State of California
AIR RESOURCES BOARD

Staff Report: Initial Statement of Reasons for Proposed Rulemaking

PUBLIC HEARING TO CONSIDER PROPOSED AMENDMENTS TO THE TABLES OF MAXIMUM INCREMENTAL REACTIVITY (MIR) VALUES

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Proposal Summary

The Air Resources Board staff is proposing to add 102 new compounds with associated Maximum Incremental Reactivity (MIR) values[1] into section 94700 of title 17, California Code of Regulations (CCR) and to update the MIR values for 14 existing reactive organic compounds whose MIR values have changed by at least 5 percent. We are proposing no changes to section 94701 of title 17, CCR.

Background

At its June 22, 2000, public hearing, the Air Resources Board (ARB or Board) approved amendments to the Regulation for Reducing the Ozone Formed from Aerosol Coating Products (the "Aerosol Coating Product Regulation;" sections 94520–94528, title 17, CCR), and proposed Tables of Maximum Incremental Reactivity (MIR) Values. The main component of the rulemaking was to establish reactivity limits for 36 aerosol coating categories based on the MIR scale. The amendments became legally effective on July 18, 2001.

In Resolution 00-22, which approved the rulemaking action, the Board directed the Executive Officer to review the MIR values 18 months after the effective date of amendments and every 18 months thereafter to determine if modifications to the MIR values are warranted. This is because the chemical mechanism used to calculate the MIR values is evolving and improving, as new chemical information becomes available. Since any changes to the MIR values would be technical in nature, the Board also delegated to the Executive Officer the authority to adopt regulatory amendments to the Tables of MIR Values, and to conduct public hearings and take other appropriate actions to make such amendments. This delegation of authority allows the Executive Officer (or her delegate) to conduct these activities on behalf of the multi-member Board, as provided in Health and Safety Code sections 39515 and 39516.

The existing Tables of MIR Values are based on the work of Dr. William Carter at the University of California, Riverside. The Tables of MIR Values are contained in two sections of title 17, CCR. Section 94700 contains the MIR values for individual reactive organic compounds. Section 94701 contains the MIR values for 24 different hydrocarbon solvents.

Description of the Proposed Regulatory Action

Staff is proposing amendments to the existing provisions contained in section 94700, title 17, CCR (section 94700). This section sets forth the MIR values used to calculate whether an aerosol coating product meets the reactivity limits (*i.e.,* the Product-Weighted MIR (PWMIR) limits) specified in the aerosol coatings regulation. The proposed changes to section 94700 are based on updated MIR values provided by Dr. Carter, which were peer reviewed and approved by the

[1] An MIR value describes the maximum amount of ozone likely to be formed by a volatile organic compound (VOC) reacting in the atmosphere. It is expressed in gram O_3 / gram VOC.

ARB's Reactivity Scientific Advisory Committee. The proposed amendments are intended to provide aerosol coating manufacturers with more options in their reformulation processes, while supporting the use of up-to-date reactivity science.

Staff is proposing to add 102 new compounds with their associated MIR values to section 94700. Most of the new compounds are those Dr. Carter added into his tabulation of MIR values while making assignments for the SAPRC99 mechanism for various emissions inventories. Several chemicals not currently listed were also added at the request of stakeholders. Manufacturers can use the MIR values for all of these new compounds after the proposed amendments become legally effective. Staff is proposing to remove 1,3-diethyl-5-pentyl cyclohexane from section 94700 since it was inadvertently listed in the existing Tables of MIR Values.

Staff is also proposing to update the MIR values for 14 compounds that are currently listed in section 94700. The updated MIR values are also based on research conducted by Dr. Carter. A new column labeled "New MIR Value [Effective Date]" will be added to section 94700 to display the updated MIR values for the 14 currently listed compounds, as well as the MIR values for the newly added 102 compounds.

Although staff is proposing to update the MIR values for 14 currently listed compounds, it should be noted that the currently specified MIR values for these 14 compounds must continue to be used to calculate the PWMIR of aerosol coating products until June 1, 2007. In other words, the MIR values for all compounds currently listed in section 94700 will remain unchanged, for calculation purposes, until June 1, 2007.

However, all of the 102 new compounds being added to the Tables of MIR Values can be used in aerosol coatings immediately after the proposed amendments become legally effective. This provision allows formulation flexibility for aerosol coating manufacturers. Staff is also proposing to list the MIR values for all of the compounds that can be used in aerosol coating products (*i.e.,* the 102 new compounds, the 14 compounds with updated MIR values, and all of the currently listed compounds whose MIR values remain unchanged) in the new column labeled "New MIR Value [Effective Date]." This proposed new column will allow the reader to view in one place the most recent, up-to-date MIR values for all the compounds. The MIR values listed in this column would be only used prior to June 1, 2007, if any reactivity-based rulemakings for other source categories were proposed in the future.

No change is being proposed to the MIR values for 24 different hydrocarbon solvents contained in section 94701, title 17, CCR.

This Initial Statement of Reasons (ISOR) describes the ARB staff's proposal and justification for amending the Tables of MIR Values contained in section 94700 of title 17, CCR. The impacts on existing aerosol coating products, air quality, the environment, and the economy are expected to be neutral, but slightly positive.

Recommendation

Staff recommends that the Executive Officer adopt the regulatory proposal. The proposal would help ensure the ARB's reactivity-based VOC regulations are based on the most up-to-date science. In addition, it would provide more flexibility to the aerosol coating manufacturers allowing the use of 102 new compounds in aerosol coating formulations.

1 Introduction

1.1 Overview

This Initial Statement of Reasons describes the Air Resources Board staff's proposal and justification for amending the Tables of Maximum Incremental Reactivity (MIR) Values contained in section 94700 of title 17 in the California Code of Regulations (CCR). In this report, the scientific background and the process for developing these amendments are described. Staff is proposing to add 102 new compounds with associated MIR values into section 94700 and to update the MIR values for 14 existing organic compounds whose MIR values have changed by at least 5 percent. In addition, the effects of the proposed amendments on the existing aerosol coating products, the Bin system, air quality, the environment, and the economy, and other relevant information are described herein.

While we are proposing changes to the Tables of MIR Values, the existing MIR values must continue to be used to calculate the Product-Weighted MIR (PWMIR) of aerosol coatings until June 1, 2007. In other words, the MIR values for all compounds currently listed in section 94700 and hydrocarbon solvents listed in section 94701 will remain unchanged, for calculation purposes, until June 1, 2007. This existing provision is designed to ensure needed stability for coatings formulations. However, all of the 102 new compounds being added to the Tables of MIR Values can be used in aerosol coatings immediately after the proposed amendments become legally effective. This provision allows formulation flexibility for aerosol coating manufacturers while supporting the use of up-to-date reactivity science. Hence, the proposed updated MIR values would only be used prior to June 1, 2007, if any reactivity-based rulemakings for other source categories were proposed in the future.

1.2 Regulatory Background

At its June 22, 2000, public hearing, the Air Resources Board (ARB or Board) approved proposed amendments to the Regulation for Reducing the Ozone Formed from Aerosol Coating Products and proposed Tables of Maximum Incremental Reactivity (MIR) Values (ARB, 2000). The regulation was adopted by the Executive Officer on May 1, 2001, and approved by the Office of Administrative Law on June 18, 2001. The amendments became legally effective July 18, 2001. The Aerosol Coating Products Regulation was originally adopted in March of 1995 and contained mass-based volatile organic compound (VOC) limits for 35 categories of aerosol coatings (ARB, 2000).

The main component of the rulemaking was to establish reactivity limits for 36 coating categories based on the MIR scale. Reactivity is the term used for the quantification of how much different VOCs contribute to the photochemical formation of tropospheric ozone. Rather than limiting the total mass of VOCs, the amendments limit the reactivity of the VOCs used in aerosol coating products. To make the distinction that all VOCs, including compounds that in mass-based regulations are considered exempt, we use the term Reactive Organic Compound (ROC). Using the term ROC[2] in the regulation means that all VOCs - even previously exempt compounds such as acetone - must be considered in determining the overall reactivity of a product. The reactivity limits became effective for 6 general coating categories on June 1, 2002, and for the remaining 30 specialty categories on January 1, 2003.

In approving the amendments, the Board directed the Executive Officer to review the MIR values 18 months after the effective date of amendments and every 18 months thereafter to determine if modifications to the MIR values are warranted. This is because the chemical mechanism, which is used to calculate the MIR values, is evolving and improving, as new chemical information becomes available. Since any changes to the MIR values would be technical in nature, the Board also delegated to the Executive Officer the authority to conduct public hearings and take other appropriate actions to make such amendments.

1.3 Scientific Background

The regulation is based on reactivity research that began in the mid-1970s and has continued to the present day. Dozens of peer reviewed scientific journal articles have been published on the concept of photochemical reactivity (*e.g.*, Russell *et al.,* 1995). The ARB has funded an extensive research program for more than ten years to improve our understanding of the science of reactivity with the overall conclusion that consideration of VOC reactivity has merit as an ozone control strategy in California.

In 1994, Dr. William Carter at the University of California, Riverside (UCR) developed eighteen reactivity scales and proposed the MIR scale as the most appropriate scale for use in regulations for California (Carter, 1994). The MIR scale, defined as the incremental reactivity computed for conditions where VOC controls would be most effective, is calculated using a single-cell trajectory model. This allows more detailed chemistry to be included in the model, a wide range of conditions to be investigated and reactivity of hundreds of VOCs to be calculated. However, this model lacks physical details (*e.g.,* wind shear) as well as spatial and temporal details of emissions. In addition, the model does not include pollutant transport and mixing that may affect reactivity. To answer these concerns, the MIR scale has been compared with 3-dimensional airshed reactivities calculated for the South Coast Air Basin and Central California and was found to correlate well with reactivities predicted through these models for selected VOCs (Martien *et al.,* 2002). Through research sponsored by the ARB, the MIR scale has been found to be the most suitable scale to predict VOC reactivities for California's atmospheric conditions, *i.e.,* it is appropriate for use in California in areas where VOC control is needed to reduce ambient ozone concentrations (ARB, 2000).

[2] Both terms of VOC and ROC mean gaseous organic compounds and are interchangeably used throughout the report.

As a commitment to ensuring that the use of reactivity as an ozone control strategy was based on the best possible science, the ARB formed the Reactivity Scientific Advisory Committee (RSAC), consisting of six independent, distinguished scientists, to provide scientific advice on using reactivity in California's regulations. During development of the amendments to the Aerosol Coating Products Regulation, the RSAC was consulted a number of times to ensure that best science was being used, and that the science was being used correctly within the regulation. At their suggestion the chemical mechanism (SAPRC99), which serves as the basis for the MIR scale, was peer reviewed. Based on the review, the RSAC found that it represents the "state-of-the-art" in chemical mechanisms (Seinfeld, 2000).

The existing Tables of MIR Values contained in two sections of the CCR are based on the work of Dr. Carter at UCR. Section 94700 contains the MIR values for individual reactive organic compounds whereas section 94701 contains the MIR values for 24 different hydrocarbon solvents.

Section 94701 assigns MIR values for hydrocarbon solvents based on the average of their mean boiling ranges, aromatic content, and alkane content (Kwok *et al.*, 2000). These chemical characteristics allowed ARB staff to develop the Bin system to assign MIR values for solvent mixtures used in aerosol coatings that otherwise did not have an individual assigned MIR value.

2 Recent Events

A number of activities provided the basis for the proposed amendments to the Tables of MIR Values to meet the Board's directive. The first step toward review of the Tables to determine if modifications to the Tables are warranted began in September 2002 when staff requested Dr. Carter at UCR to provide an update on changes to the chemical mechanism used to calculate the MIR values as well as the most current MIR values. The preliminary report, submitted in October 2002 (Carter, 2002), was discussed at the Reactivity Research Advisory Committee (RRAC) meeting on December 4, 2002. Based on Dr. Carter's report and consultations with stakeholders, staff concluded that modifications to the Tables of MIR Values should be pursued. In response to questions raised at the RRAC meeting and by ARB staff, Dr. Carter submitted a revised report to ARB in February 2003 (Appendix C). This report was made available at a workshop held on April 23, 2003 at which the revised MIR values and the process for updating MIR values were discussed (Appendix C). In June, the revised report was distributed to the members of the ARB's Reactivity Scientific Advisory Committee (RSAC) for their review and approval (Appendix B). A detailed description of these activities is given below.

2.1 Scientific Basis for the Proposed Amendments

All of the proposed amendments are based on the research of Dr. Carter (Appendix C). In his submission to us, Dr. Carter provided a list of 106 new

VOCs with their respective MIR values, as well as a revised list of MIR values that have changed non-negligibly. Dr. Carter stated that there have been no significant changes to the SAPRC99 mechanism used to calculate the MIR values since the MIR values, used in the current Aerosol Coating Products Regulation, were calculated. The differences are due to corrections and improvements to some specific mechanisms, emissions assignments, and to some of the files and software programs.

According to the research, of the ~670 compounds listed in section 94700, the MIR values for 25 compounds have changed by more than 5 percent, 275 have changed by 1 to 5 percent, and 363 have changed by less than 1 percent. To substantiate this, Dr. Carter provided a list of 25 compounds for which the MIR value has changed non-negligibly, *i.e.*, at least 5 percent. Staff has evaluated all of the changes to the existing MIR values, and, after consultation with RSAC, believes that MIR value changes of less than 5 percent are within the uncertainty of the MIR values. Therefore, staff is only proposing to amend the MIR values for VOCs whose MIR values have changed by at least 5 percent.

Table 2-1 lists the 23 VOCs whose MIRs have changed by at least 5 percent. Note that two compounds (trimethyl amine and C15 cycloalkanes) listed in Dr. Carter's report (Appendix C) are not listed in Table 2-1 due to an assignment error (Carter, 2003a; 2003b). Changes for seven compounds are due to round-off conventions since section 94700 reports values to the hundredth place while Dr. Carter's values are sometimes reported to the thousandth place (Footnote [d] in Table 2-1). The MIR values are unchanged when rounded to the hundredth place. Two other compounds on the list of 23 VOCs, 1-(chloro-methyl)-2- chloro propene and 2-amino-2-methyl-1-propanol are already contained in section 94700 with an upper-limit MIR value calculated by ARB staff. Even though Dr. Carter provided MIR values for these two compounds, it is his opinion that the ARB staff's estimated upper limit MIR value should continue to be used, due to uncertainty in deriving values for these compounds. ARB staff is proposing to follow this recommendation. Hence, the MIR values for a total of 14 VOCs (bolded in Table 2-1) would be updated in section 94700 to reflect the change in their MIR value. Note that some of the percentage changes in Table 2-1 are slightly different from Dr. Carter's submittal due to round-off conventions.

While we are proposing to modify only the MIR values that have changed by at least 5 percent, we intend to continue to evaluate this in the future, in consultation with scientific experts, to determine if a different criterion is more appropriate.

Table 2-1. Table of VOCs whose MIR values have changed by at least 5 percent.

(Bold indicates that MIR values associated with these compounds will be changed in the regulation.)

Description	MIR (gm O_3 /gm VOC) Updated	Previous	Change	Note
2-(Chloro-Methyl)-3-Chloro Propene	3.13	1.13	177%	[a]
2-Amino-2-Methyl-1-Propanol	4.75	15.08	-69%	[b]
2,4,4-Trimethyl-2-Pentene	**8.52**	**5.85**	**46%**	**[c]**
Methane	0.014	0.01	40%	[d]
Propionic Acid	**0.79**	**1.16**	**-32%**	**[e]**
Acetic Acid	**0.50**	**0.71**	**-30%**	**[e]**
2-Ethyl Hexanoic Acid	**3.49**	**4.41**	**-21%**	**[e]**
Methyl Bromide	0.017	0.02	-15%	[d]
Methyl Chloride	0.034	0.03	13%	[d]
Chloroform	0.034	0.03	13%	[d]
Ethylene Oxide	**0.044**	**0.05**	**-12%**	**[f]**
Dipropylene Glycol Methyl Ether Isomer (2-[2-Methoxypropoxy]-1-Propanol)	**2.70**	**3.02**	**-11%**	**[g]**
C7 Terminal Alkenes	**4.20**	**4.56**	**-8%**	**[h]**
1-Heptene	**4.20**	**4.56**	**-8%**	**[h]**
1,2-Dibromoethane	0.046	0.05	-8%	[d]
C15 Terminal Alkenes	**1.27**	**1.37**	**-7%**	**[h]**
1-Pentadecene	**1.27**	**1.37**	**-7%**	**[h]**
Methyl Formate	0.064	0.06	7%	[d]
2-(2-Butoxyethoxy)-Ethanol	**2.87**	**2.70**	**6%**	**[h]**
Dichloromethane	0.066	0.07	-6%	[d]
n-C18	**0.44**	**0.47**	**-6%**	**[I]**
4,8-Dimethyl Tetradecane	**0.55**	**0.58**	**-5%**	**[I]**
n-Pentadecane	**0.53**	**0.56**	**-5%**	**[I]**

[a] The representation of the mechanism of this compound was changed. However, the mechanism is highly uncertain and the ARB staff's estimated upper limit MIR probably should be used.

[b] The "previous" value is the ARB staff's estimated upper limit MIR. The upper limit value should continue to be used in the regulation for consistency with the current policy for treatment of uncertainty.

[c] The structure for this compound was incorrectly specified as that for 2,4,4-trimethyl-2-hexene when calculated previously.

[d] Change due to round-off error, since the ARB tabulation had only two significant figures. The MIR's are the same to two significant figures.

[e] The estimated mechanisms for organic acids have changed due to a modification in the estimation of branching ratios for the initial OH reaction at various positions around carboxylic acid groups.

[f] The actual difference is less since the previous value was 0.045 before rounded to the hundredth place.

[g] Assignments for this compound could not be found on the previous databases.

[h] The change for C_7 or the C_{15} terminal alkenes is due to the change for 1-heptene or 1-pentadecene, respectively. The change for these higher molecular weight 1-alkenes must be due to some small change in the base mechanism or scenario assignments because the mechanism and the rate constants used are the same.

[i] The reactivities of these compounds are expected to be highly sensitive to small changes in the base mechanism or scenario conditions. The mechanisms for these compounds were not changed.

Dr. Carter also provided a list of 106 new VOCs with their associated MIR values that are not on the current list contained in section 94700. Three of the new VOCs (composite mineral spirit, CARB profile ID 802, thinning solvent/mineral spirits (Cal Ply SLO, 1996), and Exxon Isopar® M Fluid) are species which are properly addressed by using the hydrocarbon solvent Bins in section 94701. One of the compounds (5-methylheptyl acetate) was listed due to a spelling error. Therefore, staff is proposing to add a total of 102 new VOCs. Adding these compounds would provide more flexibility to aerosol coating manufacturers should they choose to reformulate their products. Table 2-2 lists the new VOCs that have been added to the current list (Appendix A).

All of Dr. Carter's work was reviewed and approved by the ARB's Reactivity Scientific Advisory Committee, as described below.

2.2 Scientific Peer Review

Because the amendments proposed in this document are premised from a "scientific basis," an external scientific peer review is required by Health and Safety Code Section 57004 for the scientific portion of the proposed amendments, *i.e.*, the updated MIR values. To comply with the requirement, the RSAC was requested to review the updated MIR values.

The RSAC plays a critical role in reactivity-related activities at the ARB. This committee is made up of six independent, respected scientists:

Prof. John Seinfeld, California Institute of Technology (Chairman)
Prof. Roger Atkinson, University of California, Riverside
Dr. Jack Calvert, National Center for Atmospheric Research
Prof. Harvey Jeffries, University of North Carolina, Chapel Hill
Prof. Jana Milford, University of Colorado, Boulder
Prof. Ted Russell, Georgia Institute of Technology

The committee was established to make recommendations to the ARB on the science related to VOC reactivity. For the last several years, the RSAC has supported and approved of the use of the reactivity concepts (*i.e.*, MIR scale) in regulatory control strategies. At its last meeting in October 1999, the committee accepted the peer review performed by Dr. William Stockwell at the Desert Research Institute (Stockwell, 1999) on the SAPRC99 chemical mechanism used in the MIR scale and endorsed the use of the mechanism as representing the state-of-the-art urban atmospheric chemical reaction mechanisms (Seinfeld, 2000).

After their review, the RSAC concluded that the proposed amendments do not substantially change the nature of the MIR values. In addition, the RSAC found that the updated values were arrived at in an appropriate scientific manner (Appendix B).

Table 2-2. Table of VOCs that have been added to the list.

Description	MIR ($gm\ O_3$ / gm VOC)	Notes
C8 Bicycloalkanes	1.75	
1,3-Diethyl-5-Propyl Cyclohexane	0.96	
cis-3-Methyl-2-Pentene	12.84	
m-Ethyl Toluene	9.37	
p-Ethyl Toluene	3.75	
o-Ethyl Toluene	6.61	
o-Diethyl Benzene	5.92	[a]
m-Diethyl Benzene	8.39	[a]
p-Diethyl Benzene	3.36	[a]
1,2,3,5-Tetramethyl Benzene	8.25	
Indene	3.21	
Methyl Indans	2.83	
C12 Tetralin or Indane	2.33	
Isoamyl Alcohol (3-Methyl-1-Butanol)	2.73	
2-Methyl-1-Butanol	2.60	[b]
4-Methyl-2-Pentanol (Methyl Isobutyl Carbinol)	2.89	
Dimethylpentanol (2,3-Dimethyl-1-Pentanol)	2.51	
5-Methyl-1-Heptanol	1.95	
Trimethylcyclohexanol	2.17	
Dimethylheptanol (2,6-Dimethyl-2-Heptanol)	1.07	
2,6-Dimethyl-4-Heptanol	2.37	
Menthol	1.70	
1-Decanol	1.22	
3,7-Dimethyl-1-Octanol	1.42	
Trimethylnonanolthreoerythro; 2,6,8-Trimethyl-4-Nonanol	1.55	
1,4-Butanediol	3.22	
Pentaerythritol	2.42	
2-Ethyl-1,3-Hexanediol	2.62	
1,3-Dioxolane	5.47	
1,4-Dioxane	2.71	
Diisopropyl Ether	3.56	
Ethylene Glycol Diethyl Ether; 1,2-Diethoxyethane	2.84	
Acetal (1,1-Diethoxyethane)	3.68	
4,4-Dimethyl-3-Oxahexane	2.03	
2-Methoxy-1-(2-Methoxy-1-Methylethoxy)-Propane	2.09	
3-Methoxy-1-Propanol	4.01	
Tetrahydro-2-Furanmethanol	3.54	
n-Propoxypropanol	3.84	
Triethylene Glycol	3.41	
Dipropylene Glycol Ethyl Ether	2.75	
Tetraethylene Glycol	2.84	
1-(Butoxyethoxy)-2-Propanol	2.08	
Glycol Ether dpnb (1-(2-Butoxy-1-Methylethoxy)-2-Propanol)	1.96	
gamma- Butyrolactone	1.15	
Isopropyl Formate	0.42	
Isoamyl Acetate (3-Methylbutyl Acetate)	1.18	
2-Methyl-1-Butyl Acetate	1.17	
Methyl Amyl Acetate (4-Methyl-2-Pentanol Acetate)	1.46	
n-Pentyl Propionate	0.79	[b]
Methyl Dodecanoate (Methyl Laurate)	0.53	

Description	MIR ($gm\ O_3$ / gm VOC)	Notes
Methyl Myristate (Methyl Tetradecanoate)	0.47	
Methoxypropanol Acetate	1.97	
1,2-Propylene Glycol Diacetate	0.94	[b]
Dipropylene Glycol n-Propyl Ether Isomer #1	2.13	[b]
Dipropylene Glycol Methyl Ether Acetate Isomer #1	1.41	[b]
Dipropylene Glycol Methyl Ether Acetate Isomer #2	1.58	[b]
Dipropylene Glycol Methyl Ether Acetate	1.49	[b]
Glyceryl Triacetate	0.57	
Diisopropyl Adipate	1.42	
Isobutyric Acid	1.22	
Butanoic Acid	1.78	
Malic Acid	7.51	
3-Methylbutanoic Acid	4.26	
Adipic Acid	3.37	
Hydroxypropyl Acrylate	5.56	
n-Butyl Acrylate	5.52	
Isobutyl Acrylate	5.05	
a-Terpineol	5.16	
2-Methyl-Hexanal	3.97	
Methyl Isopropyl Ketone	1.64	
2,4-Pentanedione	1.02	
2-Propyl Cyclohexanone	1.71	
4-Propyl Cyclohexanone	2.08	
2,6,8-Trimethyl-4-Nonanone; Isobutyl Heptyl Ketone	1.86	[b]
Mesityl Oxide (2-Methyl-2-Penten-4-one)	17.37	
Isophorone (3,5,5-Trimethyl-2-Cyclohexenone)	10.58	
1-Nonene-4-one	3.39	
Dihydroxyacetone	4.02	
C8 Alkyl Phenols	2.07	
C9 Alkyl Phenols	1.86	
C10 Alkyl Phenols	1.68	
C11 Alkyl Phenols	1.54	
C12 Alkyl Phenols	1.42	
2-Phenoxyethanol; Ethylene Glycol Phenyl Ether	3.61	[b,c]
Carbon Tetrachloride	0	
Methylene Bromide	0	
Unspeciated C6 Alkanes	1.48	
Unspeciated C7 Alkanes	1.79	
Unspeciated C8 Alkanes	1.64	
Unspeciated C9 Alkanes	2.13	
Unspeciated C10 Alkanes	1.16	
Unspeciated C11 Alkanes	0.90	
Unspeciated C12 Alkanes	0.81	
Unspeciated C13 Alkanes	0.73	
Unspeciated C14 Alkanes	0.67	
Unspeciated C15 Alkanes	0.61	
Unspeciated C16 Alkanes	0.55	
Unspeciated C17 Alkanes	0.52	
Unspeciated C18 Alkanes	0.49	
Unspeciated C10 Aromatics	5.48	
Unspeciated C11 Aromatics	4.96	
Unspeciated C12 Aromatics	4.53	

[a] October 26 list had incorrect molecular weight.

[b] New model compounds added January 24, 2003

[c] Mechanism estimated as discussed in Footnote 101 in the revised Table C-1 available with the full reactivity tabulation at http://www.cert.ucr.edu/~carter/reactdat.htm.

2.3 Process for Developing the Proposal

Two public meetings have been held to discuss the process for updating the MIR values. The first discussion occurred at the December 4, 2002, RRAC meeting. The RRAC was established in March 1996, and is comprised of over 50 representatives from industry associations, consumer product manufacturers, regulatory agencies, academia, and other interested stakeholders. This group met several times and provided valuable input during development of the reactivity-based aerosol coating regulation. At the December 4, 2002, RRAC meeting, the need for an update to the MIR values was discussed. Members supported the update because the proposed amendments may provide more flexibility to the aerosol coating manufacturers for their product reformulation. The preliminary report on the updated MIR values prepared by Dr. Carter (2002) was posted at the ARB's reactivity web site prior to the meeting (http://www.arb.ca.gov/research/reactivity/reactivity.htm).

In addition, a public workshop was held on April 23, 2003, to further discuss the proposed amendments to the Tables of MIR Values. A workshop notice was distributed to the RRAC members as well as the ARB's consumer product list server subscribers. (As of July 2003, the consumer product list server is comprised of 667 subscribers who receive regular updates on activities related to consumer products regulations via e-mail. Subscribers to the list server include members of government agencies, concerned citizens, environmental organizations, as well as over 50 subscribers involved with the manufacturing and distribution of aerosol coatings.) Workshop materials including a staff presentation and Dr. Carter's revised report were also posted at the web site prior to the workshop (http://www.arb.ca.gov/research/reactivity/reactivity.htm). Approximately 50 people participated in the workshop. At the workshop, a brief review of the Aerosol Coating Products Regulation, Board resolution and directive, as well as the rationale for updating the MIR values were presented. The process of developing the amendments and staff report outline were discussed. Participants at the workshop supported the decision to update the MIR values.

3 Proposed Amendments to the Table of MIR Values

Staff is proposing amendments to the existing provisions contained in section 94700, title 17, CCR (section 94700). This section sets forth the MIR values used to calculate whether an aerosol coating product meets the reactivity limits (*i.e.,* the PW MIR limits) specified in the aerosol coatings regulation. The proposed changes to section 94700 are based on updated MIR values provided by Dr. Carter, which were peer reviewed and approved by the ARB's Reactivity Scientific Advisory Committee. The proposed amendments are intended to provide aerosol coating manufacturers with more options in their reformulation processes, while supporting the use of up-to-date reactivity science.

Staff is proposing to add 102 new compounds with their associated MIR values to section 94700. Most of the new compounds are those Dr. Carter added into his tabulation of MIR values while making assignments for the SAPRC99 mechanism for various emissions inventories. Several chemicals not currently listed were also added at the request of stakeholders. Manufacturers can use the MIR values for all of these new compounds after the proposed amendments become legally effective. Staff is proposing to remove 1,3-diethyl-5-pentyl cyclohexane from section 94700 since it was inadvertently listed in the existing Tables of MIR Values (Carter, 2003b). Note that minor name changes have been made to several VOCs for consistency with chemical nomenclature but their MIR values are not affected.

Staff is also proposing to update the MIR values for 14 compounds that are currently listed in section 94700. The updated MIR values are also based on research conducted by Dr. Carter. A new column labeled “New MIR Value [Effective Date]” will be added to section 94700 to display the updated MIR values for the 14 currently listed compounds, as well as the MIR values for the newly added 102 compounds.

Although staff is proposing to update the MIR values for 14 currently listed compounds, it should be noted that the currently specified MIR values for these 14 compounds must continue to be used to calculate the PWMIR of aerosol coating products until June 1, 2007. In other words, the MIR values for all compounds currently listed in section 94700 will remain unchanged, for calculation purposes, until June 1, 2007. This existing provision is set forth in the aerosol coatings regulation, section 94522(h)(2)(A), title 17, CCR, and is designed to ensure needed stability for coatings formulations. The currently specified MIR values can be found in section 94700 in the column labeled “MIR Value (July 18, 2001).” July 18, 2001, is the date that the Table of MIR Values became legally effective, and section 94522(h)(2)(A), title 17, CCR, states:

> “The MIR values dated July 18, 2001 shall be used to calculate the PWMIR for aerosol coating products, and these MIR values shall not be changed until June 1, 2007.”

However, all of the 102 new compounds being added to the Tables of MIR Values can be used in aerosol coatings immediately after the proposed amendments become legally effective, as specified in the aerosol coatings regulation, section 94522(h)(2)(B), title 17, CCR, which states:

> “If a new ROC is added to section 94700 or 94701, then the new ROC may be used in aerosol coating products, and the MIR value for the new

ROC shall be used to calculate the PWMIR after the effective date of the MIR value."

This provision allows formulation flexibility for aerosol coating manufacturers. To implement this provision and also be consistent with section 94522(h)(2)(A), title 17, CCR, staff is proposing to add the MIR values for the 102 new compounds to the column in section 94700 labeled "MIR Value (July 18, 2001)." Since the aerosol coatings regulation specifies that the MIR values set forth in this column shall be used to calculate the PWMIR for aerosol coatings, placing the MIR values for the 102 new compounds in this column will avoid the confusion of multiple columns in section 94700. After the amendments become legally effective, manufacturers can simply look in one column—the column labeled "MIR Value (July 18, 2001)"—to determine which MIR values must currently be used to calculate the PWMIR for aerosol coatings products. Staff is also proposing to list the MIR values for all of the compounds that can be used in aerosol coating products (*i.e.,* the 102 new compounds, the 14 compounds with updated MIR values, and all of the currently listed compounds whose MIR values remain unchanged) in the new column labeled "New MIR Value [Effective Date]." This proposed new column will allow the reader to view in one place the most recent, up-to-date MIR values for all the compounds. The MIR values listed in this column would only be used prior to June 1, 2007, if any reactivity-based rulemakings for other source categories were proposed in the future.

No change is being proposed to the MIR values for 24 different hydrocarbon solvents contained in section 94701, title 17, CCR because no new solvents were added to the list and the impacts on the Bin system are negligible. As described in section 1.1, the MIR values for the hydrocarbon solvents (section 94701) will remain unchanged until June 1, 2007, to ensure regulatory stability to aerosol coating manufacturers. Hence, the updated MIR values will not affect the Bin system.

Staff did evaluate the impact of recalculating the Bin values using the updated MIR values. Of dozens of surrogates used to derive Bin values (Kwok *et. al.,* 2000), only n-pentadecane (used as a surrogate for Bins 16, 17, 19, and 20) displays more than a 5 percent change in its MIR value. Assuming the total content of n-pentadecane in one of the bins is 20 percent, because its MIR value decreased by 5 percent, the overall change of its Bin value is approximately one percent (5% x 20%), which is well within the uncertainty of MIR estimates.

4 Environmental Impacts

4.1 Summary of Environmental Impacts

In this rulemaking staff is proposing to add compounds with their respective MIR values and modify the Tables of MIR Values by updating existing MIR values for compounds whose MIR values have changed by at least 5 percent. At present, only aerosol coating products rely on the Tables of MIR Values for regulatory compliance. Therefore, the environmental impact analysis presented here will be specific to this source category, and, as explained below, will focus only on new compounds proposed for addition.

Overall, the result of our analysis shows that amending the Tables of MIR Values would have neither positive nor adverse environmental impacts. This is because the proposed amendments do not impose any requirements leading to a physical change in the environment. Moreover, because aerosol coating products have already been reformulated to meet reactivity limits, it is unlikely manufacturers would spend the considerable time and expense required to reformulate already complying products. Should manufacturers opt to reformulate with lower reactive compounds than in their present formulations, we would anticipate a positive impact, in that a slight reduction in tropospheric ozone concentrations would be realized.

Potential impacts on tropospheric ozone concentrations, particulate matter (PM), global warming, stratospheric ozone depletion, and water quality and landfill loading were considered. No significant negative impacts were identified. We also examined the possibility of increased use of toxics, potential impacts on the State Implementation Plan for ozone, as well as environmental justice issues. The environmental analysis below discusses the impacts associated with the proposed rulemaking and provides the basis for our findings.

4.2 Legal Requirements Applicable to the Analysis

The California Environmental Quality Act (CEQA) and ARB policy require an analysis to determine the potential adverse environmental impacts of proposed regulations. Because the ARB's program involving the adoption of regulations has been certified by the Secretary of Resources (Public Resources Code, Section 21080.5, Exemption of Specified Regulatory Programs), the CEQA environmental analysis requirements are allowed to be included in the ARB Staff Report or Technical Support Document in lieu of preparing an environmental impact report or negative declaration.

Our analysis of the reasonably foreseeable environmental impacts resulting from the proposed amendments, as well as, background information, and the process for gathering data for the analysis, are presented below. We will also continue to monitor source categories that rely on the MIR values for compliance to determine if mitigation measures may be necessary to ensure that no adverse impacts occur in the future. Alternatives to not going forward with the proposed rulemaking are also presented.

4.3 Alternative Means of Compliance

The proposed amendments to the Tables of MIR Values is a technical update to ensure continuous use of the best atmospheric science in ARB's reactivity-based regulations. The proposal would also provide flexibility to aerosol coating manufacturers by providing additional compounds for use when considering reformulation to less reactive products, or to produce a more optimal coating product.

Several alternatives to updating MIR values that have changed by at least 5 percent, and adding more compounds with their respective MIR values were considered. Alternatives include updating all existing MIR values that have changed, selecting a different criterion for updating the MIR values (*i.e.* a percentage different than 5 percent), only adding the new VOCs to section 94700, not updating any existing MIR values, or not adding or changing any MIR values. However, based on Dr. Carter's expert opinion, and, in consultation with the RSAC, we determined that updating MIR values that have changed by 5 percent or more would ensure use of the best atmospheric science, yet allow stakeholders consistency within the list. Because the proposal itself does not impose any requirements leading to a physical change in the environment, provides additional flexibility to manufacturers, and helps maintain overall consistency, we believe the staff's proposal is the most appropriate.

4.4 Potential Environmental Impacts

4.4.1 Analysis Procedures

To receive input as to whether any new ROCs would have potential use in aerosol coatings, manufacturers representing virtually 100 percent of aerosol coatings sales were contacted. These stakeholders received a comprehensive list of proposed ROCs to be added to the existing Tables of MIR Values for their evaluation and comments. As described above, only new ROCs were evaluated for this impact analysis. To gauge the applicability of the new ROCs for use in aerosol coatings, staff posed several questions intended to facilitate our analysis.

The questions presented to the aerosol coating industry were:

1. Are there any new ROCs that appear useful for formulating aerosol coatings?
2. If so, what are the ROCs that could be used in aerosol coatings?
3. What would the average content of the new ROC be in the product formula?
4. The new ROC would be substituted for what compound(s) currently used?
5. Would the new ROC be used universally across all aerosol coating categories or only in specific coating categories?

4.4.2 Survey Results

A general comment received was that the majority of the new ROCs do not hold much promise for use in aerosol coatings (McAuliffe, 2003). The reasons for this ranged from conflicts in the chemistry of these compounds to evaporation rates that are too slow for aerosol coatings. Consumers typically purchase aerosol coatings because of the convenience of application as well as the relatively quick drying times.

Only a few manufacturers indicated that any of the new ROCs listed may be appropriate for use in formulating aerosol coatings. The ROCs mentioned are:

n-propoxypropanol;
isoamyl acetate;
2-methy-1-butyl acetate;
methyl amyl acetate;
methoxypropanol acetate; and
methyl isopropyl ketone.

These compounds could be considered in the group of "medium" evaporation rate compounds. As a result of this survey, we refined our environmental impact analysis to focus on these six new compounds proposed for addition to the Tables of MIR Values.

Even though manufacturers indicated that these new ROCs may be suitable for use in aerosol coatings in the future, they were not sure which coating categories could be reformulated with these new ROCs or what existing ROCs might be displaced. This is not unexpected given that research and development of compliant aerosol coatings formulas has already occurred. However, absent this information we are unable to estimate how much of the new ROCs would be used in aerosol coatings or evaluate the impacts associated with substitution of the new ROCs.

After evaluating the information received from aerosol coating manufacturers, staff does not anticipate extensive use of these ROCs in aerosol coating formulations. We intend, however, to conduct a comprehensive survey of aerosol coatings in 2006 for 2005 calendar year sales. At that time we will be able to determine if manufacturers have switched to using one of the new ROCs, and in what quantities. Survey data will also indicate if the new ROCs are used across all aerosol coating categories, or are limited to certain product lines. At that time we will also evaluate the need to mitigate any impacts associated with the switch in ROCs.

4.4.3 Impact on Tropospheric (Ground-Level) Ozone Concentrations

Overall, we anticipate that the proposed update to the Tables of MIR Values will have neither a positive nor adverse impact on ground-level ozone concentrations. This is because the proposed changes do not impose any requirements that would lead to a change in ground-level ozone concentrations. Moreover, because aerosol coating products have already been reformulated to meet reactivity limits it is unlikely manufacturers would spend the considerable time and expense to reformulate already complying products. Should manufacturers opt to reformulate with less reactive compounds than in their present formulations, we would anticipate a slight reduction in tropospheric ozone concentrations.

The reactivity values for the six ROCs mentioned as possibly useful for formulating aerosol coatings vary from a value of 1.17 gram ozone per gram VOC (g O_3 / g VOC) for 2-methy-1-butyl acetate, to 3.84 g O_3 / g VOC for n-propoxypropanol. Because of the comparatively high MIR value for n-propoxypropanol, we would not anticipate appreciable usage of this compound. However, the comparatively lower MIR values for isoamyl acetate (1.18 g O_3 / g VOC); 2-methy-1-butyl acetate (1.17 g O_3 / g VOC); methyl amyl acetate (1.46 g O_3 / g VOC); methoxypropanol acetate (1.97 g O_3 / g VOC); and methyl isopropyl ketone (1.64 g O_3 / g VOC) could lead to use of these compounds in future aerosol coating formulations. If the compounds were to be used, it would likely be to further reduce product reactivity that would lead to slight decreases in ground-level ozone concentrations.

4.4.4 Impact on Particulate Matter (Aerosols)

Our evaluation found that the proposed amendments would not have significant environmental impacts on the formation of particulate matter (PM). However, information on the secondary organic aerosol (SOA) formation of many compounds is not known. Additionally, because it is unclear if manufacturers would reformulate using a newly added ROC, how much would be used, and what the new ROC would replace, it is difficult to determine definitively if an adverse impact would result from updating the Tables of MIR Values. As always, we will continue to monitor aerosol coatings formulations and reassess the impacts as more data become available.

Fine PM is prevalent in the urban atmosphere and is known to have negative impacts on human health (ARB, 2002). Like ozone, PM can be formed via atmospheric oxidation of reactive organic compounds (Finlayson-Pitts and Pitts, 2000). This photochemically-derived PM (*i.e.*, secondary organic aerosol) could contribute appreciably to the fine particle burden observed in severe air pollution episodes (Pandis *et al.*, 1992). In urban PM, these secondary organic aerosols could produce effects such as visibility degradation and toxicity (*e.g.*, Aktinson, *et al.*, 1994).

Although most organic compounds contribute to ozone formation (Carter, 2000), SOA is usually formed from photooxidation of organic compounds with carbon numbers equal to seven or more (Grosjean and Seinfeld, 1989; Wang *et. al.*, 1992). This observation is consistent with the fact that both reactivity and a product's volatility need to be considered for evaluating the aerosol formation potential of a VOC (Odum *et al.*, 1997). In other words, only chemicals, which react fast enough in the atmosphere, will generate sufficient amounts of low volatility products for forming aerosols. Aerosol formation potentials of aromatics have also been studied extensively (*e.g.*, Odum *et al.*, 1996; 1997).

None of the six compounds indicated as useful in aerosol coating formulations are aromatic compounds. However, three compounds do contain seven or more carbon atoms: isoamyl acetate (seven carbon atoms); 2-methy-1-butyl acetate (seven carbon atoms); and, methyl amyl acetate (eight carbon atoms). Therefore, it is possible that use of these compounds could result in a slight increase in SOA. As mentioned above, though, we do not have information as to what these compounds would be substituted for and how much would be used. It is likely that, if used, these compounds would replace similar, more reactive compounds such that no additional SOA would be generated.

4.4.5 Impact on Global Warming

The theory of global warming is based on the premise that emissions of anthropogenic pollutants, together with other naturally-occurring gases, absorb infrared radiation in the atmosphere, thereby increasing the overall average global temperature. Gases most often implicated in global warming include carbon dioxide, methane, water vapor, nitrous oxide, and ozone.

Almost all VOCs have the potential to contribute directly to global warming by absorbing infrared radiation from the earth's surface. In general the more complex a VOC, the greater its ability to absorb infrared radiation, however most VOCs have a very short atmospheric lifetime and are broken down by atmospheric reactions. Generally speaking the exceptions to this rule are the saturated light hydrocarbons and halogenated compounds. VOCs also contribute indirectly to global warming via their contribution to the formation of ozone, which is a potent greenhouse gas.

The Global Warming Potential (GWP) of a substance is a measure of the extra amount of heat that is trapped in the atmosphere when one kilogram of the substance is released instantaneously into it, relative to the case when one kilogram carbon dioxide is released. GWPs are calculated using computer models which incorporate the radiative heat balance of the atmosphere and the chemical kinetics of all the substances involved. The model is initially in a steady state. If a kilogram of a greenhouse gas is released, the temperature will increase until a new steady state is established. If a substance stayed in the atmosphere indefinitely, the new steady state would be permanent and the increase in temperature could be used as a measure of the GWP. However, organic compounds are removed from the atmosphere by various processes including photochemical reactions and wet and dry deposition. In time, the concentration of the emitted substance will decline to zero and the initial state will be restored. Consequently, a simple temperature increase cannot be used as a measure of GWP because it depends on the atmospheric persistence of the compound.

The GWP of a compound includes a direct effect and an indirect effect. As mentioned earlier, the direct effect is the warming due to the absorption of radiation by molecules of the compound in question. The indirect effect is due to the impact that the presence of the compound has on the concentration of other greenhouse gases. VOCs could contribute indirectly to global warming, insofar as they react chemically in the atmosphere in ways that increase greenhouse gas concentrations, most notably, concentrations of ozone. The indirect forcing through changes in OH and tropospheric O_3 is small for each VOC taken individually, but can be significant for the entire family (Johnson and Derwent 1996; Wigley *et al*. 2002). The indirect forcing of VOCs is still poorly quantified and requires the use of global three-dimensional chemical transport models. Accurate calculations of these effects are a notoriously difficult problem in atmospheric chemistry.

We do not expect the proposed rulemaking to have an adverse impact on global warming because the six ROCs mentioned as potentially useful for reformulating aerosol coatings in the future have not been specifically implicated as "greenhouse gases." As described above, reactive organic compounds, or VOCs, are not thought to contribute appreciably to global warming due to their comparatively short atmospheric lifetimes. The fact that these compounds all have MIR values greater than 1.0 g O_3 / g VOC is evidence that these compounds react fairly rapidly in the atmosphere. While it is true that these compounds will react to form ground-level ozone, a greenhouse gas, no net increase in ozone concentrations would result because the limits already in place 'cap' product reactivity. However, to the extent these compounds react in the atmosphere to produce carbon dioxide or methane they would have an adverse effect on global warming. Any increase would be negligible when compared to other sources of anthropogenic carbon dioxide in the atmosphere. For example, emissions of carbon dioxide from fossil fuel combustion represent over 75 percent of global warming-weighted greenhouse gas emissions (U.S. EPA, 2002). Once again, the potential impacts can not be fully evaluated because we do not have information to indicate which currently used compounds would be replaced with the new compounds.

4.4.6 Impact on Stratospheric Ozone Depletion

The stratospheric ozone layer shields the earth from harmful ultraviolet (UV) radiation. Depletion of the earth's ozone layer allows a higher penetration of UV radiation to the earth's surface. This increase in UV radiation penetration leads to a greater incidence of skin cancer, cataracts, and impaired immune systems. Reduced crop yields and diminished ocean productivity are also anticipated. Because the chemical reactions which form tropospheric ozone are driven by UV radiation, it is conceivable that a reduction in stratospheric ozone may also result in an increase in the formation of photochemical smog because of the increased levels of UV radiation on the earth's surface (ARB, 2000). The chemicals most implicated as causing stratospheric ozone depletion are chlorofluorocarbons (CFCs) and halons (U.S. EPA, 2003). Specifically, the chlorine or bromine atoms released by photolysis of the CFCs or halons react in chain reactions leading to the catalytic destruction of ozone (Finlayson-Pitts and Pitts, 2000).

The ARB staff has determined that the proposed amendments would have no impact on stratospheric ozone depletion. This is because none of the six compounds indicated as potentially useful for aerosol coatings formulations contain chlorine, bromine, or any other halogen.

It should be noted that the Aerosol Coating Products Regulation already contains a provision that limits the amount of ozone-depleting compounds used in aerosol coatings to ensure that manufacturers do not switch to them when they are reformulating aerosol coating products (ARB, 2000).

4.4.7 Impacts on Water Quality and Solid Waste Disposal

We do not expect an adverse impact on water quality or solid waste disposal from the proposed update. There is no direct route to water associated with the ROCs included in the update. We also do not anticipate any changes in packaging or disposal of aerosol coating products due to the proposed update that would impact waste disposal.

4.4.8 Impact from Use of Toxic Air Contaminants

Pursuant to Health and Safety Code Section 39650 et seq., the ARB is required to identify and control toxic air contaminants (TACs). The Health and Safety Code defines a TAC as an air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a hazard to human health. Current data for the ROCs identified for suitability in aerosol coating formulations are not contained on the ARB's TAC identification List (ARB, 2001). In consultation with the Office of Environmental Health Hazard Assessment staff, we also evaluated other available lists of toxic substances including:

> State of California Environmental Protection Agency Office of Environmental Health Hazard Assessment Safe Drinking Water and Toxic Enforcement Act of 1986: Chemicals Known to the State to Cause Cancer or Reproductive Toxicity, June 13, 2003 (Proposition 65 list);
>
> International Agency for Research on Cancer (IARC), Overall Evaluations of Carcinogenicity to Humans (December 4, 2002);
>
> Integrated Risk Information System (IRIS) Substance List (June 5, 2003);
>
> U.S. EPA's Persistent Bioaccumulative and Toxic (PBT) Chemical Program list of priority PBTs (April 3,2003);
>
> National Toxicology Program's Center for the Evaluation of Risk to Human Reproduction Status Table (CERHR) (June 24, 2003); and National Toxicology Program's 10^{th} Report on Carcinogens (December 2002).

None of the six compounds was listed on any of these lists as a potential toxicant, as of the date of this report. Since the six compounds are not expected to be used in great quantity, no further mitigation measures are necessary at this time. However, the ARB will continue to monitor aerosol coating emissions, and available toxicology data to assess the need for potential mitigation measures in the future.

4.5 Impacts on the State Implementation Plan for Ozone

The Federal Clean Air Act amendments of 1990 require an ozone attainment plan from every area unable to meet the national ambient air quality standard for ozone. To assist California's air districts to meet the challenge of attaining the ozone standard, the ARB and air districts developed the California State Implementation Plan (SIP) for Ozone. State law provides the legal authority to ARB to develop regulations affecting a variety of mobile sources, fuels, and consumer products. The regulations that are already adopted, and measures proposed for adoption constitute the ARB's portion of the SIP. The SIP is California's plan to attain and maintain the national ambient air quality standard for ozone.

The proposed amendments to the Tables of MIR Values have no impact on the SIP. This is because the reactivity limits are already in effect such that no ozone increase can occur from use of any new ROC proposed for addition to the Tables of MIR Values.

4.6 Environmental Justice

State law defines environmental justice as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies. The ARB is committed to evaluating community impacts of proposed regulations, including environmental justice concerns. Because the proposed amendments to the Tables of MIR Values do not impose any requirements leading to a physical change in the environment, we expect no adverse impacts. Manufacturers were not able to identify if the compounds of interest would be used in a specialty coating for a specialty application at a specific type of business. It is more likely that aerosol coatings formulated with one of the new ROCs would be used in a variety of aerosol coatings and that emissions would be "evenly" distributed within the State. Therefore, we do not believe that people of any given race, culture, or income would be more impacted than any others.

5 Other Impacts of the Proposed Amendments

5.1 Impacts on Existing Products

Amending the Tables of MIR Values would have insignificant impacts on the existing aerosol coating products. This is because the proposed amendments do not impose any requirements that would lead to a change in product formulation. Moreover, because aerosol coating products have already been reformulated to meet reactivity limits, it is unlikely manufacturers would spend the considerable time and expense to reformulate the compliant products. Should manufacturers opt to reformulate with any of the six new compounds, we would anticipate a possibly positive impact because the product could be further optimized at less cost.

5.2 Impacts on Other Reactivity-Based Regulations

The proposed amendments are not expected to have any significant impact on the California Low Emission Vehicles/Clean Fuel (LEV/CF) Regulation since the regulation maintains a separate table of MIR values for the exhaust emissions. The LEV/CF regulation is the first reactivity-based VOC regulation adopted by the Board (ARB, 2000) and was designed to compare the emissions of alternatively fueled vehicles (*i.e.*, ones that use a fuel other than conventional gasoline, such as compressed natural gas or methanol) to the emissions from gasoline-fueled vehicles as well as the industry average gasoline. This regulation has been amended several times since 1991 and can potentially use the updated MIR values for its next amendment.

The updated MIR values would also be used for future rulemakings for other source categories. Source categories under consideration include other consumer products and architectural coatings.

6 Economic Impact

The proposed amendments to the Tables of MIR Values could potentially have positive impacts on California's aerosol coatings manufacturers, in that businesses would be provided with alternative compounds that can be used in reformulation of their products. The additional choices available for reformulation could result in innovation and cost savings because manufacturers are not required to use any of the newly added compounds in their reformulation efforts unless they find that its use would be economically advantageous. Hence, it is expected that the use of new compounds would bring about an overall reduction in the cost of compliance for aerosol coatings businesses affected by the reactivity limits.

The addition of new compounds to the Tables might have very minor economic impacts on the chemical suppliers of raw materials for existing aerosol coating products. These suppliers would potentially experience an adverse economic impact if manufacturers chose to reformulate with the new compounds. However, most suppliers of existing compounds also supply the new compounds so an overall adverse impact to chemical suppliers is unlikely.

In addition, the proposed amendments may result in an overall positive impact on California's employment, business competitiveness, and business status. Since the new compounds would allow greater flexibility in reformulation of aerosol coating products, manufacturers that choose to use the new compounds are expected to experience lower compliance costs. The cost savings, whether or not they are kept by affected businesses or passed on to consumers in the form of lower prices, could result in a positive economic impact although it is likely to be quite small.

The proposed amendments are not expected to cause any change in costs or savings to any State, local agency or school district. Nor will the amendments impose a mandate on any governmental agency or school district.

Before taking final action on the proposed regulatory action, the Executive Officer must determine that no reasonable alternative considered by the agency or that has been otherwise identified and brought to the Executive Officer's attention would be more effective in carrying out the purpose for which this action is proposed or would be as effective and less burdensome to affected private persons than the proposed action.

7 Recommendation

Staff recommends that the Executive Officer adopt this regulatory proposal. The proposal described herein is necessary so that ARB's reactivity-based VOC regulations are based on the most up-to-date science. In addition, it would provide more flexibility to the aerosol coating manufacturers allowing the use of 102 new compounds in aerosol coating formulations. The impacts on existing aerosol coating products, air quality, the environment, and the economy are expected to be neutral, but slightly positive.

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