Draft Update to AP 42, Fifth Edition

Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources

Chapter 7.1: Organic Liquid Storage Tanks

Summary of Public Comments and Responses

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Volume 1: Stationary Point and Area Sources

Chapter 7.1: Organic Liquid Storage Tanks

Summary of Public Comments and Responses

Contract No. 68-D-01-079
Work Assignment No. 4-12
Project No. 95/11

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emission Standards Division
Research Triangle Park, North Carolina 27711

August 31, 2006

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INTRODUCTION

On July 1, 2006, the U.S. Environmental Protection Agency (EPA) released three documents with proposed changes to *AP 42, Fifth Edition; Compilation of Air Pollutant Emission Factors; Volume 1: Stationary Point and Area Sources*. These documents are draft updates to Chapter 7.1: *Organic Liquid Storage Tanks*. The three documents included a new section to estimate emissions that originate during the landing of a floating roof, an update to Section 7.1.3.1 mainly concerning low pressure tanks, and an update to Table 7.1-6, which gives new paint solar absorptance factors for additional tank colors.

The updates are based on research performed by The American Petroleum Institute (API) and The TGB Partnership. Nine public comment emails were received during this public comment period from July 1, 2006 to July 31, 2006.

All of the comments that were submitted during the public comment period and the responses to those comments are summarized in this document. This summary is the basis for the revisions made to the draft AP-42 document.

The comments and responses are arranged by commenter and each comment has an EPA response.

I. John Bosch. EPA. Comment received July 5, 2006 via email.

Comment:

The commenter asked that AP-42 "reference the Canadian report and conclusions and maybe include major results in an Appendix or Background document."

Response:

EPA is aware of the Canadian study entitled "Refinery Demonstration of Optical Technologies for Measurement of Fugitive Emissions and for Leak Detection" that was conducted using Differential Absorption Lidar (DIAL). We are interested in all new technologies that will allow direct measurement rather than estimation of air pollutant emissions. We will continue to watch the development of this technology, but no references to the study will be added to the AP-42 chapter at this time.

II. Michael Chastant. The WCM Group. Comments received July 28, 2006 via email.

Comment:

The commenter wrote, "The vapor space expansion factor K_E in Equation 2-31 is different from those used in other parts of AP-42 (Equation 1-5, 1-6, and 1-7). It should be noted that the other equations can be used instead because they are equivalent."

Response:

Language will be added stating, "If B is unknown, K_E may be calculated from Equation 1-5, 1-6, or 1-7, as appropriate, with the value of ? P_B set equal to zero."

Comment:

The commenter questioned the units of the B factor in Equations 1-24 and 2-31 because they do not match the units in the TANKS program.

Response:

The “B factor” is one of the Antoine constants used in equations to calculate vapor pressures and is in units of temperature. As shown by Equations 1-24 and 1-25, there are different forms of the vapor pressure equation. The equation for petroleum liquid stocks (Equation 1-24) uses two Antoine constants, with “B” in units of degrees Rankine. The equation for organic liquids (Equation 1-25) uses three Antoine constants, with “B” in units of degrees Celsius. The TANKS program is set up so that all temperatures entered are assumed to be in degrees Celsius. If the temperatures are entered in units of degrees Rankine, the resulting emission estimates will be incorrect.

Comment:

The commenter noted a typographical error in Equation 1-28. The term “a” should be replaced with the Greek letter “a”.

Response:

This change will be made to the document.

III. Tracy Fazio. C-K Associates, LLC. Comment received July 21, 2006 via email.

Comment:

The commenter was confused by the temperature term in Equation 2-23. She asked, “Should it be equal to the average of T_{AA} and T_B? Should it be equal to T_{LA}?”

Response:

The term “average temperature of the vapor and liquid below the floating roof,” is defined as “T” in many equations (including Equation 2-23). The term is the same as the average ambient temperature in degrees Rankine or T_{AA}. Language will be added to make this clearer.

IV. Rob Ferry. TGB Partnership. Comments received July 4, 2006 via email.

Comment:

The commenter noted an issue with the "L" subscripts in Equation 2-10. They are shown in the equation but not in the remaining section. The "L" subscript should be used each time the variables are used to avoid confusion.

Response:

This change will be made to the document.

Comment:

The commenter noted a typographical error in the units for the variables in Equation 2-10. The units should be "lb/episode" or "lb/landing event". The current term is "lb/yr".

Response:

This change will be made to the document.

Comment:

The commenter requested an additional statement for Equation 2-31. If the term "B" is unknown, "K_E may be calculated from Equation 1-5, 1-6, or 1-7, as appropriate, with the value of ? P_B set equal to zero."

Response:

This change will be made to the document.

V. Edmund S. Golpashin. URS Corporation. Comment received July 10, 2006 via email.

Comment:

The commenter asked, "When will the EPA include the landing emissions of a floating roof in the TANKS program?"

Response:

At this time, EPA does not plan to update the TANKS program to include the landing emissions for floating roof tanks.

VI. Philip Howard. Source Environmental Sciences, Inc. Comment received July 28, 2006 via email.

Comment:

The commenter submitted documents for EPA review pertaining to the determination of hourly emissions rates instead of only yearly emission rates. Insertion of this information and calculation techniques into Chapter 7.1 would be a "useful tool for short-term emission episodes, and facilitate the review of air operating permits."

Response:

The issue of using storage tank equations for predicting short term emissions has previously been explored by the EPA. In a report to the EPA entitled *The Adaptability of the Storage Tank Equations for Predicting Short Term Losses* dated July 14, 1993, Robin Jones of Midwest Research Institute recommended that emission estimates be generated for no less than a monthly time frame. The reasons include the fact that storage tanks are never at steady state conditions and that emissions from storage tanks are not continuous but periodic depending on vapor expansion and contraction within the tank.

A monthly time frame is more appropriate because monthly meteorological data are readily available for most locations and fluctuations that may exist in hourly or daily data are mostly mitigated over a monthly time frame.

Thank you for the submission, but this information cannot be incorporated into Chapter 7.1.

VII. Mark Piazza. Colonial Pipeline Company. Comments received July 31, 2006 via email.

Comment:

The commenter noted the choice of an appropriate clingage factor (or other factor shown in Table 7.1-10). The commenter disagreed with the assumption of 0.15 in Equation 2-22. According to the commenter, the clingage factor is based on heavy clingage on a gunite lined tank and is used to prevent drain dry tanks standing idle losses from exceeding those from tanks with liquid heels.

The commenter stated that using engineering judgment/discretion would allow a less conservative clingage factor to be used "if it is more reflective of their operations".

Response:

The clingage factors for a tank shell apply to a vertical surface that is wiped with a rim seal. Neither of those conditions is true for the tank bottom. The clingage factor applied computes to a depth of liquid of 0.01 inches. This is an amount that would be expected to evaporate in less than 3 hours (based on the algorithm for IFR deck fittings in API MPMS 19.2, 2nd Ed., Sept. 2003) at 60^{o} F, even without accounting for any wind effects. In the absence of data on which to establish an empirically derived typical thickness of the clingage layer on the bottom of drain dry tanks, this was deemed to be the lowest value that could be reasonably claimed.

Comment:

The commenter noted that in Equation 1-20, saturation is tied to the height of a vapor space. This calculation, K_S, will always exceed the filling S values for tanks with a small vapor space (i.e., leg height less than 1 ft) even though there may be no appreciable reservoir of liquid in a drain dry tank.

Response:

While the value given in the API report was calculated from a shell clingage factor, it was deemed to be a reasonable lower bound for an unwiped, non-vertical tank bottom, and was not meant to suggest that shell clingage factors are directly applicable to tank bottoms in general.

Comment:

The commenter noted the lack of qualifying language from API Technical Report 2537, which is the basis for many of the new equations in Chapter 7. The commenter recommended the following language be added, "This model does not address standing idle losses for partial days. It would be conservative (i.e., potentially overestimate emissions) to apply the model to episodes during which the floating roof remains landed for less than a day."

Response:

This statement will be added to the document.

Comment:

The commenter stated "the API research was presented as a technical report based on a very limited data set and theoretical estimates" and "it was not intended to serve as an emission estimation standard or recommendation." The commenter asked that the approach allow the user discretion and sound engineering judgment in its application and in selection of what factors or components are used to represent their facilities/operations.

Specifically, the commenter noted that Equation 2-22 will always exceed the result of Equation 2-24, based on calculations in the API Technical Report.

> Equating Equation 2-13 to Equation 2-24 shows an evaporation of almost 10 times more material than is present under the 0.01 inch thickness proposed for a drain dry tanks in the API Technical Report 2567 (Sections 3.2.3.1 and 3.2.3.2, pp 16-17). The default 60% saturation in Equation 2-24 is contrary to what has been measured in field studies (API Report 2567, Figure 8, TK-1 and TK-4; p. 16). The saturation levels for the drain dry tanks were less or equal to 30% in the first 24 hours and decreased with time. Under AP-42, drain dry tanks would always be subject to the 60% saturation level.

The commenter asked that Equation 2-13 be allowed as an alternative maximum calculation for L_{Smax} for drain dry tanks. The imposition of an upper bound of 60% on the saturation level may be an unrealistic restraint when the height of the vapor space is small.

Response:

The calculation is inherently limited to the amount of liquid in the tank, based on an assumed liquid depth of 0.01 inches. The additional constraint that it not exceed a 60% saturation of the vapor space means that, for deck heights of about one foot or less, the estimated standing idle loss from a drain dry tank would be even less than the assumed 0.01 inch thickness of liquid.

The figures referred to in the API report were from an early field study which had difficulties with the measurement procedure. The methodology used was not suitable for quantification purposes, but the results were useful for illustrating trends, but not for determination of absolute levels of vapor concentration. Nevertheless, considering the TK-1 field test at the conditions reported for those measurements (average deck height of 3 ft 2½ in., temperature of 40.4 F, and true vapor pressure of 3.05 psia), the depth of gasoline required to produce a saturation level of 30% is 0.01 inches. This corroborates, rather than contradicts, the proposed clingage thickness of 0.01 inches for a drain dry tank bottom. This same quantity of vapor in a vapor space half the size (i.e., about 1½ feet high) would result in 60% saturation at the given conditions.

VIII. Rad Scott. Eli Lilly & Company. Comment received July 5, 2006 via email.

Comment:

Can you please provide background on the proposed changes to Section 7.1.3.1.

Response:

The background document will be provided in the near future.

Comment:

What is the definition of P_I in Equations 1-36 and 1-37?

Response:

The P_I term is an actual pressure reading (the gauge pressure) instead of a calculation. It shows how pressurized the vapor space is. If the tank is held at atmospheric pressure (not under a vacuum or held at a steady pressure) P_I would be 0.

Comment:

Why were the changes made?

Response:

The changes are being implemented because Chapter 7, as it stands before this update, assumes that the tank is freely vented during working losses. The new calculations correct for this oversight.

Comment:

What is the expected impact of the changes to emission estimates done using the old method?

Response:

If the tank is freely vented, there will be no differences in emission calculations. If the tank has a pressure vent, the previous calculations may have overestimated the emissions. The amount of overestimation depends on the size of the tank, the vent setting, and how much additional liquid was loaded into the tank.

Comment:

How do I calculate P_I for a tank with a breather vent?

Response:

The P_I term is an actual pressure reading (the gauge pressure) instead of a calculation. It shows how pressurized the vapor space is.

IX. Brian Smithers. Comment received August 1, 2006 via email.

Comment:

Vapor Space Expansion Factor.

The text in the first paragraph states "If the liquid stock has a true vapor pressure greater than 0.1 psia, or if the breather vent settings are higher than a typical range of ±0.03 psig, see equation 1-7. If the liquid stored in the fixed roof tank has a true vapor pressure less than 0.1 psia AND the tank breather vent settings are ±0.03 psig, use either Equation 1-5 or Equation 1.6."

Is the “AND” I've put in capitals really an "or"? What happens if the product is low volatility but stored in a high pressure tank? Do I then use Equation 1-7?

Should there be a “=” before the ±0.03 psig at the end of the above sentence? What happens if it is open vented?

Is the pressure setting of the vent valve the all important factor - it is very easy to suck in a tank, and on "high" pressure tanks we normally have the pressure setting much higher than the vacuum setting? Should it read "if the breather vent pressure setting is higher than the typical value of +0.03 psig?

Response:

The "and" is the intent. The tank should meet both conditions in order to use the simplified expressions of Equations 1-5 or 1-6. If the product is low volatility but stored in a high pressure tank, use Equation 1-7 (doing so may show that there is no breathing loss, in that the pressure due to vapor expansion may not exceed the vent setting).

The sentence will be changed to read, “If the liquid stored in the fixed roof tank has a true vapor pressure less than 0.1 psia and the tank breather vent settings are less than or equal to ±0.03 psig, use either Equation 1-5 or Equation 1-6.

A large ?P_B could be due to a high pressure setting rather than a high vacuum setting, but there should be no ill effects from expressing the check in the general manner shown.

Comment:

Vent Setting Correction Factor.

How do I decide if the vent settings meet the criterion? Is the logical question whether to set Kb = 1:

Pbp + Pbv < 0.06 psig,
or is it :
Pbp < 0.03 psig?

Response:

If Equation 1-36 is less than or equal to 1.0, then K_B is set to 1.

Comment:

New paint solar absorptance factors.

For floating roof tanks, there is a Table in Ch 7 which gives equations to calculate the bulk stock temperature: $T_B = T_{AA} + x$ (where x depends on the tank color). However, that x does not seem to be related to the paint solar absorptance factor. Equation 1-15 for fixed roof tanks gives $T_B = T_{AA} + 6*a - 1$, where a is the paint factor. Thus for grey, where a is 0.68 for mid gray, this would give $T_B = T_{AA} + 3.08$, whereas the Table suggests $T_{AA} + 3.5$. Am I just reading this wrong? Should one calculate T_B the long way for floating roof tanks in the same way as for fixed roof tanks and ignore the Table? Or doesn't it really make a lot of difference to the overall emissions estimate?

Response:

The table for bulk liquid temperature is a rough approximation of the calculation (the calculation would be preferable). The bigger difference is that EPA uses the liquid surface temperature for floating roof tanks (as for fixed roof tanks), which is the average of the liquid bulk temperature and the vapor space temperature. API uses the liquid surface temperature for fixed roof tanks, but the liquid bulk temperature for floating roof tanks.