COMBUSTION - GAS FUELS

Date Initiated:

December 1, 1993

Dates Modified / Updated:

December 23, 1997

October 16, 1998

July 8, 1999

July 5, 2005

August 22,2022

January 09, 2023

PROCESS DESCRIPTION:

Combustion of gaseous fuels (natural gas, digester gas, and landfill gas) in boilers, engines, turbines, flares, and other miscellaneous combustion devices results in the release of several criteria pollutants and toxic air contaminants to the atmosphere. Emissions typically include NOx, SOx, ROG, PM, TSP, CO, benzene, toluene, formaldehyde, xylenes, and Toxic Air Contaminants (TACs).

Most emission factors are derived from source test results. This testing may include the speciation of nonmethane organic compounds and particulate matter in the stack gas exhaust. Some units may be equipped with control equipment, including Selective Catalytic Reduction (SCR) and ammonia injection. While SCR and ammonia injection can reduce NO_X emissions, it increases the ammonia concentration in the exhaust and leads to particulate formation. For this reason, PM10 and TSP emission factors will include measured quantities of ammonia slippage calculated as ammonium hydroxide. Factors can also be derived by applying an average destruction efficiency to combustible components of the gaseous fuel. A combination of both techniques has been used for equipment fired with digester gas and landfill gas.

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

- Sections 1.4, 2.4, 3.1, and 3.2 of AP-42 (9/98, 11/98, 4/00, & 7/00) from EPA,

- District natural gas fired engine acrolein test results,

- District digester gas test result from the Point Loma WWTP, and

- District landfill gas fired flare test results.

All emission factors have been converted into units of lbs pollutant/million ft3 fuel burned. This conversion is necessary to streamline database calculations and to allow future comparisons of like emission factors for different types of equipment and processes. Emission factors for gaseous fuel combustion represent "controlled releases". The database does not adjust these factors with any additional control efficiencies. The following equation is 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, (std. million ft3 burned)

Uh = Maximum hourly fuel usage per device, (std. million ft3 burned)

EF = Emission factor, (lbs listed substance/std. million ft3 burned)

EMISSIONS INFORMATION:

Emission factors from the above documents are used as default values for TOG, ROG, SOx, NOx, PM10, TSP, CO, and 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 into 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 identify trace contaminant emissions from source test results that were reported as nondetectable. The District does not use EPA emission factors for compounds that have never been identified as actually emitted. EPA emission factors for some other compounds are not included in the District database because the emission rates are insignificant. Factors for non-toxic, non-AB2588 compounds have also been omitted from the database calculations. Finally, EPA factors for acrolein from natural gas fired engines are not used since these values were based on invalid test methods. The default acrolein emission factors used by the District are based on local source test results using a modified TO15 procedure.

- Default emission factors should be developed for each type of fuel used in each type of equipment. In many cases, 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.

- For natural gas fired turbines, formaldehyde accounts for about two-thirds of the total HAP emissions. Polycyclic aromatic hydrocarbons (PAH), benzene, toluene, xylenes, and others account for the remaining one-third of HAP emissions.

- The formation of carbon monoxide during the combustion process is a good indication of the expected levels of HAP emissions. Similar to CO emissions, HAP emissions increase with reduced operating loads. Typically, combustion turbines operate under full loads for greater fuel efficiency, thereby minimizing the amount of CO and HAP emissions.

FORMS:

The Gaseous Fuel Combustion form can be used to obtain information for many types of fuels and equipment. A separate form for Liquid Fuel Combustion must also be completed for equipment fired on diesel, oil, propane, butane, or other distillates.