Oregon
Kate Brown, Governor

Department of Environmental Quality
Northwest Region Portland Office
700 NE Multnomah St., Suite 600
Portland, OR 97232
(503) 229-5696
FAX (503) 229-6945
TTY 711

June 30, 2022

Steven Petrin
Stimson Lumber Company
49800 SW Scoggins Valley Rd
Gaston, OR 97119-9132
Sent via email only

RE: Warning Letter with Opportunity to Correct
Stimson Lumber Company
WL 2022-WLOTC-7382
34-2066-TV-01

Steven Petrin,

Stimson Lumber Company (Stimson) was called in to the CAO program on July 2, 2020 and submitted an intial emissions inventory on September 30, 2020. DEQ met with Stimson on January 26, 2021 to discuss the initial emissions inventory, and requested additional information via email on January 28, 2021. In response, Stimson provided supplemental information and a revised emissions inventory to DEQ on April 23, 2021. DEQ met with Stimson on February 1 and February 3, 2022 to discuss outstanding data needs and additional emission estimates required prior to approval of the emissions inventory. In accordance with Oregon Administrative Rule (OAR) 340-245-0030(2), DEQ issued a written request on March 1, 2022, requiring additional information and a revised inventory to be submitted on April 18, 2022. Stimson submitted information and a revised inventory (Inventory) on April 18, 2022, and provided a minor revision to the Inventory on April 22, 2022. However, Stimson failed to sufficently address DEQ's March 1, 2022 request. DEQ completed a review of the Inventory and met with Stimson to discuss updates that remain outstanding on June 1 and June 3, 2022.

This Warning Letter with Opportunity to Correct (WLOC) cites Stimson for violation of OAR 340-245-0040(1) and (4) and allows for corrective actions. Stimson failed to sufficiently address the following requirements, as detailed in the March 1, 2022 letter issued by DEQ:

- **Requirement #3.a-d**: Report fugitive emissions associated with hardboard production for the following Toxic Emissions Units (TEUs): refiners (RF12), machine chest, header boxes, and forming machine (FORMER).
- **Requirement #7.a**: Update fuel dryer (FDRYER) maximum hourly throughput to 7.2 oven-dried tons (ODT), or provide quantitative documentation substantiating the reported capacity. Stimson's Inventory updated the maximum fuel dryer (FDRYER) capacity to 4.32 ODT per hour, but does not provide sufficient quantitative documentation to support this.

- **Requirement #8.a**: Update the boiler emission factors (BLR_ESP and BLR_SCR) to the most recent available emission factors from the National Council for Air and Stream Improvement (NCASI).
- **Requirement #9**: Update kiln emission factors to match those in the "DEQ HAP and VOC Emissions Factors for Lumber Drying, 2021" AQ-EF09 form.
- **Requirement #11.a, 11.b, 11.g, and 11.h**: Update 'Actual' activity levels to be consistent with the production values listed in the 2019 Annual Report for the boilers (BLR_SCR and BLR_ESP) and surface coating (MB_BASECOAT and MB_SURFACE - Mycostat P51)
- **Requirement #12.c**: Provide laboratory data or other justification to support the biomass concentrations used to develop the emissions estimates for wastewater treatment (SURGE, ABASE, S_POND, R_POND, and E_POND).
- **Requirement #14**: Revise the Inventory to include emission estimates for any TEUs associated with categorically insignificant activities which are not exempt TEUs per OAR 340-245-0060(3)(b). The Inventory did not include emission estimates for all such TEUs, including maintenance activities and whitewater tanks.

Additionally, the following revised emissions or TEU data in the Inventory are incomplete and require correction or additional supporting documentation:

- Documentation is needed for the following fuel dryer (FDRYER) emission factors:
  - Acetone (CASRN 67-64-1);
  - Bromomethane (CASRN 74-83-9);
  - Chloromethane (CASRN 74-87-3);
  - Methylene chloride (CASRN 75-09-2); and
  - m-Xylene (CASRN 108-38-3), p-Xylene (CASRN 106-42-3), and o-Xylene (CASRN 95-47-6);
- The reported fuel dryer (FDRYER) emission factor for phenol (CASRN 108-95-2) is incorrect;
- The reported refiner (RF12) emission factor for formaldehyde (CASRN 50-00-0) is incorrect;
- Emission estimates for phenol (CASRN 108-95-2) and propionaldehyde (CASRN 123-38-6) for the refiner (RF12) and forming machine (FORMER) should be updated to assume zero, for consistency with the results of the source test conducted on July 9,10, and 12, 2007 ("2007 source test") and Appendix G of DEQ's Recommended Procedures for Toxic Air Contaminant Health Risk Assessments (https://www.oregon.gov/deq/aq/cao/Documents/CAO_HRAProcedures.pdf);
- TACs and percent composition data are inconsistent with the provided Safety Data Sheets (SDSs) for the following surface coating products:
  - Basecoat 631-W020-1601;
  - High Gloss Topcoat 621-C020-232; and
  - Anti-Blu XP-64;
- The emission type reported for the kilns (KILN_DF, KILN_HL, and KILN_TF) in the AQ520 form is incorrectly reported as "point";
- The emissions reported in the Inventory for the hardboard press (PRESS) should include both "fugitive" and "point" components;
- The WATER9 model does not include all potentially emitted TACs and wastewater treatment processes;

- Documentation is required to support emergency generator (BGEN and FIRE) diesel particulate matter emissions;
- The reported emergency generator (BGEN and FIRE) emission factors for benzo(a)pyrene (CASRN 50-32-8) are incorrect;
- Tank emission calculations (TEUs D1, D2, G2, R1, R2, and R3) require corrections to the standing loss equation, average daily liquid temperature calculation, and daily working loss calculation;
- Tank emission calculations for the gasoline tank (G2) require corrections to the vapor space expansion factor equation;
- Tank emission calculations for the resin tanks (R1, R2, and R3) require minor corrections to the tank dimensions and constituent percentages used, and correction of the true vapor pressure and vapor density calculations; and
- Chipper throughputs and emissions should be included for all potential chipper emission points; for example, if two chippers with separate emission points are in operation, two TEUs should be identified in the Inventory.

Based on the Inventory submitted April 18 and April 22, 2022, DEQ has concluded that Stimson is responsible for the following violation of Oregon environmental law:

VIOLATION:

(1) Stimson failed to submit a timely and complete emissions inventory as required under OAR 340-245-0040(1) and (4). Specifically, Stimson failed to provide DEQ with the requested revisions, corrections, and additional information necessary to approve the Inventory by the date specified in the DEQ comment letter issued on March 1, 2022 pursuant to OAR 340-245-0030(2). This a Class II violation according to OAR 340-012-0054(2)(i).

Class I violations are the most serious violations; Class III violations are the least serious.

Corrective Actions Required:
By no later than August 15, 2022, Stimson must satisfy the following Corrective Actions:

1. Submit to DEQ a revised emissions inventory (AQ520 form) and supporting calculations in Excel format including the following updates:
    a. Forming machine (FORMER):
        i. Fugitive emissions were observed from this process during DEQ's site visit on June 14, 2022. Include an estimate of fugitive emissions, based on best available data (for example, data collected by NCASI or EPA) and engineering judgement.
        ii. Phenol (CASRN 108-95-2) and propionaldehyde (CASRN 123-38-6) emissions may be assumed zero because these TACs were below detection limits in the 2007 source test. Update the Inventory so that treatment of non-detect TACs is consistent with Appendix G of DEQ's Recommended Procedures for Toxic Air Contaminant Health Risk Assessments (https://www.oregon.gov/deq/aq/cao/Documents/CAO_HRAProcedures.pdf).
    b. Refiners (RF12):

i. Fugitive emissions were observed from this process during DEQ's site visit on June 14, 2022. Include an estimate of fugitive emissions, based on best available data (for example, data collected by NCASI or EPA) and engineering judgement.
ii. Update the formaldehyde (CASRN 50-00-0) emission factor to 6.32 x 10^{-3} pounds per ODT for consistency with the 2007 source test report referenced (the average test result for No. 2 Rotary Valve is 0.0026 pounds per hour as listed on page 9 and page 34 of the source test report).
iii. Propionaldehyde (CASRN 123-38-6) emissions may be assumed zero because this TAC was below detection limits in the 2007 source test. Update the Inventory so that treatment of non-detect TACs is consistent Appendix G of DEQ's Recommended Procedures for Toxic Air Contaminant Health Risk Assessments (https://www.oregon.gov/deq/aq/cao/Documents/CAO_HRAProcedures.pdf)..

c. Header boxes: Include emissions from this TEU, using an engineering analysis (for example, modeling volatilization of air toxics from a turbulent weir). Alternatively, apply the conservative assumption that header box emissions are equal to total (stack and fugitive) forming machine (FORMER) emissions.
d. Machine chest: Point source emissions have been observed from this process on site. In the absence of site-specific test results or representative default emission factors for this TEU, assume that machine chest emissions are equal to the "Refiners – Mix Chest Vent" emissions reported in the 2007 source test.
e. Fuel Dryer (FDRYER):
i. Update maximum hourly throughput to 7.2 oven-dried tons (ODT) for consistency with the standard definition of one "unit" of bone dry wood chips (2,400 pounds) and the capacity of 6 units per hour. Alternatively, provide specific quantitative documentation justifying the reported maximum hourly throughput (such as weights measured at maximum dryer capacity or manufacturer's specifications).
ii. Correct Table 7 notes (a) and (b) to reflect units of ODT per day rather than MMBtu per day, and the correct year of throughput information (2019 rather than 2018).
iii. Update the phenol (CASRN 108-95-2) emission factor for the FDRYER to 0.0233 pounds per ODT for consistency with the NCASI database.
f. Boilers (BOILER_ESP and BOILER_SCR):
i. Update the BOILER_ESP and BOILER_SCR emissions to include all TACs with emission factors available in NCASI's "Technical Bulletin No. 1050: Compilation of Air Toxics Emissions Data for Pulp and Paper Sources – Publication Accompanying the 2018 Air Toxics Emissions Database" (see Attachment A for a list of TACs that must be added to the Inventory).
ii. Update the 'Actual' BOILER_ESP 2019 activity value to 583,631 MMBtu per year and the BOILER_SCR 2019 activity value to 49,168 MMBtu per year to align with 2019 Annual Report and reported Fuel Heat Input to Steam Output ratio (FHISOR).
g. Surface Coating (MB_SURFACE, MB_TOPCOAT, and MB_BASECOAT):
i. Update the 'Actual' activity levels to be consistent with production values listed in the 2019 Annual Report for the following:

1. Basecoat 631-W020-160 (249 gallons);
2. Mycostat P50 + Diamulse T (1,128 gallons);
3. Anti-Blu XP-64 (2,317 gallons); and
4. Anti-Blu IP-75 (145 gallons).

ii. Update product details in the Inventory to match the provided SDSs for the following, or provide SDSs that are consistent with the product data in the Inventory:

1. Basecoat 631-W020-1601:
    a. The following TACs are listed in the Inventory but are not listed on the provided SDS:
        i. Ammonia (CASRN 7664-41-7);
        ii. Butyl acrylate (CASRN 141-32-2);
        iii. Crystalline silica (CASRN 7631-86-9); and
        iv. Vinyl acetate (CASRN 108-05-4).
    b. Constituent percentages for the following TACs are provided in the Inventory but are not listed on the provided SDS:
        i. Methanol (CASRN 67-56-1); and
        ii. Formaldehyde (CASRN 50-00-0).
2. High Gloss Topcoat 621-C020-232:
    a. The weight percent of ethylene glycol monobutyl ether (CASRN 111-76-2) is listed as 3 percent in the Inventory, and is listed on the SDS as "<10" percent (which may be reflected in the Inventory as an average of 5 percent).
    b. The product density is listed as 1.026 grams per cubic centimeter in the SDS and 1.37 grams per cubic centimeter in the Inventory.
3. Anti-Blu XP-64: The weight percent of dipropylene glycol monomethyl ether (CASRN 34590-94-8) is listed as 5 percent in the Inventory and is listed on the SDS as 7-13 percent (which may be reflected in the Inventory as an average of 10 percent).
4. Anti-Blu M6 and Mycostat P51: Two SDSs were provided for each of these products. Please clarify whether the activity values reported in the Inventory reflect the concentrated product or the mixed treatment solution, and update the constituent percentages and product density in the Inventory as appropriate.

h. Kilns (KILN_DF, KILN_HL, and KILN_TF):
    i. Update emission factors used to calculate final emissions to match those in AQ-EF09 (https://www.oregon.gov/deq/FilterPermitsDocs/AQ-EF09.pdf)
    ii. Update the Emission Type in the AQ520 form from “Point” to “Fugitive.”

i. Hardboard press (PRESS): Divide emissions into stack (98.8 percent) and fugitive (1.2 percent) portions, based on the capture efficiency demonstrated in the January 2009 source test and cited in the draft Permit Review Report for Title V Permit Number 34-2066.

j. Maintenance activities: Include emission estimates or justification for exemption of maintenance shop activities including miscellaneous chemical usage, welding, and Babbitt pot usage. Documentation of the alloy composition, throughputs, and pot temperatures will be sufficient for DEQ to evaluate emissions from the Babbitt pots.

k. Wastewater treatment:

i. Include the TACs listed below in the WATER9 model, as applicable. Assumed concentrations in wastewater may be taken from the most representative dataset listed in NCASI Technical Bulletin 773 (Tables 5.1.4, 5.2.6, 5.3.4, and 5.4.4). Alternatively, site-specific concentrations may be taken from a laboratory analysis of wastewater using the methods listed below.
    1. Acetaldehyde (CASRN 75-07-0; EPA Method 8315A);
    2. Phenol (CASRN 108-95-2; EPA Method 604 or 625.1);
    3. Propionaldehyde (CASRN 123-38-6; EPA Method 8315A);
    4. Methyl isobutyl ketone (CASRN 108-10-1; EPA Method 624.1); and
    5. Acrolein (CASRN 107-02-8; EPA Method 624.1).

ii. Update the WATER9 model to include the two wastewater hydroseives. Influent TAC concentrations may be taken from NCASI Technical Bulletin 773 or a site-specific laboratory analysis including all analytes included in the September 14, 2020 Mill Effluent Analysis as well as the additions described in Item 1.k.i above.

iii. Include emission estimates for whitewater tanks, as applicable.

l. Emergency generators (BGEN and FIRE):
    i. Update the benzo(a)pyrene (CASRN 50-32-8) emission factor used to 3.55×10^{-5} pounds per thousand gallons.
    ii. Update the headers in Tables 19 and 20 to reflect the throughput data year of 2019 rather than 2018.
    iii. Exclude cold-start emissions from the Inventory, due to negligible expected impacts.
    iv. For Diesel Particulate Matter (DEQ ID 200) emissions:
        1. Provide confirmation of Tier 2 certification or manufacturer emissions data to support the use of the Tier 2 particulate matter (PM) emission factor for Diesel Particulate Matter (DEQ ID 200); and
        2. Revise emissions to include hydrocarbon (HC) data as a conservative surrogate for the condensable particulate matter fraction.
        3. Alternatively to items 1 and 2 above, update emissions to use the default DEQ emission factor for Diesel Particulate Matter (DEQ ID 200) of 33.5 pounds per thousand gallons of fuel (source: South Coast Air Quality Management District, Supplemental Instructions - Reporting Procedures for AB2588 Facilities Reporting their Quadrennial Air Toxic Emission Inventory, December 2016, Table B-2).

m. Storage tanks:
    i. For all tanks (D1, D2, G2, R1, R2, and R3):
        1. Use effective tank diameter rather than actual tank diameter in the standing loss calculations for horizontal tanks (see AP-42 Section 7.1, Equations 1-4 and 1-14).
        2. Calculate the average daily liquid temperature (T_{LA}) using Equation 1-27 from AP-42 Section 7.1.
        3. Calculate daily working loss using the attached methodology from the Texas Commission on Environmental Quality (TCEQ; included as Attachment B). Assume maximum daily emissions are equal to maximum hourly emissions multiplied by the maximum hours of tank

filling. Provide justification for the worst-case liquid temperature used, or assume the TCEQ default of 95 degrees F.

4. Update the Inventory to clarify the source of the meteorological data in Tables 21 through 24. Footnote 5 states that the daily maximum and minimum ambient temperatures used are "based on a review of the meteorological dataset most representative for Salem, Oregon." Based on information shared during the meeting on June 3, 2022, we understand this data to be from a dataset more representative of Stimson's location.

ii. For the gasoline tank only (G1):

1. Use Equation 1-4 from AP-42 Section 7.1 to calculate the vapor space expansion factor. Equation 1-12 is only applicable for liquids with true vapor pressures less than 0.1 psia (see AP-42 Section 7, page 7.1-20).
2. Update cell J5 of Table 22 from "Storage Tank D2" to "Storage Tank G1".

iii. For the resin tanks only (R1, R2, and R3):

1. Update calculations to use a representative molecular weight and vapor pressure for the product stored and provide justification for these properties.
2. Update the weight percents for methanol (CASRN 7439-97-6) and formaldehyde (CASRN 50-00-0) to be consistent with the SDS provided (0.6 percent and 0.2 percent, respectively).
3. Update the dimensions used in calculations for tank diameter and height (for Tanks R2 and R3) and shell radius (for Tanks R1, R2, and R3) to match the inputs listed in Table 3.
4. If true vapor pressure is greater than 0.1 psia, use Equation 1-4 from AP-42 Section 7.1 to calculate the vapor space expansion factor.
5. Update the equation for stock vapor density to use the universal gas constant value of 10.731 psia $ft^3/lb \cdot mol \cdot °R$.

n. Chipper (CHIP): If more than one chipper potentially operates at Stimson, update the Inventory to include throughputs and emissions for all chipper emission points individually.

2. Provide the following additional documentation:

a. Laboratory data or other justification for parameters used in WATER9, including but not limited to: biomass concentrations, clarifier percent removal, pH, TSS, temperature, and aeration parameters.

b. Reference (screenshot or document) for the following TAC emission factors for the fuel dryer (FDRYER):

i. Acetone (CASRN 67-64-1);
ii. Bromomethane (CASRN 74-83-9);
iii. Chloromethane (CASRN 74-87-3);
iv. Methylene chloride (CASRN 75-09-2); and
v. m-Xylene (CASRN 108-38-3), p-Xylene (CASRN 106-42-3), and o-Xylene (CASRN 95-47-6);

The updated Inventory, supporting calculations, and all supporting documentation should be sent to julia.degagne@deq.oregon.gov.

DEQ issued this Warning Letter with Opportunity to Correct because the violation cited by DEQ reflects Stimson's failure to provide the required emissions data and supporting information for all regulated TAC emissions in its Inventory. Emissions of TACs such as acetaldehyde, acrolein, formaldehyde, methanol, and proprionaldehyde can pose health risks to the surrounding community, and are emitted by the kilns and hardboard processes. Acetaldehyde and formaldehyde are regulated for their cancer-causing potential and potential to cause acute and chronic noncancer health effects. Acrolein, methanol, and proprionaldehyde are regulated for their noncancer health risk potential.

Should this violation remain uncorrected, this matter may be referred to DEQ's Office of Compliance and Enforcement for formal enforcement action, including assessment of civil penalties and/or a Department order. Civil penalties may be assessed for each day of violation. Further, pursuant to OAR 340-245-0030(4)(a), DEQ may modify the information that has been submitted and provide Stimson with a final approved Emissions Inventory for use in completing the CAO process.

If you believe any of the facts in this Warning Letter are in error, you may provide information to me at julia.degagne@deq.oregon.gov. DEQ will consider new information you submit and take appropriate action.

DEQ endeavors to assist you in your compliance efforts. Should you have any questions about compliance or about the content of this letter, you may contact me at (503) 866-9643 or the email address listed above.

Sincerely,

Julia Degagne

Julia DeGagné
Air Toxics Project Manager

Cc: Brian Bartlett, Stimson Lumber Company
Andrew Rogers, Maul Foster and Alongi
Patty Jacobs, DEQ
Matt Davis, DEQ
Melissa Hovey, DEQ
JR Giska, DEQ
File

Enc: Attachment A: Additional Toxic Air Contaminants and Emission Factors for Inclusion in BOILER_ESP and BOILER_SCR Emissions
Attachment B: Estimating Short Term Emission Rates from Fixed Roof Tanks

Attachment A: Additional Toxic Air Contaminants and Emission Factors for Inclusion in BOILER_ESP and BOILER_SCR Emissions

Toxic Air Contaminant	CAS Number or DEQ ID	Emission Factor (lb/MMBtu)
dichlorobiphenyl[a]	1336-36-3	7.35E-10
hexachlorobiphenyl[a]	1336-36-3	5.45E-10
pentachlorobiphenyl[a]	1336-36-3	1.2E-09
tetrachlorobiphenyl[a]	1336-36-3	2.5E-09
trichlorobiphenyl[a]	1336-36-3	2.61E-09
Decachlorobiphenyl	2051-24-3	2.65E-10
1-Methylphenanthrene	832-69-9	2.59E-07
2,4-Dinitrotoluene	121-14-2	9.42E-07
4,6-Dinitro-o-cresol (and salts)	534-52-1	2.10E-06
Bis(2-ethylhexyl) phthalate (DEHP)	117-81-7	4.65E-08
Butyl benzyl phthalate	85-68-7	2.68E-05
Cyanide, hydrogen	74-90-8	2.05E-05
di-n-octylphthalate[b]	518	1.10E-07
Ethylene dichloride (EDC, 1,2-dichloroethane)	107-06-2	2.92E-05
Isopropylbenzene (Cumene)	98-82-8	1.77E-05
p-Dichlorobenzene (1,4-Dichlorobenzene)	106-46-7	2.79E-04
Vinyl Chloride	75-01-4	1.84E-05
Trichloroethene (TCE, Trichloroethylene)	79-01-6	1.99E-05
4-nitrophenol	100-02-7	1.14E-07
2-Chlorophenol	95-57-8	2.35E-08
2,4-Dinitrophenol	51-28-5	1.80E-07
Trichlorofluoromethane (Freon 11)	75-69-4	1.39E-05
2,4,6-Trichlorophenol	88-06-2	2.00E-07
Pentachlorophenol	87-86-5	2.14E-07
Tetrachloroethene (Perchloroethylene)	127-18-4	2.46E-05

Notes

[a] Included as part of the polychlorinated biphenyls (PCBs) group

[b] Included as part of the phthalates group

Source: National Council for Air and Stream Improvement, "Compilation of Air Toxics Emissions Data for Pulp and Paper Sources -- Publication Accompanying the 2018 Air Emissions Database (Technical Bulletin 1050), September 2018.

Air Permit Reviewer Reference Guide

APDG 6250

Estimating Short Term Emission Rates from Fixed Roof Tanks

Air Permit Division

Texas Commission on Environmental Quality

Table of Contents

Estimating Short Term Emission Rates from Fixed Roof Tanks

Scope

The goal of this document is to provide a methodology to calculate the worst case short term emissions from a vertical fixed roof tank (VFR tank) during routine operations. All calculations and derivations for short term emissions also apply to horizontal tanks. However, this calculation methodology does not apply to pressure vessels capable of handling 29.72 psia or greater, constant level or "surge" tanks (i.e., tanks that have inflow and outflow at the same time), and certain cases where a tank contains mixed phase materials (i.e., water with dense non aqueous phase liquid or crude with dissolved methane) or may otherwise have flash emissions.

Calculation Procedure

Emissions from loading a VFR tank should be calculated using Equation 1:

Equation 1

$$L_{MAX} = \frac{M_V \times P_{VA}}{R \times T} \times FR_M$$

- L_{MAX} (lb/hr) is the maximum potential short term emission rate at worst case conditions (highest liquid surface temperature, vapor pressure, and fill rate).
- M_V (lb/lbmol) is the vapor molecular weight of the VOC.
- P_{VA} (psia) is the vapor pressure of the tank contents at the worst case temperature.
- FR_M (gal/hr) is the maximum filling rate.
- R ((psia × gal)/(lbmol × ^oR)) is the ideal gas constant (80.273 for the selected units).
- T (Rankine) is the worst case liquid surface temperature. It is TCEQ practice to use either 95°F (554.67°R) or the actual temperature, whichever is higher.

Engineering Derivation

This section derives and explains Equation 1 listed above. Working losses are emissions of VOC that occur during the filling of a VFR tank. In an atmospheric vessel with fixed volume, a rising liquid level causes the displacement of vapors between the liquid surface and the vessel roof (the "headspace"). Emissions can be calculated by taking note of the fact that the total tank volume (liquid volume plus headspace) is a constant, and writing down its derivative, as is done in Equation 3.

Equation 2

$$V_{LIQUID} + V_{HEADSPACE} = Constant$$

Equation 3

$$\frac{d}{dt}V_{LIQUID} + \frac{d}{dt}V_{HEADSPACE} = 0$$

The rate at which the tank liquid volume increases (the derivative of V_{LIQUID} with respect to time) is equal to its filling rate, FR, and the rate at which the headspace volume decreases (the derivative of $V_{HEADSPACE}$ with respect to time) is equal to the volumetric emission rate, ER_{VOL}. Substituting and rearranging Equation 3, we have:

Equation 4

$$FR = ER_{VOL}$$

The mass emission rate is equal to the volumetric emission rate times the density of the vapor space, W_V. This is expressed in Equation 5 when Equation 4 is substituted.

Equation 5

$$ER = W_V \times FR$$

Assuming that the vapor space is of constant density, the vapor VOC density may be rewritten using the ideal gas law:

Equation 6

$$W_V = \frac{M_V \times P_{VA}}{R \times T}$$

All calculations for working losses are based on the relationship in Equation 5. Additional complexities such as incomplete saturation of the vapor space,[i] or pressure differentials between the vessel and the atmosphere introduced by tank breather settings, are accounted for with the use of various correction factors.

Endnote

[i] When the partial pressure of VOC in the vessel vapor space is equal to its vapor pressure, the vapor space is saturated. When the partial pressure of the VOC in the vessel space is less than its vapor pressure, the vapor space is incompletely saturated.

Summary of Changes to Guidance

Revision Date	Description of Changes
February 2020	Removed historical methodology discussion due to its reliance on a method rendered obsolete by November 2019 update of EPA AP-42. Performed other typographical corrections.
February 2018	Added clarification of product factor (K_P) relative to historical methodology discussion.
September 2014	Original publication of short-term fixed roof tank guidance document.