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]

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[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

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[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.