

Engineering Evaluation Report
Application # 31303
Irvington Memorial Cemetery, Plant #4134
Plant address: 41001 Chapel Way, Fremont, CA 94538

BACKGROUND

Irvington Memorial Cemetery (Plant # 4134) has been operating a crematory located at 41001 Chapel Way in Fremont, CA since 1968. The current facility includes five cremation furnaces, S-1, S-2, S-4, S-5, and S-6. The facility applied to install two new crematory retorts with 2,300 cremations per year for each unit:

S-7 Crematory Retort for human remains, Matthews SPP Plus, with an integral afterburner, 2.2 MMBTU/hr

S-8 Crematory Retort for human remains, Matthews SPP Plus, with an integral afterburner, 2.2 MMBTU/hr

and remove current S-1 and S-2:

S-1 Crematory Retort for human remains, All Crematory, Model 1701, with an integral afterburner, 1.4 MMBTU/hr

S-2 Crematory Retort for human remains, All Crematory, Model 1701, with an integral afterburner, 1.4 MMBTU/hr

EMISSION SUMMARY

Based on source testing conducted for S-6 at this facility in 2007, cremation processing time is less than 1.5 hours. Therefore, with 12 operating hours per day, a maximum 8 cremations per day is assumed. Criteria air pollutant emissions were estimated using the emission factors for natural gas combustion in AP-42 Table 1.4-1 and 1.4-2, emission factors for the combustion of the body and case wrappings were from EPA FIRE database (for PM₁₀) and medical waste incineration in AP-42 Table 2.3-1 and 2.3-2

Basis for S-7 and S-8 (S-7 and S-8 are identical sources):

- Crematory retort rating = 2.2 MMBtu/hr
- Maximum cremations/day = 8, Maximum cremations/year = 2,300 for each cremator
- Average body weight = 150 lbs
- Maximum hours of operation = 12 hr/day, 6 days/week
- Maximum hours of operation = 3744 hr/year
- Daily natural gas usage, $12 \text{ (hr/day)} \times 2.2 \text{ MMBtu/hr} / (1020 \text{ Btu/ft}^3) = 0.0259 \text{ MMft}^3/\text{day}$.

Hourly emissions for natural gas combustion in primary and secondary chambers are based on the total natural gas firing rate of 2.2 MMBtu/hr of this cremator. Daily natural gas combustion emissions are based on 12 hours of cremator operation per day. Emissions for body cremation are based on cremation of 8 bodies per day, 2,300 cremations per year. With these emission factors, the total daily and annual criteria pollutant potential to emit for this project are listed in Table 1.

Sample calculation for Table 1:

Daily PM₁₀ emissions from natural gas combustion:

$$(7.6 \text{ lb/MMft}^3) (2.2 \text{ MMBtu/hr}) (12 \text{ hr/day}) / (1020 \text{ Btu/ft}^3) = 0.197 \text{ lb/day}$$

Daily PM₁₀ emissions from cremation of bodies:
(0.085 lb/body) (8 bodies/day) = 0.68 lb/day

Table 1. Criteria Pollutant Emissions from S-7 and S-8

Pollutant	Emissions from Natural Gas Combustion		Emissions from Cremation of Bodies (include casket)		Each source	Each source	Project total	PTE increase
	Emission Factor (lb/MMft ³)	Max. Daily (lb/day)	Emission Factor (lb/body)	Max. Daily (lb/day)	Daily Emission (lb/day)	Annual Emission (lb/year)	Annual Emission (lb/year)	(ton/year)
PM10	7.6	0.197	0.085	0.680	0.88	256.87	513.74	0.257
NOx	100	2.588	0.267	2.136	4.72	1421.63	2843.26	1.422
CO	84	2.174	0.221	1.768	3.94	1186.62	2373.25	1.187
SO2	0.6	0.016	0.163	1.304	1.32	379.75	759.49	0.380
POC	5.5	0.142	0.224	1.792	1.93	559.61	1119.23	0.560

The potential to emit (PTE) calculation is explained in the Compliance Determination section later in this report.

Toxic Emissions from Natural Gas Combustion and Crematory Operations

Emissions factors for benzene and toluene from natural gas combustion are from AP-42 Table 1.4-3.

$$\text{Benzene} = (0.0021 \text{ lb/MMscf}) / (1020 \text{ MMBtu}/10^6 \text{ ft}^3) = 2.06 \times 10^{-6} \text{ lb/MMBtu}$$

$$\text{Toluene} = (0.0034 \text{ lb/MMscf}) / (1020 \text{ MMBtu}/10^6 \text{ ft}^3) = 3.33 \times 10^{-6} \text{ lb/MMBtu.}$$

Per the BAAQMD Permit Handbook Chapter 11.6, formaldehyde and acetaldehyde are calculated from the data in CARB's Test Report No. C-90-004, "Evaluation Test on Two Propane Fired Crematories Camellia Memorial Lawn Cemetery," October 29, 1992.

Toxic emission factors for human cremation are based on the District's most recent published emission factors.¹ Toxic emission factors used in this evaluation are listed in Table 2.

¹ Addendum to Mercury Emissions from Cremation of Human Remains, August 3, 2021

Table 2. TAC EFs for Irvington Memorial Cemetery Cremation Furnaces

Toxic Air Contaminant	Default EFs	
	Average Emission Factor (lbs/body)	Max. 1-Hr Emission Rate (lbs/hr)
Acetaldehyde	1.30E-04	1.30E-04
Arsenic	1.50E-05	1.50E-05
Beryllium	1.37E-06	1.37E-06
Cadmium	1.11E-05	1.11E-05
Chromium, hexavalent	1.35E-05	1.35E-05
Copper	2.74E-05	2.74E-05
Formaldehyde	3.40E-05	3.40E-05
Hydrogen Chloride	7.20E-02	7.20E-02
Hydrogen Fluoride	6.55E-04	6.55E-04
Lead	6.62E-05	6.62E-05
Mercury	1.50E-03	5.28E-03
Nickel	3.82E-05	3.82E-05
Selenium	2.18E-05	2.18E-05
2,3,7,8-PCDD (equivalent)	1.06E-09	1.06E-09
PAH's (as B(a)P equivalents)	2.43E-08	2.43E-08

Table 3 summarizes the maximum hourly and annual average TAC emissions from S-7 or S-8 with 2,300 bodies/year throughput for each source (S-7 and S-8 are identical source). Corresponding acute and chronic risk screening trigger levels are also shown in Table 3.

Table 3. TAC Emissions from each source (S-7 or S-8) and project

Pollutant	Annual Emissions per source (lb/yr)	Hourly Emissions per source (lb/hr)	Project Annual Emissions (lb/yr)	Project Hourly Emissions (lb/hr)	Chronic Trigger (lb/yr)	Acute Trigger (lb/hr)	Chronic Trigger?	Acute Trigger?
Acetaldehyde	3.0E-01	1.3E-04	6.0E-01	2.6E-04	2.90E+01	1.00E+00	no	no
Arsenic	3.5E-02	1.5E-05	6.9E-02	3.0E-05	1.60E-03	4.40E-04	yes	no
Beryllium	3.2E-03	1.4E-06	6.3E-03	2.7E-06	3.40E-02	NA	no	no
Cadmium	2.6E-02	1.1E-05	5.1E-02	2.2E-05	1.90E-02	NA	yes	no
Cr(VI)	3.1E-02	1.4E-05	6.2E-02	2.7E-05	5.10E-04	NA	yes	no
Copper	6.3E-02	2.7E-05	1.3E-01	5.5E-05	NA	2.20E-01	no	no
Formaldehyde	7.8E-02	3.4E-05	1.6E-01	6.8E-05	1.40E+01	0.12	no	no
HCl	1.7E+02	7.2E-02	3.3E+02	1.4E-01	3.50E+02	4.6	no	no
HF	1.5E+00	6.6E-04	3.0E+00	1.3E-03	5.80E+01	5.30E-01	no	no
Lead	1.5E-01	6.6E-05	3.0E-01	1.3E-04	2.90E-01	NA	yes	no
Mercury	3.5E+00	5.3E-03	6.9E+00	1.1E-02	2.10E-01	1.30E-03	yes	yes
Nickel	8.8E-02	3.8E-05	1.8E-01	7.6E-05	3.10E-01	3.10E-05	no	yes
Selenium	5.0E-02	2.2E-05	1.0E-01	4.4E-05	8.00E+00	NA	no	no
Dioxins	2.4E-06	1.1E-09	4.9E-06	2.1E-09	4.40E-08	NA	yes	no
PAHs	5.6E-05	2.4E-08	1.1E-04	4.9E-08	3.30E-03	NA	no	no
Benzene	1.7E-02	4.5E-06	3.4E-02	9.1E-06	2.90E+00	6.00E-02	no	no
Toluene	2.7E-02	7.3E-06	5.5E-02	1.5E-05	1.20E+04	8.20E+01	no	no

COMPLIANCE DETERMINATION

Regulation 1: General Provisions and Definitions

The facility is subject to Regulation 1, Section 301, which prohibits discharge of air contaminants resulting in public nuisance. The facility is expected to comply with this requirement.

Regulation 2, Rule 1: Permits – General Requirements

California Environmental Quality Act (CEQA): District Regulation 2, Rule 1, Section 310 specifies that all proposed new and modified sources subject to District permit requirements must be reviewed in accordance with CEQA requirements, except for ministerial projects or projects exempt from CEQA under Section 2-1-312. The engineering review for this project requires only the application of standard permit conditions and standard emission factors in accordance with Permit Handbook Chapter 11.6: Crematories. Therefore, this application is considered to be ministerial and is exempt from CEQA review.

Public Notification: The public notification requirements of Regulation 2-1-412 apply to applications which result in any increase in toxic air contaminant or hazardous air contaminant emissions at facilities within 1,000 feet of the boundary of a K-12 school. S-7 and S-8 are located within 1,000 feet of the John M. Horner Middle School (4350 Irvington Ave. Fremont, CA 94538) and therefore subject to the public notification requirements of Regulation 2-1-412, since there will be increase in toxic air contaminant emissions. In accordance with Regulation 2-1-412, the Air District is required to prepare and distribute a

public notice to the parents or guardians of children enrolled in any school within one-quarter mile of the source and to each address located within 1,000 feet of the source. The Air District will receive comments on this project for 30 days after publication of the notice and will consider all comments before making a final decision on this throughput increase application.

Regulation 2, Rule 2: Permits – New Source Review

Best Available Control Technology (BACT): Per Regulation 2, Rule 2, Section 301 BACT is required for new or modified sources with potential emissions of 10.0 pounds per day or more of POC, NPOC, NO_x, PM₁₀, or SO₂. As displayed in Table 1, neither source will emit more than 10 lbs/day of any criteria pollutant, therefore, neither source is subject to BACT requirements.

Plant Cumulative Increase:

The cumulative emission increase for this application is calculated pursuant to Regulation 2-2-604 and 2-2-605. The emissions increase is the difference between the potential to emit for S-7 and S-8 and the adjusted baseline emissions for S-1 and S-2.

The facility will be removing the existing S-1 and S-2, when the new units are put online. Baseline actual emissions for S-1 and S-2 were determined using 2018-2020 3-year average of (this is the three-year period immediately preceding the completion date for this application) actual throughput data reported by the facility. Table 4 summarizes the cumulative increase in criteria pollutants emissions.

Table 4. Cumulative Emission Increase for Application 31303

	Cumulative Increases, Post 4/5/91 (tons/year)	Application Emissions Increases (tons/year)	On-Site Credits Due to Shut Down of S-1 (tons/year)	On-Site Credits Due to Shut Down of S-2 (tons/year)	Actual Cumulative Increases (tons/year)	New Balance (tons/year)
POC	0.454	0.257	0.030	0.037	0.189	0.643
NO _x	5.154	1.422	0.205	0.197	1.019	6.173
CO	2.658	1.187	0.171	0.164	0.851	3.509
PM ₁₀	1.974	0.380	0.059	0.057	0.264	2.238
SO ₂	0.576	0.560	0.086	0.083	0.391	0.967

Emission Offsets: Under Section 2-2-302, POC and NO_x emission offsets are required for new or modified sources at a facility which emits or will be permitted to emit 10 tons per year or more on a pollutant specific basis. Since the facility does not have the potential to emit more than 10 tons per year of NO_x or POC emissions, the facility is not subject to NO_x or POC offsets.

Since the facility will not have the potential to emit more than 100 tons per year of any criteria pollutant, the facility is not a "Major Facility" as defined in Regulation 2-1-203, and is not subject to PM₁₀ or SO₂ offsets under Regulation 2-2-303.

Regulation 2, Rule 5: Permits – New Source Review of Toxic Air Contaminants

Health Risk Assessment: The District’s regulation concerning toxic air contaminant emissions is codified in Regulation 2, Rule 5, New Source Review of Toxic Air Contaminants (TAC). The TAC emissions from new and modified sources are subject to risk assessment review, if the emissions of any individual TAC exceed either the acute or chronic emission thresholds defined in Table 2-5-1.

As shown in Table 3, a health risk assessment is triggered for this application. The Air District conducted an HRA for this project in accordance with the BAAQMD HRA Guidelines. Detailed health risk calculation procedures are presented in the HRA results memo dated June 6, 2022. The facility agreed that the stack height of S-7 and S-8 to be set at 43 ft above ground level, as part of the Risk Reduction Plan of Rule 11-18 facility-wide HRA. Results from the HRA indicate that the maximum cancer risk is 4.9 in a million, the chronic hazard index is 0.34, and the maximum acute hazard index is 0.50. In accordance with the District's Regulation 2, Rule 5, this project is in compliance with the project risk requirements.

TBACT

The HRA shows that Best Available Control Technology for Toxics (TBACT) requirement in Regulation 2-5-301 is triggered for S-7 and S-8, since the source risk for S-7 or S-8 is greater than 1.0 in a million cancer risk. TBACT for a cremator as per District's BACT/TBACT Guideline: Crematory, Document#53.1 Revision:1, Date: 9/12/2007 is firing with natural gas and the operating temperature in the secondary chamber at or above 1,650-degree Fahrenheit with set point at 1,600-degree Fahrenheit. S-7 and S-8 are expected to meet the TBACT requirements, as they will be required by the permit conditions.

PSD REVIEW

Since the facility will not have the potential to emit more than 100 tons per year of any criteria pollutant, the facility is not a "Major Facility" as defined in Regulation 2-1-203, and is not subject to PSD permitting requirements under Regulation 2-2-304.

Regulation 6, Rule 1: Particulate Matter – General Requirements

Section 301 prohibits for more than 3 minutes per hour, visible emissions as dark or darker than Ringelmann 1 or equivalent opacity. This facility is expected to comply with this standard.

Section 305 prohibits emissions of visible particles from causing a nuisance on property other than the operator's. This operation is expected to comply with this standard.

As shown in Table 1, each source emits less than 1,000 kg/year of PM₁₀, Section 6-1-301.2 does not apply. Section 6-1-310.1 limits particulate emissions to 0.15 grains/dscf of exhaust gas volume. Exhaust gas flow from each cremator is estimated to be 723 scfm at 70°F (2,100 acfm at 1,100°F). At this flow rate, the estimated grain loading for the cremation is calculated as follows:

$(0.88 \text{ lbs/day}) / (12 \text{ hrs/day}) * (7,000 \text{ grains/lb}) / (60 \text{ min/hour}) / 723 \text{ (dscf/min)} = 0.012 \text{ grains/dscf}$. This particulate weight emission complies with the Regulation 6-310 requirement that no operations may exceed a particulate weight emission of 0.15 grains/dscf.

Regulation 6-1-311 limits the Total Suspended Particulate (TSP) Weight Limits. Section 6-1-311.1 limits TSP emissions to 1.78 lb/hour for sources with process weight less than 551 lbs/hour. As shown in Table 1, each source's process weight is less than 551 lb/hr, hourly PM emissions is $(0.88 \text{ lb/day}) / (12 \text{ hours/day}) = 0.073 \text{ lb/hour}$, meeting this requirement.

Section 6-1-401 requires the operator to have the means to know the appearance of emissions from the operations at all times. The emissions from the cremators will occur during active, manned operation of the sources, so the emissions will be visible to the operator at all times, in compliance with this section.

Regulation 8, Rule 2: Organic Compounds-Miscellaneous Operations

Regulation 8-2-301 prohibits any miscellaneous operation from discharging an emission containing more than 15 pounds per day and containing a concentration of 300 ppm total carbon on a dry basis. The daily POC emissions from each source were estimated at 2.87 lbs/day. Since the emissions are ~19% of 15 lbs/day limit, both sources will comply with Regulation 8-2-301. Compliance with the concentration limit of 300 ppm can only be confirmed via monitoring instrumentation or a source test. Because the mass emissions are low, S-7 and S-8 will most likely comply with Reg. 8-2-301.

Regulation 9, Rule 1: Inorganic Gaseous Pollutants – Sulfur Dioxide

The cremators are subject to and will comply with Regulation 9, Rule 1, "Inorganic Gaseous Pollutants, Sulfur Dioxide," by restricting fuel use to natural gas only. Based on the following calculation, combustion of natural gas is expected to produce a SO₂ concentration of less than 1 ppmv, thereby meeting the requirement of a maximum outlet concentration of 300 ppmv of SO₂ prescribed in Regulation 9, Rule 1-302.

$$\text{SO}_2 \text{ ppmv} = (0.00057 \text{ lb/MMBtu}) * (385.5 \text{ ft}^3 \text{ SO}_2/\text{lb mol SO}_2)/(1 \text{ ft}^3 \text{ SO}_2/10^6 \text{ sdt}^3 \text{ flue})/[(20.9)/(20.9-3)]/(64.0588 \text{ lb SO}_2/\text{lb mol SO}_2)/(8710 \text{ sdt}^3 \text{ flue/MMBTU}) = 0.338 \text{ ppmv at 3\% O}_2$$

NSPS/NESHAPS

These sources are not subject to any NSPS or NESHAP requirements.

PERMIT CONDITIONS

A new permit condition # 27714 is being proposed for S-7 and S-8.

COND# 27714 applies to S-7 and S-8
For S-7 and S-8 Cremators at Plant # 4134.

1. The owner/operator shall not cremate more than 2,300 human remains per consecutive 12-month period at S-7 or S-8. Cremation data shall be recorded in a District approved logbook to demonstrate compliance with this condition. The records shall be retained at the site for at least 24 months from the date of data entry and shall be made available to the District staff for inspection. (Basis: toxic risk screen; cumulative increase)
2. The operating temperature in the secondary chamber of the cremators shall not be less than 1,650 degree Fahrenheit during the cremation mode. Any temperature excursion below 1,600 degree Fahrenheit during the cremation mode will be considered a violation of this permit condition. A District approved continuous temperature monitoring and recording device shall be installed to ensure compliance with this condition. The location of the thermocouple shall be approved by the District. Natural gas input to the secondary chamber burner shall be increased, if necessary, to increase temperature sufficiently to control odor and visible plume. (Basis: Regulation 6-301, 6-310; TBACT)
3. After the shutdown, no cremation shall take place until the temperature in the secondary chamber is at least 1,650 degree Fahrenheit. (Basis: Regulation 6-301, 6-310; TBACT)
4. The cremators shall be fueled with natural gas only. (Basis: cumulative increase; TBACT)
5. The cremators shall be used to cremate only human remains. No other material contaminated with toxic air contaminants as listed by Air Resources Board, including radioactive and biohazardous waste shall be incinerated in these cremators without prior approval of the District. (Basis: cumulative increase; toxic risk screen)

6. The stack height of S-7 and S-8 shall be 43 ft above ground level. (Basis: toxic risk screen)
7. The District may require the owner/operator of the cremators to conduct a District approved source test to determine particulate matter, hydrocarbon, NO_x, CO, O₂, HCl, and toxic emissions under unusual conditions, such as: obese cases, and/or disaster bags. The Source Test Section of the District shall be notified at least 7 days in advance of any expected source test. A copy of source test report for each test shall be provided to the District within 30 days of source test date. (Basis: cumulative increase; toxic risk screen))
8. The cremators shall have sampling ports and platforms, the location of which shall have the approval of the Source Test Section of the District. (Basis: Regulation 6-310)
9. An operator shall be present at all times during cremations. (Basis: Regulation 6-301)
10. The cremators shall be kept in good working condition. The date and detailed description of the type of maintenance done on cremators shall be recorded in a District approved logbook. (Basis: Regulation 6-301, 6-310)
11. All monitoring, source test, and maintenance records as required per conditions 1, 5, and 9 shall be kept onsite for at least two years from the date of data entry, and shall be made available to the District staff for inspection. (Basis: cumulative increase, TBACT; Regulation 6-301,6-310)


RECOMMENDATION

The District has reviewed the permit application for the proposed crematory retorts and has made a preliminary determination that the project is expected to comply with all applicable requirements of District, state and federal air quality-related regulations. Since the sources are located within 1,000 feet of a school, the public notification requirements of District Regulation 2-1-412.6 were triggered. After comments are received and reviewed, the District will make a final determination on the permit application.

I recommend that the District initiate a public notice and consider any comments received prior to taking any final action on issuance of the Authority of Construct for the following sources:

S-7 Crematory Retort for human remains, Matthews SPP Plus, with an integral afterburner, 2.2 MMBTU/hr

S-8 Crematory Retort for human remains, Matthews SPP Plus, with an integral afterburner, 2.2 MMBTU/hr

By: 

Davis Zhu
Senior Air Quality Engineer

7/11/2022
Date