CHEMASK® WF SOLDER MASKING AGENT: AN ADVANCEMENT IN WATER REMOVABLE SPOT MASKS

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Overview

The manufacture of printed circuit boards involves many automated process steps. These processes are designed to accurately and quickly place components onto a circuit board in the minimum time required achieving the highest production quantity possible. Many chemicals are used in these steps such as soldering flux, adhesives, solder paste and temporary spot mask. While it is necessary to use these materials during various stages of the production process, residues from these chemicals can remain on the completed board and be detrimental to its performance.

Aqueous cleaning processes can be used to remove these residues. The most efficient aqueous cleaning method is the in-line, closed-loop aqueous system. This type of system involves recirculating process water through deionizing resins to remove ionic and other contaminants from the process stream, allowing the water to be reused. Though most systems are designed to remove contaminants introduced by the solder paste and flux, other materials such as protective Kapton® tape, plugs and peelable spot masks must still be removed by hand. Hand removal significantly slows down the manufacturing process. Water-soluble spot masks were introduced to increase process efficiency and throughput. However, some masks contain materials that significantly reduce the process life of the deionizing resins. This results in more frequent replacement of resin beds, and increases manufacturing costs considerably. In response to this situation, ITW Chemtronics® has developed Chemask® WF Solder Masking Agent. Chemask WF is a temporary water filterable mask that can be removed using aqueous cleaning systems without a detrimental effect on the deionizing resin beds.

Circuit Board Assembly

The circuit board assembly process is an in-line procedure that can be broken down into three sub-categories: (1) component placement, (2) soldering (wave or reflow), and (3) aqueous cleaning. The first two processes contribute contaminants to the board that challenge the integrity of the resin beds in the deionization (DI) system. Careful consideration of the contaminants involved provide a basis for the design of the DI system, as well as the choice of the proper type of spot mask (i. e. peelable or water soluble) to use.

The introduction of contaminants actually begins with the printed circuit board laminate. The laminate is built to the manufacturer's requirements based on the specifications the final assembly needs to meet. During assembly the laminate is exposed to a number of harsh acids and other chemicals. The boards are cleaned before being shipped to the component placement facility, but may still contain traces of these chemicals.

Once at the circuit board assembly area, the board continues to be exposed to contamination. Adhesives are screened onto the board to hold the surface mount components in place before soldering. Use of surface mount components also calls for the application of solder paste. After this process a spot mask is applied to protect contact surfaces where additional components will be added after circuit board assembly. These are usually components with odd geometry, or those that cannot withstand the heat of in-line processing. After the spot mask has cured, the board then moves through the wave soldering process.

Although the amount of through-hole components requiring wave soldering is decreasing, wave soldering is still an important process in circuit board assembly. Initially flux is applied to insure proper solder contact. The board passes through the preheat cycle. The

preheat activates the flux and conditions the board for exposure to the high temperatures of the molten solder. It then passes into the wave solder, bonding the through-hole components to the board. Once wave soldering is complete and the board has cooled, it moves through the aqueous cleaning process.

Aqueous Cleaning

The cleaning of the printed circuit board is required for two reasons: (1), to remove contaminants introduced to the board during the laminate fabrication and component plating processes and; (2) to remove residues left by solder flux and solder paste. These residues can interfere with the proper operation of the circuit board if they remained in place. The preferred method for cleaning circuit boards, due to cost considerations and environmental requirements, has become aqueous cleaning.

There are two primary types of in-line aqueous cleaning methods: open loop and closed loop. In both systems, the water used for cleaning is first deionized as it is pumped into the system. In an open-loop aqueous cleaning system rinse water is sent untreated to municipal waste treatment after it has been used to wash the boards. In closed-loop cleaning, the rinse water is recycled through a separation, filtration and deionization process. The cleaned rinse water is then reintroduced to the wash cycle through the final rinse by use of a cascade method. In this method, the ultra-pure recycled water is pumped into the system and used at the final rinse. The water is then circulated backwards through the rinse system until it reaches the initial wash phase. From there it is pumped to the recycling system to begin the process again.

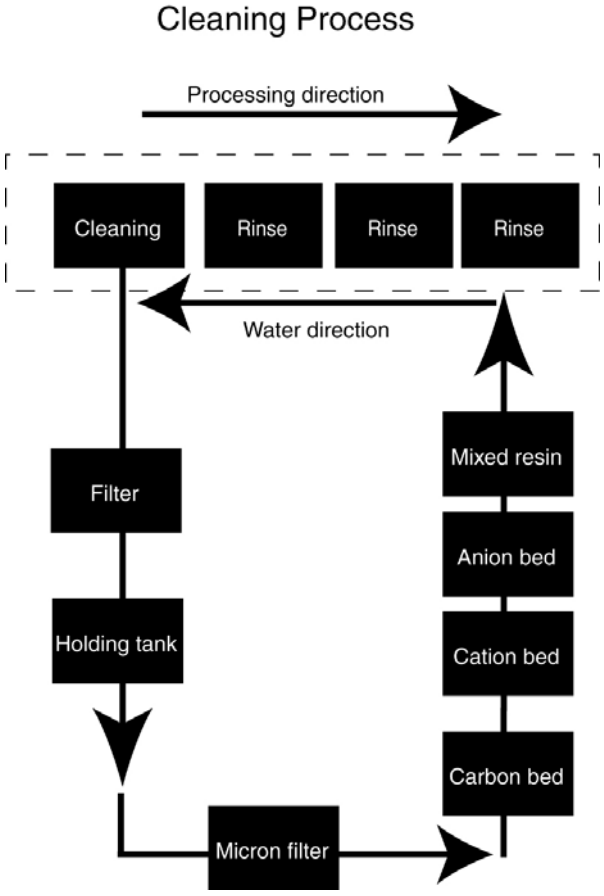

Figure 1. **In-Line cleaning cycle.**

In-line aqueous cleaning systems incorporate the cleaning process in the production line, thereby increasing manufacturing efficiency. However, the use of Kapton® tape or a peelable spot mask presents a bottleneck in the process. After the board emerges from the cleaning

process, the mask must be removed manually. The use of water-filterable spot masks eliminates this step, allowing the board to move on to the inspection process.

Requirements Of A Water-Soluble Spot Mask

The ideal water-soluble mask must meet the same requirements as any spot mask. It must be fast drying, non-sagging and resistant to short-term high-temperature exposure. In addition it must also be easily removed with hot water. Open-loop systems demand the least from a water-soluble mask, since there is no recirculating system to contaminate. For the closed-loop system, the mask must have the previous qualities with the added burden of having minimal affect on the recycling system. In order to do this the mask must not contain any ionic compounds, which would reduce the life cycle of the resin beds. This eliminates the costly premature replacement of the resin or the resin chamber.

The mask must not contain colloidal silica and clay, which are used as thickening media for some spot masks. Both of these materials pass through the smallest micron filters, deposit themselves on the resin beads, and render them ineffective.

The water-filterable mask must also be low foaming. Water in a closed-loop and open-loop systems is being agitated at very high pressure. Under this condition many spot masks can cause extreme foaming, which cause overflow in the wash system.

Chemask® WF Solder Masking Agent

Chemask WF has been designed to address the problems encountered with water-removable technology in open-loop and closed-loop aqueous cleaning systems.

- **Non-Ionic** - Chemask® WF Solder Masking Agent contains non-ionic components, resulting in minimum effect on the ion exchange system. It also does not contain clay-based thickeners or colloidal silica, two components that can attach to resin surfaces leaving a film that interferes with the resin bed deionization function.
- **Water filterable** - Chemask WF can be filtered from the rinse stream, being removed with an inexpensive ten micron bag filter. This reduces the amount of material entering the filtration system, thereby increasing the life span of the activated carbon filters and resin beds.
- **Low Foaming** - Chemask WF has been designed to be low foaming, eliminating overflow due to excessive foaming.
- **Easy To Remove** - Chemask WF is readily removed during normal aqueous cleaning processes.

Application

Conventional application of Chemask WF involves squeezing the product from an 8oz container equipped with an applicator tip. Chemask WF can also be used in a syringe to facilitate application to small areas of the circuit card.

Removal

Chemask WF can be easily removed during the aqueous cleaning process. Optimum water temperature ranges between 120°to 160° F. Optimum wash speed is 2-3 feet per second.

Filtering

It is recommended that a filter bag, rated at ten microns or less in size, be used to remove the particulate portion of Chemask WF. The filter bag is usually placed after the settling tank, and before the water stream enters the de-ionization resin system.

TYPICAL PRODUCT DATA AND PHYSICAL PROPERTIES OF Chemask® WF Solder Masking Agent

Base Material	**Synthetic Resin**
Color	**White**
Solvent Stability	**Dissolves in water with or without detergent**
Flux Compatibility	**Water Soluble Flux**
Temperature Stability	**515°F (268°C)**
Tack-Free Drying Time (10 mils @ 77°F)	**30 min.**
Cure Time (10 mils @ 77°F)	**1 hr.**
Viscosity (@ 77°F) (± 300 cps)	**9,000 cps**
Viscosity Adjusted With	**DI Water**
Contains UV Indicator	**Yes**
Solids Content	**~ 40%**
Flash Point	**Nonflammable**
Patent Number	**US # 6207265**
Weight/Gallon	**8.8 lbs.**

Kapton® is a registered trademark of DuPont.

TECHNICAL & APPLICATION ASSISTANCE

ITW Chemtronics® provides a technical hotline to answer your technical and application related questions. The toll-free number is: **1-800-TECH-401.** Or contact 1-770-424-4888 x 166.

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