



Water-Based Cleaners Used As Safer, Greener Alternatives to Solvent Chemistries

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Global, national, state, and municipal regulations continue to limit the cleaning choices available to manufacturers:

- Montreal and Kyoto protocols limit categories of substances like CFC's (chlorofluorocarbons), HCFC's (hydrochlorofluorocarbons), and HFC's (hydrofluorocarbons) due to ozone depletion, global warming, and other environmental concerns.
- EPA (Environmental Protection Agency) and state agencies like Cal-OSHA (California OSHA) limit personnel exposure to toxic chemicals. n-Propyl Bromide (nPB), Trichloroethylene (TCE), and Perchloroethylene (Perc) are three examples of harmful chemicals that are commonly used in aerosol cleaners in industrial applications.
- CARB (California Air Review Board) restricts smog producing VOC's (volatile organic compounds) in cleaners based on specific cleaning categories.

These regulatory pressures force manufacturers to evaluate new cleaners and cleaning processes to overcome these hurdles. In response, water-based cleaners are becoming more common in the industry. Unfortunately, because of poor formulations of the past, water-based cleaners have a reputation of poor performance. Water-based cleaners are innately neither better nor worse, but they work very differently from their solvent counterparts.

Water-Based Cleaners Versus Solvents

Many water-based cleaners, like the Techspray Renew cleaning product line, offer many advantages over solvent cleaners:

- Non-flammable
- Low toxicity
- Low or no VOC and GWP (global warming potential)
- Non-hazardous shipping and storage

Because water-based cleaners work so differently than solvents, it can lead to the perception of poor performance. Solvents work by solvating the soil; breaking it down into a solution. That has the general advantage of quick activity, so the soils dissolve and flow off the substrate. Because solvent cleaners are high in volatiles, they often evaporate quickly leaving very little residue.

In contrast, when using a water-based cleaner, the soils sit on the surface and have to be wiped off. This difference is due to the cleaning action of water-based cleaners in comparison to solvents. Water-based cleaners generally contain a combination of solvents, surfactants, and saponifiers, depending on the soil.

- **Solvents** – As mentioned above, solvents break down the soils. Many water-based chemistries still contain solvents for this cleaning action.
- **Surfactants** – This component cleans by binding the soils together and separating the soil from the substrate. This results in clumps that need to be physically wiped off. Figure 1 is an example of the clumping action when cleaning solder paste from an SMT (surface mount technology) stencil. The most common stencil cleaner, isopropyl alcohol, dissolves the flux binder, releasing the solder beads. A water-based cleaner (in this case, Techspray Renew Eco-Stencil Cleaner) binds the flux and solder together, allowing removal in a controlled fashion. Figures 2 and 3 show an example of how a water-based cleaner (Techspray Renew Eco-Shower Degreaser) breaks down a heavy weight oil. Surfactants also lower the surface tension of the water, allowing it to wet and clean in tighter spaces, like under electronic components.
- **Saponifiers** – They bind with organic fatty acids, commonly found in flux rosin, to form soap, which is then rinsed off. Saponifiers actually clean by changing the properties of the soil, allowing it to be easily washed off.

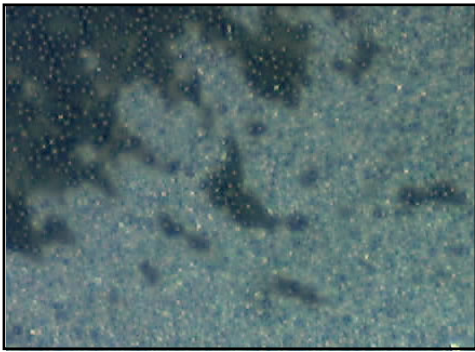


Fig. 1: Solder paste cleaned with water-based cleaner

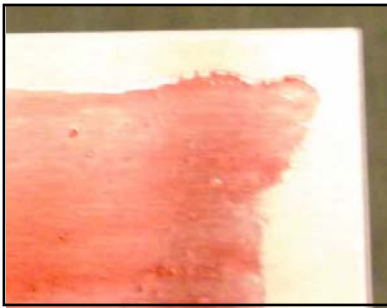


Fig. 2: 85 wt. gear oil (color added for visibility) on stainless steel



Fig. 3: Oil clumps and lifts as a result of surfactants

The combination of water, solvents, surfactants, and saponifiers can be as effective as solvent cleaning, but often requires a change in the cleaning process. In a high precision application where residues cannot be tolerated, a rinsing process is often required with water-based chemistries. Batch or in-line cleaning systems generally have rinse and dry cycles to overcome these issues.

The Winner Is...

It is impossible to credibly make an overall judgment of the superiority of solvents or water-based cleaners. It depends on the requirements of the application. Solvent cleaning is ideal for benchtop cleaning of circuit boards because of effectiveness, quick evaporation rate, and lack of residues. When cleaning greasy industrial equipment, many would choose a water-based cleaner due to safety and usability (i.e. odor). Luckily, even with the ever-mounting regulations, customers still have an array of choices that should include both solvents and water-based cleaners.

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Techspray is a formulator and manufacturer of precision cleaners for industrial and electronic applications. More information of Techspray's alternative cleaners, such as G3, can be found at www.techspray.com.