Estimating Emissions Using the Mass Balance Method

Mecklenburg County
Land Use and Environmental Services Agency
Air Quality Division
Volatile Organic Compound (VOCs)?

What is a VOC?
- any compound that contains carbon (with some exceptions)

What is not a VOC?

40 CFR 51.100 Definitions
- carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate
- This includes any such organic compounds which have been determined to have negligible photochemical reactivity... see 40 CFR 51.100 Definitions for full list. (Attachment A)
Coatings consist of **liquids** and **solids**
- Solids are resins (binders), pigments
- Liquids are water, solvents, diluents, reducers, and thinners.

**How are VOCs Emitted?**

VOCs are emitted by evaporation
- Mixing
- Application
- Curing
- Agitation
- Cleaning
- Reclaiming
- Blending
- Packaging
- Refining
- Storage
- Distribution

Coatings

Solvents

Chemical

Fueling
Mass Balance Method

Things you need to know in order to calculate emissions.

• List of the Materials Used and/or Applied;

• Actual Annual Usage;

• VOC Content by weight% or lbs/gal; and

• Control Efficiency

Types of Coatings

• Primer
• Base Coats
• Top Coat
• Clear Coats
• Undercoats/Rust Proofers
• Paint Stripper
• Cleaners/Solvents
• Reducers/Activators
### TOTAL VOC EMISSIONS CALCULATIONS
#### Mass Balance Method

<table>
<thead>
<tr>
<th>Name of Material Used or Applied</th>
<th>Annual Usage</th>
<th>VOC Content</th>
<th>Uncontrolled Emissions</th>
<th>Control Efficiency (%)</th>
<th>Controlled Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual (Unit/yr)</td>
<td>Potential (Unit/yr)</td>
<td>Unit (lb or gal)</td>
<td>Actual</td>
<td>Potential</td>
</tr>
<tr>
<td>Reference for Equation &amp; Notes:</td>
<td>a, (1)</td>
<td>b, (1)</td>
<td>(2)</td>
<td>c</td>
<td>(2)</td>
</tr>
<tr>
<td>Example:</td>
<td>Material X</td>
<td>5,000</td>
<td>10,000</td>
<td>gal</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>Material Y</td>
<td>3,000</td>
<td>7,000</td>
<td>lb</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Total VOC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**EQUATIONS:**

- \( d = a \times c \) for lb/gal
- \( g = f / 2000 \)
- \( d = a \times c / 100 \) for wt. %
- \( i = d - (d \times (h/100)) \)
- \( e = d / 2000 \)
- \( j = i / 2000 \)
- \( f = b \times c \) for lb/gal
- \( k = f - (f \times (k/100)) \)
- \( f = b \times c / 100 \) for wt. %
- \( l = k / 2000 \)

**Notes:**

1. Please provide documentation for how actual usage & potential usage values were calculated.
2. If usage is reported in pounds, VOC content must be provided in % by weight. If usage is reported in gallons, VOC content must be reported in lb / gallon.
3. Please provide information about capture efficiency and documentation for how control efficiency was determined. Attach information about retention factors and/or any assumptions made where applicable.
# TECHNICAL DATA

<table>
<thead>
<tr>
<th>Reduction</th>
<th>Up to 13% with AIR10 or AIR20</th>
<th>Viscosity (sprayable) Gardner #2 Zahn Cup (ISO calibrated)</th>
<th>18-20 sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max VOC *AIR10 OR AIR20 do not increase VOC</td>
<td>3.32 lbs/gal</td>
<td>Recommended Dry Film Thickness</td>
<td>1.5-2.0 mils</td>
</tr>
<tr>
<td>Ready to Spray Volume Solids (White)</td>
<td>53 %</td>
<td>Physical Properties*</td>
<td></td>
</tr>
<tr>
<td>Coverage @ 1 mil dry (white)</td>
<td>850 FT²/gal</td>
<td>Salt Spray 250 hours</td>
<td>1/8&quot; creep</td>
</tr>
<tr>
<td>Pot Life</td>
<td>7 Days</td>
<td>Humidity 96 hours</td>
<td>No Effect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flexibility (1/8&quot; conical mandrel)</td>
<td>Pass</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AIP100,101,102,103</th>
<th>As Packaged</th>
<th>As Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lb/Gal</strong></td>
<td><strong>G/L</strong></td>
<td><strong>Lb/Gal</strong></td>
</tr>
<tr>
<td>Density</td>
<td>11.80</td>
<td>1414</td>
</tr>
<tr>
<td>Volatiles</td>
<td>28.2</td>
<td>47.2</td>
</tr>
<tr>
<td>Solids</td>
<td>71.8</td>
<td>52.8</td>
</tr>
<tr>
<td>Water</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Exempt Compounds</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Lb/Gal</strong></td>
<td><strong>G/L</strong></td>
<td><strong>Lb/Gal</strong></td>
</tr>
<tr>
<td>VOC Total</td>
<td>3.32</td>
<td>398</td>
</tr>
<tr>
<td>VOC Less Exempt</td>
<td>3.32</td>
<td>393</td>
</tr>
<tr>
<td>HAPs</td>
<td>2.25</td>
<td>0.269</td>
</tr>
</tbody>
</table>
Using Mass Balance Method

**Estimating Actual Emissions**

\[
\text{lb/gal: } (\text{actual usage gallons}) \times (\text{VOC content (lb/gal)}) = \text{VOC Emissions (lb/year)}
\]

\[
\% \text{ by wt: } (\text{actual usage pounds}) \times \left[ \frac{\text{VOC content (\% by wt)}}{100} \right] = \text{VOC Emission (lb/year)}
\]

**Estimating Potential Emissions:**

Need to determine the maximum potential usage based upon equipment usage capability

Max Usage per year: \([(\text{max hourly usage rate}) \times 8760] = \text{lb/yr or gal/yr}\)

---

(2) If usage is reported in pounds, VOC content must be provided in % by weight. If usage is reported in gallons, VOC content must be reported in lb/gallon.
Water based Coatings

If using water based coatings, the water content should be subtracted from the paint usage total before calculating emissions.

\[(\text{gal of coating used/year}) \times [1 - (\% \text{ water by volume}/100)] = \text{gal of coating (less water)/year}\]

\[(\text{gal of coating (less water)/year}) \times (\text{lbs VOC/gal of coatings (less water))} = \text{lbs VOC /year}\]

Calculate the pounds of VOC emitted using:

\[\text{VOC Calculations (lb/yr): } d = a \times c\]

\[a=\text{actual usage (gal/yr)}\]
\[c=\text{VOC Content (lb/gal)}\]
If data sheet doesn’t list VOC?

Calculate pounds of VOC per gallons of coating for each component

\[
(\% \text{ by Volume of each Comp}) \times (\text{density of Comp (lb/gal)}) = \text{lbs Comp/gallon of coating}
\]

Sum all components listed on product data sheet

Calculate the pounds of VOC emitted using:

\[
\text{VOC Calculations (lb/yr)}: \quad d = a \times c
\]

- \(a\) = actual usage (gal/yr)
- \(c\) = VOC Content (lb/gal)
Toxic Air Pollutant (TAP)?

Many products that contain VOC also contain Toxics Air Pollutants.

What is a TAP?

- those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects.

How do I know if a pollutant is a TAP?

- Air Toxics Inventory Pollutants List
MCAPCO 1.5703 “Definitions” states in part ...(22) “Toxic air pollutant” means any of those **carcinogens, chronic toxicants, acute systemic toxicants, or acute irritants** listed in MCAPCO...

1.5711 **EMISSION RATES REQUIRING A PERMIT**
(a) A permit to emit toxic air pollutants shall be required for any facility where one or more emission release points are obstructed or non-vertically oriented whose actual rate of emissions from all sources are greater than any one of the following toxic air pollutant permitting emissions rates:

<table>
<thead>
<tr>
<th>Toxic Air Pollutant (CAS Number)</th>
<th>Carcinogens</th>
<th>Chronic Toxicants</th>
<th>Acute Systemic Toxicants</th>
<th>Acute Irritants</th>
</tr>
</thead>
<tbody>
<tr>
<td>acetaldehyde (75-07-0)</td>
<td></td>
<td></td>
<td></td>
<td>6.8</td>
</tr>
<tr>
<td>acetic acid (64-19-7)</td>
<td></td>
<td></td>
<td></td>
<td>0.96</td>
</tr>
<tr>
<td>acrolein (107-02-8)</td>
<td></td>
<td></td>
<td></td>
<td>0.02</td>
</tr>
<tr>
<td>acrylonitrile (107-13-1)</td>
<td>0.4</td>
<td>0.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ammonia (7664-41-7)</td>
<td></td>
<td></td>
<td></td>
<td>0.68</td>
</tr>
<tr>
<td>aniline (62-53-3)</td>
<td></td>
<td></td>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td>arsenic and inorganic arsenic compounds</td>
<td>0.053</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Calculating TAP Emissions

Estimating Actual Emissions

\[ \text{lb/gal: } (\text{actual usage gallons}) \times (\text{TAP content (lb/gal)}) = \text{TAP Emissions (lb/year)} \]

\[ \% \text{ by wt: } (\text{actual usage pounds}) \times \left[ \frac{\text{TAP content (\% by wt)}}{100} \right] = \text{TAP Emission (lb/year)} \]

What if my usage is in gallons, but TAPs are in % by weight?

Convert % by weight to pounds of TAP per gallons of coating:

\[ \left[ \frac{\% \text{ weight of TAP}}{100} \right] \times (\text{density of Coating (lb/gal)}) = \text{lbs TAP/gal of coating} \]

Example Calculations