TECHtips

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Electronics Manufacturing Insights from ACI Technologies, Inc.

Cleaning

The removal of residues remaining on a printed circuit assembly is required in many processes. The most common techniques available to engineers developing a process that incorporates cleaning steps are:

- solvent/co-solvent
- aqueous
- semi-aqueous
- plasma

Solvent and co-solvent cleaning involves the use of engineered solvents in a vapor phase system. The solvents classically used were Class 1 Ozone Depleting Substances, but new types of solvents have been developed that are less environmentally harmful. In some cases, isopropyl alcohol is used with a co-solvent. In these types of cleaning systems, a cloud of boiling vapor solvent is maintained between a boil sump and a cooling coil. When the items to be cleaned are immersed in the vapor cloud, the solvent condenses on the assemblies and acts to dissolve the residues. These processes usually involve a final rinse step outside of the vapor cloud to ensure that all dissolved residues are washed off the assemblies (Figure 1).

The advantages of solvent cleaning are the short cycle times of the process, the quick drying times of the solvents, and the lack of waste treatment required (as vapor phase systems are closed loop). The disadvantages of these systems are the flammability of some solvents (e.g., isopropyl alcohol) and the relative expense of the solvent materials.

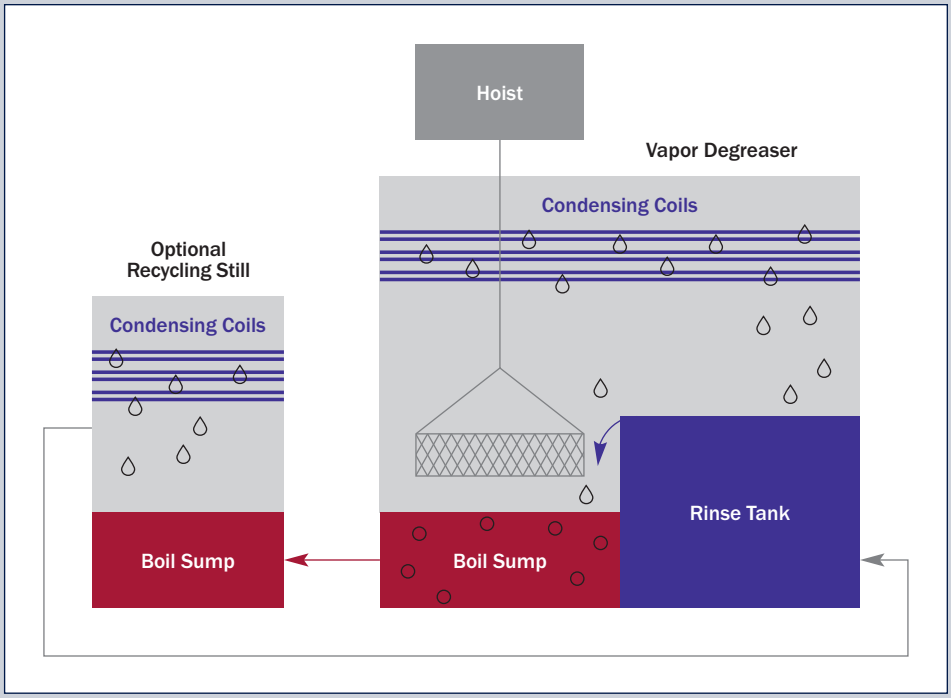

Figure 1: Final rinse step.

Semi-aqueous systems use an organic solvent that is applied by spraying liquid (sometimes heated) directly to the assembly to remove unwanted residues. The solvent leaves a residue that must be removed by rinsing in deionized water in a secondary step and then must be dried (Figure 2).

The advantages of a semi-aqueous cleaner include that the solvents are generally low in cost, provide wide compatibility with electronics materials, and the ability to minimize discharge by using a closed loop system. The disadvantages of using this type of cleaning system is that the required water rinse may be difficult to remove from under complex or fine-pitch components, the rinse water may react with and corrode hardware, and the waste water may require treatment for environmental control.

Aqueous cleaning systems use deionized water as the cleaning and rinse solution. These types of systems can be used with water-soluble fluxes. The water cleaning stage may have added saponifiers to increase the solubility of rosin-based materials and to allow the cleaning water to penetrate tighter surfaces.

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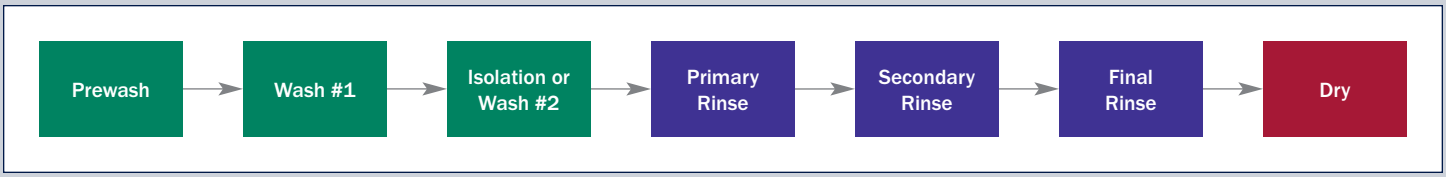

Figure 2: Secondary rinse step and drying.

The advantages of an aqueous cleaning system is that the systems have minimal requirements for waste control and handling, use less costly materials than solvents or semi-aqueous chemistries, and they allow the use of either water-soluble or rosin-based fluxes in the same cleaning system. The disadvantages of aqueous cleaning are similar to the semi-aqueous cleaners: the required water rinse may be difficult to remove from under complex or fine-pitch components, the rinse water may react with and corrode hardware, and the waste water may require treatment for environmental control.

Plasma cleaning is typically performed prior to wire bonding in order to clean the surfaces at the molecular level. Plasma is an ionized gas and is considered the fourth state of matter. In cleaning operations, the gases used are commonly Ar, O2, and CF4. The gas is energized by high frequency RF energy and the resulting plasma is introduced to the cleaning chamber. The plasma reacts with substances on the surface of the assembly and the resulting gas is evacuated from the chamber using a vacuum pump. The plasma can also clean the surface of the assembly by colliding with and knocking contaminants off the surface, where they are removed by a vacuum pump.

The advantage of plasma cleaning is that it is a solvent-free cleaning system where only the exhaust materials need to be monitored for environmental compliance. In addition, the lack of water alleviates concerns with corrosion of hardware. The disadvantage of plasma cleaning is the poor reactivity of plasma to inorganic residues.

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