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40 C.F.R. § 63.11950

What emissions calculations must I use for an emission profile?

When developing your emission profiles for batch process vents as required in § 63.11925(g), except as specified in paragraph (i) of this section, you must calculate emissions from episodes caused by vapor displacement, purging a partially filled vessel, heating, depressurization, vacuum operations, gas evolution, air drying, or empty vessel purging, using the applicable procedures in paragraphs (a) through (h) of this section.

(a) *Vapor displacement.* You must calculate emissions from vapor displacement due to transfer of material using Equation 1 of this section.

$$E = \left(\frac{V}{RT}\right)\sum_{i=1}^{n} P_i(MW_i) \qquad \text{(Eq. 1)}$$

(Eq. 1)

*Where:*E = Mass of HAP emitted.V = Volume of gas displaced from the vessel. R = Ideal gas law constant. T = Temperature of the vessel vapor space; absolute. P_i = Partial pressure of the individual HAP. MW_i = Molecular weight of the individual HAP. n = Number of HAP compounds in the emission stream. i = Identifier for a HAP compound.

(b) *Gas sweep of a partially filled vessel.* You must calculate emissions from purging a partially filled vessel using Equation 2 of this section. The pressure of the vessel vapor space may be set equal to 760 millimeters of mercury (mmHg). You must multiply the HAP partial pressure in Equation 2 of this section by a HAP-specific saturation factor determined in accordance with Equations 3 through 5 of this section. Solve Equation 3 of this section iteratively beginning with saturation factors (in the right-hand side of the equation) of 1.0 for each condensable compound. Stop iterating when the calculated saturation factors for all compounds are the same to two significant figures for subsequent iterations. Note that for multi-component emission streams, saturation factors must be calculated for all condensable compounds, not just the HAP.

$$E = \sum_{i=1}^{n} P_i MW_i \left(\frac{Vt}{RT}\right)\left(\frac{P_T}{P_T - \sum_{j=1}^{m}(P_j)}\right) \qquad \text{(Eq. 2)}$$

(Eq. 2)

*Where:*E = Mass of HAP emitted.V = Purge flow rate of the noncondensable gas at the temperature and pressure of the vessel vapor space. R = Ideal gas law constant. T = Temperature of the vessel vapor space; absolute. P_i =

Partial pressure of the individual HAP at saturated conditions. P_j = Partial pressure of individual condensable compounds (including HAP) at saturated conditions. P_T = Pressure of the vessel vapor space. MW_i = Molecular weight of the individual HAP. t = Time of purge. n = Number of HAP compounds in the emission stream. i = Identifier for a HAP compound. j = Identifier for a condensable compound. m = Number of condensable compounds (including HAP) in the emission stream.

$$S_i = \frac{K_i A}{K_i A + V + \sum_{i=1}^{n} S_i V_i^{sat}} \qquad \text{(Eq. 3)}$$

$$V_i^{sat} = \frac{VP_i}{\left(P_T - \sum_{i=1}^{n} P_i\right)} \qquad \text{(Eq. 4)}$$

$$K_i = K_o \left(\frac{M_o}{M_i}\right)^{1/3} \qquad \text{(Eq. 5)}$$

Where: S_i = Saturation factor for individual condensable compounds. P_i = Partial pressure of individual condensable compounds at saturated conditions. PT = Pressure of the vessel vapor space. A = Surface area of liquid. V = Purge flow rate of the noncondensable gas. V_i^{sat} = Volumetric flow rate of individual condensable compounds at saturated vapor pressure. K_i = Mass transfer coefficient of individual condensable compounds in the emission stream. K_o = Mass transfer coefficient of reference compound (*e.g.*, 0.83 cm/s for water). M_o = Molecular weight of reference compound (*e.g.*, 18.02 for water). M_i = Molecular weight of individual condensable compounds in the emission stream. n = Number of condensable compounds in the emission stream.