

Don't Drink the Water

Water type and quality impacts cleaning effectiveness
when cleaning circuit boards
Foresite Inc.

Introduction

Advice like this used to be limited to those visiting countries whose water supply was less than municipal. The tremendous increase in the sales of bottled water shows that people are now concerned about the quality of their water supplies. We are a clean-conscious society. Most are aware that some contamination is possible or even likely because we have been quite generous with our use (or some might say misuse) of water resources. Most of us are already aware that treated municipal water often contains chemicals added for safe human consumption. Still many of us may not be aware of the possible hazards these chemicals pose to electronics.

How concerned are we about the cleanliness of the water supply used in processing circuit boards? Often in our process troubleshooting we have found that many PCB fabricators use less-than-adequate cleaning methods to remove fabrication residues. This is troublesome considering the number of assemblers converting from traditional high-solids (RMA) fluxes to water-soluble or no-clean fluxes. These new processes have placed the burden on PCB fabricators to produce cleaner circuit boards. At the same time, increased competition demands that they control costs while preserving quality. The foundation of a cleaning regimen that meets the greater demands of a low-solids assembly process is water quality. In this month's article, we will look at the various levels of water quality and the effect water quality has on circuit reliability.

Levels of Water Purity

Water purity falls into three general categories: tap, reverse osmosis (RO), and de-ionized (DI).

Tap water, as the name implies, is water out of the tap. In most U.S. municipal water sources, tap water typically contains chlorine, fluorine, calcium, iron, heavy doses of silica from sand filtration beds, and other minerals and impurities inherent to specific geographic locations. The resistivity of tap water is usually below 0.1M Ω -cm.

Reverse osmosis (RO) water is water that is treated by passing through various filtration media such as carbon filters or semi-permeable membranes. RO water removes many of the minerals, reduces particulate levels, and eliminates much of the contamination harmful to electronics. Tap water is usually the input to RO units. If the local water is particularly concentrated in some element such as iron or sulfur, a special pre-filter may be necessary in order to remove these elements prior to entry into the RO unit. Heavy doses of these elements can drastically shorten the lifetime of the RO cartridges or membranes. Consequently, the resultant water may not be as clean as desired. RO water resistivity is approximately 0.1 – 1.0M Ω -cm.

De-ionized (DI) water is water that has been refined one step further resulting in water that is ultra-pure. DI water is free of minerals and harmful ionic materials, such as chlorine, but still may contain some soluble silica. RO water passing through a final set of cartridges or membranes creates DI water. DI water has a resistivity generally exceeding 2M Ω -cm.

Water Quality Concerns

We do not recommend tap water as a cleaning media for electronics for the same reason that household laundry is better washed in softened water; the impurities in tap water hinder the dissolving of residues and impede the work of detergents. Removing impurities allows the detergent to spend more time removing soils and less time fighting the water.

Softened tap water may be sufficient for laundry and drinking but does little for cleaning electronics. Some PCB fabricators use softened tap water with the idea that it more effectively removes detrimental fabrication residues (more so than ordinary tap water). All water softeners employ synthetic resin (beads) that contain sodium or potassium ions. Calcium and magnesium, the hard water ions, are attracted to the sodium and potassium ions as the hardened water passes through the resin material. Chloride, which has been linked to electrochemical failures on assemblies and found in treated tap water, passes through unabated. For this reason we do not recommend softened tap water as a cleaning media for electronics.

RO water represents a vast improvement over tap water. RO water has improved solvating power since it is not saturated with minerals. Because of its inherent polar nature, water does not like to be pure. Therefore, the higher the purity, the "hungrier" the water. Using RO water in cleaning circuit boards improves the cleaning power of detergents and improves the rinsing action.

DI water is best for cleaning circuit boards. It contains no ions and no minerals, and because DI water is a very hungry solvent, it is superior for cleaning flux residues. DI water also yields optimum performance from detergents or additives and from the solvating power in rinsing. Additional benefits include longer equipment life and more consistent cleaning with fewer maintenance costs.

Although implementing RO or DI water systems come at additional cost, it does not take tremendous foresight for one to realize the long-term benefits achieved through prevention. We know that PCB fabrication flux residues (chloride and bromide) and etching acids (sulfate) can drastically jeopardize circuit reliability. The cleaner the circuit boards, the less likely they will fall prey to electrical leakage, corrosion, or metal migration failures. Many an assembler has come to us with electrochemical failures that we eventually traced to contaminated bare circuit boards.