X.

Environmental Impacts

A. Summary of Environmental Impacts

In this rulemaking, we are proposing to amend both the Aerosol Coatings Regulation and Air Resources Board (ARB) Method 310 “Determination of Volatile Organic Compounds (VOCs) in Consumer Products.” To support the implementation of the proposal, Tables of MIR values would be contained in proposed new Subchapter 8.6. However, the ARB staff is only focusing on the potential environmental impacts of the proposed amendments to the Aerosol Coating Regulation. This is because the amendments to ARB Method 310 and the MIR Tables are based on existing scientific information and would not themselves impose any requirements leading to a physical change in the environment. Overall, the result of this analysis shows that, upon full implementation, the proposed rulemaking would have neither a positive nor adverse environmental impact. This is because staff is proposing to replace existing VOC content limits for aerosol coatings with reactivity-based VOC limits that achieve an equivalent air quality benefit. Therefore, the proposal would achieve the same ozone reduction benefit as would have been associated with implementation of the mass-based VOC limits. The mass-based VOC limits adopted by the Board on November 19, 1998, would reduce VOC emissions by about 3.1 tons per day (tpd). These proposed amendments would reduce the ozone formed from aerosol coating emissions by about 9.6 tpd.

Staff has identified a short-term negative environmental impact of the proposed amendments, a temporary ozone shortfall totaling 9.6 tpd. Under this proposal, aerosol coating manufacturers would have an additional five months, until June 1, 2002, to comply with the “general coating” category limits. At that time 7.9 tpd ozone reductions would be achieved. A smaller negative impact would continue for another seven months (1.7 tpd ozone shortfall), until January 1, 2003, when the remaining 29 “specialty coating” categories would comply. However, we believe this additional time is warranted to allow manufacturers the needed time to reformulate consumer-acceptable products. We also believe that the need to ensure viable products are available in the marketplace overrides the short-term negative environmental impact.

Reductions in particulate matter with aerodynamic diameters less than 2.5 micrometers are also anticipated to be similar to those expected from implementation of the mass-based VOC limits. Potential impacts on global warming, stratospheric ozone depletion, and water quality and landfill loading were also considered. No significant negative impacts were identified. We also examined the possibility of increased use of toxics. While we did find that there was a slight chance for an adverse impact due to the use of the toxic air contaminant, methylene chloride, we are proposing a provision that should eliminate this potential impact. The environmental analysis in Sections D, and E below discusses the impacts associated with the proposed rulemaking and provides the basis for our findings.

B. Legal Requirements Applicable to the Analysis

The California Environmental Quality Act (CEQA) and ARB policy require an analysis to determine the potential adverse environmental impacts of proposed regulations. Because the ARB's program involving the adoption of regulations has been certified by the Secretary of Resources (Public Resources Code, Section 21080.5, Exemption of specified regulatory programs), the CEQA environmental analysis requirements are allowed to be included in the ARB Staff Report or Technical Support Document in lieu of preparing an environmental impact report or negative declaration. In addition, the ARB will respond in writing to all significant environmental points raised by the public during the public review period or at the Board hearing. These responses will be contained in the Final Statement of Reasons for the proposed rulemaking for aerosol coating products.

Public Resources Code Section 21159 (Analysis of methods of compliance) requires that the environmental impact analysis conducted by ARB include the following: (1) an analysis of the reasonably foreseeable environmental impacts of the methods of compliance, (2) an analysis of reasonably foreseeable feasible mitigation measures, and (3) an analysis of reasonably foreseeable alternative means of compliance with the rule or regulation.

Our analysis of the reasonably foreseeable environmental impacts of the methods of compliance is presented in Sections D and E below. Except for a slight chance for an adverse impact due to the use of the toxic air contaminant, methylene chloride, in the proposed amendments, no significant adverse environmental impacts associated with the proposed rulemaking were identified. While there is a potential impact from the use of methylene chloride, we are proposing a provision that should eliminate this potential impact. We will also continue to monitor implementation of the amendments to ensure that no other adverse impacts occur in the future.

C. Compliance Alternatives

Alternative means to comply with the Aerosol Coatings Regulation, which limits total VOC content on a weight basis have been studied. To provide alternatives to these mass-based VOC limits, staff has been working with the consumer products industry since 1995 to develop alternative methods of compliance that could achieve equivalent air quality benefits, yet provide compliance flexibility at potentially less cost. As a result, an optional reactivity-based VOC regulatory program was initiated. However, during development of the voluntary reactivity regulation proposal, staff and several representatives of the aerosol coating industry came to the conclusion that it was preferable to pursue replacing the VOC content limits with mandatory reactivity-based VOC limits. In reaching this conclusion, the industry representatives indicated that reactivity-based VOC limits may provide more flexibility, while efficiently reducing the ozone formed from aerosol coatings. At the same time, the analysis conducted by ARB staff indicated that it would be difficult to preserve the ozone reduction associated with the mass-based regulation using a combined mass and reactivity based regulatory program. The analysis is detailed as follows.

Reactivity control approaches have the potential to be more cost-effective in protecting air quality because the ozone formation potential of each chemical is evaluated. In theory, a combined mass and reactivity (i.e. voluntary reactivity) based control approach would achieve the same air quality benefit as if there was only a mass-based control measure. However, a hidden problem in the optional reactivity-based regulation is that a product using the mass-based versus reactivity-based reformulation paths may not yield the same ozone reduction, and any lesser ozone reduction from the reactivity control would constitute a shortfall. In addition, it is difficult to predict the preference of a manufacturer to choose reactivity over the mass-based compliance path (or vice versa). Any shortfall potentially created could only be remedied by imposing more stringent reactivity limits for the remaining products. Given this unpredictability, creating a usable voluntary reactivity program while preserving the air quality benefit may not be possible. This concept is further illustrated in the Figure below.

Figure X-1 shows the impact of the reactivity compliance option to the target ozone reduction commitment for the clear coating category. Depending on the reformulation pathway, as well as a manufacturer’s choice of reformulation path, a combined reactivity-based and mass-based reformulation strategy could yield either a negative or positive impact on ozone reductions. While the actual ozone reduction loss or gain can not be known for certain, their upper limits can be estimated. The maximum percent ozone reduction loss (PORL) is defined as the sum of all potential ozone reduction losses divided by the target ozone reduction commitment based on the mass limit. In other words, if the amount of ozone reduction obtained from the mass-limit is higher than that of the reactivity limit, the difference in ozone reduction from a product would be considered as a loss (i.e. reactivity-based control is less efficient than that of the mass). The sum of all potential ozone reduction losses would be considered as the worst case scenario if the less efficient path is chosen whenever possible. Similarly, the maximum percent ozone reduction gain (PORG) can be defined as the sum of all potential ozone reduction gains divided by the mass-based target ozone reduction commitment. The percent “missing” ozone reduction (PMOR) is calculated based on the amount of ozone reduction that would have been achieved from the reformulation of non-complying products if there was no reactivity compliance option available. As can be seen in Figure X-1, at a particular reactivity limit, there could be up to 40 percent loss of total target ozone reduction. While stringent reactivity limits could be used to minimize the potential ozone reduction loss, the increasing maximum percent

FIGURE X-1 IMPACT OF REACTIVITY COMPLIANCE OPTION ON TARGET OZONE REDUCTION ozone reduction gain suggests that significant technological advances would be required to achieve these reactivity limits.

Based on the aforementioned reasons and with agreement from the majority of the aerosol coating industry, staff began working on a proposal for mandatory reactivity-based VOC limits. The result of those efforts is the subject of this rulemaking. While these reactivity limits would become mandatory, our analysis shows that compliance with the reactivity limits provides more flexibility, at less cost, than the mass-based limits. In addition, as detailed in Chapter IV, the methodology for deriving the reactivity limit is designed to preserve the ozone reduction associated with the mass-based regulation, and no assumptions on the type of ingredients or organic compounds that would be used to reformulate are made in the limit calculation. Therefore, we believe that the proposed amendments will preserve the air quality benefit to be achieved with the mass-based VOC limits.

Staff does note that one former compliance alternative would no longer be available to aerosol coating manufacturers, the Alternative Control Plan (ACP) Regulation. The ACP Regulation, Title 17, California Code of Regulations, Sections 94540-94555, is a voluntary market-based regulation that utilizes the concept of an aggregate emission cap, or "bubble." Until such time as the ACP is amended to allow emissions averaging on a reactivity-weighted basis, manufacturers would no longer be able to comply by means of the ACP. We also note, however, that no aerosol coating manufacturer is currently using the ACP to comply.

At this time, other than maintaining the mass-based VOC limits in the current regulation, ARB staff is unaware of any other scenarios that would serve as an alternative to the proposed amendments to the aerosol coatings regulation.

D. Potential Environmental Impacts

1. Impact on Ground-Level Ozone

Overall, the proposed amendment to the Aerosol Coatings Regulation, upon full implementation, will have neither a positive nor adverse environmental impact because staff is proposing to replace existing VOC content limits for aerosol coatings with reactivity-based VOC limits that provide an equivalent air quality benefit. Therefore, the proposal would achieve the same ozone reduction benefit as would have been associated with implementation of the mass-based VOC limits. The mass-based VOC limits adopted by the Board on November 19, 1998, would reduce VOC emissions by about 3.1 tpd. These proposed amendments would reduce the ozone formed from aerosol coating emissions by about 9.6 tpd.

However, to allow manufacturers the needed time to reformulate to meet the reactivity limits, there will be a short-term negative environmental impact. We are proposing that the limits for the general coating categories become effective June 1, 2002, a five month delay. On

June 1, 2002, 7.9 tpd of ozone reductions, or 82 percent of the overall reduction commitment would be achieved. A smaller negative impact (1.7 tpd ozone shortfall) would exist for an additional seven months, until January 1, 2003, when the remaining specialty categories would comply. However, we believe there are overriding considerations to the short-term negative impact. The intent of the proposed amendments is to ensure that commercial and technological feasible aerosol coatings are available such that basic market demand can be met. Without providing additional time, many manufacturers would experience adverse economic impacts and disruption of the aerosol coatings market. The postponement of the effective date will help ensure that manufacturers will be able to develop consumer-accepted, cost-effective products. We believe this consideration overrides the short-term adverse impacts that may occur as a result of these amendments.

Enhanced tropospheric ozone formation involves the interaction between VOCs and oxides of nitrogen (NO_x) in the presence of sunlight. It is now known that VOCs vary dramatically in their ability to form ozone (Carter, 1994). Thus the most effective ozone control strategy would be to limit the use of VOCs that are likely to produce the most ozone once emitted. Currently, aerosol coating products are required to reduce their mass of VOC emissions. For this control approach, it is possible that, during product reformulation, more reactive solvents (i.e. solvents that form more ozone on per gram basis) could be used, thus reducing the air quality benefit. The amendments proposed in this rulemaking would require manufacturers to reduce their product's ozone formation potential (i.e. reactivity). Reducing a product's reactivity would likely require use of compounds that have lower potentials to produce ozone when emitted from aerosol coatings. Therefore, reformulating to meet the reactivity limits should ensure ozone reductions are achieved aerosol coating products are reformulated.

2. Impact on Particulate Matter (Aerosols)

Overall, our analysis found that the proposed rulemaking would not have significant environmental impact on formation of particulate matter (PM). However, as detailed below, in the absence of secondary organic aerosol (SOA) formation data of certain ingredients, and the uncertainty associated with the reformulation approaches the manufacturers of aerosol coatings will use, it is difficult to determine definitively the full impacts that the implementation of the proposed reactivity limits would have on ambient PM concentrations. Hence, we will continue to monitor implementation of the regulation and reassess the impacts as more data become available.

Fine PM is prevalent in the urban atmosphere (see, for example, Pandis *et al.*, 1992), and ambient PM, especially those with aerodynamic diameters less than two and a half micrometers ($PM_{2.5}$) is known to have negative impacts on human health (Schwartz *et al.*,1996; Moolgavkar and Luebeck, 1996). Like ozone, PM can be formed via atmospheric oxidation of organic compounds (Finlayson-Pitts and Pitts, 2000). According to the results from several recent studies, photochemically derived PM (i.e. secondary organic aerosol) could contribute up to 80 percent of the fine particle burden observed in severe air pollution episodes (Pandis *et al.*, 1992; Turpin and Huntzicker, 1991; 1995). In urban PM, these secondary organic aerosols could produce effects such as visibility degradation and toxicity (see, for example Aktinson, *et al.*, 1994). Hence, it is necessary to assess the likelihood of a potential adverse impact resulting from implementation of the proposed rulemaking.

In the past decade, significant advances have been made in the theoretical and the experimental studies of the formation of secondary organic aerosols (SOA) (Pankow, 1994a, 1994b; Odum *et al.*, 1996; Seinfeld and Pandis,1998; Harner and Bildeman, 1998; Leach, *et al.*, 1999; Kleindienst, *et al.*, 1999; Yu *et al.*, 1999). In addition, modeling techniques to determine the amount of ozone as well as the amount of aerosol formed from a VOC have been established (Bowman *et al.*, 1995), and the concept similar to maximum incremental reactivity is being applied to quantitatively assess the aerosol formation potential of a VOC (i.e. incremental aerosol reactivity) (Griffin *et al.*, 1999). Based on the results of these studies, we now know that there is a mechanistic linkage between the ozone formation and SOA formation of a VOC. Because of this relationship, the proposed amendment may also affect the SOA formation potential of aerosol coating products. The analysis is detailed below.

Although most organic compounds contribute to ozone formation (Carter, 2000), secondary organic aerosol is usually formed from photooxidation of organic compounds with carbon numbers equal to seven or more (Grosjean and Seinfeld, 1989; Wang *et al.*, 1992). This observation is consistent with the fact that both reactivity and product's volatility need to be considered for evaluating the aerosol formation potential of a VOC (Odum *et al.*, 1997). In other words, only chemicals which react fast enough in the atmosphere will generate sufficient amounts of low volatility products for forming aerosols. Based on our 1997 Aerosol Coating Survey data, except hydrocarbon solvents and substituted aromatics, the majority of the compounds used (i.e. ~ 60-70 percent of the inventory) are either "solids" (for example, alkyd resin) or have less than seven carbon atoms in the molecule (ARB, 1998b). Accordingly, substituting less reactive compounds with less than seven carbon atoms for more reactive compounds is likely to have a negligible impact on SOA formation of aerosol coating products. Hence, our discussion of SOA potential of aerosol coating products will focus on how the proposed amendments may potentially affect aromatics and hydrocarbon solvents content. In addition, our assumption is that manufacturers would most likely target reductions of the most reactive VOCs to meet the reactivity limits.

Aerosol formation potential of aromatics has been studied extensively (Izumi and Fukuyama, 1990; Odum *et al.*, 1996; Odum *et al.*, 1997). Toluene, xylenes, trimethylbenzenes and other alkyl-substituted benzenes are commonly found in formulations of aerosol coating products (ARB, 1998b). Using the gas-to-particle partition theory of Pankow (1994a, 1994b), experimental studies of Odum *et al.* (1997) indicated that aerosol yields of toluene and ethylbenzene are higher than those of xylenes and trimethylbenzenes. To comply with the proposed reactivity limits, aerosol manufacturers would most likely substitute lower reactive VOCs for the higher reactive VOCs in their products. This would involve either substituting a less reactive aromatic for a more reactive one, and/or replacing the aromatics by non-aromatic species. The reactivity ranking of aromatics is: toluene < xylenes < trimethylbenzenes

(Carter, 2000). Hence, the replacement of xylenes by toluene would have a negative impact on PM formation (i.e. enhancement of PM formation potential of the aerosol coating products) as toluene has a higher SOA formation potential of xylenes. However, we believe that the xylenes-to-toluene substitution is a less desirable reformulation option because toluene is classified under a list of carcinogen and reproductive toxicants of the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). On the other hand, if product reformulation involves the substitution of an aromatic by a non-aromatic species, the SOA formation potential of the product is likely to be reduced. This is because the aerosol yield of aromatics are known to be the highest among all chemical classes (i.e. alkanes, cycloalkanes, and alkenes) (Grosjean, 1992).

As detailed in Chapter IV, hydrocarbon solvent mixtures used in manufacturing aerosol coatings can be classified into two major groups: aliphatic and aromatic. Aromatic solvents contain 100 percent of aromatic compounds, and they have higher potentials to form ozone as well as SOA (see above). Hence, by reducing the aromatic solvent content, both the reactivity and SOA formation potential of an aerosol coating product would be reduced. In aliphatic hydrocarbon solvents, the carbon number distribution of solvent ingredients varies from five to sixteen. In addition to alkanes (i.e. n-alkanes and isoalkanes) and cycloalkanes, these solvents may have up to 22 percent of aromatic content (ASTM, 1995). Based on the hydrocarbon solvent classification scheme developed (see Chapter IV), at a given average boiling range, the reactivity of aromatic containing hydrocarbon solvents is higher than that of their aliphatic counterparts (Kwok *et al.*, 2000). In addition, aliphatic hydrocarbon solvents that consist of high molecular weight ingredients (as indicated by their relatively high average boiling range) are less reactive than the those with "lighter" alkanes and cycloalkanes. Because most potent aerosol precursors are aromatic hydrocarbons (Grosjean, 1992), aromatic containing hydrocarbon solvents are expected to have a higher SOA formation potential. Therefore, a product reformulated by using solvent with low and/or no aromatic content would likely decrease its aerosol formation yield. However, if the product's reactivity is reduced by replacing a "light" solvent (i.e. containing mainly light weight ingredients) by the heavier one, SOA formation potential of the product may increase. This expectation is consistent with the fact that higher molecular weight alkanes and cycloalkanes are important aerosol forming precursors (Grosjean, 1992). We will continue to monitor implementation of the regulation and reassess the impacts as more data become available.

3. Impact on Global Warming

We do not expect the proposed rulemaking to have an adverse impact on global warming. The theory of global warming is based on the premise that emissions of anthropogenic pollutants, together with other naturally-occurring gases, absorb infrared radiation in the atmosphere, thereby increasing the overall average global temperature (U.S. EPA, 1995a). To comply with the reactivity limits proposed for aerosol coatings, manufacturers may choose to replace or blend the typical hydrocarbon propellants. Options for propellant replacement include using hydrofluorocarbon (HFC) compounds such as HFC-152a. Because HFC-152a has a very low potential to form ozone, it may be used to reduce the overall reactivity of an aerosol coating product. However, we do not believe that this is a likely reformulation path. Current hydrocarbon propellants used in aerosol coatings are only moderately reactive. Hence, replacement of hydrocarbon propellant with HFC-152a is not necessarily an efficient way to reduce a product's reactivity. Nevertheless, if HFC-152a is chosen to replace all or a portion of the hydrocarbon propellant there may be a slight impact on global warming. However, we have determined that even if all aerosol coating products were reformulated to use HFC-152a, the impact on global warming would be negligible.

Hydrofluorocarbons are non-chlorinated methane and ethane derivatives, which contain hydrogen and fluorine. The most likely HFC to be chosen to replace hydrocarbon propellants is HFC-152a (Applegate, 1995). Hydrofluorocarbons absorb infrared energy and therefore can contribute to global warming (Wallington, 1994). The global warming potential (GWP) of HFC-152a is 50 times greater than hydrocarbon propellants and 150 times greater than carbon dioxide. Because HFC-152a is most likely to be considered as a propellant replacement, our analysis is based on its use (Applegate, 1995; Du Pont, 1992). Based on the ARB 1997 Aerosol Coatings Survey (ARB, 1998b), about 10 tpd of hydrocarbon propellant is emitted each day. Therefore, the emissions of HFC-152a would increase by no more than 10.5 tons per day. This small increase in HFC-152a emissions would have a negligible impact on global warming.

As mentioned above, carbon dioxide is the primary man-made greenhouse gas of concern. However, the ARB 1997 Aerosol Coatings Survey data indicate that, currently, carbon dioxide is not used in these products even though it is used to some degree as a replacement propellant in other consumer products (ARB, 1998b). Although carbon dioxide is non-reactive, we do not expect it to be used in aerosol coatings. Aerosol products using CO_2 as propellant have rather coarse spray patterns (Sanders, 1987), which is not likely to be acceptable for aerosol coating product applications. Therefore, its use in aerosol coating products due to the proposed amendments would have little or no impact on global warming. In addition, most of the carbon dioxide that is used as propellant is a recycled by-product of existing processes and therefore would not contribute to the net increase in global warming (ARB, 1995b).

4. Impact on Stratospheric Ozone Depletion

The ARB staff has determined that the proposed rulemaking would have minimal, if any, impact on stratospheric ozone depletion. The stratospheric ozone layer shields the earth from harmful ultraviolet (UV) radiation (U.S. EPA, 1995b). Depletion of the earth's ozone layer allows a higher penetration of UV radiation to the earth's surface (U.S. EPA, 1995b). The increase in UV radiation penetration leads to a greater incidence of skin cancer, cataracts, and impaired immune systems (UNEP, 1996). Reduced crop yields and diminished ocean productivity are also anticipated (U.S. EPA, 1995b; UNEP, 1996). Because the chemical reactions which form tropospheric ozone are driven by UV radiation, it is conceivable that a reduction in stratospheric ozone may also result in an increase in the formation of photochemical smog because of the increased levels of UV radiation on the earth's surface (ARB, 1995a).

Compounds such as CFCs and halocarbons (e.g. halons, 1,1,1-trichloroethane (TCA), and carbon tetrachloride) cause the destruction of the stratospheric ozone (U.S. EPA, 1995b). These compounds are generally very stable and do not degrade appreciably in the troposphere (Wallington, 1994; U.S. EPA, 1995b). Instead, they gradually diffuse into the stratosphere where they release chlorine or bromine atoms. Bromine atoms released from halons are even more reactive than chlorine atoms and therefore have a greater affect on the degradation of the stratospheric ozone layer (U.S. EPA, 1995b).

The regulation currently contains a provision that limits the amount of ozone-depleting compounds used in aerosol coatings to ensure that manufacturers do not switch to them when they are reformulating aerosol coating products to lower reactivity. However, the provision does allow any ozone-depleting compound to be present as an impurity in an aerosol coating in a combined amount with perchloroethylene equal to or less than 0.01 percent, by weight, of the product.

Because it lacks chlorine, HFC-152a probably contributes only slightly to ozone depletion (Wallington, 1994). As evidence of this, HFC-152a is not included on the list of compounds that are scheduled for phase-out under the federal Clean Air Act requirements. If manufacturers choose HFC-152a as a replacement for hydrocarbon propellants, no additional decrease in stratospheric ozone is expected (ARB, 1995b; Daly, 1993). However, as previously stated, HFC-152a is not currently used and we do not expect the use of HFC-152a to be the reformulation option of choice.

5. Impacts on Water Quality and Solid Waste Disposal

We do not expect an adverse impact on water quality or solid waste disposal from the proposed rulemaking. We do not expect consumers to convert to the use of brush-on paints because the proposed rulemaking allows compliance flexibility for a variety of reformulations to be pursued in each aerosol coating category. Without the need to convert to brush-on paints there would be no impact resulting from the use of cleanup equipment or products such as brushes, paint thinner, mineral spirits, various containers, water, and water disposal. Because of this, we do not anticipate any changes in packaging or disposal of aerosol coating products due to the proposed rulemaking.

E. Other Potential Environmental Impacts

1. Impact from Use of Toxic Air Contaminants

Pursuant to Health and Safety Code Section 39650 et seq., the ARB is required to identify and control toxic air contaminants (TACs). The Health and Safety Code defines a TAC as "... an air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a hazard to human health." A number of chemicals currently used in aerosol coating product formulations have been identified as TACs. In accordance with the California Environmental Quality Act, we are required to mitigate potential adverse environmental impacts that may occur as a result of our regulations. An increased use in TACs in aerosol coating products could lead to a potential adverse environmental impact.

Solvents commonly used in aerosol coating products that have been identified as TACs, include xylene, toluene and methylene chloride. Because of the potential for increased use of these TACs, we have performed an analysis to determine if there would be any potential health impacts from an increased use of them. We also performed a health risk assessment on emissions of methylene chloride and determined that a provision to restrict its use is necessary to avoid any potential adverse impact.

a. Xylene and Toluene

Physical Characteristics (Xylene)

Mixed xylenes are colorless liquids that are insoluble in water and miscible with alcohol, ether, and many other organic solvents. The commercial mixed xylenes are composed of the three isomers, with the meta-, and para-isomers predominating. For our particular purposes, the isomers may be separated (ARB, 1997a). Xylenes are widely used as solvents in numerous aerosol coatings products.

Health Effects (Xylene)

Exposure to xylene vapors may cause eye, nose, throat, and respiratory tract irritation. It is a central nervous system depressant. Acute exposure may cause gastrointestinal effects such as vomiting, and gastric irritation. Exposure may also injure the kidneys. The toxicological endpoints for acute toxicity are the eye and respiratory irritation, whereas the toxicological endpoints for chronic toxicity are the nervous system and respiratory system (OEHHA, 1999a; 2000).

Physical Characteristics (Toluene)

Toluene is a colorless, flammable, non-corrosive liquid with a benzene-like odor. It is insoluble in water and soluble in acetone, absolute alcohol, ether, chloroform, benzene, petroleum ether, glacial acetic acid, and carbon disulfide. As a solvent, toluene is used for paints, coatings, gums, and resins (ARB, 1997a).

Health Effects (Toluene)

Exposure to toluene may cause mild eye and respiratory tract irritation. The central nervous system is the primary target organ for chronic and acute exposures. It is a central nervous system depressant. At exposures to high concentrations, liver and kidney injury may occur. Chronic exposures to toluene may also cause reproductive/developmental effects (OEHHA, 1999a; 2000).

Potential Impact

To comply with the proposed limits, manufacturers will need to reduce the overall reactivity of their product formulations. To do this, we believe the most efficient way to reduce a product's reactivity is to reduce the amount of the most highly reactive VOCs which include xylene, toluene, and other aromatic solvents. Therefore, we do not expect manufacturers would increase--and are much more likely to decrease--the amount of these higher reactive compounds in their reformulated products. We conclude that compliance with the proposed reactivity limits will have a dual benefit: efficient ozone reductions and a reduction in use of TACs. For these reasons we expect an overall positive environmental impact. Hence no further mitigation measure to limit the use of xylene, toluene, or other aromatics is necessary.

b. Methylene Chloride

Methylene chloride is used in a limited number of aerosol coating products. However, when it is used, the amount can be quite high (up to 50 percent). Some of its relevant properties are that it is inexpensive, it is a reasonably strong solvent, and it is a negligibly reactive compound. Because of its negligible reactivity, there is a potential for increased usage in products complying with the proposed regulation. The analysis as to why we believe a provision to restrict its use is warranted is described below with further detail in Appendix G. The proposed amendments should not result in any increased use of this compound.

Physical Characteristics

Methylene chloride, also known as dichloromethane, is a colorless, volatile liquid that is currently used in some aerosol coating products. It is a chlorinated hydrocarbon solvent that is non-flammable. It is slightly soluble in water and miscible with alcohol, ether, and dimethylformamide (Merck, 1989). In the absence of moisture, at ordinary temperatures, methylene chloride is relatively stable. In dry air, it decomposes at temperatures exceeding 120 degrees Celsius. It evaporates relatively quickly from water (ARB, 1997a).

Health Effects

Methylene chloride is irritating to the eyes, respiratory tract, and skin. Methylene chloride is also a central nervous system depressant, and exposure may result in decreased visual and auditory functions, and may also cause headache, nausea, or vomiting. At high exposures, methylene chloride can cause pulmonary edema, cardiac arrhythmias, and loss of consciousness. Chronic exposure can lead to bone marrow, hepatic, and renal toxicity (ARB, 1997a). Methylene chloride also has been shown to increase tumor rates in the mouse liver and lung and the rat mammary gland at concentrations ranging from 1,000 to 4,000 parts per million (ppm) (ARB, 1997a). As a result of these studies, methylene chloride was declared a B2 substance, a probable human carcinogen, by the U.S. EPA (U.S. EPA, 1994). Furthermore, the International Agency for Research on Cancer has classified methylene chloride in Group 2B; which lists possible human carcinogens based on limited animal evidence (ARB, 1997d).

Based on available data, the Occupational Safety and Health Administration (OSHA) first established a standard for methylene chloride exposure in the workplace in 1970. The limit was recently lowered to 25 ppm for an 8-hour time-weighted average (TWA) (OSHA, 1997). The State of California Occupational Safety and Health Administration has also established 25 ppm for an 8-hour TWA as a standard for exposure to methylene chloride in the workplace in California (California Code of Regulations (CCR), 1997). The State of California under the Assembly Bill 1807 TAC Identification and Control Program and Proposition 65 has listed methylene chloride as a carcinogen and as a TAC (ARB, 1989; CCR, 1996). The inhalation potency factor that has been used as a basis for regulatory action in California is 1×10^{-6} (microgram per cubic meter)$^{-1}$ $(\mu g/m^3)^{-1}$ (OEHHA, 1999b). In other words, the potential excess cancer risk for a person exposed over a lifetime to 1 microgram per cubic meter of methylene chloride is estimated to be no greater than one in one million.

Methylene Chloride Use in Aerosol Coating Products

In 1998, the ARB conducted a survey of aerosol coating products sold in California in 1997. The information requested included product formulation data and sales data and was used to estimate VOC emissions from spray paints in California. The survey results provide us with the information necessary to determine, among other things, pounds of aerosol coatings sold which contain methylene chloride, weight percentage of methylene chloride in these products, and total methylene chloride emissions for each aerosol coating category. The survey data show that approximately 38 tons per day of aerosol coating products were sold. Of this amount, 1200 pounds per day of aerosol coating products containing methylene chloride were sold. This results in approximately 380 pounds per day of methylene chloride emissions, which represents 0.5 percent of the inventory (ARB, 1998b).

Methylene chloride was reported in 10 of the 35 categories. Table X-1 presents the categories containing methylene chloride, and the methylene chloride emissions for each category. According to these data, automotive bumper and trim products are the second largest contributor to methylene chloride emissions, accounting for 44 percent of total methylene chloride emissions. (The largest contributor was the total emissions from five other categories.) The lowest methylene chloride concentration reported was less than 1 percent and the highest was 52 percent, with an average methylene chloride concentration of 24 percent (ARB, 1998b).

TABLE X-1
METHYLENE CHLORIDE EMISSIONS PER CATEGORY

Paint Category	1997 Methylene Chloride Emissions (pounds/year) x 1000	Percent of Total Methylene Chloride Emissions per Category
Clear coatings	9.7	7
Metallic coatings	2.1	2
Nonflat paint products	1.8	1
Automotive bumper & trim products	60.1	44
Other categories	63.9	46
TOTAL	**137.6**	**100%**

Summary of Potential Health Effects

To determine if an adverse impact would result if methylene chloride use would increase we conducted a health risk assessment using the above data. The complete analysis is contained in Appendix G of this report. In summary, the results of the analysis, as shown in Table X-2, shows that a worst-case scenario for an aerosol coating product containing 50 percent methylene chloride does not pose a significant risk for acute and chronic noncancer effects. However, the risk assessment analysis shows that there is a potential to increase the cancer risk if there is an increased use of an aerosol coating product containing methylene chloride, or if there is an increase in the content of methylene chloride in the aerosol coating product. Therefore, because of the potential for an increased cancer risk and because methylene chloride is already listed as a TAC, in the aerosol coating regulation we are proposing a provision to restrict the amount of methylene chloride that can be used in an aerosol coating product.

TABLE X-2
RESULTS OF SCREEN3 MODELING (MAXIMUM EXPOSED INDIVIDUAL (MEI) AT 20 METERS)

Health Criteria	Worst-Case Scenario
Methylene Chloride Emission Rate (lb/day)	0.81
Max. 1-hour Concentration (*u*g/m^3)	169.1
Max. Annual Average Concentration (*u*g/m^3)	3.33
Individual Cancer Risk (per million)	3.33
Acute Hazard Index	0.012
Chronic Hazard Index	0.33

Proposed Provision to Limit the Use of Methylene Chloride

In the existing aerosol coating regulation, methylene chloride use is restricted by requiring that the weight percent of methylene chloride in an aerosol coating product be added to the total VOC content to determine compliance with the mass-based VOC limits. For the proposed reactivity limits, however, when calculating the total reactivity of a product this type of provision does not provide the same restriction. This is because methylene chloride is negligibly reactive and hence has a low MIR value. Methylene chloride is a strong solvent that could be used as a replacement for more reactive solvents. From the results of the analysis conducted in Appendix G, we conclude that there is a potential for an increased risk in cancer.

Therefore, to limit methylene chloride use we are proposing a “no new use” provision. As proposed, if an existing product already uses methylene chloride, no additional methylene chloride could be added when the product is reformulated. The baseline would be established based on 1997 sales data. Any product not currently formulated with methylene chloride, could not reformulate using methylene chloride. This proposal is similar to a provision in the existing aerosol coating regulation, which restricts new uses of perchloroethylene and ozone-depleting substances. This provision would become effective on the same date as the limits become effective. With this provision we can ensure that emissions of methylene chloride from aerosol coatings will not increase.

F. Impacts on the State Implementation Plan for Ozone

1. Background

The Federal Clean Air Act amendments of 1990 require an ozone attainment plan from every area unable to meet the national ambient air quality standard for ozone. To assist California air districts to meet the challenge of attaining the ozone standard, the ARB and air districts developed the California State Implementation Plan (SIP) for Ozone (ARB, 1994b). State law provides the legal authority to ARB to develop regulations affecting a variety of mobile sources, fuels, and consumer products. The regulations that are already adopted, and measures proposed for adoption constitute the ARB's portion of the SIP. The SIP is California's plan to attain and maintain the national ambient air quality standard for ozone. The SIP was submitted to the U.S. EPA on November 15, 1994, and the consumer products element was formally approved on August 21, 1995.

The consumer products element of the SIP is comprised of near-term, mid-term, and long-term measures. The current consumer products element of the SIP requires an overall 85 percent reduction in VOC emissions relative to the 1990 emissions baseline by 2010. The SIP commitment for aerosol paints was a 60 percent reduction from the 1989 baseline by 2005 (ARB, 1994c). However, when the Board adopted the amendments to the Aerosol Coatings Regulation on November 19, 1998, it was determined that a 60 percent reduction in VOC emissions from aerosol coatings was not currently technologically and commercially feasible. Therefore, higher VOC limits were adopted for twelve product categories, and more stringent VOC limits were adopted for eleven product categories. The effective date was also extended from December 31, 1999, to January 1, 2002, to provide adequate time for manufacturers to reformulate their products. In the proposed amendments to the Aerosol Coatings Regulation, reactivity limits would replace the 2002 VOC limits.

2. Summary of Findings

Upon full implementation, in terms of emission reduction commitments, the proposed amendments do not affect our SIP commitment. This is because the reactivity limits are designed to provide the same ozone reduction benefit as would be associated with the current mass-based VOC limits. To do this, the ton per day VOC reduction is converted to an equivalent ozone reduction using the MIR scale. A reactivity limit is then set that achieves that ozone reduction target. This should ensure that reductions are preserved.

However, delaying the compliance dates for compliance with the reactivity-based limits from January 1, 2002 to June 1, 2002 and January 1, 2003, for general coatings and specialty coatings, respectively, will result in a short-term shortfall.

A short-term shortfall of 9.6 tpd of ozone reductions will occur for 5 months. By requiring the general coating categories to comply by June 1, 2002, 7.9 tpd, or 82 percent, of the ozone reductions will be achieved concurrent with the 2002 ozone season. For an additional seven months there will be a shortfall of 1.7 tpd ozone. By achieving 82 percent of the reductions near the beginning of the ozone season we believe the air quality impacts of delaying the effective dates of the reactivity limits will be minimal.

We believe the extension of the effective date is necessary to prevent disruptions in the aerosol coating market place and to minimize the possibility of an economic hardship for aerosol coating manufacturers. This proposal also ensures that efficacious products will continue to be available to the consumer in all 35 categories. We believe that these considerations override the short-term air quality disbenefit.

The proposed amendments satisfy our SIP commitment to consider reactivity when developing control strategies for consumer products (including aerosol coatings). We included reactivity as a potential control strategy in recognition that the 85 percent overall VOC emission reduction would be difficult to achieve on a mass-based approach alone. Since 1995 the ARB staff has been working with the affected consumer products stakeholders on approaches to include reactivity within our regulations. This proposal for aerosol coatings is the result of that work. This proposal is intended to be a “pilot project” which provides a model for additional reactivity-based controls.

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