesn't melt completely, achieving this condition is impossible. Without the lead evenly dispersed within each solder joint, premature joint cracking and early thermal fatigue are the most likely outcomes, yielding uncertain device reliability (J. Pan, et al., IPC/JEDEC Pb-free Conference, San Jose, 2006.). To account for this, some manufacturers have attempted to raise the reflow temperatures to encourage complete bump melting and the lead distribution required. This method is problematic, too, as the elevated temperatures may cause dewetting on the other solder joints on the assembly.

What's an exempt manufacturer to do? Basically, there are two options. The first, and definitely less reliable approach, is to re-bump the lead-free BGA. To do this, one must remove all the Pb-free material – including the bumps and the intermetallic – from the device and then re-bump them with tin-lead solder. This method is rife with problems: the package has to go through another intensive heat cycle which can lead cracking and delamination within the package and, thus, earlier device failure. And, because any device altering procedures violate the component manufacturer's warranty, you're basically out of luck should there be any subsequent problems with the component. As if the reliability concerns weren't enough, re-bumping a device is also a difficult, expensive and time-consuming process.

The second and better option is to find a solution that will work within an assembler's current process and enable the use of a single paste for the entire assembly. The temperature has to be raised enough so that the tin-lead/lead-free mixture dissolves the lead into the solder joint and results in a homogeneous mixture and a higher reliability end-product. Through a unique formulation, the materials experts at Henkel have developed a tin-lead paste that solves the mixed metals dilemma for today's manufacturers. Multicore® MP218 is a halide-free, no-clean solder paste developed specifically for compatibility in higher-temperature processes. Comprised of similar raw materials, activators and components used in the company's award-winning lead-free solder pastes, Multicore MP218 effectively achieves lead-free performance within a tin-lead system. The extra activity and wider process window of the material overcomes challenges caused by the interaction of SnPb solder and lead-free device finishes. What's more, Multicore MP218 also has a high resistance to humidity -- another condition that is problematic and exacerbated in a SnPb – Pb-free mixed environment. The properties of Multicore MP218 alleviate many of the humidity-related challenges of pre-mature drying or undue moisture absorption and are suitable for varied global climactic conditions.

Without question, mixed metal manufacturing is here to stay, as the exemption deadline is uncertain and the availability of tin-lead finished PCBs and devices is continually reduced. Using a tin-lead solder paste formulated to withstand higher lead-free processing conditions is the most-cost effective approach to ensuring long-term reliability.

For more information on Henkel's Multicore MP218 material technology, log onto www.goleadfree.com or call 1-888-9Henkel to speak to a technical specialist.