Texas Commission on Environmental Quality
Air Permits Division

New Source Review (NSR) Emission Calculations

This information is maintained by the Chemical NSR Section and is subject to change. Last update was made **April 2008**. These emission calculations represent current NSR guidelines and are provided for informational purposes only. The emission calculations are subject to change based on TCEQ case by case evaluation. Please contact the appropriate Chemical NSR Section management if there are questions related to the emission calculations.

Sample Loading Operations Calculations

The AP-42 loading equation listed in Chapter 5.2 is typically used to calculate emissions from loading operations. Emissions are broken down into short-term emissions (lb/hr) and annual emissions (tons/year). Short-term emissions should be estimated by using the maximum expected vapor pressure and temperature of the compound being loaded and the maximum expected pumping rate being used to fill the container (truck, rail car, ship). Annual emissions should be estimated by using the average annual temperature and corresponding vapor pressure of the compound and the expected annual throughput of the compound.

Emissions from all loading shall be estimated using the following expression which can be found in AP-42, Fifth Edition, Section 5.2, dated January 1995. Loading fugitive emissions are estimated at the proper collection efficiency. The captured emissions from the loading rack shall be vented to a control device with at least 98 percent destruction efficiency or 95 percent removal efficiency.

$$L_L = \frac{12.46SPM}{T}$$

where:

L_L = Loading Loss (lb/10^3 gal of liquid loaded)
S = Saturation factor from AP-42, Table 5.2-1
P = True vapor pressure of liquid loaded (psia)
M = Molecular weight of vapors (lb/lb-mol)
T = Temperature of bulk liquid loaded (^oR)

Example 1

The following example is based on truck loading 5,500,000 gallons of ethanol at a loading rack. It is submerged loading with dedicated normal service. The true average vapor pressure of the liquid loaded is 0.9 psia; the vapor molecular weight is 46 lb/lbmol; and the annual temperature of the bulk liquid loaded is 70^{o}F.

Annual Loading Losses

$$L_L = \frac{12.46SPM}{T}$$

Where: S = 0.6 for submerged loading, dedicated normal service
P = 0.9 psia
M = 46 lb/lb-mol
T = 530°R (70°F)

$$L_L = \frac{12.46(0.6)(0.9)(46)}{530} = 0.58\ lb/10^3\ gallons\ liquid\ loaded$$

Total Ethanol Uncontrolled Emissions =

$$\left(\frac{0.58\,lb}{1000\,gal}\right)\left(\frac{5{,}500{,}000\,gal}{yr}\right)\left(\frac{ton}{2000\,lb}\right) = 1.60\ tons/yr$$

Loading fugitive ethanol emissions =

0.05 (1.60 tons/yr) = 0.08 tons/yr

Short-Term Uncontrolled Loading Losses
Use the maximum filling rate and maximum true vapor pressure to calculate the maximum short-term emissions. At 100°F, the maximum vapor pressure is 2.32 psia. At this terminal, 50,000 gallons of ethanol can be loaded in one hour.

$$L_L = \frac{12.46(0.6)(2.32)(46)}{560} = 1.42\ lb/10^3\ gallons\ liquid\ loaded$$

Uncontrolled Emissions =

$$\left(\frac{1.42\,lb}{1000\,gal}\right)\left(\frac{50{,}000\,gal}{hr}\right) = 71.24\,lb/hr$$

Short-term loading loss emissions =

(0.05)(71.24 lb/hr) = 3.56 lb/hr

Flare Emissions
Annual: (1.60 tons/yr)(0.95)(0.02) = 0.03 tons/yr
Short-term: (71.24 lb/hr)(0.95)(0.02) = 1.35 lb/hr

Example 2
The following example is based on railcar loading 3,000,000 gal/yr of ammonium sulfide. Hard-pipe connections are used with submerged loading, dedicated normal service. The annual vapor pressure of ammonium sulfide at 70oF is 1.29 psia. Its vapor molecular weight is 64 lb/lb-mol. There will be no loading fugitives since 100 percent collection efficiency is given for hard-piped

loading of railcars. The only emissions associated with this loading operation are emissions from the control device and process fugitives.

Annual Loading Losses:

$$L_L = \frac{12.46SPM}{T}$$

Where: S = 0.6 for submerged loading, dedicated normal service
P = 1.29 psia
M = 64 lb/lb-mol
T = 530°R (70°F)

$$L_L = \frac{12.46(0.6)(1.29)(64)}{530} = 1.16\ lb/10^3\ gallons\ ammonium\ sulfide\ loaded$$

Annual emissions =

$$\left(\frac{1.16\,lb}{1000\,gal}\right)\left(\frac{3{,}000{,}000\,gal}{yr}\right)\left(\frac{ton}{2000\,lb}\right) = 1.74\,tons/yr$$

Short-Term Loading Losses

The maximum filling rate of 200 gal/min and the maximum vapor pressure of 2.34 psia at 100°F are used to calculate short-term emissions.

$$L_L = \frac{12.46(0.6)(2.34)(64)}{560} = 2.00\ lb/10^3\ gallons\ ammonium\ sulfide\ loaded$$

Short-term loading emissions =

$$\left(\frac{2.00\ lb}{1000\,gal}\right)\left(\frac{200\ gal}{\min}\right)\left(\frac{60\min}{hr}\right) = 24\ lb/hr$$

Thermal Oxidizer emissions
Annual: (1.74 tons/yr)(0.001) = 0.002 ton/yr
Short-term (24 lb/hr)(0.001) = 0.024 lb/hr

Be sure to account for the sulfur dioxide which will be formed from the burning of a sulfide and any additional nitrogen oxides from burning a nitrogen-bound vapor.

Example 3

The following example is based on ship loading 2,500,000 barrels per year of furfural. Submerged loading with dedicated normal service is used. The true annual vapor pressure at 70°F is 0.035 psia. The molecular weight is 96.08 lb/lb-mol. Furfural is being loaded without controls since its maximum vapor pressure is 0.096 psia at 100°F which is less than 0.5psia.

Annual Loading Losses

$$L_L = \frac{12.46SPM}{T}$$

Where: S = 0.6 for submerged loading, dedicated normal service
P = 0.035 psia
M = 96.08 lb/lb-mol
T = 530^{o}R (70^{o}F)

$$L_L = \frac{12.46(0.6)(0.035)(96.08)}{530} = 0.05\ lb/10^3\ gallons\ furfural\ loaded$$

Annual emissions =

$$\left(\frac{0.05\,lb}{1000\,gal}\right)\left(\frac{2{,}500{,}000\,bbl}{yr}\right)\left(\frac{42\,gal}{bbl}\right)\left(\frac{ton}{2000\,lb}\right) = 2.63\ tons/yr$$

Short-Term Loading Losses

The maximum filling rate of 1,000 bbl/hr and the maximum vapor pressure of 0.096 psia at 100^{o}F are used to calculate short-term emissions.

$$L_L = \frac{12.46(0.6)(0.096)(96.08)}{560} = 0.12\ lb/10^3\ gallons\ furfural\ loaded$$

Short-term loading emissions =

$$\left(\frac{0.12\,lb}{1000\,gal}\right)\left(\frac{1000\,bbl}{hr}\right)\left(\frac{42\,gal}{bbl}\right) = 5.04\ lb/hr$$