

## New VOC Regulations Could Disrupt Circuit Cleaning on the East Coast

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### What is happening?

This fall the Ozone Transportation Commission (OTC) is set to make its recommendation on limiting Volatile Organic Compounds (VOC's) used in aqueous based cleaning agents to the EPA. This is the one step in multi step process of establishing new regulations controlling generators of VOC's in a 14 state area including most of the Mid-Atlantic and Northeast regions of the US.

The current thinking is to use the regulatory model developed in Southern California by the local Air Quality Management District. If this model developed by the South Coast Air Quality Management District (SCAQMD) is adopted for the OTC states, it would seriously disrupt most of the circuit manufacturing operations requiring circuit de-fluxing in this region.

### Who Is Affected?

High value electronic assemblies will be most affected by these proposed changes. This includes an array of military, aerospace and medical companies and their suppliers that produce the high reliability electro-mechanical hardware this region is historically known for. These companies typically require years to qualify and implement new processes. Compliance with the SCAQMD requirements will require most companies to change soldering fluxes to meet these requirements as the current approved list of cleaning agents work with a very limited set of soldering fluxes.

An unreasonable standard or timetable could result in a migration of work off of the East Coast to other yet unaffected areas such as the Midwest or South. Companies in the region not complying could be most likely be cited and fined.

### What is the OTC?

The OTC does not make or enforce the rules regarding VOC's. It is a conduit to create model rules which become recommendations to the participating states. It is up to the individual states to accept, reject, or modify the recommendations. The OTC works with many industry segments other than the electronics to recommend ways to reduce localized VOC and NOx pollution of the lower atmosphere on the East Coast. Time has been set aside at fall meeting in Baltimore on September 8<sup>th</sup> 2011, for electronics industry input. Written responses are also being taken. Further details are available at the OTC web site.

### Proposed Rules

Most solvent and aqueous based cleaning agents contain volatile organic compounds (VOCs). VOCs have been shown to add to air pollution and have now been regulated in the US by the Clean Air Act of 1990 (CAA).

In the SCAQMD, cleaning solvents are limited to 25grams of VOC per liter of the cleaning agent. Collectively these solvents are called super-compliant solvents.

VOCs are defined in the US code of Federal Regulations - Title 40: 51.100, to be any organic compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. This includes any such organic compound other than the following, which have been determined to have negligible photochemical reactivity:

- Water
- methylene chloride (dichloromethane)
- 1,1,1-trichloroethane (methylchloroform)
- 1,1,2-trichloro-1,2,2-trifluoroethane (CFC-113)
- acetone
- perchloroethylene (tetrachloroethylene)
- methyl acetate
- dimethyl carbonate
- propylene carbonate
- some perfluorocarbon compounds
- some fluoro-chloro carbon compounds

The problem with using super-compliant solvents with less than 25g/l VOC is that they generally do not work with most modern soldering fluxes. Most broad spectrum aqueous cleaning agents that work with modern fluxes have 50 to 150 grams of VOC per liter.

### Possible Market Shifts

To meet the SCAQMD rule will require those currently using aqueous cleaning in their electronic assembly process to make fundamental changes. These changes will cause profound market shifts to occur in the electronic flux cleaning market. The obvious solutions to meet the proposed super-compliant solvent standards include;

- Stop cleaning
- Change fluxes

- Change cleaning agent
- Buy new equipment

### **No-Clean Assembly Process**

The concept of using flux that did not require cleaning caught on in the early 1990's. Starting with ratification of the Montreal Protocol, the electronics industry began to shift away from cleaning as a standard part of the assembly process. A no-clean assembly process became the standard in the late 1990's. In the recent decade, product performance and reliability concerns have increased the need to clean electronic packages. For these reasons, many assemblies manufactured with "cleaning optional" no-clean fluxes are being cleaned to achieve higher performance and reliability thresholds. A return to not cleaning may be an acceptable alternative to some, but certainly not all.

### **Change Cleaning Agents**

Today, the cleaning agent of choice is the aqueous-based solvent blends traditionally referred to as saponifiers, as opposed to vapor degreasing solvent of the 1970's and 1980's. Ironically vapor degreasing is still allowed under new recommendations issued by the OTC. In most cases for one to change back to vapor degreasing, would require a solvent change, a process re-qualification and new equipment to be purchased.

The current aqueous-based cleaning agents work at higher VOC concentrations of 50g/L to 150g/L, well above the SCAQMD limit of 25g/L. Chemical suppliers have introduced the first generation of super-compliant aqueous based de-fluxing agents with limited success. They work with some softer residues, in tighter process ranges.

### **Change Fluxes**

Changing the flux or solder paste is the most radical approach to solving this problem. If everyone could change to water soluble flux and solder paste, the VOC cleaning problem would be solved. So why, are only about 20% of the de-fluxers sold today configured for water only cleaning? Primarily, this is because of the fear that water soluble fluxes are more corrosive and therefore more financially risky to use on their products.

Another approach would be to change to a more cleanable flux. Compliance could be achieved if the flux residue could be cleaned using a super-compliant cleaning agent. Changing to a softer residue flux formulation would enhance chances of successfully using super-compliant solvents.

### **Equipment Improvements**

It is well known that adding impingement energy at the cleaning surface can significantly improve the cleaning results. Designing spray in air cleaners with high energy nozzles or immersion cleaners with ultrasonics will improve the compliant cleaning process window. In some cases replacing lower energy cleaning systems with higher energy systems can turn a marginal cleaning process into a super-compliant cleaning process.

### **Conclusions**

The course is not yet set. Next month industry will have an opportunity to be heard. The OTC is soliciting input from affected stake holders. The time is now for thoughtful input to a VOC regulation that can affect the electronics cleaning industry for many years to come.

Imposing the SCAQMD limits in 14 states listening to the OTC will certainly cause changes not only to the users, but also the suppliers. The using stakeholders could be forced to change their assembly process.

The more subtle and long term market changes will occur in the supplier base. Solder paste companies will see an increased demand for more cleanable fluxes. Cleaning agent suppliers will see lower demand for aqueous based, VOC non-compliant chemistries. Equipment sales will shift from batch dishwashers to vapor degreasers or higher energy systems like ultrasonic or inline cleaners.

Ozone has had profound influence on the cleaning industry in the last 25 years. First there was too little ozone in the upper atmosphere, so we enacted the Montreal Protocol banning CFC's used for cleaning. Now we find we have too much ozone in the lower atmosphere. Too bad that we could not find a way to transport ozone from the lower atmosphere to the upper stratosphere and start over with Freon TMS.