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## Lead-Free Cleaning

Q: Will the implementation of a lead-free soldering process impact cleaning?

A: Yes, and for a multitude of reasons.

A lead-free reflow process subjects the assemblies to higher temperatures (due to a higher melting temperature) compared to Sn/Pb. As in all post-reflow cleaning applications, reflow temperature has a direct result on the cleaning process. As a rule, higher reflow temperatures create a more challenging cleaning process. In short, the hotter the flux gets, the more difficult the cleaning process becomes.

In any soldering process, metal salts are formed during the reflow process as the flux reacts with the oxides on the board's surface. These metal salts are normally encapsulated into the flux and are easily removed during the cleaning process. In lead-free reflow applications however, higher temperatures increase oxidation and thus metal salts. Higher temperatures also reduce the flux's ability to encapsulate the metal salts allowing them instead to adhere to the board's surface creating a white residue and additional cleaning challenges. Because there are no low-temperature lead-free solder pastes, higher temperature lead-free profiles are a fact of life.

In Sn/Pb reflow applications, water soluble fluxes are normally removed without the need for a chemical additive. In lead-free applications however, a chemical additive may be required for all flux types due to the higher reflow temperatures and the resulting volatilization of the flux.

Flux removal is a process consisting of a mechanical and chemical component. Wash solution (water and chemical), delivered under pressure is sprayed onto the board's surface and under its components. In addition to the normal challenges of ensuring thorough under component penetration (impingement), the cleaning system must also contend with a more volatilized and therefore more difficult to remove flux and additional salts on the board's surface.

One potential remedy would be to increase the wash time and therefore the amount of time wash solution is sprayed onto the board's surface. This potential solution may not be desirable as most cleaning chemicals utilize a high pH formulation, which, over time, may cause solder joint dulling. A more effective solution is to increase the power in the wash section of the cleaning system. If wash solution can be delivered to the board's surface under increased pressure and flow rates, the result would be more cleaning in less time. The increased pressures assist the chemical in "solubilizing" the flux while the reduction in contact time prevents solder joint dulling due.

Cleaning has always been a combined contribution of mechanical energy (the cleaning machine) and the chemistry. In the days of solvent filled vapor degreasers, the balance of power was heavily weighted toward chemistry. The chemical performed almost all of the work while the cleaning machine mattered little. Today however, the balance of power has shifted toward the cleaning machine. While chemicals remain an undeniably vital component, the cleaning machine has the greatest influence in the effectiveness of the overall cleaning process. Recent environmental legislation (the reduction of VOC limits from 50 g/liter to 25 g/liter in some states) has pushed the reliance on the cleaning machine to an even greater level.

Advancements in cleaning equipment and cleaning chemistry technology will allow successful implementation of a cleaning process in a lead-free and low VOC environment.