NEW ADVANCES IN BENCHTOP CLEANING FOR ELECTRONICS REDUCE COSTS AND MAXIMISE ENVIRONMENTAL BENEFITS

By Mike Jones, Micro Care Corporation

Two decades of environmental progress has profoundly changed benchtop cleaning in electronics. The first major global effort to protect the environment was the phase-out of ozone-depleting CFCs that began in the 1980s and was substantially completed by the turn of the century. Today, larger and more complex issues challenge the poor production engineer: the elimination of volatile organic compounds (which cause low-altitude smog in cities); the protection of water resources; global warming; enhanced worker safety and the economic pressures of the continuing contraction of product life cycles in electronics.

Different companies and communities each select different strategies to accommodate these issues. For larger companies with facilities in many parts of the world, this often can present a problem because the rules in one community may conflict with those in another region. These conflicts may prevent companies from adopting universal cleaning procedures, potentially leading to inconsistencies in their production.

This paper will highlight the problems caused by inconsistent regulations, and recommend a three-step process engineers can use when searching for continuing improvements.

BENCHTOP CLEANING – BE CAREFUL WHAT YOU ASK FOR

Benchtop cleaning, also called 'manual cleaning' is superficially very simple, yet it is a challenging industrial process. This is because the requirements for successful benchtop cleaning are very different than the requirements for a chemical to be used in an automated cleaning machine.

A cleaning fluid must meet a number of criteria to make it a commercially acceptable product for workers to use on the benchtop. It must have exceptionally good toxicity profiles because employees touch the cleaning fluid on a daily basis. Fluid also should be fast drying and with no aroma, and preferably with no flashpoint. Of course, the cleaner has to be easy to use, easy to handle, easy to store, easy to dispose of and affordably priced. The cleaner must be powerful, but not so strong as to attack substrates and components being cleaned. There are not many chemicals that can meet all of these criteria.

On top of these performance requirements are new regulations being imposed around the world, inconsistently and often by regulators with little knowledge or interest in the particular problems of employees working on the benchtop or the companies that pay them. REACh in the EU, the GHS rules from the UN, the new CLP rules in Europe, the halogen regulations in Asia, and SCAQMD rules in California all limit the choices engineers make. These dynamic regulatory pressures are eliminating many otherwise promising chemistries.

Europe was the originator of the ROHS and WEEE initiatives, but those efforts pale in comparison to the European REACh program. This is a massive effort to detect previously-unknown health effects caused by chemicals and to control their use with the goal of improving public safety. REACh will, in a few years, touch every industry in Europe, requiring testing and analysis of every liquid, paste and solid material — including the inks on this page you are reading. It encompasses expensive compliance obligations; MSDS sheets will jump from a few terse pages only understood by experts to unreadable lengths only understood by experts. Due to the requirement of extensive toxicity testing, only well-established materials with well-understood toxicity profiles are likely to be used in the years ahead, probably stifling innovation.

The problem extends far beyond Europe. Both China and are California are home to extraordinarily innovative people, but the evolving and uncertain nature of environmental regulations are a burden on companies in both areas. For example, simple containers of isopropyl alcohol are prohibited in California because of their VOC emissions. Recently the Chinese regulatory agencies published drafts of their new ROHS and GHS environmental regulations to bring their systems in synch with the global systems, but have added significant local rules that may, if fully implemented, make it very difficult and very expensive for companies to comply globally.

Another constraint is the current packaging and labeling requirements. Many countries now require safety labeling in local languages, which is a worthy goal. But there are 23 official languages in the EU. The unintended effect of this requirement is to push companies out of smaller markets, denying customers in those regions the benefits of innovative chemical technologies simply because it is not possible to get safety warnings in 23 languages on to a label.

Lastly, many regulatory decisions are made without considering the entire work flow. For example, in many locations the recommended cleaning fluid is water because it is deemed as ‘green’ and ‘environmentally safe’. This is an over-simplification, as water does not work in every application such as in benchtop defluxing. Furthermore, since burning fossil fuels to produce electricity is one of the main sources of greenhouse gasses, any migration to water-based cleaning will have the unintended and undesired effect of increasing greenhouse gas emissions.

Like it or not, increasing regulatory pressures are a fact of life and companies are going to have to adapt to them.

BETTER CHOICES REQUIRE NEW GUIDELINES

For busy manufacturing engineers, finding, evaluating and approving benchtop defluxers and cleaners is a time-consuming and expensive process. A few simple rules may help simplify the selection process:

1. Any alternative chemical selection should limit consideration only to commercially available materials that have long-term market viability. Materials subject to international regulatory scrutiny that could affect long-term availability should be avoided.

2. Engineers also must consider not just the chemical itself but the packaging in which it comes. While aerosols tend to be more expensive per liter, i the benchtop aerosols offer several important advantages. Modern packaging can enhance the effectiveness of a cleaning fluid as well as minimize any environmental impact and improve worker safety. To make a solvent selection by simply comparing MSDS sheets, for example, is to miss a big part of the cleaning story.

3. Finally, engineers need to consider the cleaning process itself. The old-style ‘dip-and-brush’ cleaning is obsolete. Several manufacturers now provide cleaning tools

designed to work and enhance their cleaning fluids. These tools can dramatically improve cleaning performance whilst reducing cleaning costs.

There is a recommended 'one-two-three' step to finding the newest cleaning options in today's difficult regulatory constraints.

STEP ONE: FIND A NEW CLEANING CHEMISTRY

Since the turn of the century, thousands of companies across the EU have selected cleaning fluids containing 'volatile methyl siloxanes' (CAS #107-46-0). This is a superior, although not perfect, cleaning choice.

Methyl siloxanes have an unusual combination of benign qualities. Distantly related to silicone, they are mild, fast-drying fluids that have almost no aroma. With an atmospheric lifetime under 30 days, siloxanes do not accumulate in the atmosphere but rapidly degrade into naturally-occurring chemicals. This means they have a negligible contribution to global warming and urban smog and, of course, do not attack the stratospheric ozone layer. (See the references, below, for more details.)

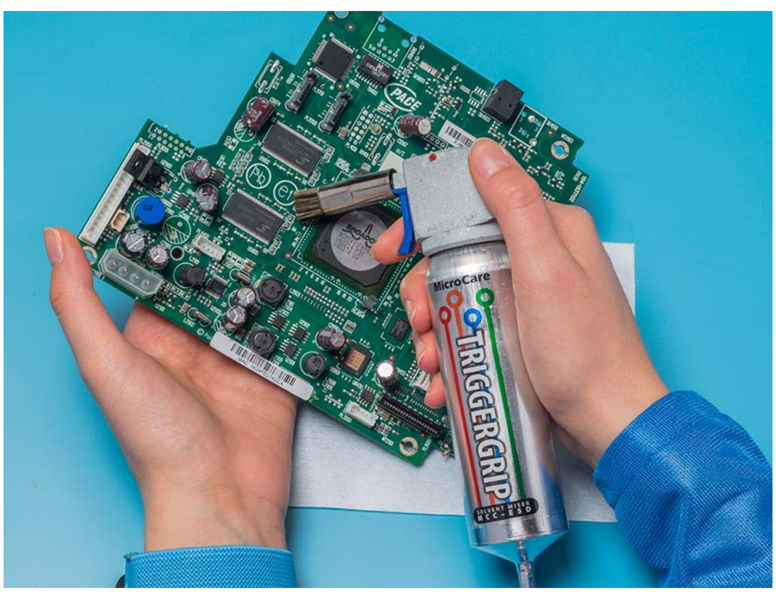
Siloxanes have an excellent toxicity pedigree. Variations on these fluids are found in cosmetics and other personal care formulations, often as carriers and emollients in antiperspirant, hair care and skin care applications. For technicians working on the benchtop, where skin contact is frequent, this is an important and unique advantage.

These fluids can be tailored to specific applications by the addition of small quantities of other ingredients. This makes them highly effective as defluxers, particularly for no-clean solders. Versatile, residue-free siloxane blends easily clean fluxes, pastes, organic residues, ionics, silicone-based conformal coatings, adhesives, grease and oils. Siloxanes easily will remove cured silicone conformal coatings and silicone adhesives. The cleaner will also temporarily swell silicone tubing without damaging its elosteric properties.

Siloxanes also are safe on components. As a nearly ‘universal’ cleaner it will not harm any substrate, material, connector or chip (except silicones), so it is popular in repair depots where the widest variety of materials are found. These fluids typically dry quickly, leave no residues and are non-corrosive.

But siloxane-based cleaners are not perfect. They are generally flammable, with a flashpoint about the same as isopropyl alcohol. This means they are not suitable for use in cleaning machines. In addition, some formulations are not strong enough to handle the toughest, lead-free fluxes which are soldered at the highest temperatures. In those instances, other choices will have to be found.

STEP TWO: FIND A NEW PROPELLANT



Aerosol products have an undeserved reputation as being harmful to the environment. Today’s aerosols in the electronics industry have a proven record of innovation and environmental compliance. In addition, and unlike consumer products, most electronics aerosols are sufficiently expensive that they are used only in essential processes.

The most significant remaining problem with industrial aerosol products has been the propellant. In the past, ozone-depleting propellants were widely used because they were safe and nonflammable. When those options were phased-out, flammable propellants were deployed and even carbon dioxide was used by some companies. But all of these alternatives have immutable limitations grounded in chemical compatibility, physics, safety, economics or applications.

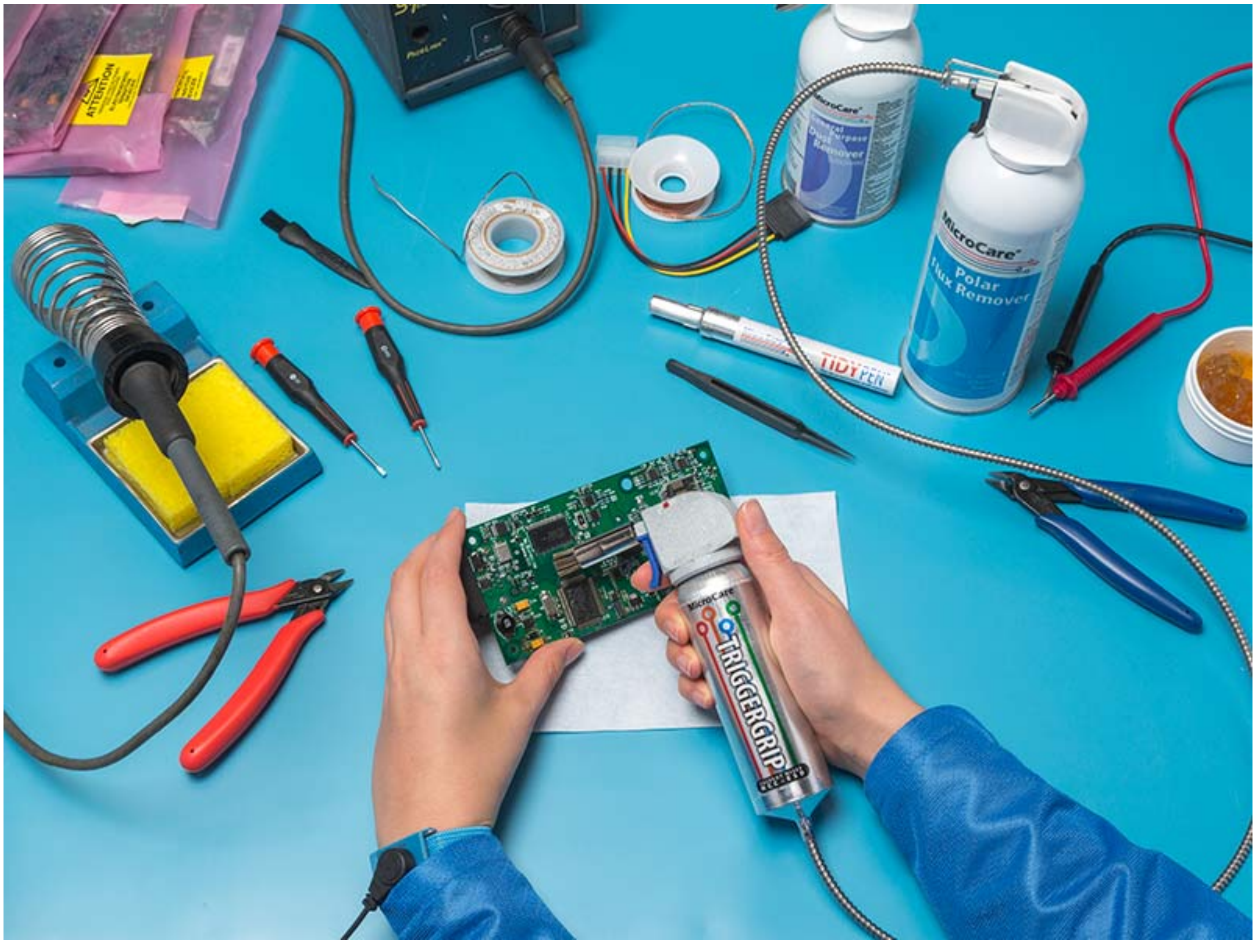
Recently several companies pioneered a new type of propellant, known as an HFO. This appears to be an excellent substitute for old-style propellants without the handling or packaging problems of flammables. Most remarkably, the material reduces the global warming impact 99.9% without compromising any other characteristics, such as flammability, aroma or performance.

Several large chemical companies are getting close to commercialising HFO or similar propellants. Some companies, including MicroCare, have begun small-scale packaging of electronics cleaners with these new HFO propellants, to test the market and confirm the commercialisation processes. Safety and environmental regulators have approved the HFO materials for use in Europe and North America. While prices today remain higher than the older alternatives, they are expected to decline as production volumes increase. Knowledgeable and concerned engineers looking for environmentally acceptable benchtop cleaners will search for vendors deploying the latest in propellant technology to ensure their aerosols are leading the industry.

STEP THREE: FIND A NEW DISPENSER

The king of benchtop cleaning has been, for years, the process widely known as 'dip-and-brush' cleaning. This involves using an inexpensive cleaning fluid – usually isopropyl alcohol – and an inexpensive brush and pump bottle to apply the cleaning fluid to the circuit board. It is now time for engineers to acknowledge that this particular king has no clothes!

The answer is found with controlled dispensing systems that attach onto the aerosol cans. Several companies market these tools, and all of them deliver faster and better cleaning, with less waste than the dip-and-brush method. They instill a true benchtop cleaning process using the universal four steps of cleaning: wet, scrub, rinse and dry. This process can easily be documented and standardised, even to ISO standards, which will improve quality across the board.



In addition, it has been documented that technicians use less solvent when they use controlled dispensing technology. This is because the solvent is fresh and pure, and it is sprayed onto the exact location where it is needed. There is no over-spray from traditional, high-pressure aerosols, and no dirty solvent being thrown away.

Another benefit of dispensing tools is that there is less waste. Everybody has experienced an aerosol can of paint or hair spray that will not empty completely. This problem is completely eliminated with controlled dispensing systems. With these systems, some manufacturers even guarantee the aerosols will empty completely. This is a cost-effective method as technicians use all the solvent. In addition, it also makes it far easier to dispose of the cans because they are not partially filled with residual solvent.

In short, cleaning more boards with less cleaning fluid produces financial savings, quality improvements and environmental benefits that everybody can appreciate.

CONCLUSIONS

These new formulations and cleaning tools represent a breakthrough in cleaning performance and environmental protection for manufacturing engineers. These are proven technologies with strong regulatory, safety, economic and performance approvals. None are a temporary fix that could put a user in jeopardy due to an unexpected regulatory twist.

New regulations may impose onerous burdens, but they also represent an opportunity to re-think manufacturing processes. Engineers should seek chemical vendors that understand international regulatory compliance and have developed answers for their customers to meet those regulations. Innovative, environmentally-progressive multi-national suppliers will help companies comply with new regulations, both domestically and internationally, and actually use this opportunity to go beyond the regulations and improve processes and reduce costs.

SIDEBAR: What's Wrong with Dip-and-Brush?

First, dip-and-brush cleaning makes it impossible to rinse the contamination from the board, so the board often remains sticky with fluxes even after cleaning. As is often said, "If you can't rinse, you can't clean."

Another issue is that the solvent invariably is contaminated. It is impossible to deliver quality cleaning when the cleaning fluid is contaminated. Quality cleaning requires pure, fresh solvent, which cannot be achieved with a pump jar of IPA.

Lastly, dip-and-brush cleaning offers little in the way of process control. Some technicians apply more pressure in cleaning than others, some take their time and others race through the process. Some use too much fluid, and some barely wet the board. In today's world of demanding electronics, a better process is required to produce reliably clean PCBs.

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Michael Jones is Vice President of MicroCare Corp., a privately-held specialist in critical cleaning for industrial applications. With more than three decades at MicroCare, Mr. Jones is a proven expert in precision cleaning, and he has contributed to the development and commercialization of new solvents, new cleaning tools and energy-efficient cleaning processes. He also has substantial expertise in business planning, communications and sales management. Averaging over 130 days a year on the road, he travels to every corner of the globe helping companies update their manufacturing processes to reduce costs, improve productivity and boost quality while protecting the environment. Mr. Jones is married and enjoys gardening, golf and flying.

About MicroCare

MicroCare Corp. is an industry-leading manufacturer of high-performance products used for critical cleaning, coating and lubrication. These products and tools improve quality, reduce operating costs and help protect the environment. MicroCare products are used in industries as diverse as electronics assembly, telecommunications, aerospace and transportation, medical devices and other precision cleaning applications. MicroCare is constantly innovating new cleaning products and processes to help customers reduce costs and improve quality.

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