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STEP 8: Cleaning
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One must first decide whether or not to clean. Is the flux left on the board after reflow inert? Will reliability be an issue? This article focuses on batch-format cleaning technology and its use to deflux high-reliability applications.

Leaving post-reflowed flux residue on the board may lead to reliability and liability issues. Proper cleaning eliminates these concerns. There are several factors to consider when choosing a defluxing method, including throughput requirements, flux type, solder alloy, effluent restrictions, and budget.

Manual defluxing methods provide the worst-case scenario with respect to cleanliness, consistency, and operator safety. These defluxing processes involve dipping a board into a solvent-based defluxing chemical or spraying a defluxing chemical onto a board - applying mechanical energy by way of an acid brush. Typically, this process is followed by dipping the assembly into a pan of water or placing it under a running faucet.

Nearly all manual cleaning scenarios dilute flux and spread it around the board. Flux is frequently trapped under components because manually applied cleaning agents cannot penetrate under the component. In most manual cleaning environments, inadequate rinsing is frequent - trapping highly conductive and corrosive cleaning agents. Modern automatic defluxing equipment eliminates common deficiencies associated with manual cleaning operations.

There are two common automated defluxing technologies - batch and inline. Each technology has specific advantages and disadvantages, strengths and weaknesses. This article focuses on batch-format technology because the majority of assemblies subjected to defluxing are used in high-reliability applications such as military, medical, and aerospace. These applications are less likely to benefit from the tremendous throughput capabilities of inline (conveyorized) defluxing systems, and require extra degrees of process control and statistical process control (SPC) commonly available on batch-format technologies (Figure 1). Before evaluating specific automated defluxing technologies, one must understand the defluxing process, which comprises four stages: wash, rinse, cleanliness test, and dry.

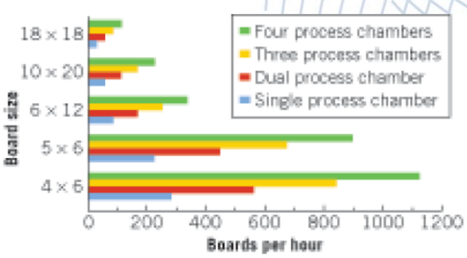

Figure 1. Throughput capability of a batch-format defluxing system.

Wash. During a wash cycle, solution is sprayed onto a load of multiple assemblies - placing flux into the solution. Environmentally safe defluxing chemicals are effective at solubilizing the flux and placing it into the solution.

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Proper wash-solution contact is vital for thorough defluxing. With board densities increasing and component standoff heights decreasing, defluxing systems must be capable of applying the wash solution to all areas of the assembly, including under components. Defluxing equipment must posses enough power to provide adequate under-component impingement of the wash solution. All modern defluxing chemicals require some degree of heat. Wash temperatures of 140°-160°F are common, making heater-equipped defluxing equipment a requirement.

Modern defluxing chemicals, although more environmentally and operator safe than solvent counterparts, can be expensive. Many modern defluxing systems are equipped with wash-solution recycling technology, enabling the filtration and subsequent reuse of the wash solution. This feature lowers the operating cost as must as 70%.

Rinse and cleanliness test. The most critical part of the defluxing process is the rinse cycle, when the wash solution itself must be removed. Wash solution is both highly conductive and corrosive if left on the board. Thorough rinsing is vital to final cleanliness and future reliability. Many batch-format defluxing systems are equipped with on-board cleanliness (resistivity) testers that can detect the presence of conductive materials in the rinse water. Fortunately, defluxing chemicals are conductive and detected easily. Many batch-format defluxing systems are equipped with control systems that detect the presence of wash chemicals, flux, and other conductive properties in the rinse water; and will adjust the quantity of rinse cycles automatically to ensure their removal.

Dry. Most batch-format defluxing systems are equipped with drying capabilities, either a convection-dry technology or a radiant-heat process. Recent advances in batch-format defluxers allow the machine to use a combination of both technologies to provide thorough drying in relatively short cycle times.

There are several specifics to consider when determining appropriate fluxing method. Before determining defluxing technology, one must consider throughput requirements and capabilities of the technology/model being investigated. As with any batch process, boards are cleaned in a group. The specific quantity of boards that may be cleaned together is based on the size of the wash chamber and the boards. Throughput capabilities of individual models vary. Consider the latest batch-format technology that incorporates a selectable quantity of multiple process chambers into a single footprint.

Once an appropriate throughput-capable machine is chosen, it is important to consider the specific flux to be removed. Ironically, the most common flux being removed from circuit board assemblies is noclean. All no-clean flux residues require a chemical additive in the wash water for thorough removal. Rosin (R, RA, RMA) and no-clean fluxes require a chemical-equipped wash solution. With several chemicals on the market and even more fluxes, it is vital to ensure that the wash chemical can remove specific flux types. It also must be compatible with the equipment.

Although all defluxing systems are capable of removing flux residues, not all systems are compatible with lead-free alloys. Lead-free solder paste generally requires higher reflow temperatures compared to eutectic alloys. Heat has always been the enemy of cleaning. Increased reflow temperatures make flux residues more difficult to remove. Modern defluxing technology incorporates specific design elements such as increased pressure and flow. Focused nozzle technology has proved effective on removing flux residues on applications using lead-free technologies.

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Although current defluxing systems and chemistries are generally considered environmentally safe, many users have implemented voluntary discharge restrictions to eliminate the possibility of liability caused by changing environmental legislation. All conventional defluxing equipment requires a water supply and a drain. Closed-loop configurations are available for water-soluble defluxing applications, but are not suitable for chemical-required applications, such as removing no-clean or rosin-based fluxes. Zero-discharge configurations using high-efficiency evaporation technologies provide environmental compliance in chemical-required defluxing applications. The price for defluxing equipment varies. Power, throughput capabilities, discharge configurations, and other options affect price. When choosing a specific defluxing system, consider all current and anticipated needs.

Conclusion

As technology changes to meet the demands of society, the government, and budgets, technological advances address these challenges. Be sure that the brand and technology you choose is capable of exceeding all current defluxing requirements to ensure equipment relevancy for several years.

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Published in SMT Magazine