

Cleaning Technologies – Trends and Developments

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Cleaning is an essential process within electronics manufacture and has been used for many years to remove potentially harmful contaminants during PCB manufacture.



Such contaminants include flux, solder and adhesive residues, and other more general contaminants such as dust and debris present from other manufacturing processes. The purpose of cleaning, specifically within the rapidly expanding electronics industry, is to essentially improve product lifetime by ensuring good surface resistance and by preventing current leakage leading to PCB failure. This developing market sees modern and future electronics becoming smaller and smaller and the requirement for high performance and reliability is stronger than ever. In order to achieve good insulation resistance and ensure adequate adhesion of conformal coatings and potting and encapsulation resins, the cleanliness of the electronic assemblies is essential.

There are many stages where cleaning is required; prior to stencilling and soldering in order to remove contaminants from the many previous production stages, after stencilling to remove excess adhesive and after soldering to remove corrosive flux residues and any excess solder paste. In industry today, many manufacturers are turning to 'no clean' processes, implying that cleaning is not required after soldering. In the 'no clean' process the solids content of the flux is

lower than traditional types, however they still contain rosin and activator. Such residues, along with any other unwanted elements collected due to the missing cleaning stage, could cause issues with adhesion and possibly affect the performance of the protecting media applied. It can therefore be stated that even with advances in new technologies, such as 'no clean' fluxes, cleaning is still an essential multi-stage process within the electronics industry. Finally, there are also cleaning stages required for the removal of coatings and adhesives when re-work is necessary, for the cleaning of actual components and for maintenance of the production line.

With environmental concerns at an all time high many electronics manufacturers are moving away from traditional solvent cleaners that use ozone depleting chemicals or contain a high VOC (volatile organic compound) content, and replacing them with safer alternatives. Although many solvent cleaners allow a convenient single stage process, water-based cleaners have several advantages including non-flammable properties, low odour, low/non-VOC and very low toxicity. Whether it be ultrasonic, spray under immersion or dishwasher type application, identifying the correct water-based cleaner for the specific job is essential. They utilise surfactant technology to assist the removal of contaminants from a PCB by reducing the interfacial tensions and suspending or emulsifying them in solution. Alternatively, water-based flux removers work by saponification, neutralising the flux acids. The only major disadvantage of water-based cleaners is that they require multiple stages to complete the cleaning process, including a two-stage rinse process and a final drying stage. Finally, there is also a newer type of surfactant-free water based cleaner. Based on glycols, these cleaners combine the advantages of water based and solvent based cleaners with only minimal rinsing required.



Safewash Total (SWAT) offered by Electrolube Ltd is an example of this more advanced water-based cleaning technology. It offers many benefits such as versatility in use, which includes its suitability for a wide range of different equipment and processing types as well as its ability to remove a vast array of contaminants. Safewash Total is even suitable for lead-free and no-clean flux, paste and adhesive residues as well as the removal of general contaminants such as grease and dust. In addition, Safewash Total offers many user and environmental benefits. Supplied in a concentrate form, the product can be used at a range of concentrations depending on the application method and also contains a corrosion inhibitor enabling safe use on sensitive metals such as copper, silver and aluminium. Supplying in concentrate form also reduces the transport cost, both in monetary and environmental terms.

With the cleaning market continually developing to meet the demands of industry expansion it is important that the level of cleanliness required is clearly defined. A significant proportion of potentially damaging flux residues and contaminants are not visible to the naked eye or even with the aid of magnification. It is therefore vitally important that the correct method is used to determine that the level of cleanliness achieved meets the standard specified by the electronics engineer. There are two types of residues; ionic and non-ionic and there are a number of methods that can assess the level of contamination after cleaning and accurately describe the term 'clean'.

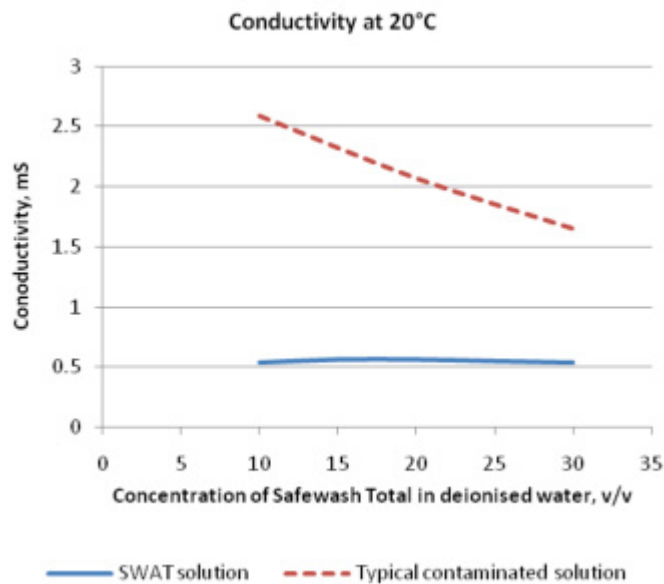
Non-ionic residues including rosin, oils and grease are non-conductive and are usually organic species that remain after board fabrication or assembly. They have insulative properties which

are a problem where plug-in contacts or connectors are utilized on assemblies. These can cause poor adhesion of solder mask, conformal coating and potting compounds as well as encapsulate ionic contaminants and foreign debris. Typical test methods include visual examination under magnification alongside other analytical methods, such as Fourier Transform Infrared Spectroscopy (FTIR).



Ionic contaminants are typically flux residues or harmful materials left behind after soldering. Water-soluble organic or inorganic residues that can disassociate in a solution as charged ions increase the overall conductivity of that solution. They can degrade the reliability of the electronic components and assemblies by contributing to current leakage between the circuitry, causing corrosion and promoting dendrite growth. While both ionic and non-ionic contaminations both impact the operation and reliability of the device on which they are present, ionic contamination accounts for the larger proportion of failures. A common method of determining the degree of ionic contamination is to measure Resistivity of Solvent Extract (ROSE), also known as Solvent Extract Conductivity (SEC). The industry standard, IPC-TM-650, employs a solution of isopropanol and deionised water to extract the contaminants whilst the meter measures the change in conductivity. This type of testing is widely accepted and offers rapid results; it can be restrictive and therefore two further methods can also be utilised to provide valuable data. These are Surface Insulation Resistance (SIR) and Ion Chromatography (IC).

In addition to the level of contamination after cleaning, the control of the cleaning solution itself is essential. The method of solution control will depend on the cleaning chemistry and type of residues being removed; some possible methods shall be discussed, however. Acidic flux residues will generally lower the pH and increase the conductivity, while being relatively unaffected by variations in concentration. Refractive index, or BRIX, gives a measurement of the solids level in the cleaner. Although this can give some indication of contamination level, changes in refractive index over time are more likely to be as a result of variations in the concentration of the solution, often affected by drag out of the cleaning solution into the rinsing cycle. All these methods are simple and require the use of a relatively inexpensive meter. Cloud temperature measurement is another alternative method to control the solution. Simply warming a small sample of the cleaning solution and noting the temperature at which it becomes cloudy will indicate if the solution has become highly contaminated or the concentration has dropped due to drag out.



The effective cleaning of PCBs and associated components is an essential part of electronics manufacture. It increases the reliability of assemblies and allows coating and encapsulation operations to be carried out with full confidence. The type of cleaner chosen depends widely on the manufacturing conditions. Additionally, the correct set-up parameters for each particular application are imperative in order to achieve successful cleaning. Electrolube Ltd offer a range of solvent-based and water-based cleaners, combined with unparalleled technical support to ensure this is possible. The Electrolube Safewash range is the most effective family of aqueous cleaning products available and is currently in use by major manufacturers in a wide variety of cleaning machines. It cleans to both military and commercial standards, at minimal financial and environmental cost. The addition of Safewash Total has ensured that the range continues to provide superior cleaning performance, allow process flexibility and meet the environmental goals of modern electronics manufacturers.

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