American Chemistry Council

SHARON H. KNEISS
VICE PRESIDENT
PRODUCTS DIVISIONS

June 24, 2008

Clerk of the Board
Air Resources Board
1001 I Street, 23rd Floor
Sacramento, California 95814

RE: Comments on the California Air Resources Board Proposed Amendments to the Regulation for Reducing Volatile Organic Compound Emissions from Consumer Products

Dear Board Members:

The American Chemistry Council (ACC) Solvents Industry Group (SIG)[1] is pleased to submit the following comments to the California Air Resources Board (CARB) concerning the proposed amendments to the *Regulation for Reducing Volatile Organic Compound Emissions from Consumer Products*. The proposal would establish new VOC emission limitations for certain consumer product categories that have previously been unregulated and reduce the existing VOC limits for other previously regulated product categories.

While SIG does not dispute the potential benefits to the ozone associated with a reduction in volatile organic compounds (VOCs), we believe that California can more effectively and efficiently meet CARB's emission reduction targets by focusing on VOC reactivity instead of percentage mass-based limitation. As described in more detail herein:

- reactivity-based standards are appropriate from a technical and manufacturing standpoint; and
- there is both a regulatory and policy framework to support reactivity-based standards.

As a stakeholder that has a long-standing and significant interest in issues raised under the proposal, we appreciate your consideration of these comments. If you have any questions, or if we can provide additional details regarding issues raised in these

[1] The following companies are members of SIG: The Dow Chemical Company; Eastman Chemical Company; ExxonMobil Chemical Company; Sasol North America, Incorporated and Shell Chemical LP.

comments, please contact Ted Waugh, Acting SIG Manager, at (703) 741-5169 or by email at ted_waugh@americanchemistry.com.

Sincerely,

Sharon H. Kneiss

Sharon H. Kneiss
Vice President, Products Divisions
American Chemistry Council

American Chemistry Council
Solvents Industry Group

Comments on the California Air Resources Board Proposed Amendments to the Regulation for Reducing Volatile Organic Compound Emissions from Consumer Products

June 24, 2008

Introduction and Summary of Comments

Chemically-formulated consumer products are integral to a modern lifestyle. Everyday, household consumers and businesses in California rely on them for personal care and health, cleaning, maintenance, manufacturing, and thousands of other uses. To be effective, many of these products, by necessity, contain volatile organic compounds ("VOCs"). VOCs, however, have the potential to form tropospheric ozone when they react with sunlight in the presence of nitrogen oxides in the atmosphere. In light of California's ongoing challenges with ozone nonattainment and the pervasiveness of consumer products in modern society, it is critical that California regulate VOC emissions as cost effectively and efficiently as possible – which, in this case, means adopting a reactivity-based approach.

The Solvents Industry Group ("SIG") of the American Chemistry Council ("ACC") is pleased to submit the following comments to the California Air Resources Board ("CARB" or the "Board") on its proposed revisions to the *Regulation for Reducing Volatile Organic Compound Emissions from Consumer Products*.[1] The proposed rule would establish new VOC emission limitations for certain consumer product categories that have previously been unregulated, and reduce the existing VOC limits for other previously regulated product categories.[2] The stated goal of the proposed regulation is to help California meet its target of

---

1 *See Notice of Public Hearing to Consider Adoption of Proposed Amendments to the California Consumer Products Regulations* (Apr. 29, 2008), available at http://www.arb.ca.gov/regact/2008/cp2008/cpnotice08.pdf; *Proposed Amendments to the Regulation for Reducing Volatile Organic Compound Emissions from Consumer Products* (Apr. 29, 2008), available at http://www.arb.ca.gov/regact/2008/cp2008/cpappb08.pdf (amending Cal. Code Regs. Tit. 17, §§ 94507 *et seq.*).

2 *See Initial Statement of Reasons for Proposed Amendments to the California Consumer Products Regulation*, at ES-11 to 12 (May 9, 2008), available at http://www.arb.ca.gov/regact/2008/cp2008/cpisor08.pdf (providing table of product categories subject to proposed rule).

reducing up to an additional 30 to 40 tons of VOC emissions per day by 2014.[3] The regulation proposes to accomplish this goal by theoretically reducing VOC emissions from the subject product categories by an additional 5.8 tons per day over the existing regulatory program.[4] The emission reductions would be achieved through the establishment of mass-based limits in which maximum VOC concentrations are established for each product category regardless of VOC reactivity or product chemistry.

As outlined in greater detail below, while SIG does not dispute the potential ozone benefits of reducing VOCs, it believes that California can more efficiently and effectively meet CARB's emission reduction targets by focusing on VOC reactivity instead of percentage-based mass limitations. As CARB itself has stated, "VOC reductions from consumer products are becoming more difficult to achieve."[5] The Board has encouraged the use of "innovative reduction strategies in the longer term" to meet its compliance targets, including the use of reactivity-based standards.[6] Without explanation, however, and despite its leadership on this issue, CARB rejected a reactivity-based approach for this rulemaking. SIG believes this is a mistake, and that there is no need to wait for the longer term to achieve the innovative benefits that reactivity-based standards can provide.

Ample technical support and regulatory precedent exist to justify implementing a reactivity-based approach in this rulemaking. Substantial research demonstrates that emissions from individual VOC compounds vary widely, and that due to chemical reactivity, some VOC compounds do contribute to ozone formation while other compounds have little effect or may

3 *See id.* at ES-7.

4 *See id.* at ES-21.

5 *Id.* at ES-7.

6 *Id.*

even *inhibit* ozone formation. Mass-balanced regulation masks these critical differences, and in some respects creates a disincentive to focus on ozone formation potential in the manufacturing process. As a result, SIG believes that reactivity-based standards would provide a more effective approach towards the goal of ozone reduction.

Reactivity-based standards would also encourage product formulators to select solvents that are not only suitable for product performance, but that maximize ozone reduction benefits as well. Specifically, product formulators strive to provide their consumers with maximum performance. If a VOC limit for a particular product is set at 10% by weight, for example, the product formulator will provide its customer with maximum product performance within that limit with decreased, if any, incentive to evaluate VOC reactivity and ozone formation potential. A standard based on reactivity, however, would encourage the formulator to focus on ozone formation potential as well as product performance. By necessity, such an approach provides greater environmental benefits while simultaneously providing manufacturers with greater latitude and options in product formulation. This combination results in, for example, greater usage of medium to low reactivity compounds, the use of which may be otherwise discouraged under a mass-based approach.

California is no stranger to a regulatory approach focusing on reactivity. CARB specifically adopted a reactivity-based standard in its aerosol coatings rule in 2001, an approach that was approved for use in California's State Implementation Plan ("SIP") in 2005 and then formally adopted by the U.S. Environmental Protection Agency ("EPA" or the "Agency") in 2008 as a national performance standard under the federal Clean Air Act. EPA has also recommended as a matter of policy that states consider using reactivity-based approaches to meet ozone attainment targets as part of their SIPs in large part based on California's strong leadership in this area. Based on this experience and past precedent, reactivity-based standards for consumer products need not wait for some "longer term" effort, as both the science and the regulatory know-how exist to develop those standards now. SIG believes that the citizens of California, the environment, and the formulators and manufacturers of consumer products will benefit from adoption in this rulemaking of a reactivity-based approach. Now is the time for CARB to maximize the efficiencies and effectiveness of ozone reduction initiatives in California and once again show strong national leadership in this area, and SIG stands ready to work with the Board to make this happen.

The balance of these comments provides a more detailed analysis and discussion of the foregoing arguments. Section I of these comments provides a brief overview of SIG and our interest in VOC regulatory issues. Section II discusses the science of VOCs and the reasons why reactivity-based standards are appropriate from a technical and manufacturing standpoint. Finally, Section III provides detailed discussion regarding the regulatory and policy framework that would support reactivity-based standards.

I. SIG is an Active and Interested Stakeholder in VOC Regulation

SIG represents major U.S. manufacturers of hydrocarbon and oxygenated organic solvents. Current members of SIG's working group include: The Dow Chemical Company, Eastman Chemical Company, ExxonMobil Chemical Company, Sasol North America, Inc . and Shell Chemical LP.. SIG was formed to address health, safety, and environmental issues affecting both the producers and users of those materials. As part of that effort, SIG supports research relating to the role VOC emissions have in ozone formation under various environmental conditions.

Because solvents play an essential role in the formulation of hundreds of everyday products, it is important to develop regulatory strategies that reduce their environmental impact without compromising product performance, including avoiding performance degradation that would lead to more frequent usages, greater emissions, and increased costs for both consumer and manufacturer. SIG believes that meaningful ozone reduction is possible through adoption and implementation of reactivity-based VOC standards in consumer products, while providing manufacturers the needed flexibility in product formulation.

SIG has worked with CARB over the past several years on the issue of photochemical reactivity, including participation in the Board's Reactivity Research Advisory Committee. SIG submitted comments and technical information to the Board supporting reactivity-based standards for the architectural and industrial maintenance ("AIM") coatings rule amendments last year. Copies of those comments are attached at Appendix A. Based on the reasons provided in those comments as well as additional new information provided in this comment document, SIG urges CARB to adopt reactivity-based standards for its consumer products regulation instead of mass-based standards.

II. Not All VOCs Are Alike: Reactivity is the Appropriate Metric for Ozone Formation

Controlling VOC emissions from consumer products based on photochemical reactivity is a scientifically sound and appropriate means of addressing ozone formation potential. As noted above, there can be significant differences in the capacity of various VOCs to react in the atmosphere to form tropospheric ozone.[7] In fact, the ozone formation potential for individual

---

7 *See, e.g., National Volatile Organic Compound Emission Standards for Aerosol Coatings*, 72 Fed. Reg. 38,952, 38,963 (July 16, 2007) (proposed rule) ("EPA recognizes that individual VOC can react differently in the atmosphere and can vary in the amount of ozone generated.").

VOCs can vary by as much as 100-fold.[8] The available scientific research shows that photochemical reactivity is a better predictor of the ozone-forming potential of VOC emissions than mass-based measurements and therefore serves as a better regulatory model for controlling VOC emissions and reducing ozone.[9] For example, as noted by Dr. William Carter, one of the leading researchers in this field, "[p]ractical implementation of ozone control strategies which take into account differences among VOCs in their effects on ozone require use of some quantitative reactivity ranking scheme. . . . [The] use of any appropriate ranking scheme would yield a more efficient ozone control strategy than ignoring reactivity altogether."[10] Similarly, researchers conducted a detailed air quality modeling study of the Los Angeles area in the 1990's and concluded that for the same cost, reactivity-based regulations would achieve significantly greater ozone reductions than mass-based regulations alone.[11] Accordingly, an effective regulatory program that seeks to reduce the adverse impacts from VOCs should take into account the individual characteristics of various VOCs, specifically reactivity.

By considering the rate and mechanism of photo-oxidation in the troposphere, reactivity-based VOC emission limits will be reflective of the actual processes that lead to ozone formation. Mass-based limits, on the other hand, treat all non-exempt VOCs as having the same potential to contribute to ozone levels. Under the latter approach, a reduction in the total amount of VOCs theoretically leads to a corresponding reduction in the amount of ambient ozone

---

8 *See* Letter from Courtney M. Price, ACC, to EPA Docket ID. No. OAR-203-0200, at 2 (Mar. 2, 2005).

9 *See, e.g.,* William P. L. Carter, *Development of Ozone Reactivity Scales for Volatile Organic Compounds,* 44 J. Air & Waste Mgmt. Ass'n 881 (1994) (hereinafter *1994 Carter Report*); A. Russell *et al.*, *Urban Ozone Control and Atmospheric Reactivity of Organic Gases*, 269 Science 491 (1995) (hereinafter *Urban Ozone Control*).

10 *1994 Carter Report*, at 44.

11 *See National Volatile Organic Compound Emission Standards for Aerosol Coatings*, 73 Fed. Reg. 15,604, 15,607 (Mar. 24, 2008).

formed. But this is a prime example of regulatory theory not being supported by sound science. For example, as explained by EPA:

> [I]f the VOC content limits are [set] too low manufacturers may be forced to use more reactive solvents to achieve comparable product performance. For example, . . . manufacturers may have to increase the usage of toluene and xylene in order to reformulate to a higher solids coating. Both toluene and xylene are very reactive compounds and have the potential to form significantly larger quantities of ozone than many other solvents. If manufacturers use VOC with higher reactivities, it is possible that decreasing the VOC content of the coating potentially increases the actual ozone formation.[12]

This is not just a theoretical concern. As noted by EPA: "This situation of a decrease in VOC emissions by mass but a potential increase in ozone formation has already been seen to occur in California. . . . The potential increase in ozone formation, notwithstanding decreased VOC emissions by mass, is a result of manufacturers using smaller amounts of total VOC, but an increased amount of more reactive VOC in order to meet tighter VOC limits."[13] By moving towards reactivity-based standards, CARB can avoid this concern and achieve more meaningful VOC reductions.

An approach based on reactivity will also incentivise manufacturers and formulators to focus not only on product performance, but VOC emissions as well. As we had noted in the introduction above, manufacturers can and will focus on maximizing product performance consistent with regulatory limits. Under a mass-based approach, this may drive some manufacturers to substitute lower quantities of higher reactivity VOCs for the currently-used larger quantities of medium reactivity VOCs to meet such standards. For example, in its 2005 approval of CARB's 2001 aerosol coatings rule, EPA noted two instances in which companies

---

[12] 72 Fed. Reg. at 38,962.

[13] *Id.* (indicating a total mass reduction of VOC emissions of 11% for flat coatings from 2001 to 2005, but an increase in ozone formation potential of 5.4% over the same time period).

used higher reactive compounds in response to mass-based limitations in order to, respectively, compensate for solvency needs and aromatic content of products. As noted in the preamble to EPA's 2005 approval of the aerosol coating rule:

> The CARB reported that one company intended to comply with stricter CARB VOC mass-based limits by using less total VOC, but also by increasing the amount of much more reactive VOCs to compensate for solvency needs in the product. The CARB also reported that another large company indicated that its compliance strategy with more stringent VOC mass limits would be to increase the aromatic content (increasing reactivity) in its products. In these instances, CARB points out that the increased reactivity of the VOC emissions likely reduces the benefits of the lower mass of VOC emissions.[14]

Based on these real world examples, a regulatory structure focused on reactivity would better discourage the types of situations noted above. Accordingly, utilization of reactivity would achieve a better end result in terms of ozone formation.

SIG also provided detailed evidence to the Board regarding this issue on October 19, 2007 as part of the AIM coatings rule amendment process (see Attachment A). As we noted at that time, CARB could have doubled the reduction of ozone forming potential emissions from the AIM coatings market segment between 2000 and 2004 had the Board used reactivity-based standards in prior rulemakings.[15] Specifically, from 2000 to 2004, mass VOC emissions from AIM coatings were reduced by 14%. Taking into account the ozone forming potential of those emissions, however, the net benefit was more likely only a 7% reduction because manufacturers replaced high volume, low reactivity solvents with low volume, high reactivity solvents during that time period. In fact, as evidenced in the following table reproduced from our earlier

---

[14] *Revisions to the California State Implementation Plan and Revision to the Definition of Volatile Organic Compounds (VOC) – Removal of VOC Exemptions for California's Aerosol Coating Products Reactivity-Based Regulation; Proposed Rule*, 70 Fed. Reg. 1,640, 1,648 (Jan. 7, 2005).

[15] *See* American Chemistry Council Comments on the California Air Resources Board Proposed Suggested Control Measure for Architectural and Industrial Maintenance Coatings, at 5-9 (Oct. 19, 2007) (attached hereto as Attachment A).

comments, due to the changes in solvent selection driven by lower mass-based VOC limits, 24 of the 38 regulated categories had *net increases* in ozone formation potential per pound of VOC emitted:

2004 versus 2000 ARB Architectural Coatings VOC Mass and Reactivity Data

					All VOC levels		
	Emissions, lb/day[1]		TOFP, lb/day		Ratio, lb TOFP/lb VOC		% Change
AIM Coating Category	2000	2004	2000[2]	2004[3]	2000	2004	OFP/lb
Floor	1,742	1,655	7440	13320	4.27	8.05	88.5%
Bond Breakers	137	340	340	1540	2.48	4.53	82.6%
Traffic Marking	6,071	3,337	8680	8480	1.43	2.54	77.7%
Mastic Texture	1,359	1,145	1820	2260	1.34	1.97	47.3%
Bituminous Roof	8,652	1,288	14400	3100	1.66	2.41	44.6%
Form release Compounds	1,222	1,600	1420	2640	1.16	1.65	42.0%
Quick Dry Primer/Sealer/UC	12,970	2,126	14980	3380	1.15	1.59	37.6%
Stains - Opaque	2,729	953	5880	2740	2.15	2.87	33.4%
Primer, Sealer, Undercoater	17,096	13,090	38220	36760	2.24	2.81	25.6%
Waterproofing Masonry Sealers	2,597	4,707	7380	16700	2.84	3.55	24.9%
Dry Fog	2,192	1,633	3720	3440	1.70	2.11	24.1%
Nonflat LG	8,104	13,288	18720	37180	2.31	2.80	21.1%
Faux Finishing	433	685	1020	1940	2.36	2.83	20.2%
Roof	1,145	800	2840	2380	2.48	2.98	20.0%
Flat	31,195	27,605	69680	73440	2.23	2.66	19.1%
Pretreatment Wash Primer	197	22	460	60	2.33	2.74	17.4%
Industrial Maintenance	30,888	8,449	92780	29740	3.00	3.52	17.2%
Nonflat HG	7,299	2,674	17760	7620	2.43	2.85	17.1%
Nonflat MG	31,156	23,468	69540	59280	2.23	2.53	13.2%
High Temperature	164	99	420	280	2.56	2.84	11.1%
Swimming Pool	110	38	520	200	4.75	5.21	9.9%
Bituminous Roof Primer	729	482	1400	1000	1.92	2.07	8.0%
Sanding Sealers	274	482	580	1060	2.12	2.20	3.8%
Other	44	49	140	160	3.19	3.24	1.6%
Total all 38 categories	216,597	186,285	489,760	454,220	2.26	2.44	7.8%

1: ARB 2005 Architectural Coatings Survey Report, Table 11-2, pg. 11-3 to 421,219.12 454,220.00
2: 2001 ARB Architectural Coatings Reactivity Analysis, Table 2-6, pg 2-26 to 2-27
3. 2005 ARB Architectural Coatings Reactivity Analysis, Table 2-2, pg. 2-5 to 2-6

The net result is that the switch to higher reactivity solvents by manufacturers during that period limited the effectiveness of the targeted regulations. Therefore, to predict the actual ozone benefits of a mass-based reduction approach, CARB would need very specific data regarding anticipated VOC usage and substitution decisions. This significant uncertainty makes regulation through mass-based limitations inherently inefficient. Utilization of a reactivity-based approach, however, would force manufacturers to consider not only quantities of VOC-bearing solvents, but their overall reactivity as well, thus requiring a balance between performance and reactivity.

For reasons such as those stated above, Dr. Carter suggests that pollution control strategies, "which encourage use of VOCs which form less ozone per gram emitted may provide a less costly way to achieve ozone reduction."[16] To do so, Dr. Carter suggests – and SIG agrees – that a quantitative reactivity ranking scheme must be used to support regulatory mechanisms that takes into account relative or incremental reactivities. Dr. Carter's 1994 study favored the Maximum Incremental Reactivity ("MIR") scale, which expresses values in grams of ozone formed per gram of VOC reacted.[17]

The advantage of the MIR scale is that it is based on "environmental conditions where ozone production is most sensitive to changes in hydrocarbon emissions and, therefore, represents conditions where hydrocarbon controls would be the most effective."[18] One of the initial hesitations of using ranking systems for VOC emissions modeling has been that calculating the actual reactivity of individual substances is highly complicated given the varying degrees of reactivity that occur based on atmospheric conditions. Nonetheless, Dr. Carter asserts that the use of his reactivity scheme would still yield better ozone control versus not considering reactivity at all.[19] Moreover, through targeted research, accurate MIR values can be developed for some of the more common individual VOCs found in consumer products.[20] In doing so, regulators may determine that certain VOCs may actually have no effect on ozone formation, when such compounds were previously of unknown reactivity and therefore assumed to be high.

---

16 *1994 Carter Report*, at 2.

17 *Id.*; *see also* 73 Fed. Reg. at 15,607.

18 73 Fed. Reg. at 15,607.

19 *1994 Carter Report,* at 44; *see also* William R. Stockwell, *Review of the Updated Maximum Incremental Reactivity Scale of Dr. William Carter*, at 1 (Nov. 29, 1999) ("The contribution of each VOC to the formation of ozone is different because each has a different oxidation mechanism in the atmosphere. The ozone formation potential has been characterized by several different measures but the MIR scale (Carter, 1994) is widely used….").

20 *See* William P. L. Carter, *Reactivity Estimates for Selected Consumer Product Compounds* (Feb. 19, 2008).

Dr. Carter, for example, recently discovered a similar result and provided his findings in a report to CARB.[21] Therefore, consistent with the science and technology of VOCs, CARB's regulatory focus should be on targeting and reducing the use of compounds that have profoundly higher impacts on ozone formation.

Use of the MIR scale is not a new concept to the Board. CARB has previously recognized this characterization of VOC volatility as being sufficiently reliable for developing reactivity-based regulatory standards. As noted by the Board itself in Resolution 00-22 discussing the forthcoming development of the aerosol coatings limits, the MIR scale "is currently used in the California Clean Fuels and Low Emission Vehicle Regulations, and can also be used to quantify the ozone formation of VOC emissions from aerosol coatings."[22] Reflecting the policy contained in that Resolution, the Board also stated that **"[t]hrough research sponsored by [CARB], the MIR scale has been found to be the most suitable scale to predict VOC reactivities for California atmospheric conditions, *i.e.*, it is appropriate for use in areas where VOC control is needed to reduce ambient ozone concentrations.**"[23] Against this backdrop, it is unclear as to why CARB has tentatively rejected a reactivity-based approach here.

---

21 *Id.* at 1. In his study, Dr. Carter tested certain amines, specifically 2-amino-2-methyl-1-propanol ("AMP") and ethanolamine, as well as several other compounds for reactivity. The results suggest that in some cases, amines such as AMP may actually inhibit ozone formation. *Id.* at 38. Other VOCs were shown to enhance ozone formation, as previously suspected. *Id.*

22 State of California Air Resources Board, *Resolution 00-22*, at 2 (June 22, 2000) (hereinafter *CARB Resolution*) (explaining that mass-based VOC limitations set to become effective January 1, 2002 should be replaced with reactivity-based standards).

23 Letter from Michael P. Kenny, CARB, to Wayne Nastri, EPA Region IX, at 2-3 (Mar. 13, 2002) (hereinafter *March 13, 2002 CARB Letter (emphasis added)*); *see also* Letter from Catherine Witherspoon, CARB, to EPA Docket ID. No. OAR-203-0200, at 2 (Feb. 25, 2005) ("With the research done to date, [the Board is] comfortable with the ability of the MIR scale to predict the ozone formation potential of VOCs for California's atmospheric conditions.") (hereinafter *February 25, 2005 CARB Letter*).

The value of the MIR scale cannot be understated as even EPA has recommended this approach for "national applicability."[24] In fact, as discussed further in Section III below, both CARB and EPA specifically relied on Dr. Carter's MIR scale to establish state and federal VOC emission standards for aerosol coatings in 2001 and 2008, respectively.[25]

III. Reactivity Can Reasonably Support Effective State and National Regulation

Based on the recognition of the inherent limits of the mass-based approach to VOC regulation, the trend in both state and federal regulatory VOC emission control policy has been towards utilization of reactivity-based approaches. CARB has successfully adopted reactivity as a principal regulatory mechanism in its 2001 aerosol coatings rule. EPA followed CARB's leadership, and formally recommended to the states in 2005 that they explore adopting reactivity-based approaches in their State Implementation Plans (SIPs) based on California's aerosol coatings rule. EPA also adopted a national emissions standard for aerosol coating in 2008 based on CARB's 2001 rule. SIG strongly encourages the Board to continue to provide national leadership in this critical area and once again adopt a reactivity-based approach for another subset of consumer products.

---

24 Memorandum from Deborah Luechen, National Exposure Research Laboratory, to J. Kaye Witfield, U.S. EPA Office of Air Quality Planning and Standards, *Review of the Technical Basis for Use of the One-Dimensional MIR Scale in the National Volatile Organic Compound Emission Standards for Aerosol Coatings*, at 1 (Mar. 15, 2007) (hereinafter *Luechen Memorandum*).

25 *See Initial Statement of Reasons for the Proposed Amendments to the Regulation for Reducing Volatile Organic Compound Emissions from Aerosol Coating Products and Proposed Tables of Maximum Incremental Reactivity (MIR) Values, and Proposed Amendments to Method 310, "Determination of Volatile Organic Compounds in Consumer Products,"* at S-2 (May 5, 2000) ("In developing the proposed reactivity limits, our goal was to propose limits that ensure that the ozone reduction commitment from the existing mass-based VOC limits would not be compromised. The limits are based on the [MIR] scale developed by Dr. William Carter of the University of California, Riverside.") (hereinafter *Aerosol ISOR*); 73 Fed. Reg. at 15,607 ("EPA's national aerosol coatings rule builds largely upon CARB's efforts to regulate this product category using the relative reactivity approach.").

CARB has been a leader in researching and exploring the use of reactivity in VOC emissions control strategies since the 1980s. For example, the Board funded Dr. Carter's initial work in the development of reactivity scales, including the MIR scale.[26] CARB also took reactivity into account when developing its Low-Emission Vehicles and Clean Fuels regulation in the early 1990s. Although the final rule eventually took a mass-based approach as to emissions limitations, it did take into account the reactivity of organic gas when comparing emissions from alternatively-fueled vehicles.[27] SIG believes that the Board should take the next step in advancing the appropriate use of reactivity as a measure of VOC regulation by adopting this basis of control for the consumer products rule as it did for the aerosol coating rule. Doing so would be not only consistent with past rulemaking; such action would also be consistent with California policies.

Evidence of California's direction in utilizing reactivity-based standards can be seen through the previously referenced aerosol coating rule. During that rulemaking, CARB accurately characterized the limitations of mass-based standards and advocated for expanded use of reactivity-based standards in the future. As stated in CARB Resolution 00-22 on June 22, 2000, the "Board staff and representatives of the aerosol coating industry came to the conclusion that it is preferable to replace the existing VOC content limits with mandatory reactivity-based

---

26 *See* 73 Fed. Reg. at 15,606-07.

27 *See* 70 Fed. Reg. at 1,645 ("In 1991 California adopted regulations intended to differentiate between species of VOC based upon a reactivity scale, instead of a two bin system. The 1991 rules were the Low-Emission Vehicles and Clean Fuels regulations that CARB intended to reduce VOC emissions by mass from motor vehicles generally, but which also took into account VOC reactivity differences in organic gas when comparing the emissions from alternatively fueled vehicles (AFVs). Although not a full-blown attempt to regulate VOCs by their relative reactivity, CARB nonetheless began the exploration of the MIR scale as a mechanism to distinguish between VOCs and encourage reduction of more reactive VOCs.").

limits."[28] This statement was justified because the original mass-based aerosol coatings rule, which had achieved "significant VOC reductions," had not done enough to achieve the hoped for air quality improvements. As a result, the Board began "to look at alternative approaches that could lead to further air quality improvements, beyond what can be achieved by controlling VOC mass alone."[29] The chosen approach was to "limit the reactivity of the VOCs used in aerosol coating products" rather than "limiting the total mass of VOCs . . . ."[30] Therefore, CARB staff proposed to amend the 35 weight-based aerosol coating limits established in the existing rule "with equivalent reactivity-based limits."[31]

CARB should apply the lessons learned from the aerosol coating rule by directly going to a reactivity-based standards approach for the consumer products rule, rather than taking the partial step of an expanded mass-based approach that only achieves partial results. By going directly to a reactivity-based standard CARB can more readily realize projected ozone reductions.

Going directly to a reactivity-based standard for the consumer products rule is consistent with stated Board policy. As CARB noted in its 2002 aerosol coatings SIP submission to EPA:

> *In the future, we intend to use the methodology established in this regulation as the basis for going beyond emission reductions that can be achieved through reducing mass only.*[32]

The kind of policy shift described above is necessary, in part, because when CARB "adopted the 1994 [SIP] for Ozone [the Board] included a commitment to consider reactivity when developing

28 *CARB Resolution*, at 1.

29 *March 13, 2002 CARB Letter*, at 2.

30 *Id.* at 2.

31 *Aerosol ISOR*, at 2.

32 *March 13, 2002 CARB Letter*, at 2 (emphasis added).

control strategies for consumer products."[33] As further stated by the Board, "[CARB] included reactivity as a potential control strategy in recognition that [the Board's] 85 percent overall VOC emission reduction [target] may be difficult to achieve on a mass-based approach alone."[34] Thus, what CARB needs is "an aggressive, forward-thinking alternative approach that has the potential to further improve air quality beyond what can be achieved with mass reductions."[35] SIG agrees and urges CARB to continue to use reactivity-based standards in its consumer products regulations.

California is not alone in recognizing the benefits of a reactivity-based approach over a mass-based approach. Like CARB, EPA has been gradually transforming its regulatory policies regarding VOC emission control strategies over the last several decades, although it was not until CARB exhibited strong national leadership in this area that EPA fully embraced reactivity as a suitable regulatory compliance model. In rulemakings and policy statements throughout the 1970s, 80s and 90s, EPA recognized VOC reactivity as a potential regulatory model. Due to the perceived complications of regulating individual VOCs according to reactivity, however, EPA opted for mass-based approaches.[36] This view began to change in the mid-2000s as California moved forward with regulation based on reactivity.

---

33 *Aerosol ISOR*, at S-8

34 *Id.*

35 *February 25, 2005 CARB Letter*, at 1 (referring to the reactivity-based model).

36 *See Requirements for Preparation, Adoption, and Submittal of Implementation Plans*, 36 Fed. Reg. 15,486-506 (1971) (emphasizing the need to reduce total mass of VOCs, but suggesting, incidentally, that substitution of compounds could also work if a decrease in emissions due to lower reactivity could be demonstrated); *Recommended Policy on Control of Volatile Organic Compounds*, 42 Fed. Reg. 35,314, 35,315 (July 8, 1977) (exempting only four VOC compounds from regulation; questioning the utility of solvent substitutions in contrast to the 1971 policy; and noting that most VOCs "eventually react in the atmosphere to form some oxidant"); *Air Quality; Revision to EPA Policy Concerning Ozone Control Strategies and Volatile Organic Compound Reactivity*, 56 Fed. Reg. 11,418 (Mar. 18, 1991) (adding several more compounds to the list of exempted VOCs); *National Volatile Organic Compound Emission Standards for Consumer Products*, 63 Fed. Reg. 48,819 (Sept. 11, 1998)

(continued...)

EPA's change in view on reactivity-based emission controls appears to have come to light in 2005 with its approval of California's SIP amendment that incorporated the revised aerosol coatings rule. On the same day that EPA approved that amendment, EPA issued its *Interim Guidance on Control of Volatile Organic Compounds in Ozone State Implementation Plans*.[37] That policy guidance "encourages States to consider recent scientific information on the photochemical reactivity of [VOCs] in the development of [SIPs] designed to meet the national ambient air quality standards . . . for ozone."[38] Noting that EPA, CARB, and other organizations had invested significant efforts in VOC reactivity research to develop more efficient control strategies, the policy statement indicates that substituting high reactivity compounds for low reactivity compounds can be effective at reducing one and eight-hour ozone concentrations.[39] EPA therefore encouraged states to develop emissions inventories that accounted for reactivity and not just mass-based calculations.[40]

EPA took a further step in promoting the use of reactivity as an emissions control strategy in its *National Volatile Organic Compound Emission Standards for Aerosol Coatings*, promulgated as a direct final rule on March 24, 2008.[41] That standard, based largely on CARB's 2001 rule,[42] is the first national standard specifically regulating VOC emissions based on reactivity. During the development of that rule, EPA officials noted that "given what we already

(continued)

(mass-based VOC limits for consumer products); *National Volatile Organic Compound Emission Standards for Architectural Coatings*, 63 Fed. Reg. 48,848 (Sept. 11, 1998) (mass-based VOC limits for architectural coatings).

37 70 Fed. Reg. 54,046 (Sept. 13, 2005).

38 *Id.*

39 *Id.* at 54,047-48.

40 *Id.* at 54,048.

41 73 Fed. Reg. 15,604.

42 *Id.* at 15,608.

know, EPA can already make a compelling case for considering reactivity as a basis for VOC control."[43] SIG agrees, and has been consistently making that case to CARB for several years.

The available scientific data suggest that we now understand ozone formation potential and VOC reactivity well enough to develop targeted regulatory policies based on reactivity. The era of mass-based regulation should be put behind us as we strive to meet increasingly more stringent ambient air quality standards while population growth and consumer demand continue to tax our environmental resources. Focused, cost effective and scientifically viable regulations must be the norm. A reactivity-based approach satisfies those conditions. Mass reductions do not. Accordingly, CARB should apply this modern and more scientifically supported standard— one it created— to the consumer products rule as the Board has in other VOC regulatory contexts.

Conclusion

SIG supports CARB's general efforts to address ozone non-attainment in California, but does not agree that the proposed mass-based VOC emission limitations for the targeted consumer products adequately and cost effectively accomplish CARB's stated objective – the reduction of ground-level ozone. SIG believes that both regulatory and scientific advancements over the past decade strongly support the adoption of reactivity-based VOC limitations for consumer products. The reactivity approach is favored by manufacturers and product formulators because it allows for greater flexibility in the manufacturing process.[44] Moreover, it leads manufacturers and formulators to consider both performance and volatility. At the same time, this approach affords

---

43 *Luechen Memorandum*, at 1.

44 *See, e.g.*, Letter from Doug Raymond, Sherwin Williams, to CARB (Feb. 13, 2001); Letter from Heidi K. McAuliffe, Spray Paint Manufacturers Committee, to CARB (Feb. 13, 2001); Letter from Jerry Howard, Plasti-Kote, to CARB (Feb. 13, 2001).

regulators the ability to reduce ozone formation more effectively and to promote greater ambient air quality improvements throughout California. CARB itself has recognized the net environmental benefits from granting manufacturers greater regulatory flexibility in selecting product formulations, stating that a mass-based approach, while forcing a reduction in total VOC content, does not prevent the use of more reactive VOC compounds; only limiting the reactivity of the VOCs in the products themselves will ensure adequate, cost effective, and sustainable ground-level ozone reductions.[45] SIG therefore strongly urges CARB to reconsider its regulatory approach for consumer products and adopt a scientifically-sound, reactivity-based approach instead of an outdated, mass-based scheme.

SIG remains committed to working with CARB on these issues and looks forward to continued dialogue in this area. For further information, contact Ted Waugh, Acting SIG Manager, at 703-741-5169 or ted_waugh@americanchemistry.com

Attachment: SIG comments on Architectural and Industrial Maintenance Coatings (October 19, 2007)

---

45 *See Aerosol ISOR,* at S-9.

ATTACHMENT A

American Chemistry Council
Solvents Industry Group

Comments on the California Air Resources Board Proposed Suggested Control Measure for Architectural and Industrial Maintenance Coatings

October 19, 2007

Executive Summary

Architectural and industrial maintenance (AIM) coatings play critical roles in our environment. They protect and beautify homes, schools, offices, bridges and other important structures; they are also sources of volatile organic compound (VOC) emissions. While controlling VOCs from AIM Coatings is important to improving the environment, it is critical that VOC control regulations do so in an environmentally efficient way because of the essential job these coatings perform. The Solvents Industry Group (SIG) believes that the Air Resources Board (ARB) could achieve better reductions in ozone formation potential (OFP), while providing more options to coating manufacturers through the use of reactivity-based VOC controls. ARB has been a leader in the field of VOC photochemical reactivity and has made prior statements clearly acknowledging that reactivity-based approaches would be expected to provide equal or greater environmental benefits[1]. These benefits include:

- Differentiating VOC species based on their respective potential impact on ozone levels.
- Encouraging formulators to select solvents and blends that have the least impact on ground-level ozone formation;
- Accomplishing the above while allowing manufacturers the greater formulation latitude necessary to formulate coatings that provide the required performance properties.

There are significant opportunities to further reduce OFP from AIM Coatings using reactivity. For example, during the period from 2000 to 2004 there were significant reductions in the amount of VOC emissions from AIM Coatings – approximately a 14% (15 ton/day) reduction. However, Californians saw only a 7% (17 tons/day) reduction in OFP from these emissions. This is because the relative reactivity of many of the VOC emissions from AIM Coatings increased from 2000 to 2004; across all of the AIM

[1] ARB Resolution 00-23 (June, 2000) as described in 2005 Architectural Coatings Survey Draft Reactivity Analysis (January 2007), p. 1-5.

Coating categories the reactivity increased by 7.8%. While that may not appear to be a significant increase in relative reactivity, it resulted in California only getting *half* of the OFP reductions it could have achieved just by keeping the reactivity steady from 2000 to 2004. Further, had the reactivity of AIM Coatings been lowered by 14% over the same period, instead of mass, California would have gotten *twice* the reduction in OFP it got with the mass reductions. By utilizing a reactivity-based approach to AIM Coatings, CARB could target the SCM more appropriately on reducing ozone formation potential, the true measure of the environmental objective being pursued.

This is an urgent matter. The Board by resolution in 2000 directed ARB staff to work with industry to evaluate reactivity-based approaches to reducing the ozone-forming impact of VOC emissions from architectural coatings. Tremendous progress in the area has been made since then, such that it is now possible to adopt reactivity-based limits. If the Board does not act now, to direct the ARB staff to take the additional time to incorporate reactivity into this SCM; another 7-10 years of opportunities to significantly reduce ozone formation potential from these solvent VOC emissions could be lost before the next update of this SCM. We urge the Board to follow its own example, set by the Aerosol Coatings Rule adopted in 2000. The outcome of that rule demonstrates that reactivity-based approaches work, are feasible, and are enforceable. To avoid missed opportunities of VOC controls that just focus on mass, it is necessary to apply reactivity-based approaches more broadly. The Board has an opportunity now to utilize reactivity for this AIM Coating SCM and we ask it to do so.

Introduction

The American Chemistry Council's Solvents Industry Group (ACC SIG)[2] is pleased to submit the following comments to the California Air Resources Board (ARB) on its proposed revisions to the Suggested Control Measure (SCM) for Architectural and Industrial Maintenance (AIM) Coatings. The Solvents Industry Group represents major U.S. manufacturers of hydrocarbon and oxygenated organic solvents. SIG was formed to address health, safety, and environmental issues that affect producers and users of hydrocarbon and oxygenated solvents and has supported research pertaining to the role volatile organic compounds (VOCs) may play in ozone formation under different environmental conditions. SIG members manufacture a wide range of solvents, including VOC exempt solvents, low-reactive solvents, higher-reactive solvents, and also solvents that are essential in water-based coatings[3]. Because solvents play an essential role in the formulation of a wide range of products, including water-based formulations, the ACC SIG believes it is important to develop regulatory strategies that reduce the environmental impact of those solvents without compromising product performance, including avoiding performance decrements that would lead to more frequent recoating and ultimately higher emissions.

SIG has worked extensively with ARB over the past few years on the issue of photochemical reactivity and participated in ARB's Reactivity Research Advisory Committee (RRAC) research on the reactivity of solvents used frequently in architectural coatings. SIG has also provided previous comments to ARB during the development of this SCM; including presentations in February, June and July 2007 (Attachments A-C) and written comments in May and June 2007 (Attachments D and E). Also attached is the representation that SIG recently made at the South Coast AQMD Technology Forum on VOC Reactivity (Attachment F). SIG strongly encourages ARB to reconsider the

---

[2] The following companies are members of the ACC Solvents Industry Group: The Dow Chemical Company; ExxonMobil Chemical Company; Shell Chemical LP; Eastman Chemical Company; and Sasol North America, Incorporated.

[3] While water-based coatings may use considerably less total solvent per gallon than their solvent-based counterparts, the inclusion of some solvent and other VOCs remains critical to achieving the application, appearance, and performance properties required in any given application.

currently proposed mass-based approach to the AIM SCM and employ a reactivity-based approach in order to best achieve the goal of reducing ozone formation.

In section I of these comments we present an analysis of VOC emissions from AIM Coatings in California from 2000 to 2004, considering the changes in relative reactivity of the VOC ingredients and how these offset some of the potential ozone reductions that could be potentially achieved. In Section II we discuss how reactivity is the appropriate metric for achieving ozone reductions and that controlling the reactivity of VOC emissions is a much more efficient means to achieving ozone reductions from AIM Coatings. Section III addresses some of the concerns about reactivity-based approaches that have been raised by ARB staff, and explains why the SIG does not believe these concerns should stand in the way of using the best science to address the persistent problem of tropospheric ozone. We note that many of the concerns that have been identified have already been overcome once in the context of the successful ARB Aerosol Coatings Rule, which used a reactivity-based approach, and we believe ARB can do the same with AIM Coatings.

1. Analysis of VOC Reactivity in California AIM Coatings

SIG compared the reactivity of VOC emissions from AIM Coatings in California over the period 2000 to 2004 using the analysis of data gathered and published by ARB in the 2001 and the (Draft) 2005 AIM Coatings Surveys and the 2001 and (Draft) 2005 Reactivity Analyses. In these reports, ARB assessed the total sales, VOC ingredients, reactivity and ozone formation potential (OFP[4]) of AIM Coatings in 2000 and 2004. Of the 46 product categories covered by the surveys, 38 categories had sufficient information for further analysis; several categories had limited products/producers and therefore information was not provided on those categories in order to avoid the publication of sensitive business information. Fortunately all of the major product categories had sufficient information to continue with the assessment. During this period there were significant reductions in the amount of VOC emissions from AIM Coatings

[4] For the purposes of these comments the terms ozone formation potential (OFP) and total ozone formation potential (TOFP) are interchangeable.

going from 216,597 pounds/day to 186,285 pounds/day – approximately a 14% (15 ton/day[5]) reduction. However, this 14% reduction in VOC emissions only corresponded to a 7% (17 tons/day) reduction in OFP; going from 489,760 pounds/day to 454,220 pounds/day (see Table 1 below).

Table 1

2004 versus 2000 ARB Architectural Coatings VOC Mass and Reactivity Data

					All VOC levels		
	Emissions, lb/day[1]		TOFP, lb/day		Ratio, lb TOFP/lb VOC		% Change
AIM Coating Category	2000	2004	2000[2]	2004[3]	2000	2004	OFP/lb
Floor	1,742	1,655	7440	13320	4.27	8.05	88.5%
Bond Breakers	137	340	340	1540	2.48	4.53	82.6%
Traffic Marking	6,071	3,337	8680	8480	1.43	2.54	77.7%
Mastic Texture	1,359	1,145	1820	2260	1.34	1.97	47.3%
Bituminous Roof	8,652	1,288	14400	3100	1.66	2.41	44.6%
Form release Compounds	1,222	1,600	1420	2640	1.16	1.65	42.0%
Quick Dry Primer/Sealer/UC	12,970	2,126	14980	3380	1.15	1.59	37.6%
Stains - Opaque	2,729	953	5880	2740	2.15	2.87	33.4%
Primer, Sealer, Undercoater	17,096	13,090	38220	36760	2.24	2.81	25.6%
Waterproofing Masonry Sealers	2,597	4,707	7380	16700	2.84	3.55	24.9%
Dry Fog	2,192	1,633	3720	3440	1.70	2.11	24.1%
Nonflat LG	8,104	13,288	18720	37180	2.31	2.80	21.1%
Faux Finishing	433	685	1020	1940	2.36	2.83	20.2%
Roof	1,145	800	2840	2380	2.48	2.98	20.0%
Flat	31,195	27,605	69680	73440	2.23	2.66	19.1%
Pretreatment Wash Primer	197	22	460	60	2.33	2.74	17.4%
Industrial Maintenance	30,888	8,449	92780	29740	3.00	3.52	17.2%
Nonflat HG	7,299	2,674	17760	7620	2.43	2.85	17.1%
Nonflat MG	31,156	23,468	69540	59280	2.23	2.53	13.2%
High Temperature	164	99	420	280	2.56	2.84	11.1%
Swimming Pool	110	38	520	200	4.75	5.21	9.9%
Bituminous Roof Primer	729	482	1400	1000	1.92	2.07	8.0%
Sanding Sealers	274	482	580	1060	2.12	2.20	3.8%
Other	44	49	140	160	3.19	3.24	1.6%
Total all 38 categories	216,597	186,285	489,760	454,220	2.26	2.44	7.8%

1: ARB 2005 Architectural Coatings Survey Report, Table 11-2, pg. 11-3 to 421,219.12 454,220.00
2: 2001 ARB Architectural Coatings Reactivity Analysis, Table 2-6, pg 2-26 to 2-27
3. 2005 ARB Architectural Coatings Reactivity Analysis, Table 2-2, pg. 2-5 to 2-6

SIG then considered the reactivity information that ARB developed for these 38 categories and determined that 24 categories (shown in Table 1) had increases in total ozone formation potential (TOFP) per pound of VOC in the product (TOFP/VOC[6]). This

[5] The 15 ton/day VOC emissions reductions from 2000 to 2004 provide a very good basis of comparison for the SCM since this is the same amount of VOC mass reductions ARB expects to achieve with the proposed SCM.
[6] OFP/VOC = total mass of ozone formation potential of a product category in pounds or tons divided by the total mass of the VOC ingredients in the product category in pounds or tons.

is a measure of the relative reactivity of the VOCs used in these coatings. In these 24 categories the increase in reactivity ranged from 1.6% for the "Other Coatings" category to a staggering 88.5% for the "Floor Coatings" category. This increase in VOC reactivity occurred in categories with both solvent-borne and water-borne coatings. Across all 38 categories, including the 24 categories with reactivity increases and the 14 categories with no increase, the overall increase in reactivity was 7.8%, going from 2.26 TOFP/VOC to 2.44 TOFP/VOC. SIG then considered what would have occurred if the reactivity of the VOC species in AIM Coatings had stayed constant over this time (something that reactivity-based regulations can achieve) and determined that this modest increase in relative reactivity corresponded to a missed opportunity of 17 tons/day of TOFP that could have been reduced but wasn't. This was determined by the taking the total emissions from AIM Coatings in 2004 of 95 tons/day and comparing the actual TOFP to theoretical level if reactivity had stayed the same as 2000.

Actual TOFP in 2004:

2.44 TOFP/VOC x 95 tons VOC/day = 232 tons TOFP/day

Theoretical TOFP assuming no change in reactivity from 2000 to 2004:

2.26 TOFP/VOC x 95 tons VOC/day = 215 tons TOFP/day

Difference (missed opportunity):

232 tons TOFP/day – 215 tons TOFP/day = <u>17 tons TOFP/day</u>

SIG also considered what would happen if rather than focusing on VOC mass reductions during the period from 2000 to 2004, ARB had reduced just the reactivity.

TOFP assuming a 14% reduction in reactivity and no reduction in mass from 2000 to 2004:

2.26 TOFP/VOC x 0.86 (14% reduction) x 110 tons VOC/day (2000 emissions) = <u>214 tons TOFP/day</u>

The results show that if VOC reactivity was reduced for AIM Coatings, instead of mass, ARB would have achieved better results that what actually occurred and would have achieved similar results to reducing mass and holding reactivity constant (which did not actually occur). The bottomline is that by not controlling the relative reactivity of VOCs, California only got *half* of the ozone formation potential reductions it could have achieved by reducing reactivity by 14% and not reducing mass at all.

In the Technical Background Document (TBD), ARB indicates that it anticipates the total reactivity of formulations will go down[7] because formulators will meet these new limits by using more water or more exempt solvents. However, this position does not appear to be supported by any specific data, whereas the data from ARB's reactivity analyses on AIM Coatings from 2000 to 2004 clearly show that previous formulation decisions have resulted in an increase in the use of more reactive solvents. This position also fails to consider that the 4 largest coatings categories, both in terms of volume and ozone formation, are, in aggregate, already 99.5% water borne, leaving only a trivial volume of product that could shift to water. In addition, none of the solvents listed as exempt in the SCM are in technologically feasible for use in these particular categories of coatings. Since those categories account for roughly 90% of the volume and 74% of the total emissions for categories which will be affected by this SCM, it is obvious that this assumption is valid only for a minority of products.

The ARB survey data clearly shows that the selection of higher-reactivity VOC materials in numerous categories is significantly offsetting the air quality improvements anticipated by the current mass-based regulations. This is not mere speculation – it is supported by actual data. To take this analysis further, consider just one of the major coatings categories – Flat Coatings. During the period from 2000 to 2004, the data indicated that:

---

[7] September 2007, ARB SCM Technical Background Document, Section 6.B.1.

A. The total volume of coating reported sold in California rose by 2.47 million gallons (7.1%).

B. The sales-weighted average VOC (SWAVOC) was reduced from 96 grams per liter to 82.

C. The total mass of VOC emissions was reduced from 11.3 million pounds to 10.0 million, a decrease of 1.3 million pounds of emissions per year (11%).

D. The real air quality impact for this category INCREASED by 1.4 million pounds OFP; an increase of 5.4 %.

ARB, U.S. EPA and others have recognized this potential for mass-based approaches to drive product formulators in some cases to use *more reactive compounds* albeit in smaller quantities and that substitutions can negate some of the expected benefits of the mass-based limits or, in some circumstances, even lead to a net increase in ozone-forming potential of the formulated products.[8] These data demonstrate that this is indeed what is occurring as mass-based VOC limits are driven lower. Such a circumstance could be averted with reactivity-based VOC emissions standards as the total ozone formation potential would be regulated, not simply the mass of VOC emissions.

2. Reactivity is the Appropriate Metric for Ozone

Controlling VOC emissions from coatings and consumer products based on photochemical reactivity is a scientifically sound and appropriate means of addressing ozone formation potential. There can be enormous differences in the capacity of various VOCs to react in the atmosphere to form tropospheric ozone. ARB has been at the forefront of this field supporting much of the major work on reactivity by Dr. Carter, University of California – Riverside, and others. This scientific research shows that photochemical reactivity has a more direct correlation to the ozone-forming potential (i.e. potential air quality impacts) of VOC emissions than does a simple mass-based measure

[8] U.S. EPA, 70 Fed. Reg. at 1642; January 7, 2005. Approval of Aerosol Coating Rule in California SIP.

of emissions. The impact of mass-based VOC emissions reductions on ozone formation potential is uncertain and can vary greatly depending on the VOC substitution decisions made to meet specific mass limits. Reactivity-based VOC emissions limits, by considering the rate and mechanism of photo-oxidation in the troposphere, are reflective of the actual processes that lead to ozone formation. Relative photochemical reactivity thus provides a more rigorous scientific approach to assessing an individual compound's potential contribution to ozone accumulation than does consideration of its mass alone. Accordingly, SIG believes that such an approach is scientifically sound and ARB should not further delay the development of a reactivity-based AIM Coating SCM.

Further, SIG believes reactivity-based approaches should be considered in future coating and consumer product regulations within California, wherever reductions of VOC emissions are necessary to achieve compliance with ozone standards. This is consistent with the U.S. EPA's September 2005 "Interim Guidance on Control of Volatile Organic Compounds in Ozone State Implementation Plans," which specifically "encourages states to consider recent scientific information on the photochemical reactivity of volatile organic compounds in the development of state implementation plans designed to meet the national ambient air quality standards for ozone."[9] Reactivity-based VOC standards should not be considered only as a supplement to mass-based approaches, but rather as a scientifically valid and appropriate means for controlling ozone formation. The advantages of reactivity-based approaches are not limited to circumstances where mass-based approaches fall short of regulatory goals. As stated above, reactivity-based emissions regulations allow for direct assessment of the impact on ozone formation potential. Assessing the impact of mass-based emissions regulations on ozone formation potential requires additional information on anticipated VOC usage and substitution decisions.[10]

---

[9] 70 FR 54046-54051; September 13, 2005.

[10] EPA addresses the issue of uncertainty of chemical mechanisms and reactivity on page 38963 of the preamble. While SIG agrees that the uncertainty is smaller for the majority of VOCs, we wish to emphasize that any uncertainty in reactivity of individual compounds pales in comparison to the *known* inaccuracy of current mass-based approaches, which assume that all non-exempt VOCs have the same reactivity. As is clearly shown in the reactivity tables from the Aerosol Coating Rule, reactivity of non-exempt VOCs varies widely.

The key point on reactivity-based approaches is that they measure the right thing – the potential of a substance to contribute to ozone levels.[11] There is a direct connection between the metric being used and the environmental objective being pursued. Given ARB's significant work on photochemical reactivity-adjusted VOC control measures for the reduction of ozone formation potential the Board is certainly aware of the many benefits, including:

- Differentiating VOC species based on their respective potential impact on ozone levels;
- Encouraging formulators to select solvents and blends that have the least impact on ground-level ozone formation;
- Directly measuring, enforcing and reducing the impact of VOC emissions on air quality, as opposed to the indirect and highly uncertain results from mass-based regulations;
- More efficiently achieving the reductions in ozone formation potential needed to meet federal air quality standards;
- Accomplishing the above while allowing manufacturers the greater formulation latitude necessary to formulate coatings that provide the required performance properties; and
- Minimizing the impact that lower mass-based limits have had on reducing service life of coatings, thus causing a higher frequency of application, which is an unintended negative impact on air quality.

None of the above benefits will be realized if the current focus on mass-based VOC reductions is continued. Formulators will have no incentive to take reactivity into account when reformulating to meet tighter VOC limits. As a result, the new formulations that result might have lower overall potential to contribute to ozone levels, *but they also might not.* Historical data proves that continuing mass-based VOC

[11] We recognize that there are NOx-limited areas where changes in VOC emissions inventories have little or no impact on ozone levels. For purposes of this letter, we are assuming that emissions occur in areas where changes in VOC emissions inventories can make a difference.

regulations will not achieve air quality improvements commensurate with the effort and cost involved, either in the development and enforcement of the regulations or in the required reformulation of products to meet those regulations. Moreover, if the new product formulation needs to be applied more often, there could be a double-negative result.

3. ARB has Recognized Success with Reactivity-Based Rules (Aerosol Coatings)

As ARB is well aware, it has already successfully developed and implemented a reactivity-based regulation for aerosol coatings. When the U.S. EPA approved this rule in 2005 (70 FR at 53390; September 13, 2005) it stated that California's Aerosol Coatings Rule will improve the State Implementation Plan (SIP) by "creating an incentive for the use of solvents with relatively low contribution to ozone formation."[12] EPA correctly noted that CARB's regulation will preserve the air quality benefits of its previous rule, while at the same time allowing manufacturers greater flexibility in reformulating their products, by replacing existing mass-based VOC limits for aerosol spray coatings with reactivity-based limits that are designed to achieve equivalent air quality benefits.[13] The U.S. EPA is now proposing to expand the ARB Aerosol Coating regulation to a national standard in order to capture the benefits of this regulation in other parts of the U.S. where ozone formation is a concern. Clearly the leadership role that ARB provided was critical to making the Aerosol Coatings regulation a success in both California and the rest of the U.S. While we are calling upon ARB to show leadership again, in reality, we are simply asking the Board to apply in this SCM the same good science that has been accepted and used in other California and federal regulatory programs.

Conclusion

SIG believes there is no longer any supportable scientific, policy or legal reason not to realize the many reasons stated above to take advantage of the benefits that a

---

12 70 Fed. Reg. at 1642; January 7, 2005

13 *Id.* at 1646.

reactivity-based AIM Coating SCM will achieve. Based on previous cycles between updates to the AIM Coating SCM, it is likely that ARB will not issue another SCM until the mid to late 2010's. SIG believes the Board should not allow this time to go by before realizing the benefits of a reactivity-based SCM. SIG hopes the Board will give staff more time to consider a reactivity option. We do not believe it is too late to incorporate reactivity into the SCM for AIM Coatings. Much of the required regulatory text already exists in the form of the Aerosol Coatings rule. The most significant change we would urge would be the replacement of certain reporting requirements with record-keeping requirements; we think it should be sufficient for product formulators to maintain records supporting their compliance determinations, with the requirement that such records be made available for inspection upon request. Agency resource and timing considerations should not stand in the way of adopting scientifically sound regulations, and do not justify failing to employ the best science available in the pursuit of compliance with the federal ozone standard.

The ARB Aerosol Coatings rule proves that implementation of an effective reactivity-based rule can be done. The ARB 2005 Architectural Coatings Reactivity Report demonstrates that it should be done. The ACC SIG asserts the time for reactivity-based limits has arrived. ARB, the Air Quality Management Districts (AQMDs) and product formulators should measure a parameter with impact – the total reactivity of the solvents included in coatings, not just the mass.

SIG appreciates the Board's consideration of these comments and we stand ready to continue to actively aid your effort to produce a leading-edge air quality/ozone prevention policy that has the potential to make the ARB and AQMD regulations more effective in meeting the important environmental objective of reducing ozone levels. If you have any questions, or if we can provide additional support for the incorporation of reactivity into the SCM for AIM Coatings, please contact the SIG's manager, Andrew Jaques, at (703) 741-5627 or by email at Andrew_Jaques@americanchemistry.com.