CATEGORY Type: **CREMAROTY (HUMAN OR PET)**

BACT Category: MINOR SOURCE BACT

BACT Determination Number: 317	**BACT Determination Date:** 1/30/2023

Equipment Information

Permit Number: N/A -- Generic BACT Determination

Equipment Description: CREMATORY - NATURAL GAS FIRED

Unit Size/Rating/Capacity: ≤ 19,710 MMBTU/HR & A 677 TON/YEAR CHARGE LIMIT

Equipment Location:

RESCINDED

BACT Determination Information

District Contact: Venk Reddy Phone No.: (279) 207-1146 email: vreddy@airquality.org

ROCs	**Standard:**	
	Technology Description:	Natural gas: Combustion over 1,600 deg F
	Basis:	Achieved in Practice
NOx	**Standard:**	30 PPMV or 0.036 lb/MMBTU
	Technology Description:	30 PPMV corrected to 3% O2 when fired on natural gas
	Basis:	Achieved in Practice
SOx	**Standard:**	
	Technology Description:	No standard
	Basis:	Achieved in Practice
PM10	**Standard:**	
	Technology Description:	Natural Gas: Combustion over 1,600 deg F
	Basis:	Achieved in Practice
PM2.5	**Standard:**	
	Technology Description:	No standard
	Basis:	Achieved in Practice
CO	**Standard:**	
	Technology Description:	Not addressed
	Basis:	Achieved in Practice
LEAD	**Standard:**	
	Technology Description:	No standard
	Basis:	Achieved in Practice

Comments: This is a generic BACT determination based on BACT determinations made, and published, by other air agencies in California and/or other States.

777 12th Street, Ste. 300

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Sacramento, CA 95814

BEST AVAILABLE CONTROL TECHNOLOGY DETERMINATION

RESCINDED

DETERMINATION NOS.:	317
DATE:	May 20, 2022
ENGINEER:	Venk Reddy

Category/General Equip Description:	Crematory
Equipment Specific Description:	Crematory – Natural Gas
Equipment Size/Rating:	N/A
Previous BACT Det. No.:	212 & 232

This BACT determination will update both determination 212 for a human crematory and 232 for a pet crematory. The BACT determination will only evaluate the use of natural gas fired combustion source.

This determination will also include Best Available Control Technology for Toxics (T-BACT) for the hazardous air pollutants (HAP) associated with the process.

From the Cremation Association of North America, "Flame-based cremation uses flame and heat to reduce the human remains to bone fragments or cremated remains. This is completed within a machine called a cremator."

Pet crematories work in a similar fashion.

The BACT for CO will be addressed at a later date, when a project exceeds the threshold requiring limitations. It is not expected that this type of equipment will be large enough to trigger BACT requirements for CO, since the District CO BACT trigger level is 550 lbs/day.

BACT/T-BACT ANALYSIS

A. ACHIEVED IN PRACTICE (Rule 202, §205.1a):

The following control technologies are currently employed as BACT/T-BACT for crematories by the following agencies and air pollution control districts:

US EPA

BACT
Source: EPA RACT/BACT/LAER Clearinghouse

Pollutant	Crematory	
	Standard	Source
VOC	No standard	N/A
NOx	No standard	N/A
SOx	No standard	N/A
PM10	No standard	N/A
PM2.5	No standard	N/A
CO	No standard	N/A

No determinations were identified.

T-BACT
Source: EPA RACT/BACT/LAER Clearinghouse

No determinations were found.

RULE REQUIREMENTS:
None

California Air Resource Board (CARB)

BACT
Source: CARB BACT Clearinghouse

Pollutant	Crematory	
	Standard	Source
VOC	No standard	N/A
NOx	No standard	N/A
SOx	No standard	N/A
PM10	No standard	N/A

Pollutant	Crematory	
	Standard	Source
PM2.5	No standard	N/A
CO	No standard	N/A

No determinations were identified.

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:
No Rules have been identified.

Sacramento Metropolitan AQMD

BACT
Source: SMAQMD BACT Clearinghouse

From SMAQMD BACT #212 & 232 issued on 1/30/20 & 8/11/20	
VOC	Natural gas fuel and a secondary combustion chamber (afterburner) ≥ 1,600 °F
NOx	60 ppmv corrected to 3% O_2 or 0.073 lb/MMBTU, measured as emissions from the fuel burning, not with the charge.
SOx	Natural gas fired
PM10	Natural gas fired with secondary chamber operating at > 1,600 °F
PM2.5	No Standard
CO	Secondary Chamber ≥ 1,500 °F

BACT 232 has an operation restriction of 19,710 MMbtu/year and a charge limit of less than 677 tons of charge per year.

T-BACT
T-BACT has been identified as following the BACT requirements.

RULE REQUIREMENTS:
Rule 419 - NOx from Miscellaneous Combustion Units (10-25-2018)

New crematories fired at greater than 1,200 °F that are rated at 2 MMBTU/hr or greater located at a major source or greater than or equal to 5 MMBTU/hr located at an area source, must meet a standard of 60 ppmv corrected to 3% O_2 for NOx and 400 ppmv corrected to 3% O_2 for CO.

South Coast AQMD

BACT
Source: SCAQMD BACT Guidelines for Non-Major Polluting Facilities, Pg 38

SCAQMD BACT Guidelines for Non Major Polluting Facilities Rev 1 Date: 2-1-2019	
VOC	Natural gas fired, Secondary Chamber ≥ 1,500 °F
NOx	60 ppm compliance with Rule 1147 (A)
SOx	Natural gas fired
PM10	Natural gas fired, Secondary Chamber ≥ 1,500 °F
PM2.5	No Standard
CO	No Standard

(A) Rule 1147 was updated on 5-6-22 and no longer reflects the current rule requirement.

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:

Rule 1147 - NOx Reductions from Miscellaneous Sources

New crematories cannot exceed 30 ppmv corrected to 3% O_2 or 0.036 lb/MMbtu when fired on gaseous fuel or 60 ppmv or 0.073 lb/MMBTU when fired on liquid fuel and when the temperatures are greater than or equal to 1,200 °F and, per table 2 of this rule. CO limit of 1,000 ppmv corrected to 3% O_2 for all fuels. A phone call to SCAQMD (Derek Hollinshead, 909-396-2275), permitting department confirmed that the NOx standard is for the burner operation only and not the cremation process. Additional conversations with the author of the recent amendments (Shawn Wang on 5-20-22) shows that the new standards have been achieved in practice. This rule amendment was passed on May 6, 2022.

Requirements of Table 2 Rule 1147

Table 2 - NOx and CO emission limits	**NOx Emission Limit PPM @ 3% O_2, dry or Pounds/MMBTU heat input**	
	NOx Limit	**CO Limit**
Crematory - Gaseous Fuel Fired Equipment	30 ppmv or 0.036 lb/MMbtu	1,000 ppmv

San Joaquin Valley Unified APCD

BACT
Source: SJVUAPCD BACT Guideline 1.9.3 (6/9/22)

SJVAPCD BACT Guidline 1.9.3	
VOC	Natural gas fuel and a secondary combustion chamber (afterburner) ≥ 1,600 °F
NOx	60 ppmv@ 3% O_2 (0.73 lb/MMBTU) without charge
SOx	Natural gas fired
PM10	Natural gas fired and a secondary combustion chamber (afterburner) ≥ 1,600 °F
PM2.5	No Standard
CO	No Standard

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:
Rule 4302 Incinerator Burning
The rule states that a person shall not burn in any incinerator within the District except in a multi-chamber incinerator as defined in Rule 1020 (Definitions). Section 3.27 of Rule 1020 defines a multi chamber incinerator as that used to dispose of combustible refuse by burning. Since human or pet remains are not considered refuse, this definition and thus Rule 4302 is not applicable to this source category.

San Diego County APCD

BACT
Source: NSR Requirements for BACT (June 2011)

SDCAPCD NSR Requirements for BACT	
VOC	No Standard
NOx	No Standard
SOx	No Standard
PM10	No Standard
PM2.5	No Standard
CO	No Standard

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:
None

Bay Area AQMD

BACT
Source: BAAQMD BACT Guideline Document # 53.1 (9.12.2007)

From BAAQMD BACT Guideline – Crematory (Revision 1 Date: 9/12/2007)	
VOC	Secondary Combustion ≥ 1,500 °F
NOx	Natural Gas Fired
SOx	Natural Gas Fired
PM10	Secondary Combustion ≥ 1,500 °F
PM2.5	No Standard
CO	Secondary Chamber ≥ 1,500 °F

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:

None

Summary of Achieved in Practice Control Technologies

The following control technologies have been identified and are ranked based on stringency:

SUMMARY OF ACHIEVED IN PRACTICE CONTROL TECHNOLOGIES	
VOC	1) Natural gas fired and a secondary combustion chamber (afterburner) ≥ 1,600 °F, when fired on natural gas SMAQMD, SJVUAPCD, 2) Natural gas fired and a secondary combustion chamber (afterburner) ≥ 1,500 °F, when fired in natural gas SCAQMD, BAAQMD,
NOx	1) 30 ppmv corrected to 3% O_2 or 0.036 lb/MMbtu when using natural gas or 2) 60 ppmv corrected to 3% O_2 or 0.073 lb/MMBTU measurement of the fuel burned only, SMAQMD, SJVUAPCD 3) Natural gas fired, BAAQMD
SOx	Natural gas fired, SMAQMD, SCAQMD, BAAQMD, SJVUAPCD
PM10	1) Natural gas fired with secondary chamber operating at ≥ 1,600 °F SMAQMD, SJVAPCD 2) Natural gas fired with secondary chamber operating at ≥ 1,500 °F, SCAQMD, BAAQMD
PM2.5	No Standard

SUMMARY OF ACHIEVED IN PRACTICE CONTROL TECHNOLOGIES	
CO	1) 400 ppmv corrected to 3% O_2 if the unit is greater than or equal to 2 MMBTU/hr at a major source or greater than or equal to 5 MMBTU/hr at an area source. SMAQMD 2) Secondary chamber operating at ≥ 1,500 °F, BAAQMD 3) 1,000 ppmv at 3% O_2, SCAQMD

CO
The 400 ppmv corrected to 3% O_2 CO requirement listed in the table above was taken from SMAQMD Rule 419. Since there are currently no crematory units that operate at a major source nor any rated at greater than 5 MMBTU/hr operating at area sources, this standard will not be considered achieved in practice for this application.

The following control technologies have been identified as the most stringent, achieved in practice control technologies:

BEST CONTROL TECHNOLOGIES ACHIEVED		
Pollutant	**Standard**	**Source**
VOC	Natural gas fuel and a secondary combustion chamber (afterburner) ≥ 1,600 °F (natural gas)	SMAQMD, SJVUAPCD
NOx	30 ppmv correct to 3% O_2 or 0.073 lb/MMBTU (natural gas)	SCAQMD
SOx	Natural gas fired	SCAQMD, SMAQMD, BAAQMD, SJVAPCD
PM10	Natural gas fired with secondary chamber operating at ≥ 1,600 °F	SMAQMD, SJVAPCD, BAAQMD
PM2.5	No standard	
CO	Secondary chamber operating at ≥ 1,500 °F (natural gas) & 1,000 ppmv correct to 3% O_2 (natural gas)	BAAQMD, SCAQMD

B. TECHNOLOGICALLY FEASIBLE AND COST EFFECTIVE (Rule 202, §205.1.b.):

Per the October 2015, "Procedures for Making Best Available Control Technology (BACT) and Best Available Control Technology for Toxics (T-BACT) Determinations for new and Modified Emission Units" the interest rate used to calculate the CRF is the 6-month average of the ten year treasury + 2% rounded up. As of April 2022, the 10-year treasury rate (as found on http://www.multpl.com/10-year-treasury-rate/table/by-month) for the last 6 months beginning in October 2021 and ending in April 2022 is 1.56%, 1.47%, 1.76%, 1.93%, 2.13%, and 2.75%. The average is 1.93%. Therefore, the resultant annual interest rate to be used is 1.93% + 2% = 3.93% or 4%. The CRF value in the calculation tables have been updated. NOx values have also been adjusted to take into account the 30 ppmv corrected to 3% O_2 requirement for NOx. Calculations for the SCR system have been adjusted to show both volumetric standards.

Technologically Feasible Alternatives:
Any alternative basic equipment, fuel, process, emission control device or technique, singly or in combination, determined to be technologically feasible and cost effective by the Air Pollution Control Officer.

Updated in 2005, the SJVAPCD lists the use of a baghouse with a dry scrubber or a wet scrubber as technologically feasible for the control of SOx, the use of a baghouse and venturi scrubber for the control of PM10 and the use of an SCR or a low NOx burner for the control of NOx. The control strategies appear to be carryovers from other natural gas combustion operations and do not appear to be fully evaluated for a crematory. The BAAQMD evaluated the same source category in 2007 and do not list a baghouse, venturi scrubber, the use of an SCR or a low NOx burner as technologically feasible options. No other district lists these options as technologically feasible either. Additionally, SMAQMD contacted SJVAPCD (Manuel Salinas, Air Quality Engineer, 559-230-5833) and verified that an SCR, low NOx burner, baghouse or scrubber has not been installed on any crematories to date. Irrespective of the discussion above that questions San Joaquin's intent for listing add on controls as being technologically feasible for a crematory application, the following analysis will assume that add on controls are technologically feasible and a cost effectiveness determination needs to be conducted to determine if add on controls are in fact considered cost effective.

NOx:
A cost effectiveness analysis was done to determine if an SCR system could be considered cost effective to control the NOx from a crematory and is calculated in Appendix A of this document. The crematory is estimated to have a burner that when fired with no body will emit NOx at less than 30 ppmv when fired on natural gas. To estimate the NOx emissions attributed to the burning of the charge, AP-42 Chapter 2.3 - Medical Waste Incineration Table 2.3-1(7/93) was used. This value for NOx is 3.56 lb of NOx per ton of charge. As a worst-case assumption, and consistent with the crematory permitting manual of the BAAQMD, the NOx emission factor that is used in this analysis will be the combined emission factor of 4.43 of NOx/ton of charge which includes the emission factor of combustion added to the emission factor from burning of the charge. Calculations are based on a crematory rated at 2.7 MMBTU/hr with a burn rate of 225 lbs/hr.

With a burn rate of 225 lbs per hour, and operation occurring 12 hours per day, 6 days per week, and 52 weeks per year, the total charge would be 421 tons per year. With an SCR NOx control efficiency of 90%, the NOx emissions from the crematory is calculated to be 0.1 tons per year (421 TPY*4.43 lb/ton * (1 - 0.9) / 2000 lb/ton = 0.1 tons/year).

A cost for an SCR system was estimated using EPA's Cost Control Manual, 6th Edition. The SCR sizing criteria for which the costs are based are primarily determined from the exhaust flow rate and temperature. The spreadsheet that was used determines the flow rate from the burner rating. However, a crematory unit's flow rate is much larger than the flow rate estimated from the burner rating alone as it is dependent on exhaust generated from gas combustion, exhaust generated from the charge itself, and additional excess air. As a result, the analysis will utilize the actual average flow rate observed during source testing of two identical crematory units and a calculated equivalent burner rating.

The total annualized cost for the SCR system is estimated to be $47,379. The total NOx controlled would be 0.8 (@ 30 ppmv) (421 tpy * 4.43 lb/ton * 0.9/2000 lb/ton=0.8). The analysis shows the cost effectiveness calculation to be $56,376 per ton of NOx reduced. Since the District's cost effectiveness threshold for NOx is $24,500 per ton, the addition of the

SCR would not be considered cost effective.

Total Annualized Cost of SCR	Quantity of NOx Controlled (TPY)	Cost of SCR per ton removed	SMAQMD cost effective threshold for NOx	Cost effective
$47,379	0.8 @ 30 ppmv	$ 56,376 @ 30 ppmv of NOx	$24,500	No

PM:
A screening cost effectiveness analysis was done to determine if a baghouse could be considered cost effective to control the particulate from a crematory. Based on source testing of a crematory unit (P/O 24785 North Sacramento Funeral home Inc. source test) only about 32% of the total particulate collected is filterable. However, this analysis will assume that the baghouse will collect 100% of the filterable emissions which would be approximately 0.152 tons/yr, based on 12 hrs/day, 6 days/week, and 52 weeks/yr. With the District's particulate cost effectiveness threshold of $11,400/ton, interest rate of 4% and an equipment life of 10 years, the capital cost for the control would have to be less than $14,055 to be considered cost effective.

Based on EPA's Cost Control Manual, 6th Edition, the capital cost of a baghouse needed to control the flow characteristics of a crematory is estimated to be approximately $21,499.74 (refer to Attachment A). Since the capital costs of a baghouse alone is higher than the capital costs needed to be considered cost effective, the baghouse will not be considered cost effective. The analysis above only considers the amortized capital costs of the control device and no other annualized costs (such as maintenance, energy, etc.) were included. Inclusion of these other annualized costs would only drive the cost effectiveness higher.

Therefore, the conclusion is that a baghouse used to control particulate matter for a crematory is not considered cost effective and as such will not be considered BACT. See Appendix A for cost analysis.

Total Annualized Cost of a Baghouse	Quantity of PM10 Controlled (TPY)	Cost of a Baghouse per ton Removed	SMAQMD cost effective Threshold for PM10	Cost Effective
$2,651	0.152	$17,448	$11,400	No

A screening cost effective analysis was done for a venturi scrubber using the EPA Cost Control Manual, 6th Edition. Unlike the baghouse discussion above, the entire PM quantity (filterable and condensable) was used for cost effectiveness determination, as opposed to only the filterable fraction of PM for the baghouse. The lowest cost option was considered when making the determination of costs. A venturi scrubber system sized to control 3,337 cfm of exhaust gas is estimated to cost $82,572 (refer to Attachment A) which only takes into account the equipment costs. The cost effectiveness for this system would then be $38,745 per ton of PM controlled. Since the system costs are greater than the District's cost effectiveness criteria, a venturi scrubber is not considered cost effective.

Total Annualized Cost of Venturi Scrubber	Quantity of PM10 Controlled (TPY)	Cost of Venturi per ton removed	SMAQMD cost effective threshold for PM10	Cost effective
$10,180	0.152	$66,976	$11,400	No

SOx:A cost effectiveness analysis was done for the control of SOx with the use of a wet scrubber. Based on the information presented in the EPA Cost Control Manual, 6th Edition, the cost of the capital equipment was selected by using the lowest surface area and subsequent cost information available in this section of the manual. For SOx, the District's cost effectiveness threshold is $18,300 per ton. The cost of the wet scrubber was estimated to have a total annual cost of $27,308 (refer to Attachment A) and control efficiency was assumed to be 100%. The cost of the electricity, or caustic was not considered. The total SOx emissions controlled is 0.46 tons/year. The cost per ton removed for this control was calculated to be $58,807.49 and therefore is not considered to be cost effective.

Total Annualized Cost of Wet Scrubber	Quantity of SOx Controlled per yr	Cost of wet scrubber per ton removed	SMAQMD cost effective threshold for SOx	Cost effective
$27,052	0.46 tons	$58,808	$18,300	No

The EPA Cost Control Manual, 6th Edition does not have a chapter on dry scrubbers. A dry scrubber consists of a dry reactant or powder injection system and a baghouse. Costs for a dry scrubber are estimated using the equipment costs of a baghouse plus the annual operating costs of a wet scrubber. Since the reference manual does not have cost information for the powder injection system, the cost of electricity, powder reactant and the powder injection system was not considered in this analysis. The total annualized costs are estimated to be $23,132 (refer to Attachment A). The cost per ton of SOx removed is calculated to be $50,286 and therefore is not considered to be cost effective.

Total Annualized Cost of Dry Scrubber	Quantity of SOx Controlled (TPY)	Cost of Dry Scrubber per ton Removed	SMAQMD Cost Effective Threshold for SOx	Cost Effective
$23,131.52	0.46	$50,285.91	$18,300	No

PM + SOx:
Per the SMAQMD *Procedures for Making Best Available Control Technology (BACT) and Best Available Control Technology for Toxic (T-BACT) Determinations for New and Modified Emission Units (10/15)*, when a control technology is expected to control multiple forms of criteria pollutants both shall be assessed for cost effectiveness. In the case of a wet scrubber, the control of SOx, and PM10 should be considered. Per the calculation method found in the document, and assuming that 100% of PM10 and SOx is removed by the wet scrubber:

$$\text{Max Cost} = \sum^{P} (\text{Emissions Reduced} * \text{Cost Effectiveness Value})$$

P = Each pollutant subject to BACT

Max Cost = (0.152 ton PM10/yr X $11,400/ton PM) + (0.46 ton SOx/yr X $18,300/ ton SOx)
= $10,150.80/ yr

Since the annualized costs of a wet scrubber or a dry scrubber with baghouse is $27,051.45 and/or $23,131.52, respectively and since either is greater than the Max Cost value calculated above the use of a wet scrubber or dry scrubber with baghouse is not considered cost effective.

APC Device	Total Annualized Cost	Quantity of SOx & PM10 Controlled per Yr	Aggregate Max Cost Threshold for SOx & PM10	Cost Effective
Wet Scrubber	$27,051.45	0.46 tons SOx 0.156 tons PM10	$10,150.80	No
Dry Scrubber with Baghouse	$23,131.52	0.46 tons SOx 0.156tons PM10	$10,150.80	No

C. SELECTION OF BACT:

No technologically feasible control technologies were found to be cost effective and therefore not selected. BACT will be standards that have been achieved in practice.

BACT for a crematory with operation restrictions of 19,710 MMBTU/hr and a 677 ton per year charge limit		
Pollutant	**Standard**	**Source**
VOC	Natural gas fuel and a secondary combustion chamber (afterburner) ≥ 1,600 °F	SMAQMD, SJVUAPCD
NOx	30 ppmv corrected to 3% O_2 or 0.036 lb/MMBTU, measured as emissions from the fuel burning, not with the charge.	SCAQMD
SOx	Natural gas fired	SCAQMD, SMAQMD, BAAQMD, SJVAPCD
PM10	Natural gas-fired with secondary chamber operating at ≥ 1,600 °F	SMAQMD, SJVAPCD,
PM2.5	No Standard	
CO	Not addressed	

D. SELECTION OF T-BACT:

There are no Federal NSPS's, NESHAP's nor State ATCM's for this source category. None of the sources surveyed have any toxic T-BACT determinations published. The District contacted the SCAQMD, the BAAQMD and the SJVAPCD to inquire about any T-BACT determinations that may not have been published for this source category. In all cases, the T-BACT determinations were essentially the crematory's operational parameters that have been required as BACT. Therefore, T-BACT standards will be considered as meeting the BACT standards identified above.

APPROVED BY: Brian F Krebs **DATE:** **01-30-2023**

Attachment A

Cost Analysis

SCR COST EFFECTIVENESS CALCULATION

EPA AIR POLLUTION CONTROL COST MANUAL, Sixth Edition, EPA/452/B-02-001, January 2002
Section 4.2 - NOx Post-Combustion, Chapter 2 - Selective Catalytic Reduction

Cost Effectiveness = $ 56,375.50 $/ton

Equipment

Crematory rating	5.914481559	mmBTU/hr	Back Calculated from flow rate							
Crematory Operating hours	3744	hours								
Crematory capacity factor	1									
SCR Operating Days	312	days								
Total Capacity Factor	0.854794521									
Baseline Nox (225 lb/hr burn rate, 3.56 lb/ton of charge*, 1.8 MMBTU/hr)										
*Nox emission Rate from AP-42 Table 2.3-1 Medical waste incineration	2.23E-01	lb/mmBTU								
SCR Nox (90% control)	2.23E-02	lb/mmBTU								
Ammonia Slip	10	ppm								
Ammonia Stochiometric Ratio	1.05									
Stored Ammonia Conc	29	%								
Amonnia Storage days	90	days								
Sulfur Content	0.005	%								
Pressure drop for SCR Ductwork	3	inches W.G.		Buffalo Cremation			Lifeplan Cremations			
Pressure drop for each Catalyst Layer	1	inche W.G.		9/18/2008			1/1/2011			**AVE**
Temperature at SCR Inlet	1297.783333	degrees F		1316	1241	1193	1336.8	1366.3	1333.6	**1297.78**
Cost year	1998									
Equipment Life	10	years								
Annual interest Rate	4	%								
Catalyst cost, Initial	240	$/ft2								
Catalyst cost, replacement	290	$/ft2								
Electrical Power cost	0.05	$/KWh								
Ammonia Cost	0.101	$/lb								
Catalyst Life	24000	hr								
Catalyst Layers	2 full, 1 empty									

Crematory Calculations

Q_B	5.914481559	mmBTU/hr							
$q_{flue\ gas}$	3337.4	acfm	3904.7	3445.7	3734	2954	2976	3010	**3337.4**
N_{NOx}	0.9								

SCR Reactor Calculations

$Vol_{Catalyst}$	134.1927791	ft3
$A_{Catalyst}$	3.476458333	ft2
A_{SCR}	3.997927083	ft2
l=w=	1.999481704	ft
n_{layer}	12	
h_{layer}	4.216702322	
n_{total}	13	
h_{SCR}	154.8171302	ft

Reagent Calculations

$m_{reagent}$	0.51144438	lb/hr
m_{sol}	1.763601312	lb/hr
q_{sol}	0.23559824	gph
Tank Volume	508.8921974	gal

Cost Estimation

Direct Costs

DC	$	219,976.07	

Indirect Costs

General Facilites	$	10,998.80	
Engineering and home office fees	$	21,997.61	
Process Contingency	$	10,998.80	
Total Indirect Installation Costs	$	43,995.21	
Project Contingency	$	39,595.69	
Total Plant Cost	$	303,566.98	
Preproduction Cost	$	6,071.34	
Inventory Capital	$	384.75	
Total Capital Investment	$	310,023.07	

Direct Annual Costs

Maintenance Costs	$	4,650.35	per yr
Power		5.092523877	KW
Annual Electricity	$	1,906.64	per yr
Reagent Solution Cost	$	1,560.36	per yr

Catalyst Replacement

FWF		0.320348539	
Annual Catalyst Replacement	$	1,038.89	per yr
Total Variable Direct Cost	$	4,505.89	per yr
Total Direct Annual Cost	$	9,156.24	per yr
CRF		0.123290944	
Indirect Annual Cost	$	38,223.04	per yr
Total annual Cost	$	47,379.28	per yr
NOx Removed		0.84	tons per year
Cost of Nox controlled per ton removal	$	56,375.50	per ton

3.56	NOX lb/ton(A)		225 lb/hr (B)
	(A) - Table 2.3-1 AP-42, 2.3 Medical Waste Incineration		(B) Burn rate of the crematory
0.87	Nox lb/ton (C)	based ona 2.7 mmbtu/hr unit	
	(C) - Natural gas combustion at 30 ppm		
4.43	Combined Nox lb/ton		
tons of charge based on 12 hrs a day 6 days a week 52 weeks a year and burn rate of crematory	lb of Nox based on 3.56 lb of Nox/ ton of charge	LB of Nox controlled based on 90%	
421 tons	0.93 tons	0.84 tons	

Venk Reddy

From: Venk Reddy
Sent: Monday, January 30, 2023 7:20 AM
To: Cheryl D. Roberts; twkipp@verdantas.com
Cc: Steve Mosunic
Subject: Sac Air Quality Response to Comment RE: BACT #317 Crematory (Pet and Human)

Dear Ms. Roberts,

Thank you for submitting a comment regarding the Sacramento Air Quality BACT determination #317 for Crematory operations and participating in the BACT review process. Sacramento Air Quality has contacted South Coast Air Quality Management District (SCAQMD) and reviewed the rule making information provided for SCAQMD Rule 1147. This rule is the basis of the updated NOx standard in BACT #317. SCAQMD considers the 30 ppm NOx corrected to 3% O2 standard achieved in practice for crematories. This has been verified with source tests that show emissions for crematories have met this limit. Since the NOx emission standard is considered achieved in practice, Sacramento Air Quality must adopt it as a BACT limit. The comment period for BACT # 317 has concluded and will not be extended.

Thanks
Venk Reddy
Permit Engineer - SMAQMD

From: BACT Determinations <bactdeterminations@airquality.org>
Sent: Tuesday, January 24, 2023 6:59 AM
To: Venk Reddy <VReddy@airquality.org>
Cc: Brian Krebs <BKrebs@airquality.org>; Steve Mosunic <SMosunic@airquality.org>
Subject: FW: BACT #317 Crematory (Pet and Human)

Only comment received in the BACT email inbox for BACT 317.

Ali

From: Cheryl D. Roberts <cdroberts@verdantas.com>
Sent: Monday, January 23, 2023 4:11 PM
To: BACT Determinations <bactdeterminations@airquality.org>
Cc: Timothy W. Kipp <twkipp@verdantas.com>
Subject: BACT #317 Crematory (Pet and Human)

We are working on a crematory unit installation project and were recently made aware during the application process of the new NOx BACT standard for natural gas burners utilized in cremation units. We, and the unit manufacturer, are having difficulty in locating a burner that meets the 30 ppm NOx standard that is available and appropriate for use in cremation. At this time we have not definitively concluded our search for an appropriate burner. However, with the comment deadline of January 23rd we are raising the concern from the results of the search thus far that burners which meet the new standard are difficult to locate and implement in cremation units. We would appreciate the opportunity to comment further on the standard once our efforts to locate such burners have concluded.

Thank you.
Cheryl

Cheryl Roberts
(She/Her/Hers)
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