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Category: 28 – Exempt Solvents

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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SUBJECT: VOC Content of Coatings with Exempt Solvents

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Many States have exempted certain volatile organic compounds of negligible photochemical reactivity, such as 1,1,1-trichloroethane and methylene chloride from their VOC rules. Recently I was asked by a representative of a major supplier of such solvents how to calculate the reactive¹ VOC content of a coating that contained both VOC and exempt solvents.² I suggested that exempt solvents should be subtracted out from coatings just like water with the ultimate value of interest being the mass of VOC per unit volume of coating less exempt solvent and water.³ (Footnote 3). I provided several sample calculations. These examples are attached.

¹ The word reactive has been dropped after this point. All subsequent references to VOC in this memo and attachments mean reactive VOC.

² The term exempt solvent as used in this memo and attachments means those compounds of negligible photochemical reactivity that States are not required to control in their ozone SIPs. These compounds are listed in Attachment III.

³ Since coatings that contain exempt solvents such as 1,1,1-trichloroethane and methylene chloride are not likely to

Attachment I

Given the mass of VOC and mass of exempt solvent per unit volume of coating, determine the mass of VOC per unit volume of coating less exempt solvent.

Let x = mass of exempt solvent per unit volume of coating
 y = mass of VOC per unit volume of coating
 d = density of exempt solvent
 z = mass of VOC per unit volume of coating less exempt solvent

Then

$$z = \left(\frac{y}{1 - \frac{x}{d}} \right)$$

Example 1 - Each gallon of coating contains 3 pounds of VOC and 2 pounds of exempt solvent. The density of the exempt solvent is 11 pounds per gallon.

$$z = \left(\frac{3}{1 - \frac{2}{11}} \right) = 3.7 \text{ pounds of VOC per gallon of coating less exempt solvent}$$

Example 2 - Each liter of coating contains 0.2 kg of VOC and 0.4kg of exempt solvent. The density of the exempt solvent is 1.3 kg per liter.

$$z = \left(\frac{0.2}{1 - \frac{0.4}{1.3}} \right) = 0.27 \text{ kg of VOC per liter of coating less exempt solvent}$$

Note: The term VOC as used above means reactive VOC only.

Attachment II

A paint formulator wants to add both VOC and exempt solvent to 0.25 gallons of coating solids to make 1 gallon of coating. The coating must meet an emission limit of 3 pounds of VOC per gallon less exempt solvent. What is the maximum amount of VOC that can be added? How much exempt solvent should be added to make 1 gallon of coating?

The answer to this problem depends on the density of the VOC and exempt solvent. If we assume that the VOC density is 7.2 pounds per gallon, the exempt solvent density is 11 pounds per gallon, and let:

x = maximum pounds of VOC that can be added

Then:
$$3 = \left(\frac{x}{0.25 - \frac{x}{7.2}} \right)$$

$$x = 0.75 + \frac{x}{2.4}$$

$$0.58x = 0.75$$

$$x = 1.3 \text{ pounds VOC}$$

Since the VOC has density 7.2 pounds per gallon, this is equivalent to

$$\frac{1.3}{7.2} = 0.18 \text{ gallons VOC}$$

Finally, to make a full gallon of coating the formulator must still add:

$$1 - 0.25 - 0.18 = 1 - 0.43 = 0.57 \text{ gallon exempt solvent}$$

or

$$0.57 \times 11 = 6.3 \text{ pounds exempt solvent}$$

If VOC or exempt solvent with different densities were used the results would differ. The same calculation can be done using the appropriate solvent densities.

Note: The term VOC as used above means reactive VOC only.

Attachment III

Compounds of negligible photochemical reactivity that States are not required to control in their ozone SIPs of February 1981:

methane
ethane
1,1,1-trichloroethane (methyl chloroform)
trichlorotrifluoroethane
methylene chloride
trichlorofluoromethane
dichlorodifluoromethane
chlorodifluoromethane
trifluoromethane
dichlorotetrafluoroethane
chloropentafluoroethane

Federal Register References:

42FR35314 - July 8, 1977
44FR32042 - June 4, 1979
45FR32424 - May 16, 1980
45FR48941 - July 22, 1980