



Air Resources Board



Linda S. Adams
Secretary for
Environmental Protection

Mary D. Nichols, Chairman
1001 I Street • P.O. Box 2815
Sacramento, California 95812 • www.arb.ca.gov

Arnold Schwarzenegger
Governor

May 19, 2008

Dear Air Pollution Control Officers:

The purpose of this letter is to inform you of the results of our assessment of methyl formate (MF) in response to volatile organic compounds (VOC) exemption petitions submitted to the ARB by Foam Supplies, Inc. (FSI) and Pactiv Corporation (Pactiv). FSI and Pactiv may also have requested that you exempt MF from your district's definition of a VOC. Therefore, our environmental impact assessment presented here may be helpful in the event that you consider providing a VOC exemption for MF. This letter also discusses our respective exemption authorities as well as the recommendations based on our assessment.

After a federal VOC exemption is granted, ARB as well as districts can determine whether an exemption is appropriate for source categories under their respective jurisdictions. The U.S. EPA exempted MF from its definition of VOC in November 2004 (see Attachment A) based on its negligible photochemical reactivity. Subsequently, ARB staff, in conjunction with staff from the Office of Environmental Health Hazard Assessment (OEHHA), conducted an environmental impact evaluation of MF.

We do not expect MF to be found in consumer products (such as aerosol coatings, automotive maintenance products, and adhesives) for which ARB has regulatory authority. Therefore, we do not intend to provide an exemption for MF within the Consumer Product Regulations. However, we anticipate that MF will be used in stationary source categories (such as foam-blowing, as a blowing agent), which are under district authority. In fact, some districts have requested that ARB conduct an environmental impact assessment of MF to assist with VOC exemptions they are considering for MF. As such, we believe that all districts will find our evaluation helpful with respect to any exemption decisions that they may consider for MF. Our assessment, which is summarized below, was prepared with the assistance of the OEHHA.

SUMMARY OF ARB STAFF ASSESSMENT

Methyl formate is the methyl ester of formic acid, with the following semi-structural formula: HCOOCH_3 . It is a clear liquid with a high vapor pressure (boiling point = 32°C , or $\sim 89^\circ\text{F}$). It has an ethereal odor with a threshold of about 200 parts per million. Its

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our website: <http://www.arb.ca.gov>.

California Environmental Protection Agency

main industrial uses are to manufacture formamides and formic acid. Because of its high vapor pressure, it is used for quick-drying finishes. It is also used as an insecticide and to manufacture pharmaceuticals.

Methyl formate has a negligible ozone forming potential (reactivity), which is defined as a VOC's ability to form ozone. When released to the atmosphere, MF is expected to react primarily with hydroxyl radicals and is not expected to react with ozone and nitrate radicals or to photolyze to a significant extent. Environmental chamber experiments and model calculations were carried out to assess the atmospheric ozone formation potential of MF. Dr. Carter's 2007 research final report, "Development of the SAPRC-07 Chemical Mechanism and Updated Ozone Reactivity Scales" (<http://www.arb.ca.gov/research/abstracts/03-318.htm>) shows MF's maximum incremental reactivity (MIR) to be 0.053 gram ozone per gram VOC. As such, it is much less reactive to ozone formation than ethane (MIR=0.26), a benchmark compound for exemption purposes. Therefore, we do not expect MF to contribute meaningfully to ozone formation.

In April 2006, ARB staff drafted "Guidance for Submitting and Responding to Requests for Granting Volatile Organic Compound Exemptions," (<http://www.arb.ca.gov/research/reactivity/vocguide.pdf>). This document shows that besides reactivity, we also consider other environmental impacts, such as depletion of stratospheric ozone and climate change. Methyl formate's reactivity corresponds to an atmospheric lifetime of about 20 days, which is so short that very little MF could diffuse into the stratosphere. Further, since MF has no halogens to react with stratospheric ozone, MF would have a negligible stratospheric ozone depletion potential (ODP=0).

Climate change refers to a change in climate due to human activity or natural variability observed over comparable time periods. MF's atmospheric lifetime is short enough that it has a negligible global warming potential. Furthermore, we do not expect the products of MF's reactions in the atmosphere to contribute significantly to global warming. In comparison, some of the substances that MF may replace for foam blowing (such as hydrofluorocarbons or HFCs) are potent greenhouse gases.

Like ozone, secondary organic aerosol (SOA) results from the atmospheric oxidation of VOCs. While the oxidation of most VOCs results in ozone formation, SOA is generally formed only from the oxidation of compounds with much lower volatility. This is because the oxidation products must have vapor pressures that are sufficiently low to enable them to partition into the aerosol phase. Thus, we do not expect MF to generate SOA.

SUMMARY OF OEHHA ASSESSMENT

Due to the fact that substitution of MF for more reactive compounds could result in a significant increase in MF emissions, we requested that OEHHA evaluate the possible health effects associated with exposure to MF. We summarize their response below (see Attachment B for the complete memorandum).

Methyl formate is rapidly hydrolyzed in the body to methanol and formic acid. Methanol is enzymatically oxidized to formaldehyde, and the oxidation of formaldehyde to formic acid is rapid. As part of its review, OEHHA considered the toxicity of MF as well as the toxicity of its metabolites.

Increased use of MF would lead to increased exposure to workers and the general population near facilities using MF. MF is an ester and would be expected to be less irritating to mucous membranes than formaldehyde or formic acid. For foam blowing, the health concern is the internal levels of methanol and formic acid (or formate ion) in solution due to metabolism of MF, not the external air concentrations of the chemicals.

No carcinogenicity or long-term toxicity data exist for MF. No carcinogenicity data exist for methanol, despite substantial data on toxicity and a long history of human exposure. Formaldehyde is carcinogenic by inhalation, but it has not been determined that internal levels of dissolved or bound formaldehyde produced by intermediary metabolism or by methanol oxidation are associated with cancer. OEHHA staff did note the lack of data in two areas: effects of lifetime inhalation, and effects of exposure to neonatal rats. Based on the available data associated with MF's toxicity, OEHHA concludes that "At dose levels likely to be achieved in environmental exposures by inhalation, these concerns appear to be minor."

CONCLUSION

Following the assessment as described above, ARB recommends that you consider MF for exemption in your definition of VOC, based on its low reactivity and the positive environmental benefits that may result if MF displaces the use of other foam-blowing agents. However, you should evaluate such an application based on the specific circumstances when you update your applicable rules. Specifically, in addition to the information provided in this letter, we recommend that you consider the following information when you update your applicable rules:

- Substances that MF is likely to replace.
- The amount of MF expected to be used and the nature of the use (e.g., applications where it may be used and how it will be used).

Air Pollution Control Officers

May 19, 2008

Page 4

- Estimates of the annual average population exposure in major urban areas.
- Estimate of peak (i.e., hourly and annual average) near-source population exposure.
- Estimate of peak indoor exposure resulting from use.
- Impact of MF on other media such as water and soil, especially because of limited data on its behavior in other media.

If you have any questions regarding our assessment, please contact Dr. Dongmin Luo of my staff at (916) 324-8496 or dluo@arb.ca.gov.

Sincerely,



Michael H. Scheible
Deputy Executive Officer

Attachments (2)

cc: Dr. Dongmin Luo
Research Division

Attachments

Attachment A. United States Environmental Protection Agency, "Air Quality: Revision to Definition of Volatile Organic Compounds--Exclusion of Four Compounds," published in Federal Register, November 29, 2004 (Volume 69, Number 228, Page 69290-69298)

Attachment B. Office of Environmental Health Hazard Assessment, "Health Effects of Exposure to Methyl Formate, a Chemical Petitioned for Exemption from VOC Rules," Memorandum to the Air Resources Board from the Office of Environmental Health Hazard Assessment, March 14, 2008

ATTACHMENT A

ENVIRONMENTAL PROTECTION AGENCY

follow all provisions set forth in 37 CFR part 259.

d. Hand Delivery by Commercial Courier

Section 259.5(a)(2) directs that claims delivered by a commercial courier must be delivered directly to the Congressional Courier Acceptance Site ("CCAS") located at 2nd and D Streets, N.E. The CCAS will accept items from couriers with proper identification, e.g., a valid driver's license, Monday through Friday, between 8:30 a.m. and 4 p.m. The envelope containing an original and two copies of each claim should be addressed as follows: Office of the General Counsel/CARP, Room LM-403, James Madison Memorial Building, 101 Independence Avenue, S.E., Washington, D.C. The date of receipt as documented by CCAS will be considered the date of receipt by the Copyright Office for purposes of timely filing. Any claim received by CCAS which does not have a date stamp of February 28, 2005, or earlier, will be considered untimely for this filing period and will be rejected by the Copyright Office.

Claimants delivering their claims by commercial courier should note that they must follow all provisions set forth in 37 CFR part 259.

e. By Mail

Section 259.5(a)(3) directs claimants filing their claims by mail to send the claims to the Copyright Arbitration Royalty Panel, P.O. Box 70977, Southwest Station, Washington, DC 20024. Claimants electing to send their claims by mail are encouraged to send their claims by certified mail return receipt requested, to have the certified mail receipt (PS Form 3800) stamped by the United States Postal Service, and to retain the certified mail receipt in order to provide proof of timely filing, should the claim reach the Office after February 28, 2005. In the event there is a question as to whether the claim was deposited with the United States Postal Service during the months of January or February, the claimant must produce the certified mail receipt (PS Form 3800) which bears a United States Postal Service postmark, indicating an appropriate date. 37 CFR 259.5(e). Claims received after February 28, 2005, dated with only a business meter mark will be rejected as untimely unless the claimant is able to produce the certified mail receipt. See *Universal Studios LLLP v. Peters*, 308 F.Supp.2d 1 (D.D.C. 2004); *Metro-Goldwyn-Mayer Studios, Inc. v. Peters*, 309 F.Supp.2d 48 (D.D.C. 2004).

Claimants should also note that §259.5(a)(4) prohibits the filing of claims by overnight delivery services

such as Federal Express, United Parcel Service, etc. Claimants opting to file their claims by means of overnight delivery must use the Express Mail service provided by the U.S. Postal Service and address the envelope as instructed in this section. Using this service will better ensure the procurement of a January or February postmark and the receipt of the claim by the Office in a timely manner.

However, as noted above, disruption of the mail service and delivery of incoming mail to an off-site screening center have reduced the timeliness of receipt of mail by the Copyright Office. Therefore, the Office suggests that claimants use the mail only if none of the other methods outlined above are feasible.

When filing claims by this method, claimants must follow all provisions set forth in 37 CFR part 259.

Waiver of Regulation

The regulations governing the filing of DART claims require "the original signature of the claimant or of a duly authorized representative of the claimant," 37 CFR 259.3(b), and do not allow claims to be filed by "facsimile transmission," 37 CFR 259.5(d). This Notice, however, waives these provisions as set forth herein solely for the purpose of filing claims to the 2004 DART royalties. The Office is not waiving the statutory deadline for the filing of DART claims, a deadline the Office has no power to waive. See, *United States v. Locke*, 471 U.S. 84, 101 (1985). Thus, claimants are still required to file their claims by February 28, 2005.

Waiver of an agency's rules is "appropriate only if special circumstances warrant a deviation from the general rule and such deviation will serve the public interest." *Northeast Cellular Telephone Company v. FCC*, 897 F.2d 1164, 1166 (D.C. Cir. 1990); see also, *Wait Radio v. FCC*, 418 F.2d 1153

(D.C. Cir. 1969), cert. denied, 409 U.S. 1027 (1972). Under ordinary circumstances, the Office is reluctant to waive its regulations. However, due to the continuing delays in the delivery of mail and the transition to an electronic filing system, the Office believes under these special circumstances the public interest will best be served by waiving, for this filing period, for the final time the requirement that DART claims bear the original signature of the claimant or of a duly authorized representative of the claimant, when, and only when, such claim is filed on-line through the Office's website. See 67 FR at 5214.

Since the Office cannot waive the statutory deadline set forth in 17 U.S.C. 1007 and accept claims filed after

February 25, 2005, see *Locke*, supra, the Office believes the public interest will be served by providing claimants with alternative methods of filing, in addition to those set forth in the regulations, in order to assist them in timely filing their claims. By allowing claims to be filed on-line and by facsimile transmission, the Office is affording to all claimants an equal opportunity to meet the statutory deadline.

Dated: November 22, 2004.

Marybeth Peters,

Register of Copyrights.

[FR Doc. 04-26266 Filed 11-26-04; 8:45 am]

BILLING CODE 1410-33-5

40 CFR Part 51

[FRL-7840-7]

RIN 2060-AK37

Air Quality: Revision to Definition of Volatile Organic Compounds—Exclusion of Four Compounds

AGENCY: Environmental Protection Agency (EPA). **ACTION:** Final rule.

SUMMARY: This action revises EPA's definition of volatile organic compounds (VOC) for purposes of preparing State implementation plans (SIPs) to attain the national ambient air quality standards (NAAQS) for ozone under title I of the Clean Air Act (CAA). This revision would add four compounds to the list of compounds excluded from the definition of VOC on the basis that these compounds make a negligible contribution to tropospheric ozone formation. This revision will modify the definition of VOC to say that: 1,1,1,2,2,3,3-heptafluoro-3-methoxy-propane (n-C₃F₇OCH₃) (known as HFE-7000); 3-ethoxy 1,1,1,2,3,4,4,5,5,6,6-dodecafluoro-2(trifluoromethyl) hexane (known as HFE-7500, HFE-s702, T-7145, and L-15381); 1,1,1,2,3,3,3-heptafluoropropane (known as HFC 227ea); and methyl formate (HCOOCH₃) will be considered to be negligibly reactive. If you use or produce any of these four compounds and are subject to EPA regulations limiting the use of VOCs in your product, limiting the VOC emissions from your facility, or otherwise controlling your use of VOCs, then you will not count these four compounds as a VOC in determining whether you meet these regulatory obligations. This action may also affect whether these four compounds are considered to be VOCs

for State regulatory purposes, depending on whether the State relies on EPA's definition of VOC. As a result, if States and States' industries are subject to certain Federal regulations limiting emissions of VOCs, *i.e.*, emissions of 1,1,1,2,2,3,3-heptafluoro-3-methoxypropane, or 3-ethoxy-1,1,1,2,2,3,3,4,4,5,5,6,6,6-dodecafluoro-2-(trifluoromethyl) hexane, or 1,1,1,2,2,3,3,3-heptafluoropropane, or methyl formate, these emissions may not be regulated for some purposes according to the rules governing States' enforceability of the measures.

With this action, EPA is not finalizing a decision on how the Agency will evaluate future VOC exemption petitions. Currently, EPA is in the process of assessing its VOC policy in general. We intend to publish a future notice inviting public comment on the VOC exemption policy and the concept of negligible reactivity as part of a broader review of overall policy.

In addition to granting the four new exemptions described above, we are making a nomenclature clarification to two previously-exempted compounds. We will thus add the nomenclature designations "HFE-7100" to 1,1,1,2,2,3,3,4,4-nonafluoro-4-methoxybutane (C₄F₉OCH₃) and "HFE-7200" to 1-ethoxy-1,1,2,2,3,3,4,4,4-nonafluorobutane (C₄F₉OC₂H₅).
DATES: This rule is effective December 29, 2004.

ADDRESSES:

A. How Can I Get Copies of This Document and Other Related Information?

1. *Docket.* The EPA has established a public docket for this action, OAR- 2003-0086, which consists of the documents specifically referenced in this action, any public comments received, and other information related to this action. Although a part of the official docket, the public docket does not include Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. The public docket is the collection of materials that is available for public viewing at the Docket in the EPA Docket Center, (EPA/DC) EPA West, Room B102, 1301 Constitution Ave., NW., Washington, DC. The EPA Docket Center Public Reading Room is open from 8:30 a.m. to 4:30 pm., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566-1744, and the telephone number for the Docket is (202) 566 . A reasonable fee may be charged for copying.

2. *Electronic Access.* You may access this **Federal Register** document electronically through the EPA Internet under the "**Federal Register**" listing at <http://www.epa.gov/fedrgstr/>. An electronic version of the public docket is available through EPA's electronic

public docket and comment system, EPA Dockets. You may use EPA Dockets at <http://www.epa.gov/edocket/> to view public comments, access the index listing of the contents of the official public docket, and to access those documents in the public docket that are available electronically. Although not all docket materials may be available electronically, you may still access any of the publicly available docket materials through the docket facility identified in Unit I.B. Once in the system, select "search" then key in the appropriate docket identification number.

FOR FURTHER INFORMATION CONTACT:

David Sanders, Office of Air Quality Planning and Standards, Air Quality Strategies and Standards Division (C539-02), Research Triangle Park, NC 27711, phone (919) 541-3356.

SUPPLEMENTARY INFORMATION:

I. General Information

A. Regulated Entities

Entities potentially affected by this action are those that use and emit VOC as well as States that have programs to control VOC emissions. This action has no substantial direct effects on the States or industry because it does not impose any new mandates on these entities but, to the contrary, removes four chemical compounds from regulation as a VOC.

Category	Examples of regulated entities
Industry	Industries that use or make refrigerants, blowing agents, fire suppressants, or solvents.
States	States which have regulations to control volatile organic compounds.
This matrix lists the types of entities that EPA is now aware could potentially be affected by this action. Other types of entities not listed in the table have the potential of being affected.	compounds. The fourth compound, 3ethoxy-1,1,1,2,2,3,3,4,4,5,5,6,6,6dodecafluoro-2-(trifluoromethyl) hexane, has not been reviewed under SNAP because it was submitted for use in secondary loop refrigeration systems. Fluids used in these systems are not covered by the SNAP program (62 FR 10700 March 10, 1997). However, this compound is a member of a larger class of compounds known as hydrofluoroethers (HFEs), and other HFEs have been recognized by SNAP as substitutes for ozone-depleting substances.
The four compounds we are excluding from the definition of VOC all have potential for use as refrigerants, fire suppressants, aerosol propellants, or blowing agents (used in the manufacture of foamed plastic). In addition, all of these compounds, may be used as an alternative to ozone-depleting substances such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs).	designations for the two compounds and can be found in the book titled, <i>Handbook for Critical Cleaning</i> by Barbara Kanegsberg and Edward Kanegsberg, CRC Press, 2001, p. 77. The EPA is now in the process of assessing its VOC policy in general. As part of this process, we intend to publish a future notice inviting public comment on the VOC exemption policy and the concept of negligible reactivity as part of a broader review of overall policy. One of the issues we will address in this notice is the extent to which compounds that are exempt from the VOC definition should still be subject to recordkeeping, emissions reporting, and inventory requirements which apply to VOC. The Agency wants to investigate whether substantial emissions of "negligibly reactive" compounds may contribute to ozone formation under certain conditions. This effort will require additional
Three of the compounds, 1,1,1,2,2,3,3-heptafluoro-3-methoxy-propane, 1,1,1,2,2,3,3,3-heptafluoropropane, and methyl formate are approved by EPA's Significant New Alternatives Policy (SNAP) program (CAA section 612; 40 CFR part 82, subpart G) as acceptable substitutes for ozone-depleting	Also, we are making a nomenclature clarification to two previously exempted compounds. We have added the designations "HFE-7100" to 1,1,1,2,2,3,3,4,4-nonafluoro-4-methoxybutane (C ₄ F ₉ OCH ₃) and "HFE-7200" to 1-ethoxy-1,1,2,2,3,3,4,4,4-nonafluorobutane (C ₄ F ₉ OC ₂ H ₅). These names are widely accepted alternative

modeling, and it may be necessary to have a more accurate inventory of such compounds in order to obtain accurate modeling results. However, instead of addressing this issue in this rule, which applies to only four compounds, we intend to address it more broadly in our upcoming notice dealing with our overall VOC policy.

To determine whether your organization is affected by this action, you should carefully examine the applicability criteria in § 51.100 of title 40 of the Code of Federal Regulations. If you have questions regarding the applicability of this action to a particular entity, consult the person listed in the preceding **FOR FURTHER INFORMATION CONTACT** section.

Outline

I. Background

A. Reactivity Policy

B. Current Exemption Petitions

- 1,1,1,2,2,3,3-Heptafluoro-3-methoxypropane and 3-ethoxy 1,1,1,2,3,4,4,5,5,6,6,6-dodecafluoro-2(trifluoromethyl) hexane
- 1,1,1,2,3,3,3-Heptafluoropropane
- Methyl Formate

II. The EPA Response to the Petitions

III. The EPA Response to Comments

- Final Action
- Statutory and Executive Order Reviews
 - Executive Order 12866: Regulatory Planning and Review
 - Paperwork Reduction Act
 - Regulatory Flexibility Act
 - Unfunded Mandates Reform Act
 - Executive Order 13132: Federalism
 - Executive Order 13175: Consultation and Coordination with Indian Tribal Governments
 - Executive Order 13045: Protection of Children From Environmental Health and Safety Risks
 - Executive Order 13211: Actions that Significantly Affect Energy Supply, Distribution, or Use
 - National Technology Transfer Advancement Act
 - Congressional Review Act

I. Background

A. Reactivity Policy

Tropospheric ozone, commonly known as smog, occurs when VOCs and nitrogen oxides (NO_x) react in the atmosphere. Because of the harmful health effects of ozone, EPA and State governments limit the amount of VOCs and NO_x that can be released into the atmosphere. Volatile organic compounds are those compounds of carbon (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate) which form ozone through atmospheric photochemical reactions. Compounds of carbon (also known as organic compounds) have different levels of reactivity—that is, they do not

react to form ozone at the same speed or do not form ozone to the same extent. It has been EPA's policy that organic compounds with a negligible level of reactivity need not be regulated to reduce ozone. The EPA determines whether a given organic compound has "negligible" reactivity by comparing the compound's reactivity to the reactivity of ethane. The EPA lists these compounds in its regulations (at 40 CFR 51.100(s)) and excludes them from the definition of VOCs. The chemicals on this list are often called "negligibly reactive" organic compounds.

In 1977, EPA published the "Recommended Policy on Control of Volatile Organic Compounds" (42 FR 35314, July 8, 1977) which established the basic policy that EPA has used regarding organic chemical photochemical reactivity since that time. In that statement, EPA identified the following four compounds as being of negligible photochemical reactivity and said these should be exempt from regulation as VOCs under SIPs: methane; ethane; 1,1,1-trichloroethane (methyl chloroform); 1,1,2-trichloro 1,2,2-trifluoroethane (CFC-113). That policy statement said that as new information becomes available, EPA may periodically revise the list of negligibly reactive compounds to add compounds to or delete them from the list.

The EPA's decision to exempt certain organic compounds in its 1977 policy was heavily influenced by experimental smog chamber experiments performed by EPA's Office of Research and Development earlier in the 1970's. In this experimental work, various compounds were injected into a smog chamber at a molar concentration that was typical of the total molar concentration of VOC in Los Angeles ambient air (4 parts per million by volume (ppmV)). As the compound was allowed to react with NO_x at concentrations of 0.2 parts per million (ppm), the maximum ozone formed in the chamber was measured. If the compound in the smog chamber did not result in ozone formation of

(0.08 ppm was the NAAQS for oxidants at that time), it was assumed that emissions of the compound would not cause an exceedance of the NAAQS. Following this reasoning, EPA concluded that the compound was negligibly reactive. Ethane was the most reactive compound tested that did not cause the 0.08 ozone level in the smog chamber to be met or exceeded. Based on those findings and judgments, EPA therefore designated ethane as negligibly reactive, and ethane became the benchmark VOC species for

separating reactive from negligibly reactive compounds under the assumed conditions.

Since 1977, EPA's primary method for comparing the reactivity of a specific compound to that of ethane has been to compare the *k_{OH}* values for ethane and the specific compound of interest. The *k_{OH}* value represents the molar rate constant for reactions between the subject compound (e.g., ethane) and the hydroxyl radical (i.e., •OH). This reaction is very important since it is the primary pathway by which most organic compounds initially participate in atmospheric photochemical reaction processes to form ozone. The EPA has exempted 45 compounds or classes of compounds based on a comparison of *k_{OH}* values since 1977.

In 1994, in response to a petition to exempt volatile methyl siloxanes, EPA, used another type of comparison to ethane based on incremental reactivity (IR) metrics (59 FR 50693, October 5, 1994). The use of IR metrics allowed EPA to take into consideration the ozone forming potential of other reactions of the compound in addition to the initial reaction with the hydroxyl radical. Volatile methyl siloxanes proved to be less reactive than ethane on a per mole basis. In 1995, EPA considered another compound, acetone, using IR metrics. Because acetone breaks down to form ozone by the process of photolysis rather than by the normal OH reaction scheme, EPA considered the IR metrics instead of *k_{OH}* values, and exempted acetone based on the fact that acetone was less reactive than ethane on the basis of grams of ozone formed per grams of VOC emitted (60 FR 31635, June 16, 1995). Prior to 1994, EPA had only granted VOC exemptions based on *k_{OH}* values. Since 1995, EPA has exempted one additional compound, methyl acetate, reinforced by comparisons of IR metrics. Besides a lower *k_{OH}* value than ethane, EPA found that the reactivity of methyl acetate was comparable to or less than that for ethane, under a per mole basis.

B. Current Exemption Petitions

- 1,1,1,2,2,3,3-Heptafluoro-3-Methoxy-Propane and 3-Ethoxy 1,1,1,2,3,4,4,5,5,6,6,6-Dodecafluoro-2(Trifluoromethyl) Hexane

On February 5, 1999, the Performance Chemicals and Fluid Division of the 3M Company submitted to EPA a petition requesting that the compound 1,1,1,2,2,3,3-heptafluoro-3-methoxypropane be added to the list of compounds which are negligibly reactive and therefore exempt from the definition of VOC at 40 CFR 51.100(s).

The next year, on August 21, 2000, the Performance Chemicals and Fluid Division of the 3M Company submitted to EPA a petition requesting that the compound 3-ethoxy-1,1,1,2,3,4,4,5,5,6,6,6-dodecafluoro-2

(trifluoromethyl) hexane be added to the same list. Potential uses for these two compounds (and other compounds for consideration under this proposal) are shown in Table 1. In its first petition, 3M points out that it has requested the

compound 1,1,1,2,2,3,3-heptafluoro-3-methoxy-propane be listed as an acceptable substitute for CFCs and HCFCs in certain uses and; as such, use of this substance may help mitigate the depletion of stratospheric ozone.

TABLE 1.—POTENTIAL USES OF COMPOUNDS

Compound	Potential use
1,1,1,2,2,3,3-Heptafluoro-3-methoxy-propane	Refrigerant; aerosol propellant.
3-ethoxy-1,1,1,2,3,4,4,5,5,6,6,6-dodecafluoro-2-(trifluoromethyl) hexane	Refrigerant.
1,1,1,2,3,3,3-Heptafluoropropane	Fire suppressant; aerosol propellant.

Although 3-ethoxy-1,1,1,2,3,4,4,5,5,6,6,6-dodecafluoro-2(trifluoromethyl) hexane has not been identified as a CFC substitute, specifically, the SNAP program has identified hydrofluoroethers (HFEs), as a class, as replacement substitutes for CFCs.

In support of the 1,1,1,2,2,3,3heptafluoro-3-methoxy-propane and the 3-ethoxy-1,1,1,2,3,4,4,5,5,6,6,6dodecafluoro-2-(trifluoromethyl) hexane petitions, 3M Company supplied information on the photochemical reactivities of the compounds. The 3M Company stated that, as hydrofluoroethers, these compounds are very similar in structure, toxicity, and atmospheric properties to other compounds such as C₄F₉OCH₃, (CH₃)₂CFCF₂OCH₃, C₄F₉OC₂H₅, and (CH₃)₂CFCF₂OC₂H₅ which are exempt already from the VOC definition.

Other information submitted by 3M Company consists mainly of a peer-reviewed article entitled "Atmospheric Chemistry of Some Fluoroethers," Guschin, Molina, Molina: Massachusetts Institute of Technology, May 1998. This article discusses a study in which the rate constant for the reaction of HFE- 7000 (and several other individual compounds) with the hydroxyl (OH) radical is shown to be less than the rate constant for ethane but slightly more than the rate constant for methane on a mole basis. This rate constant (k_{OH} value) is commonly used as one measure of the photochemical reactivity of compounds. The petitioner compared the rate constants with that of ethane which has already been listed as photochemically negligibly reactive (ethane is the compound with the highest k_{OH} value which is currently regarded as negligibly reactive). The two compounds under consideration for exemption are listed with their reported k_{OH} rate constants in Table 2 along with ethane (and compounds for consideration under this proposal). 3M

Company has also included Material Safety Data Sheets, together with 5-day and 28-day inhalation toxicity studies, indicating both their compounds as having very low toxicity. The scientific information which the petitioner has submitted in support of the petition has been added to the docket for this rulemaking. This information includes references for the journal articles where the rate constant values are published.

GWP at 3800 times that of carbon dioxide, making it a probable substitute for its competitor fire suppressants which have even higher GWPs. The GWP is a number that refers to the amount of global warming caused by a substance. The GWP is the ratio of the warming caused by a substance to the warming caused by a similar mass of carbon dioxide. Thus, the GWP of CO₂ is defined to be 1.0. CFC-12 has a GWP of 8,500, while CFC-11 has a GWP of 5,000. Various HCFCs and HFCs have GWPs ranging from 93 to 12,100. Water, a substitute in numerous end-uses, has a GWP of 0.

TABLE 2.—REACTION RATE CONSTANTS (AT 25°C) WITH OH RADICAL

Compound	cm ³ /molecule/sec (k _{OH})
Ethane	2.4 × 10 ⁻¹³
n-C ₃ F ₇ OCH ₃	1.2 × 10 ⁻¹⁴
HFE-7500	2.2 × 10 ⁻¹⁴
HFC-227ea	1.09 × 10 ⁻¹⁵
Methyl formate	2.27 × 10 ⁻¹⁵

2. 1,1,1,2,3,3,3-Heptafluoropropane

On February 18, 1998, the Great Lakes Chemical Corporation ("Great Lakes") petitioned EPA for the exemption of 1,1,1,2,3,3,3-heptafluoropropane (HFC-227ea) from the definition of VOC. The rate constant for the reaction of HFC- 227ea with the OH radical was based on studies performed at the laboratories of Aerodyne Research, Inc. and reported by Nelson, Zahniser, and Kolb in the *Geophysical Research Letters.*, Vol. 20, No. 2, pages 197-200. The rate constant for HFC-227ea as reported in this paper (Table 2) is 1.09 × 10⁻¹⁵ cm³/molecule/ sec at 277K (0°C) which places it well under two orders of magnitude below ethane's reactivity.

Great Lakes also claims that HFC- 227ea is not an ozone-depleting substance. The EPA has approved this compound already under the SNAP program as an acceptable substitute for Halon 1301 and Halon 1211 in various fire suppression applications. Also, EPA has determined HFC-227ea to have a

3. Methyl Formate

On February 12, 2002, Foam Supplies, Inc. submitted a petition to exclude methyl formate from the definition of VOC. Also submitted were journal articles detailing three separate studies with hydroxyl radicals in which methyl formate's rate constants are measured against that of ethane on a mole basis (cm³/molecule/sec). Of the three studies, the highest value tested for methyl formate was that of 2.27 × 10⁻¹⁵ cm³/molecule/sec which is slightly below that for ethane at 2.4 × 10⁻¹³ cm³/ molecule/sec (shown in Table 2).

Foam Supplies, Inc. also notes that methyl formate has a zero ODP and a very low or zero GWP. In addition, Foam Supplies, Inc. notes that EPA has approved this compound under SNAP as an acceptable alternative to HCFC- 141b and HCFC-22 in various blowing agent applications.

Because of the closeness in rate constant values attributed to methyl formate and ethane, in addition to the information on k_{OH} value submitted by the petitioner, EPA has examined further evidence of low reactivity for methyl formate. This evidence, which is desirable when rate constant values are so close (as in the case of methyl formate and ethane), increases the confidence level with which EPA can

make a final decision on whether to approve or disapprove of a petition to exempt a compound from the VOC definition. Dr. William P. L. Carter of the University of California at Riverside has published "The SAPRC-99 Chemical Mechanism and Updated VOC Reactivity Scales," (revised 11/29/2000) on his Web site at: <http://ftp.cert.ucr.edu/pub/carter/SAPRC99/appndxc.doc>. Appendix C of his report gives maximum incremental reactivity (MIR) values which are another accepted measure of photochemical reactivity. Dr. Carter's MIR values are calculated in grams ozone per gram of organic compound. These same MIR values can be calculated on the basis of grams of ozone per mole of organic compound as discussed in the above section concerning differences between gram-basis and mole-basis reactivity rates. Methyl formate has negligible reactivity rates at less than half that of ethane. Sections of the Carter report showing ethane and methyl formate

values have been added to the docket. Also, this same data may be seen on Dr. Carter's website as stated above. While the purpose of exempting negligibly reactive VOCs is to avoid unnecessary regulation that will not help in the attainment of the ozone NAAQS, it is possible that exempting specific compounds from regulation as a VOC could result in significant health risks or other undesirable environmental impacts. The EPA has included available information about the toxicity of the four compounds under consideration in the docket. Also, EPA invited public comment, during the comment period, on the potential for significant health or environmental risks that may be expected as a result of the proposed exemptions, taking into account the expected uses for the compounds.

II. The EPA Response to the Petitions

For the petitions submitted by the 3M Company, Great Lakes Chemical

Corporation, and Foam Supplies, Inc., the data submitted by the petitioners support the contention that the reactivities of the compounds submitted, with respect to reaction with OH radicals in the atmosphere, are lower than that of ethane. There is ample evidence in the literature that methyl formate and the halogenated paraffinic VOC, listed above, do not participate in such reactions significantly.

The EPA is responding to the petitions by adding the compounds in Table 3 to the list of compounds exempt from the definition of VOC appearing in 40 CFR 51.100(s). Also, EPA is adding the following nomenclature designations "HFE-7100" to 1,1,1,2,2,3,3,4,4-nonafluoro-4-methoxybutane (C₄F₉OCH₃) and "HFE-7200" to 1-ethoxy-1,1,2,2,3,3,4,4,4-nonafluorobutane (C₄F₉OC₂H₅).

TABLE 3.—COMPOUNDS TO BE ADDED TO THE LIST OF NEGLIGIBLY-REACTIVE COMPOUNDS

Compound	Chemical name or formula
n-C ₃ F ₇ OCH ₃	1,1,1,2,2,3,3-Heptafluoro-3-methoxy-propane.
HFE-7500	3-Ethoxy-1,1,1,2,3,4,4,5,5,6,6,6-dodecafluoro-2-(trifluoromethyl)hexane.

III. The EPA Response to Comments

In the proposal for the exemption of 4 compounds, EPA indicated that interested persons could request that EPA hold a public hearing on the proposed action (*see* section 307(d)(5)(ii) of the CAA). EPA received no requests for a public hearing.

The EPA also provided for a public comment period in the proposal. The EPA received 13 comments on the proposal. The comments fell into three general categories: (1) Comments in favor of the exemptions, (2) comments of concern about toxicity and stratospheric ozone depletion, and (3) comments that object to the reporting and recordkeeping requirements. All comment letters are in the docket for this action. In today's final action, we have summarized what EPA views as the significant comments and provided the Agency's responses. We provide no responses to favorable comments because they referred to industry's desire for suitable negligibly-reactive compounds that would serve as substitutes for higher-reacting ozone precursor compounds.

While EPA concurs that encouraging use of lower reactivity compounds is the

primary basis for the VOC exemption approach, today's action focuses on the technical basis and appropriateness of exempting these four specific compounds.

Comment(s) With Respect to Toxicity and Stratospheric Ozone Depletion

Comment: One comment asserted that EPA should not encourage the production of any chemical that will enlarge the hole in the stratosphere above the Antarctic or (in the same letter with reference to methyl formate) have properties that make it toxic, flammable, or cause pulmonary damage.

Response: Section 612 of 40 CFR part 82 subpart G of the EPA SNAP rule, requires EPA to establish a method to identify alternatives to Class I (CFCs, halons, carbon tetrachloride, methylchloroform, methyl bromide, and hydrobromofluorocarbons) and Class II (HCFCs) ozone-depleting substances and to publish lists of acceptable and unacceptable substitutes. Pursuant to SNAP's rule, it is illegal to replace a Class I or Class II substance with any substitute which the Administrator determines may present adverse effects to human health or the environment

where other substitutes have been identified that reduce overall risk and are currently or potentially available. In addition, all of the compounds affected by this action, may be used as an alternative to ozone-depleting substances such as CFCs and HCFCs.

Three of the compounds, 1,1,1,2,2,3,3-heptafluoro-3-methoxy-propane, 1,1,1,2,3,3,3-heptafluoropropane, and methyl formate are already approved by the SNAP program as acceptable substitutes for ozone-depleting compounds. The fourth compound, 3-ethoxy-1,1,1,2,3,4,4,5,5,6,6,6-dodecafluoro-2-(trifluoromethyl) hexane, has not been reviewed by EPA under SNAP because it was submitted for use in secondary loop refrigeration systems. Fluids used in these systems are not covered by the SNAP program (62 FR 10700, March 10, 1997). However, this fourth compound is a member of a larger class of compounds known as HFEs, and other HFEs have been recognized by SNAP as ODS substitutes.

The EPA uses the SNAP program to identify substitutes for ozone-depleting compounds, to evaluate the acceptability of these substitutes, to

promote the use of those substitutes EPA determines to present lower overall risks to human health and the environment (relative to the Class I and Class II compounds being replaced, as well as to other substitutes for the same end-use), and to prohibit the use of those substitutes found, based on the same comparisons, to increase overall risks. EPA's SNAP program has identified the HFCs as a class of replacement substitutes for CFCs. Because they do not contain chlorine or bromine, they do not deplete the ozone layer. All HFCs have an ozone depletion potential (ODP) of 0 although some HFCs have high global warming potential (GWP).

In its VOC exemption petition, 3M points out that it has requested EPA list the compound 1,1,1,2,2,3,3-heptafluoro3-methoxy-propane as an acceptable substitute for CFCs and HCFCs in certain uses and; as such, use of this substance may mitigate depletion of stratospheric ozone. Although 3-ethoxy-1,1,1,2,3,4,4,5,5,6,6-dodecafluoro-2-(trifluoromethyl)hexane has not been identified as a substitute, specifically, the SNAP program has identified HFEs, as a class, as replacement substitutes for CFCs.

Great Lakes also claims in its VOC exemption petition that HFC-227ea is not an ozone-depleting substance. EPA has approved this compound under the SNAP program as an acceptable substitute for Halon 1301 and Halon 1211 in various fire suppression applications. As stated in the background section above, EPA has determined HFC-227ea to have a GWP at 3800 times that of carbon dioxide, making it a probable substitute for its competitor fire suppressants which have even higher GWPs.

In approving methyl formate as an acceptable substitute for CFC's and HCFC's, EPA's SNAP Program noted that methyl formate is toxic and flammable and should be handled by users with proper precautions. Methyl formate causes irritation to the eyes, skin, and lungs, and at high levels may cause pulmonary damage. However, EPA believes that use of methyl formate is well regulated by other programs; therefore, exposures to this compound will be below levels of concern. The Occupational Safety and Health Administration (OSHA) has established an enforceable occupational exposure limit of 100 ppm as an 8-hour time-weighted average. The National Institute for Occupational Safety and Health (NIOSH) has also established a short-term exposure limit (averaged over 15 minutes) of 150 ppm. There is only one supplier of methyl formate in the U.S.,

and its total production is less than 10 million pounds per year. We estimate that use of methyl formate as an HCFC replacement in the foam sector will be relatively small, reaching 2.5 million pounds between years 2008 and 2010. Although we do not have information on all the possible exposure scenarios for methyl formate, based on information provided by industry, the air concentration levels reached in testing methyl formate as a foam blowing agent have been less than 10 ppm (without ventilation), a concentration well below the occupational exposure limits set by other agencies.

Comment(s) With Respect to Recordkeeping and Reporting

Comment: The EPA received a number of comments opposing the implementation of recordkeeping and reporting requirements. According to the commenters, this requirement would cause some inequity in marketability and in cost-burden for their chemicals, resulting in a competitive advantage to companies producing the chemicals that EPA had previously exempted. Client companies and States' environmental agencies would bear the burden of additional recordkeeping and reporting costs. Could the same information be gotten from manufacturers? Could EPA employ purchase and use records as inventories? Also, there is concern that EPA will impose daily recordkeeping and reporting in order to follow multi-day ozone events and ozone transport phenomena. Another point for discussion questions how adequate atmospheric modeling can be done without data to represent the total of over forty compounds that have been exempted already. Can EPA find an optional method to atmospheric modeling? The EPA may be wiser to defer recordkeeping and reporting considerations until after development of the forthcoming reactivity policy reassessment.

Response: The EPA agrees that it would be more appropriate to address this issue as part of the reassessment of our overall reactivity policy. We have therefore decided not to include recordkeeping and reporting requirements in today's rule.

We recognize that most organic compounds that EPA has exempted as "negligibly reactive" do have some photochemical reactivity, albeit small. At some future point during the reassessment of our reactivity policy, in order to develop an accurate assessment of the atmospheric chemistry, EPA may need to begin incorporating at least

some of the widely used exempt VOCs into a model that determines a significant, or insignificant, or possibly even a beneficial environmental impact. An assessment toward this end has begun already under the aegis of an ongoing Reactivity Research Working Group (RRWG) investigation of the current scientific findings.

This type of modeling effort may require better speciated inventories of organic compounds, including compounds that we have exempted from the VOC definition. Thus, it may be necessary to develop some sort of system for gathering more accurate information about these compounds—at least those that are widely used. (In this regard, we note that the four compounds we are excluding from the VOC definition today are expected to be used in relatively small amounts.) Rather than addressing this issue in today's rule, which applies to only four compounds, we intend to address it more broadly in our upcoming notice dealing with our overall VOC policy.

Again, with this action, the EPA is not finalizing a decision on how future petitions will be evaluated. As noted above, the Agency is currently in the process of assessing its overall policy toward regulating VOCs with the inclusion of multi-day ozone and ozone transport events, as well as toxicity and stratospheric ozone depletion and global warming potential concerns. We intend to publish in the near future a notice inviting public comment on the VOC exemption policy and the concept of negligible reactivity as part of a broader review of overall policy.

IV. Final Action

Today's final action is based on EPA's review of the material in Docket No. OAR-2003-0086. The EPA hereby amends its definition of VOC at 40 CFR 51.100(s) to exclude the compounds in Table 3 from the term "VOC" for ozone SIP and ozone control purposes. States are not obligated to exclude from control as a VOC those compounds that EPA has found to be negligibly reactive. However, as this action is made final, States may not include reductions in emissions of these compounds in their calculations for determining reasonable further progress under the CAA (e.g., section 182(b)(1)) and may not take credit for controlling these compounds in their ozone control strategy.

V. Statutory and Executive Order Reviews

A. Executive Order 12866: Regulatory Planning and Review

Under Executive Order 12866 (58 FR 51735, October 4, 1993), the Agency must determine whether a regulatory action is “significant” and therefore subject to Office of Management and Budget (OMB) review and the requirements of this Executive Order. The Order defines “significant regulatory action” as one that is likely to result in a rule that may:

(1) Have an annual effect on the economy of \$100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or Tribal governments or communities;

(2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

(3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs, or the rights and obligation of recipients thereof; or

(4) Raise novel legal or policy issues arising out of legal mandates, the President’s priorities, or the principles set forth in the Executive Order.

Pursuant to the terms of Executive Order 12866, it has been determined that this rule is not “significant” because none of the listed criteria apply to this action. Consequently, this action is not submitted to OMB for review under Executive Order 12866.

B. Paperwork Reduction Act

This action does not contain any information collection requirements subject to OMB review under the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.* It does not contain any recordkeeping or reporting requirement burden.

Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply, with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of

information; and transmit or otherwise disclose the information. An Agency does not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. The control numbers for EPA’s regulations are listed in 40 CFR part 9 and 48 CFR chapter 15.

C. Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), 5 U.S.C. 601 *et seq.* requires the identification of potentially adverse impacts of Federal regulations upon small business entities. The Act specifically requires the completion of a RFA analysis in those instances where the regulation would impose a substantial impact on a significant number of small entities. Because this rulemaking imposes no adverse economic impacts, an analysis has not been conducted.

The RFA generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

After considering the economic impacts of today’s final rule on small entities, I certify that this action will not have a significant economic impact on a substantial number of small entities. This rule will not impose any requirements on small entities. Today’s rule concerns only the definition of VOC and does not directly regulate any entities. The RFA analysis does not consider impacts on entities which the action in question does not regulate. See *Motor & Equipment Manufacturers Ass’n v. Nichols*, 142 F. 3d 449, 467

(D.C. Cir. 1998); *United Distribution Cos. v. FERC*, 88 F. 3d 1105, 1170 (D.C. Cir. 1996), cert. denied, 520 U.S. 1224 (1997). Pursuant to the provision of 5

U.S.C. 605(b), I hereby certify that the rule will not have an impact on small entities.

D. Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), Public Law 104–4, establishes requirements for Federal agencies to assess the effects of their regulatory actions on State, local, and Tribal governments and the private sector. Under section 202 of the UMRA, EPA generally must prepare a written

statement, including a cost-benefit analysis, for proposed and final rules with “Federal mandates” that may result in expenditures to State, local, and Tribal governments, in the aggregate, or to the private sector, of \$100 million or more in any 1 year. Before promulgating an EPA rule for which a written statement is needed, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective or least burdensome alternative if the Administrator publishes with the final rule an explanation why that alternative was not adopted. Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including Tribal governments, it must have developed under section 203 of the UMRA a small government agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant Federal intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

Since this rule is deregulatory in nature and does not impose a mandate upon any source, this rule is not estimated to result in the expenditure by State, local and Tribal governments or the private sector of \$100 million in any 1 year. Therefore, the Agency has not prepared a budgetary impact statement or specifically addressed the selection of the least costly, most cost-effective, or least burdensome alternative. Because small governments will not be significantly or uniquely affected by this rule, the Agency is not required to develop a plan with regard to small governments.

E. Executive Order 13132: Federalism

Executive Order 13132, entitled “Federalism” (64 FR 43255, August 10, 1999), requires EPA to develop an accountable process to ensure “meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications.” “Policies that have federalism implications” is defined in the Executive Order to include

regulations that have “substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government.”

This action addressing the exemption of four chemical compounds from the VOC definition does not have federalism implications. It will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132. This action does not impose any new mandates on State or local governments. Thus, Executive Order 13132 does not apply to this rule. In the spirit of Executive Order 13132, and consistent with EPA policy to promote communications between EPA and State and local governments, EPA specifically solicited comment on the proposed rule for this final rule from State and local officials.

F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments

Executive Order 13175, entitled “Consultation and Coordination with Indian Tribal Governments” (65 FR 67249, November 6, 2000), requires EPA to develop an accountable process to ensure “meaningful and timely input by tribal officials in the development of regulatory policies that have tribal implications.” “Policies that have tribal implications” is defined in the Executive Order to include regulations that have “substantial direct effects on one or more Indian tribes, on the relationship between the Federal government and the Indian tribes, or on the distribution of power and responsibilities between the Federal government and Indian tribes.”

This rule does not have Tribal implications. It will not have substantial direct effects on Tribal governments, on the relationship between the Federal government and Indian Tribes, or on the distribution of power and responsibilities between the Federal government and Indian Tribes, as specified in Executive Order 13175. Today’s action does not have any direct effects on Indian Tribes. Thus, Executive Order 13175 does not apply to this rule. In the spirit of Executive Order 13175, and consistent with EPA policy to promote communications between EPA and Tribal governments, EPA solicited comment on the proposed rule for this final rule from Tribal officials.

G. Executive Order 13045: Protection of Children From Environmental Health and Safety Risks

Executive Order 13045: “Protection of Children from Environmental Health Risks and Safety Risks” (62 FR 19885, April 23, 1997) applies to any rule that: (1) Is determined to be “economically significant” as defined under Executive Order 12866, and (2) concerns an environmental health or safety risk that EPA has reason to believe may have a disproportionate effect on children. If the regulatory action meets both criteria, the Agency must evaluate the environmental health or safety effects of the planned rule on children, and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the Agency.

While this rule is not subject to the Executive Order because it is not economically significant as defined in Executive Order 12866, EPA has reason to believe that ozone has a disproportionate effect on active children who play outdoors (62 FR 38856; 38859, July 18, 1997). The EPA has not identified any specific studies on whether or to what extent the four above listed chemical compounds affect children’s health. The EPA has placed the available data regarding the health effects of these four chemical compounds in docket no. OAR–2003–0086. The EPA invites the public to submit or identify peer-reviewed studies and data, of which EPA may not be aware, that assess results of early life exposure to any of the four above listed chemical compounds.

H. Executive Order 13211: Actions That Significantly Affect Energy Supply, Distribution, or Use

This rule is not subject to Executive Order 13211, “Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use” (66 FR 28355, May 22, 2001) because it is not a significant regulatory action under Executive Order 12866.

I. National Technology Transfer Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (“NTTAA”), Public Law 104–113, section 12(d), (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and

business practices) that are developed or adopted by voluntary consensus standards bodies. The NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards. This rulemaking does not involve technical standards. Therefore, EPA is not considering the use of any voluntary consensus standards.

J. Congressional Review Act

The Congressional Review Act, 5 U.S.C. 801 *et seq.*, as added by the Small Business Regulatory Enforcement Fairness Act of 1996, generally provides that before a rule may take effect, the agency promulgating the rule must submit a rule report, which includes a copy of the rule, to each House of the Congress and to the Comptroller General of the United States. The EPA will submit a report containing this rule and other required information to the U.S. Senate, the U.S. House of Representatives, and the Comptroller General of the United States prior to publication of the rule in the **Federal Register**. A Major rule cannot take effect until 60 days after it is published in the **Federal Register**. This action is not a major rule as defined by 5 U.S.C. 804(2). This rule will be effective upon publication in the **Federal Register**. This final rule is a deregulatory action and, therefore, does not result in expenditures by State, local, and Tribal governments, in the aggregate, or to the private sector of \$100 million or more in any 1 year. Also, this final rule will not have a significant economic impact on a substantial number of small entities. The deregulatory nature of this final rule will result in a cost benefit for industries using or manufacturing these chemical compounds.

List of Subjects in 40 CFR Part 51

Environmental protection, Administrative practice and procedure, Air pollution control, Ozone, Reporting and recordkeeping requirements, Volatile organic compounds.

Dated: November 18, 2004.

Michael Leavitt,
Administrator.

■ For reasons set forth in the preamble, part 51 of chapter I of title 40 of the Code of Federal Regulations is amended as follows:

PART 51—REQUIREMENTS FOR PREPARATION, ADOPTION, AND SUBMITTAL OF IMPLEMENTATION PLANS

■ 1. The authority citation for part 51 continues to read as follows:

Authority: 23 U.S.C.; 42 U.S.C. 7401-7641q.

■ 2. Section 51.100 is amended by revising paragraph (s)(1) as follows:

Subpart F—[Amended]

§ 51.100 Definitions.

* * * * *

(s) * * *

(1) This includes any such organic compound other than the following, which have been determined to have negligible photochemical reactivity: methane; ethane; methylene chloride (dichloromethane); 1,1,1-trichloroethane (methyl chloroform); 1,1,2-trichloro-1,2,2-trifluoroethane (CFC-113); trichlorofluoromethane (CFC-11); dichlorodifluoromethane (CFC-12); chlorodifluoromethane (HCFC-22); trifluoromethane (HFC-23); 1,2-dichloro-1,1,2,2-tetrafluoroethane (CFC-114); chloropentafluoroethane (CFC-115); 1,1,1-trifluoro-2,2-dichloroethane (HCFC-123); 1,1,1,2-tetrafluoroethane (HFC-134a); 1,1-dichloro-1-fluoroethane (HCFC-141b); 1-chloro-1,1-difluoroethane (HCFC-142b); 2-chloro-1,1,1,2-tetrafluoroethane (HCFC-124); pentafluoroethane (HFC-125); 1,1,2,2-tetrafluoroethane (HFC-134); 1,1,1-trifluoroethane (HFC-143a); 1,1-difluoroethane (HFC-152a); perchlorobenzotrifluoride (PCBTF); cyclic, branched, or linear completely methylated siloxanes; acetone; perchloroethylene (tetrachloroethylene); 3,3-dichloro-1,1,1,2,2-pentafluoropropane (HCFC-225ca); 1,3-dichloro-1,1,2,2,3-pentafluoropropane (HCFC-225cb); 1,1,1,2,3,4,4,5,5,5-decafluoropentane (HFC 43-10mee); difluoromethane (HFC-32); ethylfluoride (HFC-161); 1,1,1,3,3,3-hexafluoropropane (HFC-236fa); 1,1,2,2,3-pentafluoropropane (HFC-245ca); 1,1,2,3,3-pentafluoropropane (HFC-245ea); 1,1,1,2,3-pentafluoropropane (HFC-245eb); 1,1,1,3,3-pentafluoropropane (HFC-245fa); 1,1,1,2,3,3-hexafluoropropane (HFC-236ea); 1,1,1,3,3-pentafluorobutane (HFC-365mfc); chlorofluoromethane (HCFC-31); 1-chloro-1-fluoroethane (HCFC-151a); 1,2-dichloro-1,1,2-trifluoroethane (HCFC-123a); 1,1,1,2,2,3,3,4,4-nonafluoro-4-methoxy-butane (C₄F₉OCH₃ or HFE-7100); 2-(difluoromethoxymethyl)-1,1,1,2,3,3,3-heptafluoropropane ((CF₃)₂CFCF₂OCH₃); 1-ethoxy-1,1,2,2,3,3,4,4,4-nonafluorobutane (C₄F₉OC₂H₅ or HFE-7200); 2-(ethoxydifluoromethyl)-1,1,1,2,3,3,3-heptafluoropropane ((CF₃)₂CFCF₂OC₂H₅); methyl acetate, 1,1,1,2,2,3,3-heptafluoro-3-methoxypropane (n-C₃F₇OCH₃, HFE-7000), 3

ethoxy-1,1,1,2,3,4,4,5,5,6,6-dodecafluoro-2-(trifluoromethyl) hexane (HFE-7500), 1,1,1,2,3,3,3-heptafluoropropane (HFC 227ea), and methyl formate (HCOOCH₃), and perfluorocarbon compounds which fall into these classes:

- (i) Cyclic, branched, or linear, completely fluorinated alkanes;
- (ii) Cyclic, branched, or linear, completely fluorinated ethers with no unsaturations;
- (iii) Cyclic, branched, or linear, completely fluorinated tertiary amines with no unsaturations; and
- (iv) Sulfur containing perfluorocarbons with no unsaturations and with sulfur bonds only to carbon and fluorine.

* * * * *

[FR Doc. 04-26070 Filed 11-26-04; 8:45 am]

BILLING CODE 6560-50-P

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 51

[OAR-2003-0084; FRL-7840-8]

RIN 2060-AI45

Revision to Definition of Volatile Organic Compounds—Exclusion of t-Butyl Acetate

AGENCY: Environmental Protection Agency (EPA). ACTION: Final rule.

SUMMARY: This action revises EPA's definition of volatile organic compounds (VOC) for purposes of Federal regulations related to attaining the National Ambient Air Quality Standards (NAAQS) for ozone under title I of the Clean Air Act (CAA). This revision modifies the definition of VOC to say that t-butyl acetate (also known as tertiary butyl acetate or informally as TBAC or TBAC) will not be VOC for purposes of VOC emissions limitations or VOC content requirements, but will continue to be VOC for purposes of all recordkeeping, emissions reporting, and inventory requirements which apply to VOC. This revision is made on the basis that this compound has negligible contribution to tropospheric ozone formation. As a result, if you are subject to certain Federal regulations limiting emissions of VOCs, your emissions of TBAC may not be regulated for some purposes.

DATES: This final rule is effective on December 29, 2004. **ADDRESSES:** The EPA has established a docket for this action under Docket ID

No. OAR-2003-0084 (legacy docket number A-99-02). All documents in the docket are listed in the EDOCKET index at <http://www.epa.gov/edocket>. Although listed in the index, some information is not publicly available, *i.e.*, Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, is not placed on the Internet and will be publicly available only in hard copy form. Publicly available docket materials are available either electronically in EDOCKET or in hard copy at the Docket, EPA/DC, EPA West, Room B102, 1301 Constitution Ave., NW., Washington, DC. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m. Monday through Friday, excluding legal holidays.

FOR FURTHER INFORMATION CONTACT:

William Johnson, Office of Air Quality Planning and Standards, Air Quality Strategies and Standards Division (C539-02), Environmental Protection Agency, Research Triangle Park, NC 27711; (919)541-5245; e-mail:

johnson.williaml@epa.gov.

SUPPLEMENTARY INFORMATION:

I. General Information

A. How Does This Rule Fit Into Existing Regulations?

The EPA is revising the definition of VOC to say that TBAC will not be a VOC for purposes of VOC emissions limitations or VOC content requirements, but will continue to be a VOC for purposes of all recordkeeping, emissions reporting, and inventory requirements which apply to VOC. If you use or produce TBAC and are subject to EPA regulations limiting the use of VOCs in your product, limiting the VOC emissions from your facility, or otherwise controlling your use of VOCs for purposes related to attaining the ozone NAAQS, then you will not count TBAC as a VOC in determining whether you meet these regulatory obligations. However, TBAC emissions will still be subject to reporting requirements that exist for other VOC emissions. This action may also affect whether TBAC is considered a VOC for State regulatory purposes, depending on whether the State relies on EPA's definition of VOC. This decision responds to a petition submitted by the Lyondell Chemical Company¹ and is based on information

¹ The petition was submitted on January 17, 1997, by ARCO Chemical Company. Lyondell is the successor to ARCO for this petition, and EPA will refer to the petitioner as Lyondell throughout this final rule.

Office of Environmental Health Hazard Assessment

Joan E. Denton, Ph.D., Director

Headquarters • 1001 I Street • Sacramento, California 95814

Mailing Address: P.O. Box 4010 • Sacramento, California 95812-4010

Oakland Office • Mailing Address: 1515 Clay Street, 16th Floor • Oakland, California 94612

Linda S. Adams
Secretary for Environmental Protection



Arnold Schwarzenegger
Governor

MEMORANDUM

TO: Richard Corey, Chief
Research and Economic Studies Branch
Research Division
Air Resources Board

FROM: Melanie A. Marty, Ph.D., Chief *nam*
Air Toxicology and Epidemiology Branch

DATE: March 14, 2008

SUBJECT: HEALTH EFFECTS OF EXPOSURE TO METHYL FORMATE, A CHEMICAL
PETITIONED FOR EXEMPTION FROM VOC RULES

Recently the Research Division sent the Office of Environmental Health Hazard Assessment (OEHHA) two Applications for VOC Exempt Status in the State of California for Methyl Formate: one submitted by Foam Supplies and one by Pactiv Corporation. Pactiv proposes to substitute up to a maximum of 1,985,507 pounds of methyl formate per year for *partial* substitution of n-butane, isobutene, and isopentane, used as blowing agents at three plastics manufacturing facilities in California, if methyl formate is exempted from VOC regulations. The Division asked OEHHA to review the health effects of methyl formate. Our review is attached.

Exposure to workers and to the general public near facilities in California using methyl formate will occur if it is exempted. Methyl formate is an ester and would be expected to be less irritating to mucous membranes than its metabolites, formaldehyde or formic acid. In the present application the concern is the internal levels of methanol and formic acid (or formate ion) in solution due to metabolism of methyl formate, not the external air concentrations of the chemicals. At dose levels likely to be achieved in environmental exposures by inhalation, these concerns appear to be minor. OEHHA has estimated an interim acute Reference Exposure Level (REL) for methyl formate. Although derived by approved methodology, the REL for methyl formate has not undergone external peer-review or review by the Board's Scientific Review Panel on Toxic Air Contaminants.

If you have questions about our review, or would like additional information, please call Dr. Jim Collins, of my staff, at 510-622-3146.

Attachment

Richard Corey
March 14, 2008
Page 2

cc: Andrew G. Salmon, M.A., D.Phil.
Senior Toxicologist
Air Toxicology and Epidemiology Branch

James F. Collins, Ph.D., D.A.B.T.
Staff Toxicologist
Air Toxicology and Epidemiology Branch

George V. Alexeeff, Ph.D., D.A.B.T.
Deputy Director for Scientific Affairs

Dongmin Luo, Ph.D., P.E.
Air Resources Supervisor I
Research Division
Air Resources Board

Ralph Propper
Staff Air Pollution Specialist
Research Division
Air Resources Board

Richard Boyd, Manager
Stationary Source Division
Air Resources Board

Methyl Formate (CAS# 107-31-3)

(Synonyms: methyl methanoate; formic acid, methyl ester)

1 Introduction

ARB received an Application for VOC Exempt Status in the State of California for Methyl Formate (Trade name ecomate®), which was submitted by Foam Supplies, Inc. and dated October 3, 2007. The application contains several documents with toxicological information. The most relevant was Document A-5, part 1 by the American Chemical Society entitled Test Plan for the Formates Category which was submitted to USEPA as part of the High Production Volume (HPV) Chemical Challenge Program. An HPV chemical is produced at more than a million pounds per year in the US.

Another petition for VOC exempt status for methyl formate was submitted by Pactiv Corporation and dated October 26, 2007. One attachment was a comprehensive toxicological profile of methyl formate which indicates that there is limited toxicological information on methyl formate itself. The petition included copies of many reports from the peer-reviewed literature related to methyl formate, methanol, and formic acid.

Pactiv Corporation has three plants in California, two in the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) and one in the South Coast Air Quality Management District. Each plant uses a different blowing agent (n-butane, isobutene, or isopentane) in plastics manufacture. In order to comply with new air pollution control rules (e.g., SJVUAPCD Rule 4682 - Polystyrene, Polyethylene, and Polypropylene Products Manufacturing), in its petition Pactiv proposes to substitute up to a maximum of 1,985,507 pounds of methyl formate per year for *partial* substitution of the three agents, if methyl formate is exempted from VOC regulations. The petition indicates that in the blowing process 10% of the agent escapes to the atmosphere, 40% is destroyed by a regenerative thermal oxidizer, and 50% is in the finished product. The methyl formate leaks from the finished product with time. The petition states that 60% of the methyl formate can potentially affect the health of workers and the public near the facility. The petition also contains a worker exposure study from a Pactiv plant in Georgia which used methyl formate in the plastics process. The study found levels of less than 5 ppm for worker exposure during the manufacturing process.

As part of its consideration of exempt status for a VOC, ARB asked OEHHA to review the toxicology of methyl formate.

2 Health Effects of Methanol and Formic Acid

Since methyl formate is hydrolyzed in the body to methanol and formic acid and methanol is oxidized to formaldehyde and then to formic acid, these metabolites should be considered in assessing the toxicity of methyl formate.

In response to Health and Safety Code Section 44300 *et seq.*, OEHHA previously reviewed the toxicology of formaldehyde and methanol and developed acute and chronic Reference Exposure

Levels (RELs) for formaldehyde and methanol (OEHHA 1999; OEHHA, 2000) and an inhalation cancer unit risk factor for formaldehyde (OEHHA, 2005).

<i>Chemical</i>	<i>Acute REL</i>	<i>Chronic REL</i>	<i>Unit Risk</i>
Methanol	28,000 $\mu\text{g}/\text{m}^3$	4000 $\mu\text{g}/\text{m}^3$	None
Formaldehyde	90 $\mu\text{g}/\text{m}^3$	3 $\mu\text{g}/\text{m}^3$	$6 \times 10^{-6} (\mu\text{g}/\text{m}^3)^{-1}$

Formaldehyde is listed under Proposition 65 as a chemical known to cause cancer. In 2006 the International Agency for Research on Cancer (IARC) classified formaldehyde as a known human carcinogen by inhalation. These listings relate to inhalation exposures to formaldehyde in the gas phase; evidence of carcinogenesis by formaldehyde in solution or metabolically generated is lacking.

The Agency for Toxic Substances and Disease Registry has produced a comprehensive review of the toxicity of formaldehyde (ATSDR, 1999). The National Toxicology Program has reviewed methanol, concentrating on its reproductive and developmental toxicity (2003). Other general reviews of methanol toxicity include Roe (1955) and Kavet and Nauss (1990).

The current discussion will focus on methyl formate and formic acid. The toxicologic database for these chemicals is much smaller than the databases for methanol and formaldehyde. Both methyl formate and formic acid have been used in workplaces for decades and acceptable workplace exposure levels (threshold limit values or TLVs) exist for both (ACGIH, 2007). The current TLV for methyl formate is 100 ppm (ACGIH, 2007). OEHHA notes that increased public exposure to these chemicals is likely if methyl formate is exempted from VOC regulation, and its use becomes more widespread in California. The petition by Pactiv indicates that increased exposure will occur. Thus we would want to compare an interim REL for methyl formate with estimated exposures from industrial use in California. Additionally, we look at formation of methyl formate metabolites which could contribute to toxicity.

3 Physical and Chemical Properties of Methyl Formate (HSDB, 2007)

<i>Description</i>	Colorless liquid; pleasant odor
<i>Molecular formula</i>	C2-H4-O2
<i>Molecular weight</i>	60.05 g/mol
<i>Density</i>	0.987 @ 15°C/15°C
<i>Boiling point</i>	31.5 °C
<i>Melting point</i>	-99.8 °C
<i>Vapor pressure</i>	585.7 mm Hg @ 25°C
<i>Odor threshold</i>	600 ppm (Amoore & Hautala, 1983)
<i>Log Kow</i>	0.03
<i>Solubility</i>	soluble in ether, chloroform, water; miscible with ethanol
<i>Atmospheric half-life</i>	66.9 days (LeCalve <i>et al.</i> , 1999)
<i>Conversion factor</i>	2.45 µg/m ³ per ppb @ 25°C

4 Toxicity of Methyl Formate

4.1 Absorption, Distribution, Metabolism, and Excretion of Methyl Formate

Background (endogenous) levels of methanol and formate, the ion of formic acid (pKa = 3.7), can be measured in the blood of humans. The range for methanol is 0.01 to 0.11 mM (Lee *et al.*, 1992; Sedivec *et al.*, 1981), while the range for formate (n = 30 normal individuals) is 0.12-0.28 mM (Buttery and Chamberlain, 1988).

Methyl formate is hydrolyzed in the body by various esterases (see Dahl *et al.*, 1987) and by cytochrome P450 enzymes (Peng *et al.*, 1995) to methanol and formic acid (which ionizes to formate ion in most tissues). The half-time of methyl formate in the body is calculated to be 6.1 seconds based on a kinetic constant (K_{MF}) of 6.7 min^{-1} (Nihlén and Droz, 2000). Methanol can be oxidized to formaldehyde by at least three enzyme systems (catalase-peroxidase in rodents, alcohol dehydrogenase in humans and monkeys, and possibly a mixed function oxidase) (Liesivuori and Savolainen, 1991). Formaldehyde or its hydrated form methanediol is subsequently oxidized by one or more aldehyde/formaldehyde dehydrogenases to formic acid. The oxidation of formaldehyde to formic acid is also fast (hydrated formaldehyde half-life = 1 minute) (NTP-CERHR, 2003). (The metabolism of formic acid results in carbon dioxide and water.)

Nihlén and Droz (2000) developed a toxicokinetic (TK) model to describe the inhalation of methyl formate in humans. The model has four "compartments:" (1) the methyl formate "pool"; pools of the metabolites (2) methanol and (3) formic acid; and (4) a urinary compartment in which formic acid shows saturable reabsorption. Levels of methanol and formic acid in urine reported in an experimental study, in which 20 people were exposed for 8 hours at rest to 100 ppm methyl formate (Sethre *et al.*, 2000a; summarized below) were used for model validation. After inhalation of methyl formate, the model predicted a nonlinear and a linear relationship, respectively, between methyl formate exposure and formic acid (nonlinear) or methanol (linear)

excretion in urine. This was also seen after occupational exposure to methyl formate (Berode *et al.*, 2000). The model has also been modified to simulate methanol exposure. Low exposures of methyl formate (due to low concentration or minimal exercise) produce only marginal increases in urinary excretion of formic acid due to its reabsorption. When methyl formate exposure is increased, urinary excretion of formic acid increases because its reabsorption is saturated. Using urinary excretion of formic acid as the critical indicator, the authors suggest an occupational exposure limit value for methyl formate of no greater than 50 ppm based on model predictions. The TLV for workers is 100 ppm with a short term exposure level (STEL) of 150 ppm (ACGIH, 2007). The current TLV is based on upper and lower respiratory tract and eye irritation (ACGIH, 2007). Methanol in urine is a biomarker of low methyl formate exposure, because of a linear relationship with exposure and lower background values of methanol compared to formic acid. At higher methyl formate levels formic acid could be used as a biomarker of exposure; after formic acid reabsorption is saturated, it is a progressively more sensitive indicator of methyl formate exposure. Biological monitoring for methyl formate is difficult because of individual variations in background values of methanol of ten-fold (Lee *et al.*, 1992; Sedivec *et al.*, 1981) and formate of more than two-fold (Buttery and Chamberlain, 1988).

4.2 Animal Toxicity of Methyl Formate

Schrenk *et al.* (1936) exposed groups of six guinea pigs for up to 8 hours to 0.15%, 0.35%, 1.0%, 2.5%, and 5% methyl formate (1500, 3500, 10,000, 25,000 and 50,000 ppm). At 1500 ppm the only effect was nasal irritation. At 3500 ppm there was both nasal and eye irritation. At 10,000 ppm there were additional symptoms (incoordination, narcosis) plus some death within 3 hours. Thus 1500 ppm was an 8 hour inhalation LOAEL. An LC_{50} was not calculated by the authors but is > 3500 ppm.

The IUCLID dataset lists a rat 4 hour LC_{50} as > 5.2 mg/L (> 2100 ppm) and a mouse 3 hour LC_{50} of 7.48 mg/L (3050 ppm) (European Commission, 2000).

4.3 Human Toxicity of Methyl Formate

In an older study, men exposed to 1500 ppm methyl formate vapor in air for 1 minute noticed the "pleasant" odor, but had no nasal or eye irritation (Schrenk *et al.*, 1936).

In order to study the acute effects of methyl formate on the nervous system, Sethre *et al.* (2000a) exposed 20 subjects to 100 ppm methyl formate for 8 hours in a chamber. Twenty control subjects had the same ages (20 - 30 years), gender, and education level. The subjects did not know if they were exposed or not (odor threshold of methyl formate = 600 ppm). Three times during the exposure, several tests of mood, neurobehavioral performance, vision, and postural sway were administered. During an undemanding test (Profile of Mood State) and a demanding performance task (determination test), the pulse was taken and electromyography (EMG) of the forehead and of the neck were recorded. Early and late during the exposure various spirometry tests were carried out and the odor perception threshold determined. In the late afternoon fatigue was significantly increased in the exposed group; the EMG of the forehead during a demanding task showed a different development during exposure. The other tests showed no significant solvent effect, but 16 of 43 test parameters showed a significant effect of time. The study indicates a possible effect of methyl formate exposure on fatigue after 8 h exposure at 100 ppm

in young and healthy subjects, without measurable impairment of neurobehavioral performance. The study indicates a LOAEL of 100 ppm for acute exposure of healthy workers.

No data were available in the literature for chronic exposure of humans to methyl formate, even though it has a long history of use.

5 Toxicity of Formic Acid

Since formic acid is one of the metabolites of methyl formate, staff looked for relevant toxicity studies on it in the open literature. Although much of the toxicity data is from inhalation exposure, in the present application the concern is the internal level of formic acid (or formate ion) in solution due to metabolism of methyl formate, not the external air concentrations of the chemicals.

5.1 Animal Toxicity of Formic Acid

Amdur (1960) exposed guinea pigs (n=7-16/level) to 0.34, 1.0, 2.8, 6.6, 13.5, or 42.5 ppm formic acid for 1 hour. Physiological measurements were made before and during exposure, so that each animal served as its own control. At all exposure levels including 0.34 ppm, animals showed increased pulmonary resistance and decreased pulmonary compliance. The elastic and resistance work of breathing was increased at 2.8 ppm and above. A more overt sign of pulmonary irritation, decreased breaths per minute, was only seen at 42.5 ppm. Thus 42.5 ppm was a LOAEL and 13.5 ppm a NOAEL for respiratory irritation, but more subtle adverse effects were measured at lower concentrations.

NTP (1992) conducted 2- and 13-week toxicity studies in male and female F344/N rats and B6C3F₁ mice exposed by whole body inhalation exposure to formic acid vapors. In 2-week studies, groups of 5 F344/N rats and 5 B6C3F₁ mice of each sex were exposed 6 hours/day, 5 days/week, to 0, 31, 62.5, 125, 250, or 500 ppm. Deaths occurred in animals exposed to 500 ppm (rats and mice) and 250 ppm (1 female mouse). At 62.5 ppm and above, microscopic lesions of squamous metaplasia, necrosis, and inflammation in the respiratory and olfactory epithelia were detected in rats and mice. Severity increased with concentration.

In 13-week studies, groups of 10 animals of each species and sex were exposed to 0, 8, 16, 32, 64, and 128 ppm formic acid 6 hours/day, 5 days/week. One male and one female mouse in the 128 ppm groups died. Body weight gains were significantly decreased in mice exposed to 64 and 128 ppm. Microscopic changes in both species ranged from minimal to mild and were limited to exposure at 128 ppm. Lesions related to exposure were squamous metaplasia and degeneration of the respiratory and olfactory epithelia, respectively.

NTP concluded that the effects of formic acid were consistent with those of other irritants administered by inhalation. The no-observed-adverse-effect level (NOAEL) for respiratory injury was 32 ppm in rats and mice. There was no significant evidence of systemic toxicity.

Formate inhibits cytochrome c oxidase activity in the electron transport chain in intact mitochondria and in submitochondrial particles. The inhibition increases with decreasing pH, indicating that HCOOH may be the inhibitory species. Formate is permeable through the inner mitochondrial membrane (Nicholls, 1976)

In genetic toxicity tests *in vitro* with *Salmonella typhimurium*, formic acid was not mutagenic either with or without metabolic activation (NTP, 1992).

U.S. EPA also does not have any health values for exposure of the general public to methyl formate.

6 Toxicity of Methanol

Inhalation of methanol by humans is associated with headache and narcosis due to methanol itself. Ingestion of methanol induces blindness in humans (Roe 1955). Medinsky and Dorman (1995) reviewed methanol disposition (including its metabolite formate) in humans, non-human primates, and rodents after neurotoxic doses. Formate is also formed endogenously from serine and is detoxified to CO₂ and H₂O by a tetrahydrofolate-(THF) dependent pathway. Rodents detoxify formate more rapidly than primates. Species (e.g., rodents) with high liver THF levels are less sensitive to neurotoxicity due to large methanol doses than species with low THF levels (e.g., humans and non-human primates). The capacity of primates to detoxify formate from low level methanol inhalation can be extrapolated to assess human risk from methanol. Cynomolgus monkeys exposed to 10-200 ppm [¹⁴C]methanol for 2 hours have blood levels of methanol-derived formate that are 100- to 1000-fold *lower* than endogenous levels of formate (Dorman et al., 1994). Healthy human volunteers exposed at rest or during exercise to 200 ppm methanol for 6 hours (Lee et al., 1992) or exposed to 20 mg/kg orally have elevated blood levels of methanol, but blood formate levels are not significantly increased above endogenous levels. Deficiencies in THF may prolong elevated blood levels of formate and increase the likelihood of toxicity. Monkeys with low THF levels exposed to 900 ppm methanol for 2 hours had methanol-derived blood formate levels below endogenous levels (Dorman et al., 1994). Medinsky and Dorman concluded that humans may not be at added risk of neurotoxicity from low level methanol exposure.

Since methyl formate is metabolized in the liver to methanol and formic acid, a study of methanol by the oral route, in which there would be a first pass effect of methanol in the liver, is more relevant than inhalation studies. Sprague-Dawley rats (30/sex/dose) were gavaged daily with 0, 100, 500, or 2500 mg/kg/day methanol (USEPA, 1986). At six weeks, 10 rats/sex/dose group were subjected to interim necropsy and the other 20 were dosed until necropsy at 90 days. No differences between dosed and controls were found for body weight gain, food consumption, and gross or microscopic evaluations. There were elevated levels of serum glutamate pyruvate transaminase (SGPT, also known as alanine aminotransferase), serum alkaline phosphatase (SAP), and increased, but not statistically significant, liver weights in both male and female rats at the highest dose. These effects could be treatment-related although there were no liver lesions detected by histopathology. In addition, brain weights in both high-dose males and females were

significantly less than control group. The USEPA considered 500 mg/kg/day of methanol a NOAEL for rats (USEPA, 2008).

7 Toxicity of Formaldehyde

The non-cancer adverse health effects of airborne formaldehyde are due to its irritation of mucous membranes (OEHHA, 2007). However, in the case of methyl formate exposure, formaldehyde would only be formed internally where it is rapidly metabolized to formate.

As a result of its solubility in water and high reactivity, formaldehyde is efficiently absorbed into the mucus layers protecting the eyes and respiratory tract where it rapidly reacts, leading to localized irritation. Acute high inhalation exposure may lead to eye, nose and throat irritation, and in the respiratory tract, nasal obstruction, pulmonary edema and dyspnea. Prolonged or repeated exposures have been associated with allergic sensitization, asthma-like symptoms, histopathological changes in respiratory epithelium, and decrements in lung function. Children, especially those diagnosed with asthma, may be more likely to show impaired pulmonary function and symptoms of asthma than are adults following chronic exposure to formaldehyde.

8 Derivation of Interim Acute REL (1-hour exposure) for Methyl Formate

<i>Study</i>	Sethre <i>et al.</i> , 2000
<i>Study population</i>	20 volunteers, 20-30 years old
<i>Exposure method</i>	Inhalation of 100 ppm
<i>Critical effects</i>	Nervous system
<i>LOAEL</i>	100 ppm
<i>NOAEL</i>	not found
<i>Exposure duration</i>	8 hr once
<i>Extrapolation to 1 hour</i>	$C^n * T = K$, where $n = 2$ (Ten Berge <i>et al.</i> , 1986)
<i>Extrapolated 1 hour concentration</i>	280 ($100^2 * 8 = C^2 * 1$)
<i>LOAEL uncertainty factor</i>	6
<i>Interspecies uncertainty factor</i>	1
<i>Intraspecies uncertainty factor</i>	10
<i>Cumulative uncertainty factor</i>	60
<i>Reference Exposure Level</i>	4.7 ppm (11.4 mg/m ³ ; 11,400 µg/m ³)

The draft acute REL was developed using methodology published in 1999 (OEHHA, 1999). The acute REL of 11,400 µg/m³ is much greater than the acute REL for formaldehyde (90 µg/m³) and somewhat less than half that for methanol (28,000 µg/m³). The low acute REL of formaldehyde reflects the reactivity of the aldehyde group which causes sensory effects and tissue damage at the point of contact with the respiratory system and the eyes. Although derived by approved

methodology, the REL for methyl formate has not undergone external peer-review. It is derived to gauge toxicity relative to the better studied methanol and formaldehyde.

From the gavage study in rats, USEPA (2008) developed an oral Reference Dose (RfD) of 0.5 mg/kg-day based on liver damage. The dose for a standard 70 kg man at the RfD would be 35 mg methanol (0.5 x 70) or 65.9 mg methyl formate per day, a dose similar to breathing methyl formate at the level of the acute REL for 4-6 hours.

For comparison an inhalation acute REL was derived from the 8 hour LOAEL of 1500 ppm derived by Schrenk et al. (1936) for guinea pigs. Since the effect was respiratory irritation, time extrapolation was not used. After applying a LOAEL uncertainty factor of 6, an interspecies UF of 10, and an intraspecies UF of 10 (cumulative UF=600), an acute REL of 2.5 ppm was calculated, in good agreement with that based on the human data of Sethre et al. (2000).

As mandated by the Children's Environmental Health Protection Act (SB25, 1999), OEHHA is currently reevaluating its methodology to determine if children are adequately protected by our methodology. Thus the value could change with a new methodology.

No data are available on long term inhalation of methyl formate, so a chronic REL could not be developed.

9 Data Gaps

Data gaps of concern to OEHHA staff include:

1. No lifetime inhalation study of methyl formate is available. The longest inhalation study available in the open literature is a 13 week subchronic study of formic acid in F344/N rats and B6C3F₁ mice (NTP, 1992). This is a serious data gap for a high production volume chemical, even though there are no direct indicators of concern for carcinogenicity of this chemical.
2. The group sizes in the 13 week study are only 10 males and 10 females at each level.
3. There are no data on neonatal rats of methyl formate or formic acid. In the 13 week study of formic acid (NTP, 1992), rats were exposed beginning at approximately 6-7 weeks of age. OEHHA has a mandate to determine if our health values adequately protect infants and children. The database does not include a developmental toxicology study for methyl formate, although there are several studies of methanol (reviewed in NTP-CERHR, 2003). The most sensitive developmental toxicity study reported an inhalation NOAEL of 1000 ppm (1300 mg/m³) methanol for congenital malformations (Rogers et al., 1993). OEHHA used the data to develop a secondary acute inhalation REL of 10 ppm for 7 hours to protect against severe adverse effects (OEHHA, 1999).

10 Conclusion

There are no carcinogenicity or long-term toxicity data on methyl formate. There is no evidence of carcinogenicity for methanol despite a robust database on toxicity and a long history of human exposure. IARC has no listing for methanol. Formaldehyde is carcinogenic by inhalation and has recently been classified by IARC as a human carcinogen (IARC, 2006), but it has not been determined that the internal levels of dissolved or bound formaldehyde produced by intermediary metabolism or by methanol oxidation are associated with cancer.

Exposure to workers and the general public near facilities in California using methyl formate will occur if it is exempted. Methyl formate is an ester and would be expected to be less irritating to mucous membranes than formaldehyde or formic acid. In the present application the concern is the internal levels of methanol and formic acid (or formate ion) in solution due to metabolism of methyl formate, not the external air concentrations of the chemicals.

11 References

ACGIH (2007). American Conference of Governmental Industrial Hygienists. TLVs® and BEIs®. Cincinnati: American Conference of Governmental Industrial Hygienists.

ATSDR (1999). Agency for Toxic Substances and Disease Registry. Toxicological Profile for Formaldehyde. PB/99/166654.

Amdur MO (1960). The response of guinea pigs to inhalation of formaldehyde and formic acid alone and with a sodium chloride aerosol. *Int J Air Pollut.* 3:201-20.

Amoore JE, Hautala E (1983). Odor as an aid to chemical safety: odor thresholds compared with threshold limit values and volatilities for 214 industrial chemicals in air and water dilution. *J Appl Toxicol.* 3(6):272-90.

Berode M, Sethre T, Laubli T, Savolainen H (2000). Urinary methanol and formic acid as indicators of occupational exposure to methyl formate. *Int Arch Occup Environ Health.* 73(6):410-4.

Buttery JE, Chamberlain BR (1988). A simple enzymatic method for the measurement of abnormal levels of formate in plasma. *J Anal Toxicol.* 12(5):292-4.

Dahl AR, Miller SC, Petridou-Fischer J (1987). Carboxylesterases in the respiratory tracts of rabbits, rats and Syrian hamsters. *Toxicol Lett.* 36(2):129-36.

Dorman DC, Moss OR, Farris GM, Janszen D, Bond JA, Medinsky MA (1994). Pharmacokinetics of inhaled [¹⁴C]methanol and methanol-derived [¹⁴C]formate in normal and folate-deficient cynomolgus monkeys. *Toxicol Appl Pharmacol.* 128(2):229-38.

European Commission (2000). Methyl formate. IUCLID Dataset. European Chemicals Bureau. Available online at <http://ecb.jrc.it/IUCLID-DataSheets/107313.pdf>

HSDB (2007). Available online at: <http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB> Last accessed Oct. 29, 2007.

IARC (2006). Formaldehyde, 2-Butoxyethanol and 1-*tert*-Butoxypropan-2-ol. IARC Monographs. Vol. 88. Lyon: International Agency for Research on Cancer.

Kavet R, Nauss KM (1990). The toxicity of inhaled methanol vapors. Crit Rev Toxicol. 21(1):21-50.

LeCalve S, LeBras G, Mellouki A (1999). Kinetics for the OH reaction with oxygenated VOCs. Proceedings of EUROTRAC Symposium '98. Borrell PM, Borrell P, eds. Southampton: WIT Press. pp. 112-115.

Lee EW, Terzo TS, D'Arcy JB, Gross KB, Schreck RM (1992). Lack of blood formate accumulation in humans following exposure to methanol vapor at the current permissible exposure limit of 200 ppm. *Am Ind Hyg Assoc J*. 53(2):99-104.

Liesivuori J, Savolainen H (1991). Methanol and formic acid toxicity: biochemical mechanisms. *Pharmacol Toxicol*. 69(3):157-63.

Medinsky MA, Dorman DC (1995). Recent developments in methanol toxicity. *Toxicol Lett*. 82-83:707-11.

NTP (1992). National Toxicology Program. Toxicity Studies of Formic Acid (CAS No. 64-18-6) Administered by Inhalation to F344/N Rats and B6C3F₁ Mice. Tox-19. NIH Publication 92-3342.

NTP-CERHR (2003). National Toxicology Program. Center for the Evaluation of Risks to Human Reproduction. Monograph on the Potential Human Reproductive and Developmental Effects of Methanol. NIH Publication No. 03-4478.

Nicholls P (1976). The effect of formate on cytochrome aa₃ and on electron transport in the intact respiratory chain. *Biochim Biophys Acta*. 9;430(1):13-29

Nihlén A, Droz PO (2000). Toxicokinetic modelling of methyl formate exposure and implications for biological monitoring. *Int Arch Occup Environ Health*. 73(7):479-87.

OEHHA (1999). Office of Environmental Health Hazard Assessment. Air Toxics Hot Spots Risk Assessment Guidelines. Part I. The Determination of Acute Reference Exposure Levels for Airborne Toxicants. Documentation of acute RELs is available on-line at http://www.oehha.ca.gov/air/acute_rels/allAcRELS.html

OEHHA (2000). Office of Environmental Health Hazard Assessment. Air Toxics Hot Spots Risk Assessment Guidelines. Part III. Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels. Documentation of chronic RELs is available on-line at http://www.oehha.ca.gov/air/chronic_rels/AllChrels.html

OEHHA (2005). Office of Environmental Health Hazard Assessment. Air Toxics Hot Spots Risk Assessment Guidelines. Part II. Technical Support Document for Describing Available Cancer potency Factors. Available on-line at http://www.oehha.ca.gov/air/hot_spots/pdf/TSDNov2002.pdf

OEHHA (2007). Formaldehyde. Appendix D. Individual Acute, 8-Hour, and Chronic Reference Exposure Level Summaries. Available online at: http://www.oehha.ca.gov/air/hot_spots/pdf/110207AppD.pdf

Peng HM, Raner GM, Vaz AD, Coon MJ (1995). Oxidative cleavage of esters and amides to carbonyl products by cytochrome P450. *Arch Biochem Biophys.* 318(2):333-9.

Røe O (1955). The metabolism and toxicity of methanol. *Pharmacol Rev.* 7(3):399-412.

Rogers JM, Mole ML, Chernoff N, Barbee BD, Turner CI, Logsdon TR, Kavlock RJ. 1993. The developmental toxicity of inhaled methanol in the CD-1 mouse, with quantitative dose-response modeling for estimation of benchmark doses. *Teratology.* 47(3):175-88.

Schrenk HH, Yant WP, Chornyak J, Patty FA (1936). Acute response of guinea pigs to vapors of some new commercial compounds. XIII. Methyl formate. *Pub Health Rep.* 51:1329-37.

Sedivec V, Mráz M, Flek J (1981). Biological monitoring of persons exposed to methanol vapours. *Int Arch Occup Environ Health.* 48(3):257-71.

Sethre T, Laubli T, Berode M, Hangartner M, Krueger H (2000a). Experimental exposure to methylformate and its neurobehavioral effects. *Int Arch Occup Environ Health.* 73(6):401-9.

U.S. EPA (1986). Rat oral subchronic toxicity study with methanol. Office of Solid Waste, Washington, DC.

U.S. EPA (2008). Methanol. Integrated Risk Information System. Available online at: <http://www.epa.gov/iris/subst/0305.htm>