

CREMATORY & INCINERATOR OPERATIONS

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PROCESS DESCRIPTION:

Natural gas fired crematories and incinerators that combust human remains, animal remains, refuse, agricultural products, or medical waste are sources of carbon monoxide, nitrogen oxides, particulate matter, organic compounds, sulfur oxides and trace toxic substances. Incinerators used for cremation purposes are called "retorts" and the remains are referred to as "charges". Emissions of trace toxic substances may include hydrogen chloride, formaldehyde, benzene, toluene, mercury, hexavalent chromium, PAH's, and other heavy metals.

Incinerators in San Diego County typically have a primary burner in the main chamber and a secondary burner / afterburner in the flue stack. Most permits include lb/hour charge rate limitations and periodic particulate matter source testing requirements. Emissions from these processes are highly dependent upon equipment type, control devices, operating conditions, fuel type, process time, and waste stream composition. While default emission factors have been pieced together from a variety of EPA reference sources for each type of operation, site specific test results should be used to estimate emissions whenever available.

References used to develop default emission factor estimates are;

- Sections 1.4, 2.1, and 2.3 of AP-42 (10/96) from EPA,
- VOC Speciation Profile #1167 (1/90) from EPA,
- PM Speciation Profile #42320 (1/90) from EPA, and
- AB2588 crematory stack testing results from UCSD (1990).

Emission factors for NO_x, CO, SO_x, TOG, and ROG have been converted into units of lbs pollutant / million scf fuel burned since these emissions are assumed to be most directly associated with fuel usage. Emission factors for TSP, PM₁₀, and trace toxic substances have been converted into units of lbs pollutant / ton charged since these emissions are assumed to be most directly associated with the combusted materials.

District emission estimation techniques for crematory operations are as follows;

$$Ea = Ua \times EF$$

$$Eh = Uh \times EF$$

Where:

Ea = Annual emissions of each listed substance, (lbs/yr)

Eh = Maximum hourly emissions of each listed substance, (lbs/hr)

Ua = Annual charge weight or annual fuel usage, (tons charged/yr or mmscf gas/yr)

Uh = Max. hourly charge rate or max. hourly fuel usage, (lbs charged/hr or mmscf/hr)

EF = Emission factors for each listed substance, (lbs /ton charged or lbs/mmscf gas)

EMISSIONS INFORMATION:

Default emission factors for crematories and incinerators have been assembled from a combination of sources including AP-42 information, District AB2588 source testing, and EPA speciation profiles. The District emission standard for crematories is 0.3 grains/dscf @ 12% CO₂, which equates to ~6.5 lbs PM/ton charged. Source tests of newly designed / installed multiple chamber incinerators indicate emissions of ~1/2 the maximum allowable rate. Test results from older equipment in use throughout San Diego County are usually much closer to the limit. A default value of 6.5 lbs PM/ton charged will be used to estimate particulate emissions where site specific emission rates are not provided.

CO, NO_x, SO_x, TOG, and ROG emissions are believed to be most accurately estimated with fuel usage data and AP-42 small boiler emission factors. These emissions are assumed to be most closely associated with the fuel usage even though EPA factors provided in AP-42 are reported by charge weight . Since charges have highly variable compositions and process times, the AP-42 values were discarded and the small boiler (external combustion) factors were used as defaults until more accurate information becomes available.

Extensive AB2588 source testing was performed by ARB in Sacramento during 1990 to identify toxic air contaminant emission rates from crematories. These test results are supported by local AB2588 results from the UCSD Medical Center and Bonner Hall incinerators / crematories. Trace amounts of several listed substances were detected in the exhaust stack including benzene, toluene, xylenes, formaldehyde, hydrogen chloride, hydrogen fluoride, arsenic, chromium, lead, and mercury. Default values for criteria and toxic emission estimates from the UCSD testing are provided below;

Particulate Matter (PM10)	6.0 lbs/ton charged
Nitrogen Oxides	100.0 lbs/mmscf
Sulfur Oxides	0.6 lbs/mmscf

Carbon Monoxide	21.0 lbs/mmscf
TOG	5.8 lbs/mmscf
ROG	2.8 lbs/mmscf
Acetaldehyde	1.5E-3 lbs/ton charged
Arsenic	5.8E-4 lbs/ton charged
Benzene	7.2E-4 lbs/ton charged
Beryllium	2.0E-5 lbs/ton charged
Cadmium	1.6E-4 lbs/ton charged
Chromium (total)	5.1E-4 lbs/ton charged
Chromium (hexavalent)	1.9E-4 lbs/ton charged
Copper	4.0E-4 lbs/ton charged
Formaldehyde	4.0E-4 lbs/ton charged
Hydrogen Chloride	8.6E-1 lbs/ton charged
Hydrogen Fluoride	7.8E-3 lbs/ton charged
Lead	9.8E-4 lbs/ton charged
Mercury	4.8E-2 lbs/ton charged
Nickel	5.7E-4 lbs/ton charged
PAH's (excluding naphthalene)	5.2E-5 lbs/ton charged
Selenium	6.5E-4 lbs/ton charged
Toluene	9.9E-3 lbs/ton charged
Xylenes	2.8E-3 lbs/ton charged
Zinc	5.2E-4 lbs/ton charged
Dioxins	Negligible
Furans	Negligible

ASSUMPTIONS / LIMITATIONS:

- Emission factors are questionable for the formaldehyde and acetaldehyde values since one of the samples in the source test gave a negative reading. The value for mercury is higher than expected even allowing for a reasonable amount of material present in dental fillings.
- Most crematories do not weigh their charges and may only be able to provide the number of charges burned. It is customary to assume an average charge weight of 150 pounds.
- Source test sampling began a few minutes after burning began to allow the cardboard box container to be burned through and the body mass to begin burning. This may have slightly underestimated emissions attributable to charge shrouding.
- Cardboard shrouds were used during the tests at Camellia Memorial Lawn crematorium. The chemical composition of other shrouding materials should be

considered when applying these emission factors to individual facilities. The use of plastic and wood containers could result in different emission factors.

- Emission factors based on crematorium source testing should not be used for incinerators charged with refuse, medical waste, plastics, trash, contraband, hazardous waste, or other materials not consistent with human / animal remains. Emission factors for specialized incinerators are best developed from site specific testing.

FORMS:

A separate set of emission factors should be developed for each type of multiple chamber incinerator and waste stream to be quantified. Existing default factor estimates are generic and / or ballpark estimates at best.