COMBUSTION - LIQUID FUELS

Date Initiated:

December 1, 1993

Dates Modified / Updated:

December 23, 1997

March 10, 2010

PROCESS DESCRIPTION:

Combustion of liquid fuels (residual oil, diesel fuel, jet fuel, kerosene, butane, and propane) in boilers, engines, turbines, and other miscellaneous combustion devices results in the release of several criteria pollutants and toxic air contaminants to the atmosphere. (Diesel-fired engines are discussed separately; see “Combustion – Diesel Fired Engines.”) Emissions typically include NOx, SOx, ROG, PM, CO, benzene, toluene, formaldehyde, xylenes, trace organic substances, and some metals. Most emission factors are derived from source test results and fuel analyses. Testing may include the speciation of non-methane organic compounds in the stack gas exhaust. Factors can also be derived by applying an average destruction efficiency to combustible components of the fuel. Stack testing for metals is considered less reliable for emission estimation purposes than mass balance techniques based on fuel analyses.

Current District default factors have been compiled from the following sources:

- Sections 1.3, 1.5, 3.1, 3.3, and 3.4 of AP-42 (10/96) from EPA,

-VOC Profiles #0001, #0002, #0003, #0008, and #1186 (1/90) from EPA,

- District diesel fuel sample results received from AB2588 sites (1990 - 1991),

- ARB guidance regarding Cr to Cr+6 conversion in combustion processes, and

- ARB guidance regarding PAH emissions for liquid fuel combustion.

All emission factors have been converted into units of lbs pollutant/1000 gallons fuel burned. This conversion is necessary to allow future comparisons of like emission factors for different types of equipment and fuels. Emission factors for liquid fuel combustion represent "controlled releases." The database does not adjust these factors with any additional control efficiencies. The following equations are used to calculate releases of each compound:

Ea = Ua x EF

Eh = Uh x EF

Where:

Ea = Annual emissions of each listed substance per device, (lbs/year)

Eh = Maximum hourly emissions of each listed substance per device, (lbs/hour)

Ua = Annual fuel consumption per device, (1000 gallons burned)

Uh = Maximum hourly fuel usage per device, (1000 gallons burned)

EF = Emission factor, (lbs pollutant/1000 gallons burned)

EMISSIONS INFORMATION:

Emission factors from the above documents are used as default values for TOG, ROG, SOx, NOx, PM10, CO, and trace toxics unless more accurate emission factors are entered into the database for the given device. Default factors can be "overwritten" by inserting site-specific values in the emission factor section of the data entry form.

ASSUMPTIONS / LIMITATIONS:

- Equipment types, designs, burner configurations, operating temperatures, control devices, and other variables may significantly affect emissions from any given type of device or fuel. In some cases, the existing database default factors may not adequately assess emissions from a particular type of equipment. New sets of default factors should be developed and entered into the database when available. The addition of more "default choices" improves the flexibility of the database and is the key ingredient to "continuous improvement" of the system.

- In some instances, EPA documents contain multiple conflicting values for ROG emissions or missing ROG values. A combination of the EPA TOC emission factor and the EPA VOC Speciation were usually used to derive ROG factors when a conflict or omission in reported values existed.

- Emission factors for hexavalent chromium are based on the assumption that 5% of the total chromium in the fuel is converted to a hexavalent state during the combustion process. This assumption was provided to the District by ARB staff during the initial implementation of the AB2588 program and is reportedly used in most statewide inventories of toxic air contaminants.

- Emission factors for PAH compounds that have not been assigned health risk values by the State OEHHA have been combined as "unspecified PAHs" for inventory purposes in accordance with ARB guidance.

- Emission factors for trace metals in fuels have been based on pooled fuel analyses submitted to the District. Stack testing has been unable to provide consistent results and/or recovery rates for trace metals.

- Only the SDG&E Encina and South Bay power plants are known to burn residual oil. While diesel and distillate fuel metal contents have been somewhat consistent, residual oils typically contain widely varying concentrations of toxic metals. This appears to be primarily based upon the source of the residual oil. NOx factors for residual oil combustion should be based on site-specific test results.

- Default emission factors should be developed for each type of fuel used in each type of equipment. In many cases, trace toxic data is extremely limited and criteria pollutant data is somewhat variable. General assumptions regarding fuel composition and destruction efficiency may have been used to develop default factors until more accurate information becomes available. Often, pooled testing of similar equipment is more accurate for average annual estimation purposes than a single test of the actual device.

FORMS:

The Liquid Fuel Combustion form can be used to obtain information for many types of fuels and equipment. For equipment fired on natural gas, landfill gas, or digester gas a separate form for Gaseous Fuel Combustion must also be completed. For engines burning diesel fuel, use Combustion - Diesel Fired Engines form.