

# **HOW TO CALCULATE THE VOC CONTENT OF A MIXED COATING**

# WHY DO I NEED TO KNOW THE VOC CONTENT OF A MIXTURE?

To determine if a mixed coating, or mixture, is compliant with District Rules, one cannot simply take each component's VOC information and evaluate for individual compliance.

For example, a clear coating may have small amounts of catalyst and thinner mixed into it. The VOC content of this mixture is *not* the VOC content of the clear coating alone.

The **VOC of Mixture** is a number that accounts for the following in a mixed coating:

- The VOC content of each component in the coating
- The amount of each component in the coating

It is essentially a weighted average for the entire coating. If one component in the mixture has a higher VOC content, or is added in a higher quantity than the others, then that component more strongly influences the *VOC of Mixture*.

This will be discussed in further depth later in this guide.

# WHAT INFORMATION DO I NEED TO BEGIN WITH?

To calculate the VOC content of a mixed coating, you must first collect the following information for each component in the coating:

**VOC of Material** – sometimes labeled ‘Actual VOC’, ‘Total VOC’, or ‘Emitted VOC’

**VOC Regulatory** – sometimes labeled ‘VOC content less water and exempt compounds’, ‘VOC as applied’, or ‘VOC EPA Method 24’

**Percent Water and Exempt Compounds**

Collecting two of the three above items for each component is sufficient. This information will be used to calculate the VOC content of the mixed coating.


For help with finding this information, review [How to Find VOC Information for Coating Operations](#), a guidance document posted on the San Diego APCD website.

# WHAT INFORMATION DO I NEED TO BEGIN WITH?

You will also need to know how much of each component will go into the overall mixture, or the **Mix Ratio**. The Mix Ratio is usually found in a Technical Data Sheet (TDS) or on the product label.

Ex: 4 parts of topcoat, 2 parts of thinner, and 1 part catalyst has a mix ratio of 4:2:1

A mixture of 1 gallon of topcoat, ½ gallon of thinner, and 1 quart of catalyst has a mix ratio of 4:2:1




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**MIXING**



4 SpectraPrime® + 1 AS8 or US1-US4 + 1 H38

Reducer Selection Chart	
AS 8*	55 - 85 F
US1	55 - 75 F
US2	65 - 80 F
US3	70 - 85 F
US4	75 - 90 F

# AN EXAMPLE OF HOW TO CALCULATE VOC OF MIXTURE

The remainder of this guide will provide step-by-step instruction for a hypothetical mixture. These steps will result in the VOC of Mixture for this coating.

Our hypothetical coating will be composed of three components: a basecoat, a thinner, and a catalyst. All of their VOC information will be made-up.

## STEP 1: ORGANIZE THE COMPONENTS' VOC INFORMATION

Put all known information in one place for easy reference.

NAME	BASECOAT	THINNER	CATALYST
VOC of Material	3 lbs/gal	Unknown	4 lbs/gal
VOC Regulatory	Unknown	2 lbs/gal	5 lbs/gal
Volume Percentage of Water and Exempt Compounds	25 %	0 %	Unknown
Mix Ratio	4	2	1

## STEP 2: USE THE AVAILABLE VOC INFORMATION TO FIND UNKNOWN VALUES

It is possible to use two of the VOC information quantities (VOC of Material, VOC Regulatory, and Volume Percentage of Water and Exempt Compounds) to find the third unknown quantity.

To do so, one can use and rearrange the following equation:

$$VOC_R = \frac{VOC_M}{1-v} \quad (1)$$

where  $VOC_R$  is *VOC Regulatory*,  $VOC_M$  is *VOC of Material*, and  $v$  is *Volume Percentage of Water and Exempt Compounds*.

NAME	VARIABLE	BASECOAT	THINNER	CATALYST
VOC of Material	$VOC_M$	3 lbs/gal	Unknown	4 lbs/gal
VOC Regulatory	$VOC_R$	Unknown	2 lbs/gal	5 lbs/gal
Volume Percentage of Water and Exempt Compounds	$v$	25 %	0 %	Unknown
Mix Ratio	MR	4	2	1

NAME	VARIABLE	BASECOAT	THINNER	CATALYST
VOC of Material	$VOC_M$	3 lbs/gal	Unknown	4 lbs/gal
VOC Regulatory	$VOC_R$	<b>Unknown</b>	2 lbs/gal	5 lbs/gal
Volume Percentage of Water and Exempt Compounds	$v$	25 %	0 %	Unknown
Mix Ratio	MR	4	2	1

## STEP 2A: CALCULATING VOC REGULATORY ( $VOC_R$ )

Using Equation 1 with the data for the Basecoat in the above example table:

$$VOC_R = \frac{VOC_M}{1-v} = \frac{3 \text{ lbs/gal}}{1-25\%} = \frac{3 \text{ lbs/gal}}{1-0.25} = \frac{3 \text{ lbs/gal}}{0.75}$$

$$VOC_R = 4 \text{ lbs/gal}$$

NAME	VARIABLE	BASECOAT	THINNER	CATALYST
VOC of Material	$VOC_M$	3 lbs/gal	<b>Unknown</b>	4 lbs/gal
VOC Regulatory	$VOC_R$	<b>4 lbs/gal</b>	2 lbs/gal	5 lbs/gal
Volume Percentage of Water and Exempt Compounds	$v$	25 %	0 %	Unknown
Mix Ratio	MR	4	2	1

## STEP 2B: CALCULATING VOC OF MATERIAL ( $VOC_M$ )

Rearrange Equation 1 to solve for VOC of Material ( $VOC_M$ ) :

$$VOC_M = VOC_R \times (1 - v) \quad (2)$$

Using the data for the Thinner in the example table:

$$VOC_M = VOC_R \times (1 - v) = 2 \times (1 - 0 \%)$$

$$VOC_M = 2 \text{ lbs/gal}$$



NAME	VARIABLE	BASECOAT	THINNER	CATALYST
VOC of Material	$VOC_M$	3 lbs/gal	<b>2 lbs/gal</b>	4 lbs/gal
VOC Regulatory	$VOC_R$	<b>4 lbs/gal</b>	2 lbs/gal	5 lbs/gal
Volume Percentage of Water and Exempt Compounds	$v$	25 %	0 %	<b>Unknown</b>
Mix Ratio	MR	4	2	1

## STEP 2C: CALCULATING VOLUME PERCENTAGE OF WATER AND EXEMPT COMPOUNDS ( $v$ )

Rearrange Equation 2 to solve for Volume Percentage of Water and Exempt Compounds ( $v$ ):

$$v = 1 - \frac{VOC_M}{VOC_R} \quad (3)$$

Using the data for the Catalyst in the example table:

$$v = 1 - \frac{VOC_M}{VOC_R} = 1 - \frac{4 \frac{\text{lbs}}{\text{gal}}}{5 \frac{\text{lbs}}{\text{gal}}}$$

$$v = 0.2 = 20 \%$$

## STEP 2: USE THE AVAILABLE VOC INFORMATION TO FIND UNKNOWN VALUES

All of the values have been found. The *VOC of Mixture* can now be calculated. Be sure that all values have the same units (i.e. all values are in lbs/gal or in g/L, but not both).

The *VOC of Mixture* calculation will not use **VOC Regulatory ( $VOC_R$ )**. However, it may be useful to have this information on hand in your operation.

NAME	VARIABLE	BASECOAT	THINNER	CATALYST
VOC of Material	$VOC_M$	3 lbs/gal	<b>2 lbs/gal</b>	4 lbs/gal
VOC Regulatory	$VOC_R$	<b>4 lbs/gal</b>	2 lbs/gal	5 lbs/gal
Volume Percentage of Water and Exempt Compounds	$v$	25 %	0 %	<b>20%</b>
Mix Ratio	MR	4	2	1

### STEP 3: CALCULATE VOC OF MIXTURE ( $VOC_{MIX}$ )

The *VOC of Mixture* is most easily understood if you picture a bucket of the mixed coating. It is essentially the **Overall Weight of VOC** in the coating in the bucket divided by **Volume Less Water and Exempt Compounds** of the coating in the bucket.

**Overall Weight of VOC** – Each component in the bucket has a specific weight of VOC in it. This weight is calculated with each component's VOC of Material and Mix Ratio value:

$$\text{Basecoat - Weight of VOC in Component} = VOC_M \times MR = 3 \times 4 = \mathbf{12}$$

$$\text{Thinner - Weight of VOC in Component} = VOC_M \times MR = 2 \times 2 = \mathbf{4}$$

$$\text{Catalyst - Weight of VOC in Component} = VOC_M \times MR = 4 \times 1 = \mathbf{4}$$

The **Overall Weight of VOC** in the coating is simply the sum of the weights of each component

$$\text{Overall Weight of VOC} = \mathbf{12 + 4 + 4 = 20}$$

### STEP 3: CALCULATE VOC OF MIXTURE ( $VOC_{MIX}$ )

**Volume Less Water and Exempt Compounds** – There is a specific amount or volume of each component in the bucket. However, to calculate *VOC of Mixture*, the amount of volume of water and exempt compounds must be subtracted from each component.

$$\begin{aligned} \text{Basecoat - Volume Less Water and Exempt Compounds} &= (1 - v) \times MR = (1 - .25) \times 4 \\ &= \mathbf{3} \end{aligned}$$

$$\begin{aligned} \text{Thinner - Volume Less Water and Exempt Compounds} &= (1 - v) \times MR = (1 - 0) \times 2 \\ &= \mathbf{2} \end{aligned}$$

$$\begin{aligned} \text{Catalyst - Volume Less Water and Exempt Compounds} &= (1 - v) \times MR = (1 - .20) \times 1 \\ &= \mathbf{0.8} \end{aligned}$$

The **Volume Less Water and Exempt Compounds** of the entire coating is simply the sum of the *volume less water and exempt compounds* of each component

$$\text{Volume Less Water and Exempt Compounds} = \mathbf{3 + 2 + 0.8 = 5.8}$$

### STEP 3: CALCULATE VOC OF MIXTURE ( $VOC_{MIX}$ )

The **VOC of Mixture** is simply the **Overall Weight of VOC** divided by **Volume Less Water and Exempt Compounds**:

$$\begin{aligned} \text{VOC of Mixture} &= \frac{\text{Overall Weight of VOC}}{\text{Volume Less Water and Exempt Compounds}} \\ &= \frac{20}{5.8} \\ &= 3.45 \text{ lbs/gal} \end{aligned}$$

The *VOC of Mixture* value we just calculated can be used to check if a coating in your operation is compliant with District Rules. To learn how to do this, see [How to Determine if a Coating is Compliant](#), a guidance document on the San Diego APCD website.