

SBCAPCD ENGINEERING DIVISION

APPLICATION PROCESSING AND CALCULATIONS

Liquid Fuel SO_x Emission Factor:

Applicability External Combustion units such as boilers and process heaters for liquid fuels (e.g., diesel fuel #2).

Equations: Two equations are presented. The first is the fundamental equation showing how the emission factor is generated. The second is a reduced form of the basic equation for streamlined use. Finally, a check on the units is shown.

$$EF = [wt.\% S] \times [density] \times \left[\frac{1}{MW_S} \right] \times [mol\ ratio] \times [MW_{SO_2}] \times \left[\frac{1}{HHV} \right] \times \left[\frac{10^6}{MM} \right]$$

$$EF = [20,000] \times \left[\frac{wt.\% S}{HHV} \right] \times [density]$$

$$\frac{lb}{MMBtu} = \left[\frac{lb\ S}{100\ lb\ Fuel} \right] \times \left[\frac{lb\ Fuel}{gal\ Fuel} \right] \times \left[\frac{lb - mole\ S}{lb\ S} \right] \times \left[\frac{lb - mole\ SO_2}{lb - mole\ S} \right] \times \left[\frac{64\ lb\ SO_2}{lb - mole\ SO_2} \right] \times \left[\frac{gal\ Fuel}{Btu} \right] \times \left[\frac{10^6}{MM} \right]$$

where:

- EF = SO_x emission factor in units of lb/MMBtu (HHV based, as SO₂)
- wt.% S = weight percent total sulfur in fuel (as %S)
- density = density of fuel (lb/gal)
- MW = molecular weight (lb/lb-mole)
- mol ratio = stoichiometric molar ratio for the combustion of sulfur (1 S + 1 O₂ → 1 SO₂)
- HHV = higher heating value of the fuel (Btu/gal)
- MM = million

Defaults Default emission factors can be arrived at by using standard default values for the sulfur weight percentage, density and heating value for each fuel.

Fuel	wt.% S	Density (lb/gal)	HHV (Btu/gal)	SO _x Emission Factor (lb/MMBtu)
Diesel Fuel #2 (Clean Diesel)	0.05	7.050	140,000	0.0504
Diesel Fuel #2 (Rule 311)	0.50	7.050	140,000	0.5036
Gasoline	0.03	6.170	130,000	0.0285

where:

- (a) Diesel Fuel #2: Sulfur weight percent based on State specification (*Clean Diesel per CCR, Title 13, Section 2281*). Heating value based on USEPA AP-42 Emission Factor Background Document (Chapter 1.3) and density based on USEPA AP-42, Appendix A (*Weights of Selected Substances*).
- (b) Gasoline: Sulfur weight percentage based per State specification (*CCR, Title 13, Section 2252*). Heating value and density based on USEPA AP-42, Appendix A (*Weights of Selected Substances*).

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