LVP-VOC Exemption: Regulatory Overview and Solvent/Surfactant Selection for I&I Formulators



Summary

Despite increasingly strict VOC limits at the state and federal level, I&I formulators can incorporate performance based solvents and new surfactant technology that meet current Low Vapor Pressure (LVP-VOC) exemption criteria. These compounds will not count towards a product's total VOC calculation, and may facilitate compliance with enhanced performance characteristics.

This article provides an introductory overview of current VOC regulations and exemptions, as well as solvent selection and surfactant suggestions for new VOC compliant formulations.

For more information, contact:

Patrick Hess <u>pfhess@jrhess.com</u> JR Hess & Company, Inc. 800-556-2850, ext 104

Overview of Consumer Product VOC Regulations

Current consumer product VOC regulations are driven by requirements set forth in State and Federal Clean Air Act legislation. These regulations are designed to reduce consumer product emissions in order to meet National Ambient Air Quality Standards (NAAQS) and attainment goals through <u>State Implementation Plans (SIPs)</u>.

In general, consumer product VOC rules are developed through three regulatory programs: <u>The California Air Resources Board (CARB)</u>, <u>US EPA National Consumer</u> <u>Products Regulations</u>, and the <u>Ozone Transport Commission (OTC) Model Rule</u>.

Geographic Application

CARB rules apply only to products sold in California, but they are heavily influential in the development of other regional models, including the OTC. Because of the long history of clean air legislation and air quality challenges in California, CARB has set the tone for more restrictive VOC limits and specific product category designations for other regions.

The OTC develops model rules for adoption by individual states in the Northeast, as well as the District of Columbia. OTC member states include CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, and VT.

Although outside of the OTC, other states have adopted rules and VOC limits consistent with the OTC model rule. These states include OH, IL, IN, UT, and MI. The remaining states have adopted regulations and VOC limits based on the EPA National Consumer Products Regulations.

For a comparison of VOC limits set by CARB, EPA, OTC and individual states as they apply to specific consumer product categories, <u>visit this table prepared by the ISSA</u> (table includes VOC limits as of 10/25/13).

For those looking to calculate total VOC percentages in products or formulas, <u>try using</u> <u>this calculator created by SCAQMD</u>.

Volatile Organic Compounds and Reactivity Based Exemptions

The EPA and CARB have adopted similar language for the definition of a VOC in consumer products. There are, however, differences in reference to photochemical reactivity and specifically exempted compounds based on "negligible" reactivity.

The EPA defines VOCs as the following:

"Volatile organic compounds (VOC) means any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions."

The EPA excludes a list of organic compounds which have demonstrated "negligible photochemical reactivity" (i.e. acetone and propylene carbonate). The full list can be found at <u>40 CFR § 51.100(s)</u>. Most recently, the EPA included aminomethylpropanol (AMP) in its list of exempted compounds due to a finding of low photochemical reactivity.

CARB defines a VOC as:

"Volatile Organic Compound (VOC) means any compounds containing at least one atom of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, and excluding the following.."

CARB also excludes low reactive compounds, but the list is shorter than the EPA's (i.e. propylene carbonate is not excluded, but acetone is). The list of CARB exemptions can be found at 17 Cal. Code Reg., Title 17 § 94508 (a)(151).

Importantly, the <u>proposed 2014 OTC model rule</u> gives formulators the option of adopting either the CARB or EPA definition of a VOC.

Because of broader photochemical reactivity exemptions in EPA rules, this could potentially offer a longer list of exempt compounds to choose from in states adopting the OTC rule.

The LVP-VOC Exemption

The other significant exemption in consumer product regulations applies to low vapor pressure compounds (LVP-VOC). The LVP-VOC exemption is currently recognized by all three regulatory programs.

There have been challenges to the exemption, and studies, discussion, public and industry input is ongoing. However, as it stands, the LVP-VOC exemption applies to a compound or mixture that:

(A) Demonstrates a vapor pressure less than 0.1 mm Hg at 20° C; or

(B) Is a chemical "compound" with more than 12 carbon atoms; or

(C) Is a chemical "compound" or "mixture" with a boiling point greater than 216°C

A compound or mixture that meets any of the above exemption criteria will not count towards a product's overall VOC calculation.

This is an important exemption for HI&I formulators, as it allows for continued innovation and integration of effective ingredients in many VOC compliant consumer applications.

For instance, although effective in many cleaning and stripping applications, an exempt solvent such as acetone still presents other serious health and safety challenges for formulators (i.e. flammability) and may subject formulators or end-users to additional EHS regulations (i.e. RCRA).

Additionally, solvents with certain positive environmental and performance characteristics (i.e. NMP, Ethyl Lactate or D-Limonene), are not low reactive solvents, do not meet LVP-VOC exemption criteria, and will therefore count towards a product's total VOC calculation.

*Additional consumer product rules and VOC exemptions apply to fragrances, underarm antiperspirants and deodorants, and aerosol coatings. This article does not address these categories.

LVP-VOC Solvent and Surfactant Selection

The challenge for formulators is to find effective alternatives that will offer long term solutions towards VOC compliance. Aside from the lists of specifically exempted compounds, certain solvents (or surfactants with solvent-like performance) that meet LVP-VOC criteria are a good place to start for many applications.

Below are some of the solvents and new surfactant innovations with capabilities and performance characteristics that may be suitable for certain I&I formulations and applications.

Because of the many factors involved in chemical selection, formulating, and VOC calculations, these product suggestions are provided only as a starting point. Further testing and inquiry is always recommended.

Low Vapor Pressure and/or High Boiling Solvents

<u>Dimethyl Esters:</u> The vapor pressure of certain dimethyl esters (specifically dimethyl adipate and dimethyl glutarate) is below the 0.1 mm Hg at 20°C threshold. Therefore,

specialty LVP-VOC solvent blends utilizing these esters may be good choices for VOC compliant formulations.

We work with these materials and offer <u>Sta-Sol[®] ESS II</u> and <u>Sta-Sol[®] ESS 160</u> as low VOC solvent solutions.

<u>Soy Methyl Esters</u>: These versatile solvent alternatives qualify as LVP-VOCs due to high boiling points. Soy methyl esters (or biodiesel) can be used to replace or augment the need for more volatile solvents such as D-Limonene, while maintaining a product's biobased profile.

When emulsified with certain surfactants, water soluble soy methyl ester blends can be excellent for choices in demanding applications, including asphalt emulsions and asphalt cleaning. <u>Contact us for more information about these blends</u>.

<u>Tripropylene Glycol Methy Ether:</u> TPM solvent is considered an LVP-VOC due to its low vapor pressure. Other LVP-VOC propylene glycol ethers include Glycol Ether DPNB and Glycol Ether TPNB.

<u>Propylene Carbonate (also specifically exempted by EPA)</u>: Propylene Carbonate is exempted as a low reactivity compound by the EPA and also qualifies for the LVP-VOC exemption. PC is a less aggressive solvent in certain I&I applications, but it is highly miscible and can be used in customized blends (i.e. with DMEs).

Surfactants, Additives and Aqueous Microemulsions

Surfactants and Surfactant Based Aqueous Emulsions can help formulators meet long term VOC compliance as well as overall environmental, health, safety and sustainability objectives.

<u>STEPOSOL® MET-10U</u>: Stepan's new <u>"Surfactant Solution to Solvent Replacement</u>™", MET-10U offers a bio-based alternative for many solvent replacement applications in LVP-VOC formulations.

This surfactant – developed in partnership with Elevance Renewable Sciences – is readily biodegradable, derived from renewable feedstock and meets all three LVP-VOC exemption criteria. STEPOSOL[®] MET-10U also features a KB value of >1000.

STEPOSOL[®] MET-10U has shown effectiveness (and outperformed several conventional solvents) in cleaning and removing soils in a variety of formulations. It can also be emulsified into water soluble formulas with c

Download the <u>brochure for Steposol® MET-10U</u> or <u>contact us to learn more about this</u> <u>surfactant alternative to solvents in I&I formulations</u>.

Example applications for Steposol® MET-10U include:

All-Purpose Cleaner Heavy Duty Degreaser Adhesive Remover Oven Cleaner Grill Cleaner Rig Wash Metal Cleaner Paper Chemicals Coating Remover Graffiti Remover Permanent Ink Remover Paint Stripper

<u>Tomakleen[™] G-12</u>: A new additive from Air Products designed for formulators looking for improved cleaning performance while reducing or eliminating the need for oxygenated solvents. This product is readily biodegradable and qualifies for the LVP-VOC exemption due to its high boiling point (334°C).

Tomakleen[™] G-12 can work as an additive along with surfactants in heavy-duty industrial cleaners, all-purpose alkaline and neutral cleaners, and vehicle care products.

Download the product sheet for <u>Tomakleen™ G-12</u> or <u>contact us for information about</u> <u>formulating with this additive from Air Products</u>.

Sta-Mulse[®] AQ Microemulsions

Sta-Mulse[®] AQ microemulsions offer the convenience of a pre-formulated, LVP-VOC package with excellent wetting and cleaning properties in heavy-duty cleaning applications. These are customized solutions that include highly effective solvents or surfactants in stable, water soluble emulsions.

Sta-Mulse[®] emulsions can be further optimized with additional solvents or additives, or used on their own as ready-to-use or water-dilutable concentrations.

Microemulsions give formulators and end-users a water based solvent replacement option with preferable environmental, health and safety attributes.

More product information and technical specifications coming soon.

Conclusion

Consumer product VOC regulations are here to stay. As of now, the LVP-VOC exemption gives formulators the flexibility to incorporate performance based solvents and new surfactant technology into products in order to remain both compliant and competitive.

If you have any questions or would like more information about any of the products or materials mentioned in this article, please <u>feel free to contact us.</u>

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