

December 16, 2022

Regional Program Manager
PA Department of Environmental Protection
Northeast Regional Office
2 Public Square
Wilkes-Barre, PA 18711-0790

**Subject: VOC RACT 3 Proposal Submission
Victaulic Company – Forks Facility
Forks Township, Northampton County, PA
Title V Operating Permit No. 48-00009**

Dear Sir / Madam:

On behalf of Victaulic Company (Victaulic), AECOM Technical Services, Inc. (AECOM) has prepared this submission to satisfy the requirements of 25 Pa. Code 129.96-129.100, *Additional RACT Requirements for Major Sources of NOx and VOCs* for Victaulic's Forks Facility located at 4901 Kesslersville Road, Easton, PA 18040. The Forks facility is a major source of VOCs and currently operates under Title V Operating Permit 48-00009.

On October 24, 2016 Victaulic submitted a "VOC RACT 2 Proposal" which documented the costs associated with installing VOC controls on source ID's P005 (Pouring / Casting Operations), P008 (Sand Handling / Casting Shakeout) and P016 (Core Room Operations). These three sources were both over the VOC RACT threshold and did not have a promulgated presumptive RACT.

As documented in the October 24, 2016 submittal (included as Attachment B), these three VOC sources consist of high flow, low mass emissions consisting of a multitude of VOC species. These types of streams are generally treated by thermal oxidation or carbon adsorption. Furthermore, as described in their submittal, controlling VOC emission from P005 and P008 would require additional particulate control prior to the VOC control. There are additional significant capital and technological considerations described in the October 24, 2016 submittal; however, the conclusion of that submittal was that there are no control technologies available that are cost effective assuming a RACT benchmark of \$7,000 or less per ton of VOC removed.

Since that October 24, 2016 submittal, there have been no modifications to these sources and no other changes to the facility that would significantly impact (i.e. reduce) the costs associated with the procurement and installation of VOC controls. Victaulic had utilized a cost adjustment factor based on inflation from the Federal Bureau of Labor Statistics (BLS) from 1998 (when the US EPA published its cost estimation tool for the installation of emissions controls) to 2016. This escalation factor was \$1.46 (2016) / \$1.00 (1998). Currently, this escalation factor is \$1.84 (2022 – October) / \$1.00. Furthermore, the cost of labor has also increased a commensurate factor according to similar BLS data. As a result, Victaulic asserts that its previous RACT II evaluation and conclusions are still valid and that there are no additional VOC controls that can be installed

This submittal includes this cover letter along with the following:

- Attachment A – Responsible Official Certification;
- Attachment B – October 24, 2016 RACT II Submittal;
- Attachment C – RACT III Submittal.

If you have any questions on this application, please do not hesitate to contact Kevin Voit at 610-529-0613 or Kraig Hume, Global Environmental Manager for Victaulic at Kraig.Hume@victaulic.com or 610-559-3476

Sincerely,

Handwritten signature of Kevin W Voit in black ink.

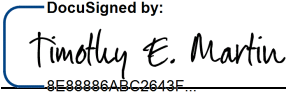
Kevin Voit
Manager, Air Permitting and Compliance Services
kevin.voit@aecom.com

Attachment A – Responsible Official Certification

**VOC RACT 3 Proposal Submission
Victaulic Company – Forks Facility
Forks Township, Northampton County, PA
Title V Operating Permit No. 48-00009**

Certification of Truth, Accuracy and Completeness by a Responsible Official

I certify that, subject to the penalties of Title 18 Pa. C.S.A. Section 4904 and 35 P.S. Section 4009(b)(2), I am the responsible official having primary responsibility for the design and operation of the facilities to which this submittal applies and that the information provided in this application is true, accurate, and complete to the best of my knowledge, information, and belief formed after reasonable inquiry.

(Signed)  Date: 12/16/2022

Name (Typed): Timothy E. Martin Title: VP US Operations

Telephone: (610) 923-3859

Email: tim.martin@victaulic.com

Attachment B – Previous RACT II Submittal



October 24, 2016

Regional Air Program Manager
PA Department of Environmental Protection
Northeast Regional Office
2 Public Square
Wilkes-Barre, PA 18711-0790

VIA CERTIFIED MAIL 7011 2970 0001 8743 6301

**Re: VOC RACT 2 Proposal Submission
Victaulic Company - Forks Facility
Forks Township, Northampton County, Pennsylvania
Title V Operating Permit No. 48-00009**

Dear Sir/Madam:

Victaulic Company (Victaulic) has prepared this submission to satisfy the requirements of 25 Pa. Code §§129.96-129.100, *Additional RACT Requirements for Major Sources of NOx and VOCs* for its Victaulic Company-Forks Facility located at 4901 Kesslersville Road, Easton, PA 18040. The Forks Facility is a major source of volatile organic compounds (VOCs) and currently operates under Title V Operating Permit 48-00009.

The Forks Facility manufactures ductile iron pipe fittings with functions including a foundry, general manufacturing, surface coating, assembly/testing, and distribution operations. Along with the VOC sources subject to 25 Pa. Code §129.99(d) (RACT 2 Proposal), there are other VOC sources that either are not applicable since the source's potential to emit is less than 1 tpy (e.g., P004: Inoculation, P014: Annealing Operation) or are subject to and comply with 25 Pa. Code §129.52 (e.g., P009: Large Piece Spraybooth, P012A: Dip Process Paint System). The remainder of this document will address the sources subject to the RACT 2 Proposal requirements.

Sources Subject to Alternative RACT Requirements & their Permit Limits/Capacity

Source ID	Source Name	Permit Limits	
P005	Pouring/ Casting Operations	134,784 tons of scrap/ year	7,488 hours/year
P008	Sand Handling (Casting Shakeout)		

Source ID	Source Name	Capacity	Operating Hours
P016	Core Room Operations	60,000 tons of sand/year	8,760 hours/year

4901 Kesslersville Road
Easton, PA 18040 USA

610-559-3300
610-250-8817 (fax)



Physical Description of Sources Subject to Alternative RACT Requirements

- *P005: Pouring/Casting Operations – SCC 3-04-003-20*

The source of VOCs is the volatilization of organic materials contained within the casting sand and cores. The VOCs are liberated the moment the 2700°F molten iron is poured into the sand mold. The Forks Foundry has two (2) separate sand molding machines, two (2) Disamatic molding machines. Each sand molding machine has one (1) pouring zone for a facility total of two (2) pouring zones.

Particulate matter emissions from the Pouring/Casting Operations source are currently ducted to one of two (2) large baghouses. The combined exhaust volume is approximately 16,000 cubic feet per minute to exhaust the Pouring/Casting Operations. Due to the particulate loading from this source, the RACT analysis will include the installation of a dedicated baghouse to prevent fouling of the VOC control device.

- *P008: Sand Handling (Casting Shakeout) – SCC 3-04-003-31*

The source of the VOCs in the casting shake-out area is the continued volatilization of organic material from the time the molten iron is poured into the sand mold. Once poured on one of the two (2) molding lines, the castings cool and are conveyed to one of two (2) Didion rotary drum shake-out units where the sand is tumbled away from the iron castings.

Particulate matter emissions from the Sand Handling (Casting Shakeout) source are currently ducted to one of two (2) large baghouses. The combined exhaust volume is approximately 47,000 cubic feet per minute to exhaust the Sand Handling (Casting Shakeout). Due to the particulate loading from this source, the RACT analysis will include the installation of a dedicated baghouse to prevent fouling of the VOC control device.

- *P016: Core Room Operations – SCC 3-04-003-70*

The primary sources of VOCs in the Core Room Operations consist of cold box (isocure) core production and shell core production.

The cold-box core production consists of a two-part resin and a catalyst. Sand is mixed with the two-part resin and formed into a core. Then the catalyst is used to accelerate the curing of the resin. VOC emissions from the catalyst are exhausted to an acid scrubber; whereas, VOC emissions from the resin are exhausted via general facility ventilation over a period of time, up to 7 days (168 hours) after the core is formed.

The shell core production consists of resin-coated sand being formed and then heated with burners fueled by natural gas. VOC emissions from the shell core production are exhausted via general facility ventilation.

The general facility exhaust volume is approximately 75,000 cubic feet per minute.

Along with the shell core machines, there is a water heater that uses natural gas. The maximum natural gas usage is 46.53 mmcf/year. Based on AP-42/ FIRE emission factors for SCC 01-02-006-02, the VOC emissions are minimal at 0.13 tons per year.



Actual & Potential VOC Emissions of Source Subject to Alternative RACT Requirements

Source ID	Source Name	2015 Actual VOC Emissions	Potential to Emit Emissions
P005	Pouring/ Casting Operations	1.33 tpy	9.43 tpy
P008	Sand Handling (Casting Shakeout)	11.40 tpy	80.87 tpy
P016	Core Room Operations	1.96 tpy	9.22 tpy

RACT Analysis of Sources Subject to Alternative RACT Requirements

As described above, the VOC sources to be controlled consist of high flow, low mass emissions consisting of a multitude of volatile organic species. Due to these overall characteristics, control technologies that are generally employed to successfully treat low-concentration VOC air streams are thermal oxidation and carbon adsorption.

As described above, P005: Pouring/Casting Operations and P008: Sand Handling (Casting Shakeout) are exhausted to two (2) dust collectors, which also control other non-applicable sources. Prior to VOC removal using the identified technologies, primary treatment of these streams for particulate matter would be required to prevent fouling and malfunction. For the purpose of this evaluation, it is assumed that a new dedicated pulse-jet, modular collector would be provided to the RACT-applicable sources prior to VOC control, as the alternative (providing VOC control for all the collectors' exhaust volume) would be unnecessary, impractical, and more costly on a capital and operating basis.

Some other key assumptions made in the control technology evaluation are as follows:

- Even though the facility currently has effective particulate matter control, the existing hoods and capture systems are not designed for VOC capture. The capture efficiencies have never been determined as it relates to VOCs. Thus, 90% capture efficiency of VOCs was assumed for the evaluation.
- For the thermal oxidation control technology, a 99% destruction efficiency was assumed. Various heat recovery scenarios (0%, 35%, 50%, and 70%) were evaluated.
- For the carbon adsorption control technology, an 85% adsorption efficiency was assumed.
- The baghouse designs were based on Victaulic's current standardized approach of modular design, bag type and size, and an air-to-cloth ratio of 4. Waste disposal and utility costs were not accounted in the cost estimates, because these were assumed to be already incurred through existing baghouse collection systems.
- For the thermal oxidation control technology where annual costs were evaluated at the various heat recovery rates, a 1-to-1 cost savings was conservatively assumed for each BTU recovered.
- No costs associated with building modifications or site preparations were included.

Attachments A and B detail the capital and annual costs, as well as the VOC reduction cost rates associated with thermal oxidation and carbon adsorption control technologies, respectively. Below is a summary of the RACT Analysis for both control technologies; only the thermal oxidation 0% and 70% heat recovery scenarios are presented. As can be seen, none of the control technologies are cost effective assuming a RACT benchmark of \$7,000 or less per ton of VOC removed.



Summary of VOC RACT Analysis

Control Technology	Potential Emissions	Overall Control Efficiency (Capture x Control)	Emissions After Control	Annualized Cost (\$/year) (Capital + Operating)	Cost Effectiveness (\$/ton of VOC reduced)
P005: Pouring/Casting Operations					
Thermal Oxidation – 0% Heat Recovery	9.43 tpy	89.1%	1.03 tpy	\$3,052,000	\$363,000
Thermal Oxidation – 70% Heat Recovery		89.1%	1.03 tpy	\$1,257,000	\$150,000
Carbon Adsorption		76.5%	2.22 tpy	\$2,981,000	\$413,000
P008: Sand Handling (Casting Shakeout)					
Thermal Oxidation – 0% Heat Recovery	80.87 tpy	89.1%	8.81 tpy	\$8,324,000	\$116,000
Thermal Oxidation – 70% Heat Recovery		89.1%	8.81 tpy	\$2,944,000	\$41,000
Carbon Adsorption		76.5%	19.0 tpy	\$8,036,000	\$130,000
P016: Core Room Operations					
Thermal Oxidation – 0% Heat Recovery	9.22 tpy	89.1%	1.00 tpy	\$12,770,000	\$1,554,000
Thermal Oxidation – 70% Heat Recovery		89.1%	1.00 tpy	\$4,142,000	\$504,000
Carbon Adsorption		76.5%	2.17 tpy	\$13,700,000	\$1,942,000

Should you have any questions, please do not hesitate to contact me at (610) 559-3476 or kraig.hume@victaulic.com.

Sincerely,

Kraig L. Hume, CHMM
 Manager, Environmental Engineering

Attachment A: Thermal Oxidizer
 Attachment B: Carbon Adsorption

cc: Tim Martin, Victaulic-Forks Facility Plant Manager

CERTIFIED MAIL™



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Attachment A-Thermal Oxidation

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-1
Thermal Oxidation
Cost Summary

Total Thermal Oxidizer Installed Cost Estimate		
Technology Description:	Thermal Oxidizer	
Category	Cost	
0% Heat Recovery		
Casting Shakeout (CS)	\$	362,803
Casting Pouring (CP)	\$	281,489
Core Room	\$	405,015
35% Heat Recovery		
Casting Shakeout (CS)	\$	609,615
Casting Pouring (CP)	\$	460,213
Core Room	\$	688,668
50% Heat Recovery		
Casting Shakeout (CS)	\$	704,495
Casting Pouring (CP)	\$	538,009
Core Room	\$	791,883
70% Heat Recovery		
Casting Shakeout (CS)	\$	879,627
Casting Pouring (CP)	\$	671,898
Core Room	\$	988,646

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-2
Thermal Oxidation
Cost Summary

Total Dust Collector Installed Cost Estimate		
Technology Description:	Dust Collector	
Category	Cost	
0% Heat Recovery		
Casting Shakeout (CS)	\$	588,971
Casting Pouring (CP)	\$	199,225
Core Room	\$	-
35% Heat Recovery		
Casting Shakeout (CS)	\$	588,971
Casting Pouring (CP)	\$	199,225
Core Room	\$	-
50% Heat Recovery		
Casting Shakeout (CS)	\$	588,971
Casting Pouring (CP)	\$	199,225
Core Room	\$	-
70% Heat Recovery		
Casting Shakeout (CS)	\$	588,971
Casting Pouring (CP)	\$	199,225
Core Room	\$	-

Victaulic Company - Forks Facility
 VOC RACT 2 Evaluation
 Table A-3
 Thermal Oxidation
 Cost Summary

Annual Cost Estimate		
Technology Description:	Thermal Oxidizer & Dust Collector	
Category	Cost	
0% Heat Recovery		
Casting Shakeout (CS)	\$	8,324,424
Casting Pouring (CP)	\$	3,051,739
Core Room	\$	12,769,626
35% Heat Recovery		
Casting Shakeout (CS)	\$	5,634,987
Casting Pouring (CP)	\$	2,152,320
Core Room	\$	8,458,291
50% Heat Recovery		
Casting Shakeout (CS)	\$	4,477,867
Casting Pouring (CP)	\$	1,766,122
Core Room	\$	6,603,239
70% Heat Recovery		
Casting Shakeout (CS)	\$	2,944,476
Casting Pouring (CP)	\$	1,256,578
Core Room	\$	4,141,919

Victaulic Company - Forks Facility
 VOC RACT 2 Evaluation
 Table A-4
 Thermal Oxidation
 Cost Summary

VOC Reduction Cost	
Technology Description:	Thermal Oxidizer & Dust Collector
Category	Cost of Control (\$/ton)
0% Heat Recovery	
Casting Shakeout (CS)	\$ 115,528
Casting Pouring (CP)	\$ 363,210
Core Room	\$ 1,554,424
35% Heat Recovery	
Casting Shakeout (CS)	\$ 78,204
Casting Pouring (CP)	\$ 256,164
Core Room	\$ 1,029,613
50% Heat Recovery	
Casting Shakeout (CS)	\$ 62,145
Casting Pouring (CP)	\$ 210,199
Core Room	\$ 803,801
70% Heat Recovery	
Casting Shakeout (CS)	\$ 40,864
Casting Pouring (CP)	\$ 149,555
Core Room	\$ 504,189

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-5
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Shakeout - 0% Recovery	
Design Inputs:			
Volumetric flowrate (scfm): (500 - 50,000)		48,754	
Heat Recovery (%):		0	
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 225,344
Thermal Oxidizer (EC)			\$ 190,969
Intrumentation	10%	EC	\$ 19,097
Sales Tax	3%	EC	\$ 5,729
Freight	5%	EC	\$ 9,548
Direct Installation Costs (DIC)			\$ 67,603
Foundations and supports	8%	PEC	\$ 18,027
Handling and erection	14%	PEC	\$ 31,548
Electrical	4%	PEC	\$ 9,014
Piping	2%	PEC	\$ 4,507
Insulation for ductwork	1%	PEC	\$ 2,253
Painting	1%	PEC	\$ 2,253
Indirect Installation Costs (IIC)			\$ 69,857
Engineering	10%	PEC	\$ 22,534
Construction and field expenses	5%	PEC	\$ 11,267
Contractor fees	10%	PEC	\$ 22,534
Start-up	2%	PEC	\$ 4,507
Performance test	1%	PEC	\$ 2,253
Contingencies	3%	PEC	\$ 6,760
Total Capital Investment (PEC + DIC + IIC)			\$ 362,803

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-6
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Shakeout - 0% Recovery	
Design Inputs:			
Annual Natural Gas Consumption (MCF)		788,000	
Natural Gas Cost (\$/MCF)		10.00	
Annual Electrical Consumption (kWh)		274,500	
Electrical Cost (\$/kWh)		0.07	
Equipment Life (years)		10	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 7,949,305
Operating Labor			
Operator	0.5 hr/shift	\$32.20/hr	\$ 15,070
Supervisor	15% of operator	-	\$ 2,260
Maintenance			
Labor	0.5 hr/shift	\$35/hr	\$ 16,380
Materials	100% of maintenance labor	-	\$ 16,380
Utilities			
Natural Gas	-	-	\$ 7,880,000
Electricity	-	-	\$ 19,215
Indirect Annual Costs (IAC)			\$ 88,465
Overhead	60% of Operating and Maintenance	-	\$ 30,054
Administrative Charges	2% of Total Capital Investment	-	\$ 7,256
Property Taxes	1% of Total Capital Investment	-	\$ 3,628
Insurance	1% of Total Capital Investment	-	\$ 3,628
Capital Recovery ⁽³⁾	CRF*[Total Capital Investment]	-	\$ 43,899
Total Annual Costs (DAC + IAC)			\$ 8,037,770

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment$ life.

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-7
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾⁽³⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Shakeout - 0% Recovery	
Design Inputs:			
Volumetric flowrate (acfm): (4,000 - 500,000)	47,000		
Air to Cloth (A/C) Ratio	4		
Insulated	Yes		
Bag Diameter (in)	6		
Bag Length (ft)	12		
Bag type	Top Bag Removal		
Bag Material	16-oz Polyester		
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 268,936
Fabric Filter System (EC)			\$227,936
Fabric Filter with Insulation			\$200,736
Bags & Cages			\$27,200
Auxiliary Equipment			
Intrumentation	10%	EC	\$ 22,800
Sales Tax	3%	EC	\$ 6,800
Freight	5%	EC	\$ 11,400
Direct Installation Costs (DC)			\$ 199,013
Foundations and supports	4%	PEC	\$ 10,757
Handling and erection	50%	PEC	\$ 134,468
Electrical	8%	PEC	\$ 21,515
Piping	1%	PEC	\$ 2,689
Insulation for ductwork	7%	PEC	\$ 18,826
Painting	4%	PEC	\$ 10,757
Site Preparation	LS		
Facilities & Buildings	LS		
Indirect Costs (IC)			\$ 121,021
Engineering	10%	PEC	\$ 26,894
Construction and field expenses	20%	PEC	\$ 53,787
Contractor fees	10%	PEC	\$ 26,894
Start-up	1%	PEC	\$ 2,689
Performance test	1%	PEC	\$ 2,689
Contingencies	3%	PEC	\$ 8,068
Total Capital Investment (PEC + DC + IC)			\$ 588,971

1. Figure 1.9 Equipment costs for pulse-jet filters (modular) from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
2. Table 1.8 Bag Prices for Pulse-Jet, TR polyester bags from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
3. Average CPI from 1998 is 163.0 and the Average CPI for 2016 first 2 quarters is 238.782 (CPI Detailed Report by U.S. Bureau of Labor Statistics, Table 24 (August 2016)

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-8
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Shakeout - 0% Recovery	
Design Inputs:			
Bag Change Frequency (years)		5	
Annual Electrical Consumption (kWh)		0	
Electrical Cost (\$/kWh) ⁽³⁾		0.00	
Equipment Life (years)		20	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 140,280
Operating Labor			
Operator ⁽⁴⁾	2 hr/shift	\$32.2/hr	\$ 60,278
Supervisor	15% of operator	-	\$ 9,042
Maintenance			
Labor ⁽⁴⁾	1 hr/shift	\$35/hr	\$ 32,760
Materials	100% of maintenance labor	-	\$ 32,760
Bag & Parts Replacement			
Bags & Cages	-	-	\$ 5,440
Utilities			
Electricity	Already used	-	\$ -
Compressed Air	Already used	-	\$ -
Waste Disposal	Already used	-	\$ -
Indirect Annual Costs (IAC)			\$ 146,374
Overhead	60% of Operating and Maintenance	-	\$ 80,904
Administrative Charges	2% of Total Capital Investment	-	\$ 11,779
Property Taxes	1% of Total Capital Investment	-	\$ 5,890
Insurance	1% of Total Capital Investment	-	\$ 5,890
Capital Recovery ⁽⁵⁾	CRF*[Total Capital Investment]	-	\$ 41,911
Total Annual Costs (DAC + IAC)			\$ 286,654

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 6, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Electric costs based on actuals at Forks Facility as provided by Facilities Engineering 2016-10-14

4) Labor wages based on actuals at Forks Facility as provided by Plant Manager 2016-10-13

5) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where i = interest and n = equipment life.

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-9
Thermal Oxidation
Cost Summary

VOC Reduction Cost	
Process Description:	Casting Shakeout - 0% Recovery
Design Inputs:	
VOC Controlled (tons):	73
Dust Collector	
Annual Cost (\$) ⁽¹⁾	\$ 286,654
Thermal Oxidizer	
Annual Cost (\$) ⁽¹⁾	\$ 8,037,770
Total	
Annual Cost (\$) ⁽¹⁾	\$ 8,324,424
Cost of Control (\$/ton)	\$ 115,528

(1) Includes recurring annual costs (e.g. maintenance, utilities) and recovery of capital costs

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-10
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Shakeout - 35% Recovery	
Design Inputs:			
Volumetric flowrate (scfm): (500 - 50,000)		48,754	
Heat Recovery (%):		35	
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 378,643
Thermal Oxidizer (EC)			\$ 320,884
Intrumentation	10%	EC	\$ 32,088
Sales Tax	3%	EC	\$ 9,627
Freight	5%	EC	\$ 16,044
Direct Installation Costs (DIC)			\$ 113,593
Foundations and supports	8%	PEC	\$ 30,291
Handling and erection	14%	PEC	\$ 53,010
Electrical	4%	PEC	\$ 15,146
Piping	2%	PEC	\$ 7,573
Insulation for ductwork	1%	PEC	\$ 3,786
Painting	1%	PEC	\$ 3,786
Indirect Installation Costs (IIC)			\$ 117,379
Engineering	10%	PEC	\$ 37,864
Construction and field expenses	5%	PEC	\$ 18,932
Contractor fees	10%	PEC	\$ 37,864
Start-up	2%	PEC	\$ 7,573
Performance test	1%	PEC	\$ 3,786
Contingencies	3%	PEC	\$ 11,359
Total Capital Investment (PEC + DIC + IIC)			\$ 609,615

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-11
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Shakeout - 35% Recovery	
Design Inputs:			
Annual Natural Gas Consumption (MCF)		512,200	
Natural Gas Cost (\$/MCF)		10.00	
Annual Electrical Consumption (kWh)		686,300	
Electrical Cost (\$/kWh)		0.07	
Equipment Life (years)		10	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 5,220,131
Operating Labor			
Operator	0.5 hr/shift	\$32.20/hr	\$ 15,070
Supervisor	15% of operator	-	\$ 2,260
Maintenance			
Labor	0.5 hr/shift	\$35/hr	\$ 16,380
Materials	100% of maintenance labor	-	\$ 16,380
Utilities			
Natural Gas	-	-	\$ 5,122,000
Electricity	-	-	\$ 48,041
Indirect Annual Costs (IAC)			\$ 128,202
Overhead	60% of Operating and Maintenance	-	\$ 30,054
Administrative Charges	2% of Total Capital Investment	-	\$ 12,192
Property Taxes	1% of Total Capital Investment	-	\$ 6,096
Insurance	1% of Total Capital Investment	-	\$ 6,096
Capital Recovery ⁽³⁾	CRF*[Total Capital Investment]	-	\$ 73,763
Total Annual Costs (DAC + IAC)			\$ 5,348,333

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment$ life.

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-12
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾⁽³⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Shakeout - 35% Recovery	
Design Inputs:			
Volumetric flowrate (acfm): (4,000 - 500,000)	47,000		
Air to Cloth (A/C) Ratio	4		
Insulated	Yes		
Bag Diameter (in)	6		
Bag Length (ft)	12		
Bag type	Top Bag Removal		
Bag Material	16-oz Polyester		
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 268,936
Fabric Filter System (EC)			\$227,936
Fabric Filter with Insulation			\$200,736
Bags & Cages			\$27,200
Auxiliary Equipment			
Instrumentation	10%	EC	\$ 22,800
Sales Tax	3%	EC	\$ 6,800
Freight	5%	EC	\$ 11,400
Direct Installation Costs (DC)			\$ 199,013
Foundations and supports	4%	PEC	\$ 10,757
Handling and erection	50%	PEC	\$ 134,468
Electrical	8%	PEC	\$ 21,515
Piping	1%	PEC	\$ 2,689
Insulation for ductwork	7%	PEC	\$ 18,826
Painting	4%	PEC	\$ 10,757
Site Preparation	LS		
Facilities & Buildings	LS		
Indirect Costs (IC)			\$ 121,021
Engineering	10%	PEC	\$ 26,894
Construction and field expenses	20%	PEC	\$ 53,787
Contractor fees	10%	PEC	\$ 26,894
Start-up	1%	PEC	\$ 2,689
Performance test	1%	PEC	\$ 2,689
Contingencies	3%	PEC	\$ 8,068
Total Capital Investment (PEC + DC + IC)			\$ 588,971

1. Figure 1.9 Equipment costs for pulse-jet filters (modular) from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
2. Table 1.8 Bag Prices for Pulse-Jet, TR polyester bags from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
3. Average CPI from 1998 is 163.0 and the Average CPI for 2016 first 2 quarters is 238.782 (CPI Detailed Report by U.S. Bureau of Labor Statistics, Table 24 (August 2016)

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-13
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Shakeout - 35% Recovery	
Design Inputs:			
Bag Change Frequency (years)		5	
Annual Electrical Consumption (kWh)		0	
Electrical Cost (\$/kWh) ⁽³⁾		0.00	
Equipment Life (years)		20	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 140,280
Operating Labor			
Operator ⁽⁴⁾	2 hr/shift	\$32.2/hr	\$ 60,278
Supervisor	15% of operator	-	\$ 9,042
Maintenance			
Labor ⁽⁴⁾	1 hr/shift	\$35/hr	\$ 32,760
Materials	100% of maintenance labor	-	\$ 32,760
Bag & Parts Replacement			
Bags & Cages	-	-	\$ 5,440
Utilities			
Electricity	Already used	-	\$ -
Compressed Air	Already used	-	\$ -
Waste Disposal	Already used	-	\$ -
Indirect Annual Costs (IAC)			\$ 146,374
Overhead	60% of Operating and Maintenance	-	\$ 80,904
Administrative Charges	2% of Total Capital Investment	-	\$ 11,779
Property Taxes	1% of Total Capital Investment	-	\$ 5,890
Insurance	1% of Total Capital Investment	-	\$ 5,890
Capital Recovery ⁽⁵⁾	CRF*[Total Capital Investment]	-	\$ 41,911
Total Annual Costs (DAC + IAC)			\$ 286,654

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 6, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Electric costs based on actuals at Forks Facility as provided by Facilities Engineering 2016-10-14

4) Labor wages based on actuals at Forks Facility as provided by Plant Manager 2016-10-13

5) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment$ life.

Victaulic Company - Forks Facility
 VOC RACT 2 Evaluation
 Table A-14
 Thermal Oxidation
 Cost Summary

VOC Reduction Cost	
Process Description:	Casting Shakeout - 35% Recovery
Design Inputs:	
VOC Controlled (tons):	73
Dust Collector	
Annual Cost (\$) ⁽¹⁾	\$ 286,654
Thermal Oxidizer	
Annual Cost (\$) ⁽¹⁾	\$ 5,348,333
Total	
Annual Cost (\$) ⁽¹⁾	\$ 5,634,987
Cost of Control (\$/ton)	\$ 78,204

(1) Includes recurring annual costs (e.g. maintenance, utilities) and recovery of capital costs

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-15
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Shakeout - 50% Recovery	
Design Inputs:			
Volumetric flowrate (scfm): (500 - 50,000)		48,754	
Heat Recovery (%):		50	
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 437,575
Thermal Oxidizer (EC)			\$ 370,826
Intrumentation	10%	EC	\$ 37,083
Sales Tax	3%	EC	\$ 11,125
Freight	5%	EC	\$ 18,541
Direct Installation Costs (DIC)			\$ 131,272
Foundations and supports	8%	PEC	\$ 35,006
Handling and erection	14%	PEC	\$ 61,260
Electrical	4%	PEC	\$ 17,503
Piping	2%	PEC	\$ 8,751
Insulation for ductwork	1%	PEC	\$ 4,376
Painting	1%	PEC	\$ 4,376
Indirect Installation Costs (IIC)			\$ 135,648
Engineering	10%	PEC	\$ 43,757
Construction and field expenses	5%	PEC	\$ 21,879
Contractor fees	10%	PEC	\$ 43,757
Start-up	2%	PEC	\$ 8,751
Performance test	1%	PEC	\$ 4,376
Contingencies	3%	PEC	\$ 13,127
Total Capital Investment (PEC + DIC + IIC)			\$ 704,495

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-16
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Shakeout - 50% Recovery	
Design Inputs:			
Annual Natural Gas Consumption (MCF)		394,000	
Natural Gas Cost (\$/MCF)		10.00	
Annual Electrical Consumption (kWh)		823,500	
Electrical Cost (\$/kWh)		0.07	
Equipment Life (years)		10	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 4,047,735
Operating Labor			
Operator	0.5 hr/shift	\$32.20/hr	\$ 15,070
Supervisor	15% of operator	-	\$ 2,260
Maintenance			
Labor	0.5 hr/shift	\$35/hr	\$ 16,380
Materials	100% of maintenance labor	-	\$ 16,380
Utilities			
Natural Gas	-	-	\$ 3,940,000
Electricity	-	-	\$ 57,645
Indirect Annual Costs (IAC)			\$ 143,478
Overhead	60% of Operating and Maintenance	-	\$ 30,054
Administrative Charges	2% of Total Capital Investment	-	\$ 14,090
Property Taxes	1% of Total Capital Investment	-	\$ 7,045
Insurance	1% of Total Capital Investment	-	\$ 7,045
Capital Recovery ⁽³⁾	CRF*[Total Capital Investment]	-	\$ 85,244
Total Annual Costs (DAC + IAC)			\$ 4,191,213

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment$ life.

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-17
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾⁽³⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Shakeout - 50% Recovery	
Design Inputs:			
Volumetric flowrate (acfm): (4,000 - 500,000)	47,000		
Air to Cloth (A/C) Ratio	4		
Insulated	Yes		
Bag Diameter (in)	6		
Bag Length (ft)	12		
Bag type	Top Bag Removal		
Bag Material	16-oz Polyester		
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 268,936
Fabric Filter System (EC)			\$227,936
Fabric Filter with Insulation			\$200,736
Bags & Cages			\$27,200
Auxiliary Equipment			
Intrumentation	10%	EC	\$ 22,800
Sales Tax	3%	EC	\$ 6,800
Freight	5%	EC	\$ 11,400
Direct Installation Costs (DC)			\$ 199,013
Foundations and supports	4%	PEC	\$ 10,757
Handling and erection	50%	PEC	\$ 134,468
Electrical	8%	PEC	\$ 21,515
Piping	1%	PEC	\$ 2,689
Insulation for ductwork	7%	PEC	\$ 18,826
Painting	4%	PEC	\$ 10,757
Site Preparation	LS		
Facilities & Buildings	LS		
Indirect Costs (IC)			\$ 121,021
Engineering	10%	PEC	\$ 26,894
Construction and field expenses	20%	PEC	\$ 53,787
Contractor fees	10%	PEC	\$ 26,894
Start-up	1%	PEC	\$ 2,689
Performance test	1%	PEC	\$ 2,689
Contingencies	3%	PEC	\$ 8,068
Total Capital Investment (PEC + DC + IC)			\$ 588,971

- Figure 1.9 Equipment costs for pulse-jet filters (modular) from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
- Table 1.8 Bag Prices for Pulse-Jet, TR polyester bags from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
- Average CPI from 1998 is 163.0 and the Average CPI for 2016 first 2 quarters is 238.782 (CPI Detailed Report by U.S. Bureau of Labor Statistics, Table 24 (August 2016)

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-18
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Shakeout - 50% Recovery	
Design Inputs:			
Bag Change Frequency (years)		5	
Annual Electrical Consumption (kWh)		0	
Electrical Cost (\$/kWh) ⁽³⁾		0.00	
Equipment Life (years)		20	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 140,280
Operating Labor			
Operator ⁽⁴⁾	2 hr/shift	\$32.2/hr	\$ 60,278
Supervisor	15% of operator	-	\$ 9,042
Maintenance			
Labor ⁽⁴⁾	1 hr/shift	\$35/hr	\$ 32,760
Materials	100% of maintenance labor	-	\$ 32,760
Bag & Parts Replacement			
Bags & Cages	-	-	\$ 5,440
Utilities			
Electricity	Already used	-	\$ -
Compressed Air	Already used	-	\$ -
Waste Disposal	Already used	-	\$ -
Indirect Annual Costs (IAC)			\$ 146,374
Overhead	60% of Operating and Maintenance	-	\$ 80,904
Administrative Charges	2% of Total Capital Investment	-	\$ 11,779
Property Taxes	1% of Total Capital Investment	-	\$ 5,890
Insurance	1% of Total Capital Investment	-	\$ 5,890
Capital Recovery ⁽⁵⁾	CRF*[Total Capital Investment]	-	\$ 41,911
Total Annual Costs (DAC + IAC)			\$ 286,654

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 6, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Electric costs based on actuals at Forks Facility as provided by Facilities Engineering 2016-10-14

4) Labor wages based on actuals at Forks Facility as provided by Plant Manager 2016-10-13

5) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment$ life.

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-19
Thermal Oxidation
Cost Summary

VOC Reduction Cost	
Process Description:	Casting Shakeout - 50% Recovery
Design Inputs:	
VOC Controlled (tons):	73
Dust Collector	
Annual Cost (\$) ⁽¹⁾	\$ 286,654
Thermal Oxidizer	
Annual Cost (\$) ⁽¹⁾	\$ 4,191,213
Total	
Annual Cost (\$) ⁽¹⁾	\$ 4,477,867
Cost of Control (\$/ton)	\$ 62,145

(1) Includes recurring annual costs (e.g. maintenance, utilities) and recovery of capital costs

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-20
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Shakeout - 70% Recovery	
Design Inputs:			
Volumetric flowrate (scfm): (500 - 50,000)		48,754	
Heat Recovery (%):		70	
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 546,352
Thermal Oxidizer (EC)			\$ 463,010
Intrumentation	10%	EC	\$ 46,301
Sales Tax	3%	EC	\$ 13,890
Freight	5%	EC	\$ 23,151
Direct Installation Costs (DIC)			\$ 163,906
Foundations and supports	8%	PEC	\$ 43,708
Handling and erection	14%	PEC	\$ 76,489
Electrical	4%	PEC	\$ 21,854
Piping	2%	PEC	\$ 10,927
Insulation for ductwork	1%	PEC	\$ 5,464
Painting	1%	PEC	\$ 5,464
Indirect Installation Costs (IIC)			\$ 169,369
Engineering	10%	PEC	\$ 54,635
Construction and field expenses	5%	PEC	\$ 27,318
Contractor fees	10%	PEC	\$ 54,635
Start-up	2%	PEC	\$ 10,927
Performance test	1%	PEC	\$ 5,464
Contingencies	3%	PEC	\$ 16,391
Total Capital Investment (PEC + DIC + IIC)			\$ 879,627

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-21
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Shakeout - 70% Recovery	
Design Inputs:			
Annual Natural Gas Consumption (MCF)		236,400	
Natural Gas Cost (\$/MCF)		10.00	
Annual Electrical Consumption (kWh)		1,029,400	
Electrical Cost (\$/kWh)		0.07	
Equipment Life (years)		10	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 2,486,148
Operating Labor			
Operator	0.5 hr/shift	\$32.20/hr	\$ 15,070
Supervisor	15% of operator	-	\$ 2,260
Maintenance			
Labor	0.5 hr/shift	\$35/hr	\$ 16,380
Materials	100% of maintenance labor	-	\$ 16,380
Utilities			
Natural Gas	-	-	\$ 2,364,000
Electricity	-	-	\$ 72,058
Indirect Annual Costs (IAC)			\$ 171,674
Overhead	60% of Operating and Maintenance	-	\$ 30,054
Administrative Charges	2% of Total Capital Investment	-	\$ 17,593
Property Taxes	1% of Total Capital Investment	-	\$ 8,796
Insurance	1% of Total Capital Investment	-	\$ 8,796
Capital Recovery ⁽³⁾	CRF*[Total Capital Investment]	-	\$ 106,435
Total Annual Costs (DAC + IAC)			\$ 2,657,822

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment$ life.

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-22
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾⁽³⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Shakeout - 70% Recovery	
Design Inputs:			
Volumetric flowrate (acfm): (4,000 - 500,000)	47,000		
Air to Cloth (A/C) Ratio	4		
Insulated	Yes		
Bag Diameter (in)	6		
Bag Length (ft)	12		
Bag type	Top Bag Removal		
Bag Material	16-oz Polyester		
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 268,936
Fabric Filter System (EC)			\$227,936
Fabric Filter with Insulation			\$200,736
Bags & Cages			\$27,200
Auxiliary Equipment			
Intrumentation	10%	EC	\$ 22,800
Sales Tax	3%	EC	\$ 6,800
Freight	5%	EC	\$ 11,400
Direct Installation Costs (DC)			\$ 199,013
Foundations and supports	4%	PEC	\$ 10,757
Handling and erection	50%	PEC	\$ 134,468
Electrical	8%	PEC	\$ 21,515
Piping	1%	PEC	\$ 2,689
Insulation for ductwork	7%	PEC	\$ 18,826
Painting	4%	PEC	\$ 10,757
Site Preparation	LS		
Facilities & Buildings	LS		
Indirect Costs (IC)			\$ 121,021
Engineering	10%	PEC	\$ 26,894
Construction and field expenses	20%	PEC	\$ 53,787
Contractor fees	10%	PEC	\$ 26,894
Start-up	1%	PEC	\$ 2,689
Performance test	1%	PEC	\$ 2,689
Contingencies	3%	PEC	\$ 8,068
Total Capital Investment (PEC + DC + IC)			\$ 588,971

1. Figure 1.9 Equipment costs for pulse-jet filters (modular) from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
2. Table 1.8 Bag Prices for Pulse-Jet, TR polyester bags from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
3. Average CPI from 1998 is 163.0 and the Average CPI for 2016 first 2 quarters is 238.782 (CPI Detailed Report by U.S. Bureau of Labor Statistics, Table 24 (August 2016)

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-23
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Shakeout - 70% Recovery	
Design Inputs:			
Bag Change Frequency (years)		5	
Annual Electrical Consumption (kWh)		0	
Electrical Cost (\$/kWh) ⁽³⁾		0.00	
Equipment Life (years)		20	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 140,280
Operating Labor			
Operator ⁽⁴⁾	2 hr/shift	\$32.2/hr	\$ 60,278
Supervisor	15% of operator	-	\$ 9,042
Maintenance			
Labor ⁽⁴⁾	1 hr/shift	\$35/hr	\$ 32,760
Materials	100% of maintenance labor	-	\$ 32,760
Bag & Parts Replacement			
Bags & Cages	-	-	\$ 5,440
Utilities			
Electricity	Already used	-	\$ -
Compressed Air	Already used	-	\$ -
Waste Disposal	Already used	-	\$ -
Indirect Annual Costs (IAC)			\$ 146,374
Overhead	60% of Operating and Maintenance	-	\$ 80,904
Administrative Charges	2% of Total Capital Investment	-	\$ 11,779
Property Taxes	1% of Total Capital Investment	-	\$ 5,890
Insurance	1% of Total Capital Investment	-	\$ 5,890
Capital Recovery ⁽⁵⁾	CRF*[Total Capital Investment]	-	\$ 41,911
Total Annual Costs (DAC + IAC)			\$ 286,654

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 6, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Electric costs based on actuals at Forks Facility as provided by Facilities Engineering 2016-10-14

4) Labor wages based on actuals at Forks Facility as provided by Plant Manager 2016-10-13

5) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment$ life.

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-24
Thermal Oxidation
Cost Summary

VOC Reduction Cost	
Process Description:	Casting Shakeout - 70% Recovery
Design Inputs:	
VOC Controlled (tons):	73
Dust Collector	
Annual Cost (\$) ⁽¹⁾	\$ 286,654
Thermal Oxidizer	
Annual Cost (\$) ⁽¹⁾	\$ 2,657,822
Total	
Annual Cost (\$) ⁽¹⁾	\$ 2,944,476
Cost of Control (\$/ton)	\$ 40,864

(1) Includes recurring annual costs (e.g. maintenance, utilities) and recovery of capital costs

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-25
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Pouring - 0% Recovery	
Design Inputs:			
Volumetric flowrate (scfm): (500 - 50,000)		16,597	
Heat Recovery (%):		0	
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 174,838
Thermal Oxidizer (EC)			\$ 148,168
Intrumentation	10%	EC	\$ 14,817
Sales Tax	3%	EC	\$ 4,445
Freight	5%	EC	\$ 7,408
Direct Installation Costs (DIC)			\$ 52,451
Foundations and supports	8%	PEC	\$ 13,987
Handling and erection	14%	PEC	\$ 24,477
Electrical	4%	PEC	\$ 6,994
Piping	2%	PEC	\$ 3,497
Insulation for ductwork	1%	PEC	\$ 1,748
Painting	1%	PEC	\$ 1,748
Indirect Installation Costs (IIC)			\$ 54,200
Engineering	10%	PEC	\$ 17,484
Construction and field expenses	5%	PEC	\$ 8,742
Contractor fees	10%	PEC	\$ 17,484
Start-up	2%	PEC	\$ 3,497
Performance test	1%	PEC	\$ 1,748
Contingencies	3%	PEC	\$ 5,245
Total Capital Investment (PEC + DIC + IIC)			\$ 281,489

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-26
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Pouring - 0% Recovery	
Design Inputs:			
Annual Natural Gas Consumption (MCF)		268,000	
Natural Gas Cost (\$/MCF)		10.00	
Annual Electrical Consumption (kWh)		93,500	
Electrical Cost (\$/kWh)		0.07	
Equipment Life (years)		10	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 2,736,635
Operating Labor			
Operator	0.5 hr/shift	\$32.20/hr	\$ 15,070
Supervisor	15% of operator	-	\$ 2,260
Maintenance			
Labor	0.5 hr/shift	\$35/hr	\$ 16,380
Materials	100% of maintenance labor	-	\$ 16,380
Utilities			
Natural Gas	-	-	\$ 2,680,000
Electricity	-	-	\$ 6,545
Indirect Annual Costs (IAC)			\$ 75,374
Overhead	60% of Operating and Maintenance	-	\$ 30,054
Administrative Charges	2% of Total Capital Investment	-	\$ 5,630
Property Taxes	1% of Total Capital Investment	-	\$ 2,815
Insurance	1% of Total Capital Investment	-	\$ 2,815
Capital Recovery ⁽³⁾	CRF*[Total Capital Investment]	-	\$ 34,060
Total Annual Costs (DAC + IAC)			\$ 2,812,009

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment$ life.

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-27
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾⁽³⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Pouring - 0% Recovery	
Design Inputs:			
Volumetric flowrate (acfm): (4,000 - 500,000)	16,000		
Air to Cloth (A/C) Ratio	4		
Insulated	Yes		
Bag Diameter (in)	6		
Bag Length (ft)	12		
Bag type	Top Bag Removal		
Bag Material	16-oz Polyester		
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 90,971
Fabric Filter System (EC)			\$77,071
Fabric Filter with Insulation			\$67,871
Bags & Cages			\$9,200
Auxiliary Equipment			
Intrumentation	10%	EC	\$ 7,700
Sales Tax	3%	EC	\$ 2,300
Freight	5%	EC	\$ 3,900
Direct Installation Costs (DC)			\$ 67,318
Foundations and supports	4%	PEC	\$ 3,639
Handling and erection	50%	PEC	\$ 45,485
Electrical	8%	PEC	\$ 7,278
Piping	1%	PEC	\$ 910
Insulation for ductwork	7%	PEC	\$ 6,368
Painting	4%	PEC	\$ 3,639
Site Preparation	LS		
Facilities & Buildings	LS		
Indirect Costs (IC)			\$ 40,937
Engineering	10%	PEC	\$ 9,097
Construction and field expenses	20%	PEC	\$ 18,194
Contractor fees	10%	PEC	\$ 9,097
Start-up	1%	PEC	\$ 910
Performance test	1%	PEC	\$ 910
Contingencies	3%	PEC	\$ 2,729
Total Capital Investment (PEC + DC + IC)			\$ 199,225

- Figure 1.9 Equipment costs for pulse-jet filters (modular) from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
- Table 1.8 Bag Prices for Pulse-Jet, TR polyester bags from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
- Average CPI from 1998 is 163.0 and the Average CPI for 2016 first 2 quarters is 238.782 (CPI Detailed Report by U.S. Bureau of Labor Statistics, Table 24 (August 2016)

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-28
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Pouring - 0% Recovery	
Design Inputs:			
Bag Change Frequency (years)		5	
Annual Electrical Consumption (kWh)		0	
Electrical Cost (\$/kWh) ⁽³⁾		0.00	
Equipment Life (years)		20	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 136,680
Operating Labor			
Operator ⁽⁴⁾	2 hr/shift	\$32.2/hr	\$ 60,278
Supervisor	15% of operator	-	\$ 9,042
Maintenance			
Labor ⁽⁴⁾	1 hr/shift	\$35/hr	\$ 32,760
Materials	100% of maintenance labor	-	\$ 32,760
Bag & Parts Replacement			
Bags & Cages	-	-	\$ 1,840
Utilities			
Electricity	Already used	-	\$ -
Compressed Air	Already used	-	\$ -
Waste Disposal	Already used	-	\$ -
Indirect Annual Costs (IAC)			\$ 103,050
Overhead	60% of Operating and Maintenance	-	\$ 80,904
Administrative Charges	2% of Total Capital Investment	-	\$ 3,985
Property Taxes	1% of Total Capital Investment	-	\$ 1,992
Insurance	1% of Total Capital Investment	-	\$ 1,992
Capital Recovery ⁽⁵⁾	CRF*[Total Capital Investment]	-	\$ 14,177
Total Annual Costs (DAC + IAC)			\$ 239,730

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 6, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Electric costs based on actuals at Forks Facility as provided by Facilities Engineering 2016-10-14

4) Labor wages based on actuals at Forks Facility as provided by Plant Manager 2016-10-13

5) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where i = interest and n = equipment life.

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-29
Thermal Oxidation
Cost Summary

VOC Reduction Cost	
Process Description:	Casting Pouring - 0% Recovery
Design Inputs:	
VOC Controlled (tons):	8
Dust Collector	
Annual Cost (\$) ⁽¹⁾	\$ 239,730
Thermal Oxidizer	
Annual Cost (\$) ⁽¹⁾	\$ 2,812,009
Total	
Annual Cost (\$) ⁽¹⁾	\$ 3,051,739
Cost of Control (\$/ton)	\$ 363,210

(1) Includes recurring annual costs (e.g. maintenance, utilities) and recovery of capital costs

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-30
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Pouring - 35% Recovery	
Design Inputs:			
Volumetric flowrate (scfm): (500 - 50,000)		16,597	
Heat Recovery (%):		35	
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 285,847
Thermal Oxidizer (EC)			\$ 242,243
Intrumentation	10%	EC	\$ 24,224
Sales Tax	3%	EC	\$ 7,267
Freight	5%	EC	\$ 12,112
Direct Installation Costs (DIC)			\$ 85,754
Foundations and supports	8%	PEC	\$ 22,868
Handling and erection	14%	PEC	\$ 40,019
Electrical	4%	PEC	\$ 11,434
Piping	2%	PEC	\$ 5,717
Insulation for ductwork	1%	PEC	\$ 2,858
Painting	1%	PEC	\$ 2,858
Indirect Installation Costs (IIC)			\$ 88,613
Engineering	10%	PEC	\$ 28,585
Construction and field expenses	5%	PEC	\$ 14,292
Contractor fees	10%	PEC	\$ 28,585
Start-up	2%	PEC	\$ 5,717
Performance test	1%	PEC	\$ 2,858
Contingencies	3%	PEC	\$ 8,575
Total Capital Investment (PEC + DIC + IIC)			\$ 460,213

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-31
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Pouring - 35% Recovery	
Design Inputs:			
Annual Natural Gas Consumption (MCF)		174,200	
Natural Gas Cost (\$/MCF)		10.00	
Annual Electrical Consumption (kWh)		233,600	
Electrical Cost (\$/kWh)		0.07	
Equipment Life (years)		10	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 1,808,442
Operating Labor			
Operator	0.5 hr/shift	\$32.20/hr	\$ 15,070
Supervisor	15% of operator	-	\$ 2,260
Maintenance			
Labor	0.5 hr/shift	\$35/hr	\$ 16,380
Materials	100% of maintenance labor	-	\$ 16,380
Utilities			
Natural Gas	-	-	\$ 1,742,000
Electricity	-	-	\$ 16,352
Indirect Annual Costs (IAC)			\$ 104,148
Overhead	60% of Operating and Maintenance	-	\$ 30,054
Administrative Charges	2% of Total Capital Investment	-	\$ 9,204
Property Taxes	1% of Total Capital Investment	-	\$ 4,602
Insurance	1% of Total Capital Investment	-	\$ 4,602
Capital Recovery ⁽³⁾	CRF*[Total Capital Investment]	-	\$ 55,686
Total Annual Costs (DAC + IAC)			\$ 1,912,590

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment$ life.

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-32
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾⁽³⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Pouring - 35% Recovery	
Design Inputs:			
Volumetric flowrate (acfm): (4,000 - 500,000)		16,000	
Air to Cloth (A/C) Ratio		4	
Insulated		Yes	
Bag Diameter (in)		6	
Bag Length (ft)		12	
Bag type		Top Bag Removal	
Bag Material		16-oz Polyester	
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 90,971
Fabric Filter System (EC)			\$77,071
Fabric Filter with Insulation			\$67,871
Bags & Cages			\$9,200
Auxiliary Equipment			
Intrumentation	10%	EC	\$ 7,700
Sales Tax	3%	EC	\$ 2,300
Freight	5%	EC	\$ 3,900
Direct Installation Costs (DC)			\$ 67,318
Foundations and supports	4%	PEC	\$ 3,639
Handling and erection	50%	PEC	\$ 45,485
Electrical	8%	PEC	\$ 7,278
Piping	1%	PEC	\$ 910
Insulation for ductwork	7%	PEC	\$ 6,368
Painting	4%	PEC	\$ 3,639
Site Preparation	LS		
Facilities & Buildings	LS		
Indirect Costs (IC)			\$ 40,937
Engineering	10%	PEC	\$ 9,097
Construction and field expenses	20%	PEC	\$ 18,194
Contractor fees	10%	PEC	\$ 9,097
Start-up	1%	PEC	\$ 910
Performance test	1%	PEC	\$ 910
Contingencies	3%	PEC	\$ 2,729
Total Capital Investment (PEC + DC + IC)			\$ 199,225

1. Figure 1.9 Equipment costs for pulse-jet filters (modular) from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
2. Table 1.8 Bag Prices for Pulse-Jet, TR polyester bags from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
3. Average CPI from 1998 is 163.0 and the Average CPI for 2016 first 2 quarters is 238.782 (CPI Detailed Report by U.S. Bureau of Labor Statistics, Table 24 (August 2016))

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-33
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Pouring - 35% Recovery	
Design Inputs:			
Bag Change Frequency (years)		5	
Annual Electrical Consumption (kWh)		0	
Electrical Cost (\$/kWh) ⁽³⁾		0.00	
Equipment Life (years)		20	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 136,680
Operating Labor			
Operator ⁽⁴⁾	2 hr/shift	\$32.2/hr	\$ 60,278
Supervisor	15% of operator	-	\$ 9,042
Maintenance			
Labor ⁽⁴⁾	1 hr/shift	\$35/hr	\$ 32,760
Materials	100% of maintenance labor	-	\$ 32,760
Bag & Parts Replacement			
Bags & Cages	-	-	\$ 1,840
Utilities			
Electricity	Already used	-	\$ -
Compressed Air	Already used	-	\$ -
Waste Disposal	Already used	-	\$ -
Indirect Annual Costs (IAC)			\$ 103,050
Overhead	60% of Operating and Maintenance	-	\$ 80,904
Administrative Charges	2% of Total Capital Investment	-	\$ 3,985
Property Taxes	1% of Total Capital Investment	-	\$ 1,992
Insurance	1% of Total Capital Investment	-	\$ 1,992
Capital Recovery ⁽⁵⁾	CRF*[Total Capital Investment]	-	\$ 14,177
Total Annual Costs (DAC + IAC)			\$ 239,730

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 6, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Electric costs based on actuals at Forks Facility as provided by Facilities Engineering 2016-10-14

4) Labor wages based on actuals at Forks Facility as provided by Plant Manager 2016-10-13

5) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where i = interest and n = equipment life.

Victaulic Company - Forks Facility
 VOC RACT 2 Evaluation
 Table A-34
 Thermal Oxidation
 Cost Summary

VOC Reduction Cost	
Process Description:	Casting Pouring - 35% Recovery
Design Inputs:	
VOC Controlled (tons):	8
Dust Collector	
Annual Cost (\$) ⁽¹⁾	\$ 239,730
Thermal Oxidizer	
Annual Cost (\$) ⁽¹⁾	\$ 1,912,590
Total	
Annual Cost (\$) ⁽¹⁾	\$ 2,152,320
Cost of Control (\$/ton)	\$ 256,164

(1) Includes recurring annual costs (e.g. maintenance, utilities) and recovery of capital costs

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-35
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Pouring - 50% Recovery	
Design Inputs:			
Volumetric flowrate (scfm): (500 - 50,000)		16,597	
Heat Recovery (%):		50	
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 334,167
Thermal Oxidizer (EC)			\$ 283,192
Intrumentation	10%	EC	\$ 28,319
Sales Tax	3%	EC	\$ 8,496
Freight	5%	EC	\$ 14,160
Direct Installation Costs (DIC)			\$ 100,250
Foundations and supports	8%	PEC	\$ 26,733
Handling and erection	14%	PEC	\$ 46,783
Electrical	4%	PEC	\$ 13,367
Piping	2%	PEC	\$ 6,683
Insulation for ductwork	1%	PEC	\$ 3,342
Painting	1%	PEC	\$ 3,342
Indirect Installation Costs (IIC)			\$ 103,592
Engineering	10%	PEC	\$ 33,417
Construction and field expenses	5%	PEC	\$ 16,708
Contractor fees	10%	PEC	\$ 33,417
Start-up	2%	PEC	\$ 6,683
Performance test	1%	PEC	\$ 3,342
Contingencies	3%	PEC	\$ 10,025
Total Capital Investment (PEC + DIC + IIC)			\$ 538,009

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-36
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Pouring - 50% Recovery	
Design Inputs:			
Annual Natural Gas Consumption (MCF)		134,000	
Natural Gas Cost (\$/MCF)		10.00	
Annual Electrical Consumption (kWh)		280,400	
Electrical Cost (\$/kWh)		0.07	
Equipment Life (years)		10	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 1,409,718
Operating Labor			
Operator	0.5 hr/shift	\$32.20/hr	\$ 15,070
Supervisor	15% of operator	-	\$ 2,260
Maintenance			
Labor	0.5 hr/shift	\$35/hr	\$ 16,380
Materials	100% of maintenance labor	-	\$ 16,380
Utilities			
Natural Gas	-	-	\$ 1,340,000
Electricity	-	-	\$ 19,628
Indirect Annual Costs (IAC)			\$ 116,674
Overhead	60% of Operating and Maintenance	-	\$ 30,054
Administrative Charges	2% of Total Capital Investment	-	\$ 10,760
Property Taxes	1% of Total Capital Investment	-	\$ 5,380
Insurance	1% of Total Capital Investment	-	\$ 5,380
Capital Recovery ⁽³⁾	CRF*[Total Capital Investment]	-	\$ 65,099
Total Annual Costs (DAC + IAC)			\$ 1,526,392

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment$ life.

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-37
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾⁽³⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Pouring - 50% Recovery	
Design Inputs:			
Volumetric flowrate (acfm): (4,000 - 500,000)	16,000		
Air to Cloth (A/C) Ratio	4		
Insulated	Yes		
Bag Diameter (in)	6		
Bag Length (ft)	12		
Bag type	Top Bag Removal		
Bag Material	16-oz Polyester		
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 90,971
Fabric Filter System (EC)			\$77,071
Fabric Filter with Insulation			\$67,871
Bags & Cages			\$9,200
Auxiliary Equipment			
Intrumentation	10%	EC	\$ 7,700
Sales Tax	3%	EC	\$ 2,300
Freight	5%	EC	\$ 3,900
Direct Installation Costs (DC)			\$ 67,318
Foundations and supports	4%	PEC	\$ 3,639
Handling and erection	50%	PEC	\$ 45,485
Electrical	8%	PEC	\$ 7,278
Piping	1%	PEC	\$ 910
Insulation for ductwork	7%	PEC	\$ 6,368
Painting	4%	PEC	\$ 3,639
Site Preparation	LS		
Facilities & Buildings	LS		
Indirect Costs (IC)			\$ 40,937
Engineering	10%	PEC	\$ 9,097
Construction and field expenses	20%	PEC	\$ 18,194
Contractor fees	10%	PEC	\$ 9,097
Start-up	1%	PEC	\$ 910
Performance test	1%	PEC	\$ 910
Contingencies	3%	PEC	\$ 2,729
Total Capital Investment (PEC + DC + IC)			\$ 199,225

1. Figure 1.9 Equipment costs for pulse-jet filters (modular) from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
2. Table 1.8 Bag Prices for Pulse-Jet, TR polyester bags from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
3. Average CPI from 1998 is 163.0 and the Average CPI for 2016 first 2 quarters is 238.782 (CPI Detailed Report by U.S. Bureau of Labor Statistics, Table 24 (August 2016)

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-38
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Pouring - 50% Recovery	
Design Inputs:			
Bag Change Frequency (years)		5	
Annual Electrical Consumption (kWh)		0	
Electrical Cost (\$/kWh) ⁽³⁾		0.00	
Equipment Life (years)		20	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 136,680
Operating Labor			
Operator ⁽⁴⁾	2 hr/shift	\$32.2/hr	\$ 60,278
Supervisor	15% of operator	-	\$ 9,042
Maintenance			
Labor ⁽⁴⁾	1 hr/shift	\$35/hr	\$ 32,760
Materials	100% of maintenance labor	-	\$ 32,760
Bag & Parts Replacement			
Bags & Cages	-	-	\$ 1,840
Utilities			
Electricity	Already used	-	\$ -
Compressed Air	Already used	-	\$ -
Waste Disposal	Already used	-	\$ -
Indirect Annual Costs (IAC)			\$ 103,050
Overhead	60% of Operating and Maintenance	-	\$ 80,904
Administrative Charges	2% of Total Capital Investment	-	\$ 3,985
Property Taxes	1% of Total Capital Investment	-	\$ 1,992
Insurance	1% of Total Capital Investment	-	\$ 1,992
Capital Recovery ⁽⁵⁾	CRF*[Total Capital Investment]	-	\$ 14,177
Total Annual Costs (DAC + IAC)			\$ 239,730

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 6, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Electric costs based on actuals at Forks Facility as provided by Facilities Engineering 2016-10-14

4) Labor wages based on actuals at Forks Facility as provided by Plant Manager 2016-10-13

5) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where i = interest and n = equipment life.

Victaulic Company - Forks Facility
 VOC RACT 2 Evaluation
 Table A-39
 Thermal Oxidation
 Cost Summary

VOC Reduction Cost	
Process Description:	Casting Pouring - 50% Recovery
Design Inputs:	
VOC Controlled (tons):	8
Dust Collector	
Annual Cost (\$) ⁽¹⁾	\$ 239,730
Thermal Oxidizer	
Annual Cost (\$) ⁽¹⁾	\$ 1,526,392
Total	
Annual Cost (\$) ⁽¹⁾	\$ 1,766,122
Cost of Control (\$/ton)	\$ 210,199

(1) Includes recurring annual costs (e.g. maintenance, utilities) and recovery of capital costs

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-40
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Pouring - 70% Recovery	
Design Inputs:			
Volumetric flowrate (scfm): (500 - 50,000)		16,597	
Heat Recovery (%):		70	
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 417,328
Thermal Oxidizer (EC)			\$ 353,668
Intrumentation	10%	EC	\$ 35,367
Sales Tax	3%	EC	\$ 10,610
Freight	5%	EC	\$ 17,683
Direct Installation Costs (DIC)			\$ 125,198
Foundations and supports	8%	PEC	\$ 33,386
Handling and erection	14%	PEC	\$ 58,426
Electrical	4%	PEC	\$ 16,693
Piping	2%	PEC	\$ 8,347
Insulation for ductwork	1%	PEC	\$ 4,173
Painting	1%	PEC	\$ 4,173
Indirect Installation Costs (IIC)			\$ 129,372
Engineering	10%	PEC	\$ 41,733
Construction and field expenses	5%	PEC	\$ 20,866
Contractor fees	10%	PEC	\$ 41,733
Start-up	2%	PEC	\$ 8,347
Performance test	1%	PEC	\$ 4,173
Contingencies	3%	PEC	\$ 12,520
Total Capital Investment (PEC + DIC + IIC)			\$ 671,898

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-41
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Casting Pouring - 70% Recovery	
Design Inputs:			
Annual Natural Gas Consumption (MCF)		80,400	
Natural Gas Cost (\$/MCF)		10.00	
Annual Electrical Consumption (kWh)		350,400	
Electrical Cost (\$/kWh)		0.07	
Equipment Life (years)		10	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 878,618
Operating Labor			
Operator	0.5 hr/shift	\$32.20/hr	\$ 15,070
Supervisor	15% of operator	-	\$ 2,260
Maintenance			
Labor	0.5 hr/shift	\$35/hr	\$ 16,380
Materials	100% of maintenance labor	-	\$ 16,380
Utilities			
Natural Gas	-	-	\$ 804,000
Electricity	-	-	\$ 24,528
Indirect Annual Costs (IAC)			\$ 138,230
Overhead	60% of Operating and Maintenance	-	\$ 30,054
Administrative Charges	2% of Total Capital Investment	-	\$ 13,438
Property Taxes	1% of Total Capital Investment	-	\$ 6,719
Insurance	1% of Total Capital Investment	-	\$ 6,719
Capital Recovery ⁽³⁾	CRF*[Total Capital Investment]	-	\$ 81,300
Total Annual Costs (DAC + IAC)			\$ 1,016,848

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment$ life.

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-42
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾⁽³⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Pouring - 70% Recovery	
Design Inputs:			
Volumetric flowrate (acfm): (4,000 - 500,000)	16,000		
Air to Cloth (A/C) Ratio	4		
Insulated	Yes		
Bag Diameter (in)	6		
Bag Length (ft)	12		
Bag type	Top Bag Removal		
Bag Material	16-oz Polyester		
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 90,971
Fabric Filter System (EC)			\$77,071
Fabric Filter with Insulation			\$67,871
Bags & Cages			\$9,200
Auxiliary Equipment			
Intrumentation	10%	EC	\$ 7,700
Sales Tax	3%	EC	\$ 2,300
Freight	5%	EC	\$ 3,900
Direct Installation Costs (DC)			\$ 67,318
Foundations and supports	4%	PEC	\$ 3,639
Handling and erection	50%	PEC	\$ 45,485
Electrical	8%	PEC	\$ 7,278
Piping	1%	PEC	\$ 910
Insulation for ductwork	7%	PEC	\$ 6,368
Painting	4%	PEC	\$ 3,639
Site Preparation	LS		
Facilities & Buildings	LS		
Indirect Costs (IC)			\$ 40,937
Engineering	10%	PEC	\$ 9,097
Construction and field expenses	20%	PEC	\$ 18,194
Contractor fees	10%	PEC	\$ 9,097
Start-up	1%	PEC	\$ 910
Performance test	1%	PEC	\$ 910
Contingencies	3%	PEC	\$ 2,729
Total Capital Investment (PEC + DC + IC)			\$ 199,225

1. Figure 1.9 Equipment costs for pulse-jet filters (modular) from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
2. Table 1.8 Bag Prices for Pulse-Jet, TR polyester bags from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
3. Average CPI from 1998 is 163.0 and the Average CPI for 2016 first 2 quarters is 238.782 (CPI Detailed Report by U.S. Bureau of Labor Statistics, Table 24 (August 2016)

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-43
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Pouring - 70% Recovery	
Design Inputs:			
Bag Change Frequency (years)		5	
Annual Electrical Consumption (kWh)		0	
Electrical Cost (\$/kWh) ⁽³⁾		0.00	
Equipment Life (years)		20	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 136,680
Operating Labor			
Operator ⁽⁴⁾	2 hr/shift	\$32.2/hr	\$ 60,278
Supervisor	15% of operator	-	\$ 9,042
Maintenance			
Labor ⁽⁴⁾	1 hr/shift	\$35/hr	\$ 32,760
Materials	100% of maintenance labor	-	\$ 32,760
Bag & Parts Replacement			
Bags & Cages	-	-	\$ 1,840
Utilities			
Electricity	Already used	-	\$ -
Compressed Air	Already used	-	\$ -
Waste Disposal	Already used	-	\$ -
Indirect Annual Costs (IAC)			\$ 103,050
Overhead	60% of Operating and Maintenance	-	\$ 80,904
Administrative Charges	2% of Total Capital Investment	-	\$ 3,985
Property Taxes	1% of Total Capital Investment	-	\$ 1,992
Insurance	1% of Total Capital Investment	-	\$ 1,992
Capital Recovery ⁽⁵⁾	CRF*[Total Capital Investment]	-	\$ 14,177
Total Annual Costs (DAC + IAC)			\$ 239,730

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 6, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Electric costs based on actuals at Forks Facility as provided by Facilities Engineering 2016-10-14

4) Labor wages based on actuals at Forks Facility as provided by Plant Manager 2016-10-13

5) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where i = interest and n = equipment life.

Victaulic Company - Forks Facility
 VOC RACT 2 Evaluation
 Table A-44
 Thermal Oxidation
 Cost Summary

VOC Reduction Cost	
Process Description:	Casting Pouring - 70% Recovery
Design Inputs:	
VOC Controlled (tons):	8
Dust Collector	
Annual Cost (\$) ⁽¹⁾	\$ 239,730
Thermal Oxidizer	
Annual Cost (\$) ⁽¹⁾	\$ 1,016,848
Total	
Annual Cost (\$) ⁽¹⁾	\$ 1,256,578
Cost of Control (\$/ton)	\$ 149,555

(1) Includes recurring annual costs (e.g. maintenance, utilities) and recovery of capital costs

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-45
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Core Room - 0% Recovery	
Design Inputs:			
Volumetric flowrate (scfm): (500 - 50,000)		77,800	
Heat Recovery (%):		0	
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 251,562
Thermal Oxidizer (EC)			\$ 213,188
Intrumentation	10%	EC	\$ 21,319
Sales Tax	3%	EC	\$ 6,396
Freight	5%	EC	\$ 10,659
Direct Installation Costs (DIC)			\$ 75,469
Foundations and supports	8%	PEC	\$ 20,125
Handling and erection	14%	PEC	\$ 35,219
Electrical	4%	PEC	\$ 10,062
Piping	2%	PEC	\$ 5,031
Insulation for ductwork	1%	PEC	\$ 2,516
Painting	1%	PEC	\$ 2,516
Indirect Installation Costs (IIC)			\$ 77,984
Engineering	10%	PEC	\$ 25,156
Construction and field expenses	5%	PEC	\$ 12,578
Contractor fees	10%	PEC	\$ 25,156
Start-up	2%	PEC	\$ 5,031
Performance test	1%	PEC	\$ 2,516
Contingencies	3%	PEC	\$ 7,547
Total Capital Investment (PEC + DIC + IIC)			\$ 405,015

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-46
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Core Room - 0% Recovery	
Design Inputs:			
Annual Natural Gas Consumption (MCF)		1,258,000	
Natural Gas Cost (\$/MCF)		10.00	
Annual Electrical Consumption (kWh)		438,000	
Electrical Cost (\$/kWh)		0.07	
Equipment Life (years)		10	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		8,760	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 12,669,259
Operating Labor			
Operator	0.5 hr/shift	\$32.20/hr	\$ 17,630
Supervisor	15% of operator	-	\$ 2,644
Maintenance			
Labor	0.5 hr/shift	\$35/hr	\$ 19,163
Materials	100% of maintenance labor	-	\$ 19,163
Utilities			
Natural Gas	-	-	\$ 12,580,000
Electricity	-	-	\$ 30,660
Indirect Annual Costs (IAC)			\$ 100,367
Overhead	60% of Operating and Maintenance	-	\$ 35,159
Administrative Charges	2% of Total Capital Investment	-	\$ 8,100
Property Taxes	1% of Total Capital Investment	-	\$ 4,050
Insurance	1% of Total Capital Investment	-	\$ 4,050
Capital Recovery ⁽³⁾	CRF*[Total Capital Investment]	-	\$ 49,007
Total Annual Costs (DAC + IAC)			\$ 12,769,626

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where i = interest and n = equipment life.

Victaulic Company - Forks Facility
 VOC RACT 2 Evaluation
 Table A-47
 Thermal Oxidation
 Cost Summary

VOC Reduction Cost	
Process Description:	Core Room - 0% Recovery
Design Inputs:	
VOC Controlled (tons):	8
Thermal Oxidizer	
Annual Cost (\$) ⁽¹⁾	\$ 12,769,626
Cost of Control (\$/ton)	\$ 1,554,424

(1) Includes recurring annual costs (e.g. maintenance, utilities) and recovery of capital costs

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-48
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Core Room - 35% Recovery	
Design Inputs:			
Volumetric flowrate (scfm): (500 - 50,000)		77,800	
Heat Recovery (%):		35	
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 427,744
Thermal Oxidizer (EC)			\$ 362,495
Intrumentation	10%	EC	\$ 36,250
Sales Tax	3%	EC	\$ 10,875
Freight	5%	EC	\$ 18,125
Direct Installation Costs (DIC)			\$ 128,323
Foundations and supports	8%	PEC	\$ 34,220
Handling and erection	14%	PEC	\$ 59,884
Electrical	4%	PEC	\$ 17,110
Piping	2%	PEC	\$ 8,555
Insulation for ductwork	1%	PEC	\$ 4,277
Painting	1%	PEC	\$ 4,277
Indirect Installation Costs (IIC)			\$ 132,601
Engineering	10%	PEC	\$ 42,774
Construction and field expenses	5%	PEC	\$ 21,387
Contractor fees	10%	PEC	\$ 42,774
Start-up	2%	PEC	\$ 8,555
Performance test	1%	PEC	\$ 4,277
Contingencies	3%	PEC	\$ 12,832
Total Capital Investment (PEC + DIC + IIC)			\$ 688,668

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-49
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Core Room - 35% Recovery	
Design Inputs:			
Annual Natural Gas Consumption (MCF)		817,700	
Natural Gas Cost (\$/MCF)		10.00	
Annual Electrical Consumption (kWh)		1,095,100	
Electrical Cost (\$/kWh)		0.07	
Equipment Life (years)		10	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		8,760	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 8,312,256
Operating Labor			
Operator	0.5 hr/shift	\$32.20/hr	\$ 17,630
Supervisor	15% of operator	-	\$ 2,644
Maintenance			
Labor	0.5 hr/shift	\$35/hr	\$ 19,163
Materials	100% of maintenance labor	-	\$ 19,163
Utilities			
Natural Gas	-	-	\$ 8,177,000
Electricity	-	-	\$ 76,657
Indirect Annual Costs (IAC)			\$ 146,035
Overhead	60% of Operating and Maintenance	-	\$ 35,159
Administrative Charges	2% of Total Capital Investment	-	\$ 13,773
Property Taxes	1% of Total Capital Investment	-	\$ 6,887
Insurance	1% of Total Capital Investment	-	\$ 6,887
Capital Recovery ⁽³⁾	CRF*[Total Capital Investment]	-	\$ 83,329
Total Annual Costs (DAC + IAC)			\$ 8,458,291

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment$ life.

Victaulic Company - Forks Facility
 VOC RACT 2 Evaluation
 Table A-50
 Thermal Oxidation
 Cost Summary

VOC Reduction Cost	
Process Description:	Core Room - 35% Recovery
Design Inputs:	
VOC Controlled (tons):	8
Thermal Oxidizer	
Annual Cost (\$) ⁽¹⁾	\$ 8,458,291
Cost of Control (\$/ton)	\$ 1,029,613

(1) Includes recurring annual costs (e.g. maintenance, utilities) and recovery of capital costs

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-51
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Core Room - 50% Recovery	
Design Inputs:			
Volumetric flowrate (scfm): (500 - 50,000)		77,800	
Heat Recovery (%):		50	
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 491,853
Thermal Oxidizer (EC)			\$ 416,824
Intrumentation	10%	EC	\$ 41,682
Sales Tax	3%	EC	\$ 12,505
Freight	5%	EC	\$ 20,841
Direct Installation Costs (DIC)			\$ 147,556
Foundations and supports	8%	PEC	\$ 39,348
Handling and erection	14%	PEC	\$ 68,859
Electrical	4%	PEC	\$ 19,674
Piping	2%	PEC	\$ 9,837
Insulation for ductwork	1%	PEC	\$ 4,919
Painting	1%	PEC	\$ 4,919
Indirect Installation Costs (IIC)			\$ 152,474
Engineering	10%	PEC	\$ 49,185
Construction and field expenses	5%	PEC	\$ 24,593
Contractor fees	10%	PEC	\$ 49,185
Start-up	2%	PEC	\$ 9,837
Performance test	1%	PEC	\$ 4,919
Contingencies	3%	PEC	\$ 14,756
Total Capital Investment (PEC + DIC + IIC)			\$ 791,883

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-52
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Core Room - 50% Recovery	
Design Inputs:			
Annual Natural Gas Consumption (MCF)		629,000	
Natural Gas Cost (\$/MCF)		10.00	
Annual Electrical Consumption (kWh)		1,314,100	
Electrical Cost (\$/kWh)		0.07	
Equipment Life (years)		10	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		8,760	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 6,440,586
Operating Labor			
Operator	0.5 hr/shift	\$32.20/hr	\$ 17,630
Supervisor	15% of operator	-	\$ 2,644
Maintenance			
Labor	0.5 hr/shift	\$35/hr	\$ 19,163
Materials	100% of maintenance labor	-	\$ 19,163
Utilities			
Natural Gas	-	-	\$ 6,290,000
Electricity	-	-	\$ 91,987
Indirect Annual Costs (IAC)			\$ 162,653
Overhead	60% of Operating and Maintenance	-	\$ 35,159
Administrative Charges	2% of Total Capital Investment	-	\$ 15,838
Property Taxes	1% of Total Capital Investment	-	\$ 7,919
Insurance	1% of Total Capital Investment	-	\$ 7,919
Capital Recovery ⁽³⁾	CRF*[Total Capital Investment]	-	\$ 95,818
Total Annual Costs (DAC + IAC)			\$ 6,603,239

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment$ life.

Victaulic Company - Forks Facility
 VOC RACT 2 Evaluation
 Table A-53
 Thermal Oxidation
 Cost Summary

VOC Reduction Cost	
Process Description:	Core Room - 50% Recovery
Design Inputs:	
VOC Controlled (tons):	8
Thermal Oxidizer	
Annual Cost (\$) ⁽¹⁾	\$ 6,603,239
Cost of Control (\$/ton)	\$ 803,801

(1) Includes recurring annual costs (e.g. maintenance, utilities) and recovery of capital costs

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-54
Thermal Oxidation
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Core Room - 70% Recovery	
Design Inputs:			
Volumetric flowrate (scfm): (500 - 50,000)		77,800	
Heat Recovery (%):		70	
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 614,066
Thermal Oxidizer (EC)			\$ 520,395
Intrumentation	10%	EC	\$ 52,039
Sales Tax	3%	EC	\$ 15,612
Freight	5%	EC	\$ 26,020
Direct Installation Costs (DIC)			\$ 184,220
Foundations and supports	8%	PEC	\$ 49,125
Handling and erection	14%	PEC	\$ 85,969
Electrical	4%	PEC	\$ 24,563
Piping	2%	PEC	\$ 12,281
Insulation for ductwork	1%	PEC	\$ 6,141
Painting	1%	PEC	\$ 6,141
Indirect Installation Costs (IIC)			\$ 190,360
Engineering	10%	PEC	\$ 61,407
Construction and field expenses	5%	PEC	\$ 30,703
Contractor fees	10%	PEC	\$ 61,407
Start-up	2%	PEC	\$ 12,281
Performance test	1%	PEC	\$ 6,141
Contingencies	3%	PEC	\$ 18,422
Total Capital Investment (PEC + DIC + IIC)			\$ 988,646

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table A-55
Thermal Oxidation
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Thermal Oxidizer	
Process Description:		Core Room - 70% Recovery	
Design Inputs:			
Annual Natural Gas Consumption (MCF)		377,400	
Natural Gas Cost (\$/MCF)		10.00	
Annual Electrical Consumption (kWh)		1,642,700	
Electrical Cost (\$/kWh)		0.07	
Equipment Life (years)		10	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		8,760	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 3,947,588
Operating Labor			
Operator	0.5 hr/shift	\$32.20/hr	\$ 17,630
Supervisor	15% of operator	-	\$ 2,644
Maintenance			
Labor	0.5 hr/shift	\$35/hr	\$ 19,163
Materials	100% of maintenance labor	-	\$ 19,163
Utilities			
Natural Gas	-	-	\$ 3,774,000
Electricity	-	-	\$ 114,989
Indirect Annual Costs (IAC)			\$ 194,331
Overhead	60% of Operating and Maintenance	-	\$ 35,159
Administrative Charges	2% of Total Capital Investment	-	\$ 19,773
Property Taxes	1% of Total Capital Investment	-	\$ 9,886
Insurance	1% of Total Capital Investment	-	\$ 9,886
Capital Recovery ⁽³⁾	CRF*[Total Capital Investment]	-	\$ 119,626
Total Annual Costs (DAC + IAC)			\$ 4,141,919

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 3.2, Chapter 2, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment$ life.

Victaulic Company - Forks Facility
 VOC RACT 2 Evaluation
 Table A-56
 Thermal Oxidation
 Cost Summary

VOC Reduction Cost	
Process Description:	Core Room - 70% Recovery
Design Inputs:	
VOC Controlled (tons):	8
Thermal Oxidizer	
Annual Cost (\$) ⁽¹⁾	\$ 4,141,919
Cost of Control (\$/ton)	\$ 504,189

(1) Includes recurring annual costs (e.g. maintenance, utilities) and recovery of capital costs

Attachment B-Carbon Adsorption

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table B-1
Carbon Adsorption
Cost Summary

Total Carbon Adsorption Installed Cost Estimate

Technology Description:		Carbon Adsorption
Area	Cost	
Casting Shakeout (CS)	\$	2,260,178
Casting Pouring (CP)	\$	2,767,059
Core Room (CR)	\$	12,042,623

Total Dust Collector Installed Cost Estimate

Technology Description:		Dust Collector
Area	Cost	
Casting Shakeout (CS)	\$	588,971
Casting Pouring (CP)	\$	199,225
Core Room (CR)	\$	-

Annual Cost Estimate

Technology Description:		Carbon Adsorption & Dust Collector
Area	Cost	
Casting Shakeout (CS)	\$	8,035,587
Casting Pouring (CP)	\$	2,981,092
Core Room (CR)	\$	13,699,851

VOC Reduction Cost

Technology Description:		Carbon Adsorption
Area	Cost of Control (\$/ton)	
Casting Shakeout (CS)	\$	129,888
Casting Pouring (CP)	\$	413,240
Core Room (CR)	\$	1,942,332

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table B-2
Carbon Adsorption
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾

Technology Description: Carbon Adsorber

Process Description: Casting Shakeout (CS)

Design Inputs:

Volumetric flowrate (acfm): (4,000 - 500,000)	47,000
Number of Carbon Beds (#):	20
Length of Bed (in Direction of Flow) (ft)	15
Bed Shape (Perpendicular to Flow)	Circle
Diameter (ft)	6
Carbon Requirement (lbs):	93,400

Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 1,403,837
Carbon Adsorber (EC)			\$ 1,189,693
Intrumentation	10%	EC	\$ 118,969
Sales Tax	3%	EC	\$ 35,691
Freight	5%	EC	\$ 59,485

Direct Installation Costs (DC)			\$ 421,151
Foundations and supports	8%	PEC	\$ 112,307
Handling and erection	14%	PEC	\$ 196,537
Electrical	4%	PEC	\$ 56,153
Piping	2%	PEC	\$ 28,077
Insulation for ductwork	1%	PEC	\$ 14,038
Painting	1%	PEC	\$ 14,038

Indirect Costs (IC)			\$ 435,190
Engineering	10%	PEC	\$ 140,384
Construction and field expenses	5%	PEC	\$ 70,192
Contractor fees	10%	PEC	\$ 140,384
Start-up	2%	PEC	\$ 28,077
Performance test	1%	PEC	\$ 14,038
Contingencies	3%	PEC	\$ 42,115

Total Capital Investment (PEC + DC + IC) \$ 2,260,178

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlined in Section 3.1, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1999. These have been adjusted to reflect inflation using a factor of \$1.43 (2016) / \$1.00 (1999).

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table B-3
Carbon Adsorption
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾

Technology Description: Carbon Adsorber

Process Description: Casting Shakeout (CS)

Design Inputs:

Carbon Usage (lbs)	7,278,300
Carbon Cost (\$/lb)	1.00
Annual Electrical Consumption (kWh)	380,000
Electrical Cost (\$/kWh) ⁽³⁾	0.07
Equipment Life (years)	10
Interest Rate (%):	3.625
Annual Operating Hours (hours)	7,488

Category	Suggested Factor	Unit Cost	Cost
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Direct Annual Costs (DAC)			\$ 7,354,990
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Operating Labor

Operator ⁽⁴⁾	0.5 hr/shift	\$32.2/hr	\$ 15,070
Supervisor	15% of operator	-	\$ 2,260

Maintenance

Labor ⁽⁴⁾	0.5 hr/shift	\$35/hr	\$ 16,380
Materials	100% of maintenance labor	-	\$ 16,380

Carbon Replacement

Carbon	-	-	\$ 7,278,300
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Utilities

Electricity	-	-	\$ 26,600
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Indirect Annual Costs (IAC)			\$ 393,943
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Overhead	60% of Operating and Maintenance	-	\$ 30,054
Administrative Charges	2% of Total Capital Investment	-	\$ 45,204
Property Taxes	1% of Total Capital Investment	-	\$ 22,602
Insurance	1% of Total Capital Investment	-	\$ 22,602
Capital Recovery ⁽⁵⁾	CRF*[Total Capital Investment]	-	\$ 273,482

Total Annual Costs (DAC + IAC)			\$ 7,748,933
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- 1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlined in Section 3.1, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.
- 2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1999. These have been adjusted to reflect inflation using a factor of \$1.43 (2016) / \$1.00 (1999).
- 3) Electric costs based on actuals at Forks Facility as provided by Facilities Engineering 2016-10-14
- 4) Labor wages based on actuals at Forks Facility as provided by Plant Manager 2016-10-13
- 5) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = \text{interest}$ and $n = \text{equipment life}$.

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table B-4
Carbon Adsorption
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾⁽³⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Shakeout - 0% Recovery	
Design Inputs:			
Volumetric flowrate (acfm): (4,000 - 500,000)	47,000		
Air to Cloth (A/C) Ratio	4		
Insulated	Yes		
Bag Diameter (in)	6		
Bag Length (ft)	12		
Bag type	Top Bag Removal		
Bag Material	16-oz Polyester		
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 268,936
Fabric Filter System (EC)			\$227,936
Fabric Filter with Insulation			\$200,736
Bags & Cages			\$27,200
Auxiliary Equipment			
Intrumentation	10%	EC	\$ 22,800
Sales Tax	3%	EC	\$ 6,800
Freight	5%	EC	\$ 11,400
Direct Installation Costs (DC)			\$ 199,013
Foundations and supports	4%	PEC	\$ 10,757
Handling and erection	50%	PEC	\$ 134,468
Electrical	8%	PEC	\$ 21,515
Piping	1%	PEC	\$ 2,689
Insulation for ductwork	7%	PEC	\$ 18,826
Painting	4%	PEC	\$ 10,757
Site Preparation	LS		
Facilities & Buildings	LS		
Indirect Costs (IC)			\$ 121,021
Engineering	10%	PEC	\$ 26,894
Construction and field expenses	20%	PEC	\$ 53,787
Contractor fees	10%	PEC	\$ 26,894
Start-up	1%	PEC	\$ 2,689
Performance test	1%	PEC	\$ 2,689
Contingencies	3%	PEC	\$ 8,068
Total Capital Investment (PEC + DC + IC)			\$ 588,971

- Figure 1.9 Equipment costs for pulse-jet filters (modular) from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
- Table 1.8 Bag Prices for Pulse-Jet, TR polyester bags from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
- Average CPI from 1998 is 163.0 and the Average CPI for 2016 first 2 quarters is 238.782 (CPI Detailed Report by U.S. Bureau of Labor Statistics, Table 24 (August 2016)

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table B-5
Carbon Adsorption
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Shakeout (CS)	
Design Inputs:			
Bag Change Frequency (years)		5	
Annual Electrical Consumption (kWh)		0	
Electrical Cost (\$/kWh) ⁽³⁾		0.00	
Equipment Life (years)		20	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 140,280
Operating Labor			
Operator ⁽⁴⁾	2 hr/shift	\$32.2/hr	\$ 60,278
Supervisor	15% of operator	-	\$ 9,042
Maintenance			
Labor ⁽⁴⁾	1 hr/shift	\$35/hr	\$ 32,760
Materials	100% of maintenance labor	-	\$ 32,760
Bag & Parts Replacement			
Bags & Cages	-	-	\$ 5,440
Utilities			
Electricity	Already used	-	\$ -
Compressed Air	Already used	-	\$ -
Waste Disposal	Already used	-	\$ -
Indirect Annual Costs (IAC)			\$ 146,374
Overhead	60% of Operating and Maintenance	-	\$ 80,904
Administrative Charges	2% of Total Capital Investment	-	\$ 11,779
Property Taxes	1% of Total Capital Investment	-	\$ 5,890
Insurance	1% of Total Capital Investment	-	\$ 5,890
Capital Recovery ⁽⁵⁾	CRF*[Total Capital Investment]	-	\$ 41,911
Total Annual Costs (DAC + IAC)			\$ 286,654

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 6, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Electric costs based on actuals at Forks Facility as provided by Facilities Engineering 2016-10-14

4) Labor wages based on actuals at Forks Facility as provided by Plant Manager 2016-10-13

5) Capital Recovery Factor (CRF) is calculated by $[(1+i)^n]/[(1+i)^n - 1]$; where i = interest and n = equipment life.

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table B-6
Carbon Adsorption
Cost Summary

VOC Reduction Cost	
Process Description:	Casting Shakeout (CS)
Design Inputs:	
VOC Controlled (tons):	73
Dust Collector	
Annual Cost (\$) ⁽¹⁾	\$ 286,654
Carbon Adsorber	
Annual Cost (\$) ⁽¹⁾	\$ 7,748,933
Total	
Annual Cost (\$) ⁽¹⁾	\$ 8,035,587
Cost of Control (\$/ton)	\$ 129,888

(1) Includes recurring annual costs (e.g. maintenance, utilities) and recovery of capital costs

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table B-7
Carbon Adsorption
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾

Technology Description: Carbon Adsorber

Process Description: Casting Pouring (CP)

Design Inputs:

Volumetric flowrate (acfm): (4,000 - 500,000)	16,000
Number of Carbon Beds (#):	52
Length of Bed (in Direction of Flow) (ft)	8
Bed Shape (Perpendicular to Flow)	Circle
Diameter (ft)	4
Carbon Requirement (lbs):	28,600

Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 1,718,670
Carbon Adsorber (EC)			\$ 1,456,500
Instrumentation	10%	EC	\$ 145,650
Sales Tax	3%	EC	\$ 43,695
Freight	5%	EC	\$ 72,825

Direct Installation Costs (DC)			\$ 515,601
Foundations and supports	8%	PEC	\$ 137,494
Handling and erection	14%	PEC	\$ 240,614
Electrical	4%	PEC	\$ 68,747
Piping	2%	PEC	\$ 34,373
Insulation for ductwork	1%	PEC	\$ 17,187
Painting	1%	PEC	\$ 17,187

Indirect Costs (IC)			\$ 532,788
Engineering	10%	PEC	\$ 171,867
Construction and field expenses	5%	PEC	\$ 85,934
Contractor fees	10%	PEC	\$ 171,867
Start-up	2%	PEC	\$ 34,373
Performance test	1%	PEC	\$ 17,187
Contingencies	3%	PEC	\$ 51,560

Total Capital Investment (PEC + DC + IC) \$ 2,767,059

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlined in Section 3.1, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1999. These have been adjusted to reflect inflation using a factor of \$1.43 (2016) / \$1.00 (1999).

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table B-8
Carbon Adsorption
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Carbon Adsorber	
Process Description:		Casting Pouring (CP)	
Design Inputs:			
Carbon Usage (lbs)		2,206,600	
Carbon Cost (\$/lb)		1.00	
Annual Electrical Consumption (kWh)		130,300	
Electrical Cost (\$/kWh) ⁽³⁾		0.07	
Equipment Life (years)		10	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 2,265,811
Operating Labor			
Operator ⁽⁴⁾	0.5 hr/shift	\$32.2/hr	\$ 15,070
Supervisor	15% of operator	-	\$ 2,260
Maintenance			
Labor ⁽⁴⁾	0.5 hr/shift	\$35/hr	\$ 16,380
Materials	100% of maintenance labor	-	\$ 16,380
Carbon Replacement			
Carbon	-	-	\$ 2,206,600
Utilities			
Electricity	-	-	\$ 9,121
Indirect Annual Costs (IAC)			\$ 475,551
Overhead	60% of Operating and Maintenance	-	\$ 30,054
Administrative Charges	2% of Total Capital Investment	-	\$ 55,341
Property Taxes	1% of Total Capital Investment	-	\$ 27,671
Insurance	1% of Total Capital Investment	-	\$ 27,671
Capital Recovery ⁽⁵⁾	CRF*[Total Capital Investment]	-	\$ 334,815

Total Annual Costs (DAC + IAC)	\$ 2,741,362
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1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlined in Section 3.1, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1999. These have been adjusted to reflect inflation using a factor of \$1.43 (2016) / \$1.00 (1999).

3) Electric costs based on actuals at Forks Facility as provided by Facilities Engineering 2016-10-14

4) Labor wages based on actuals at Forks Facility as provided by Plant Manager 2016-10-13

5) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment\ life$.

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table B-9
Carbon Adsorption
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾⁽³⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Pouring	
Design Inputs:			
Volumetric flowrate (acfm): (4,000 - 500,000)		16,000	
Air to Cloth (A/C) Ratio		4	
Insulated		Yes	
Bag Diameter (in)		6	
Bag Length (ft)		12	
Bag type		Top Bag Removal	
Bag Material		16-oz Polyester	
Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 90,971
Fabric Filter System (EC)			\$77,071
Fabric Filter with Insulation			\$67,871
Bags & Cages			\$9,200
Auxiliary Equipment			
Intrumentation	10%	EC	\$ 7,700
Sales Tax	3%	EC	\$ 2,300
Freight	5%	EC	\$ 3,900
Direct Installation Costs (DC)			\$ 67,318
Foundations and supports	4%	PEC	\$ 3,639
Handling and erection	50%	PEC	\$ 45,485
Electrical	8%	PEC	\$ 7,278
Piping	1%	PEC	\$ 910
Insulation for ductwork	7%	PEC	\$ 6,368
Painting	4%	PEC	\$ 3,639
Site Preparation	LS		
Facilities & Buildings	LS		
Indirect Costs (IC)			\$ 40,937
Engineering	10%	PEC	\$ 9,097
Construction and field expenses	20%	PEC	\$ 18,194
Contractor fees	10%	PEC	\$ 9,097
Start-up	1%	PEC	\$ 910
Performance test	1%	PEC	\$ 910
Contingencies	3%	PEC	\$ 2,729
Total Capital Investment (PEC + DC + IC)			\$ 199,225

1. Figure 1.9 Equipment costs for pulse-jet filters (modular) from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
2. Table 1.8 Bag Prices for Pulse-Jet, TR polyester bags from "EPA Air Pollution Control Cost Manual," 6th Edition, EPA/452/B-02-001, January 2002, Costs are in Second Quarter 1998 \$USA.
3. Average CPI from 1998 is 163.0 and the Average CPI for 2016 first 2 quarters is 238.782 (CPI Detailed Report by U.S. Bureau of Labor Statistics, Table 24 (August 2016)

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table B-10
Carbon Adsorption
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾			
Technology Description:		Continuous, Pulse-Jet (modular)	
Process Description:		Casting Pouring (CP)	
Design Inputs:			
Bag Change Frequency (years)		5	
Annual Electrical Consumption (kWh)		0	
Electrical Cost (\$/kWh) ⁽³⁾		0.00	
Equipment Life (years)		20	
Interest Rate (%):		3.625	
Annual Operating Hours (hours)		7,488	
Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 136,680
Operating Labor			
Operator ⁽⁴⁾	2 hr/shift	\$32.2/hr	\$ 60,278
Supervisor	15% of operator	-	\$ 9,042
Maintenance			
Labor ⁽⁴⁾	1 hr/shift	\$35/hr	\$ 32,760
Materials	100% of maintenance labor	-	\$ 32,760
Bag & Parts Replacement			
Bags & Cages	-	-	\$ 1,840
Utilities			
Electricity	Already used	-	\$ -
Compressed Air	Already used	-	\$ -
Waste Disposal	Already used	-	\$ -
Indirect Annual Costs (IAC)			\$ 103,050
Overhead	60% of Operating and Maintenance	-	\$ 80,904
Administrative Charges	2% of Total Capital Investment	-	\$ 3,985
Property Taxes	1% of Total Capital Investment	-	\$ 1,992
Insurance	1% of Total Capital Investment	-	\$ 1,992
Capital Recovery ⁽⁵⁾	CRF*[Total Capital Investment]	-	\$ 14,177
Total Annual Costs (DAC + IAC)			\$ 239,730

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlines in Section 6, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1998. These have been adjusted to reflect inflation using a factor of \$1.46 (2016) / \$1.00 (1998).

3) Electric costs based on actuals at Forks Facility as provided by Facilities Engineering 2016-10-14

4) Labor wages based on actuals at Forks Facility as provided by Plant Manager 2016-10-13

5) Capital Recovery Factor (CRF) is calculated by $[(1+i)^n]/[(1+i)^n - 1]$; where i = interest and n = equipment life.

Victaulic Company - Forks Facility
 VOC RACT 2 Evaluation
 Table B-11
 Carbon Adsorption
 Cost Summary

VOC Reduction Cost	
Process Description:	Casting Pouring (CP)
Design Inputs:	
VOC Controlled (tons):	8
Dust Collector	
Annual Cost (\$) ⁽¹⁾	\$ 239,730
Carbon Adsorber	
Annual Cost (\$) ⁽¹⁾	\$ 2,741,362
Total	
Annual Cost (\$) ⁽¹⁾	\$ 2,981,092
Cost of Control (\$/ton)	\$ 413,240

(1) Includes recurring annual costs (e.g. maintenance, utilities) and recovery of capital costs

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table B-12
Carbon Adsorption
Cost Summary

Installed Cost Estimate⁽¹⁾⁽²⁾

Technology Description: Carbon Adsorber

Process Description: Core Room (CR)

Design Inputs:

Volumetric flowrate (acfm): (4,000 - 500,000)	75,000
Number of Carbon Beds (#):	280
Length of Bed (in Direction of Flow) (ft)	8
Bed Shape (Perpendicular to Flow)	Circle
Diameter (ft)	4
Carbon Requirement (lbs):	128,800

Category	Cost Factor	Applied to	Cost
Purchased Equipment (PEC)			\$ 7,479,890
Carbon Adsorber (EC)			\$ 6,338,890
Instrumentation	10%	EC	\$ 633,889
Sales Tax	3%	EC	\$ 190,167
Freight	5%	EC	\$ 316,944

Direct Installation Costs (DC)			\$ 2,243,967
Foundations and supports	8%	PEC	\$ 598,391
Handling and erection	14%	PEC	\$ 1,047,185
Electrical	4%	PEC	\$ 299,196
Piping	2%	PEC	\$ 149,598
Insulation for ductwork	1%	PEC	\$ 74,799
Painting	1%	PEC	\$ 74,799

Indirect Costs (IC)			\$ 2,318,766
Engineering	10%	PEC	\$ 747,989
Construction and field expenses	5%	PEC	\$ 373,994
Contractor fees	10%	PEC	\$ 747,989
Start-up	2%	PEC	\$ 149,598
Performance test	1%	PEC	\$ 74,799
Contingencies	3%	PEC	\$ 224,397

Total Capital Investment (PEC + DC + IC) \$ 12,042,623

1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlined in Section 3.1, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.

2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1999. These have been adjusted to reflect inflation using a factor of \$1.43 (2016) / \$1.00 (1999).

Victaulic Company - Forks Facility
VOC RACT 2 Evaluation
Table B-13
Carbon Adsorption
Cost Summary

Annual Cost Estimate⁽¹⁾⁽²⁾

Technology Description: Carbon Adsorber

Process Description: Casting Pouring (CP)

Design Inputs:

Carbon Usage (lbs)	11,617,200
Carbon Cost (\$/lb)	1.00
Annual Electrical Consumption (kWh)	714,700
Electrical Cost (\$/kWh) ⁽³⁾	0.07
Equipment Life (years)	10
Interest Rate (%):	3.625
Annual Operating Hours (hours)	8,760

Category	Suggested Factor	Unit Cost	Cost
Direct Annual Costs (DAC)			\$ 11,725,828

Operating Labor

Operator ⁽⁴⁾	0.5 hr/shift	\$32.2/hr	\$ 17,630
Supervisor	15% of operator	-	\$ 2,644

Maintenance

Labor ⁽⁴⁾	0.5 hr/shift	\$35/hr	\$ 19,163
Materials	100% of maintenance labor	-	\$ 19,163

Carbon Replacement

Carbon	-	-	\$ 11,617,200
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Utilities

Electricity	-	-	\$ 50,029
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Indirect Annual Costs (IAC) **\$ 1,974,023**

Overhead	60% of Operating and Maintenance	-	\$ 35,159
Administrative Charges	2% of Total Capital Investment	-	\$ 240,852
Property Taxes	1% of Total Capital Investment	-	\$ 120,426
Insurance	1% of Total Capital Investment	-	\$ 120,426
Capital Recovery ⁽⁵⁾	CRF*[Total Capital Investment]	-	\$ 1,457,159

Total Annual Costs (DAC + IAC) **\$ 13,699,851**

- 1) Purchases equipment cost, direct installations costs, and indirect installations costs are based on the methodology outlined in Section 3.1, Chapter 1, of the EPA Air Pollution Control Cost Manual, 6th Edition, 2002.
- 2) Costs provided in the EPA Air Pollution Control Cost Manual reflected the cost of equipment in 1999. These have been adjusted to reflect inflation using a factor of \$1.43 (2016) / \$1.00 (1999).
- 3) Electric costs based on actuals at Forks Facility as provided by Facilities Engineering 2016-10-14
- 4) Labor wages based on actuals at Forks Facility as provided by Plant Manager 2016-10-13
- 5) Capital Recovery Factor (CRF) is calculated by $[i(1+i)^n]/[(1+i)^n - 1]$; where $i = interest$ and $n = equipment\ life$.

Victaulic Company - Forks Facility
 VOC RACT 2 Evaluation
 Table B-14
 Carbon Adsorption
 Cost Summary

VOC Reduction Cost	
Process Description:	Casting Pouring (CP)
Design Inputs:	
VOC Controlled (tons):	8
Carbon Adsorber	
Annual Cost (\$) ⁽¹⁾	\$ 13,699,851
Cost of Control (\$/ton)	\$ 1,942,332

(1) Includes recurring annual costs (e.g. maintenance, utilities) and recovery of capital costs

Attachment C – RACT III Submittal



**CHAPTER 129. STANDARDS FOR SOURCES ADDITIONAL RACT REQUIREMENTS
FOR MAJOR SOURCES OF NO_x AND VOCs FOR THE 2015 OZONE NAAQS**

Written notification, 25 Pa. Code §§129.111 and 129.115(a)

25 Pa. Code Sections 129.111 and 129.115(a) require that the owner and operator of an air contamination source subject to the final-form RACT III regulations submit a notification describing how you intend to comply with the final-form RACT III requirements, and other information spelled out in subsection 129.115(a). The owner or operator may use this template to notify DEP. Notification must be submitted in writing or electronically to the appropriate Regional Manager located at the appropriate DEP regional office. In addition to the notification required by §§ 129.111 and 129.115(a), you also need to submit an applicable analysis or RACT determination as per § 129.114(a) or (i).

Is the facility major for NO_x?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Is the facility major for VOC?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>

FACILITY INFORMATION						
Facility Name	Victaulic Co / Forks Facility					
Permit Number	48-00009	PF ID if known				
Address Line1	4901 Kesslersville Road					
Address Line2						
City	Easton	State	PA	Zip	18040-6714	
Municipality	Forks Township			County	Northampton	
OWNER INFORMATION						
Owner	Victaulic Co					
Address Line1	4901 Kesslersville Road					
Address Line2						
City	Easton	State	PA	Zip	18040-6714	
Email				Phone	610-559-3476	
CONTACT INFORMATION						
Permit Contact Name	Kraig L Hume					
Permit Contact Title	Global Environmental Mgr					
Address Line	4901 Kesslersville Road					
City	Easton	State	PA	Zip	18040-6714	
Email	Kraig.Hume@Victualic.com			Phone	610-559-3476	

Complete Table 1, including all air contamination sources that commenced operation on or before August 3rd, 2018. Air contamination sources determined to be exempt from permitting requirements also must be included. You may find this information in section A and H of your operating permit.

Table 1 - Source Information

Source ID	Source Name	Make	Model	Physical location of a source (i.e, building#, plant#, etc.)	Was this source subject to RACT II?
110	Cold Core Box Machine				No
111	Sand Conveyance Silos #3 & #4				No
112	Sand Conveyance Silos #1 & #2				No
113	Shell Core Machines				No
120	Cold Core Box Machine #2				No
P001	Charge Handling & Chip Feeding				No
P002	Venetta Preheater				No
P003	Furnaces – Melting				No
P004	Inoculation				No
P005	Pouring / Casting Operation				Yes
P007	Casting Finishing				No
P008	Sand Handng (Casting Shakeout)				Yes
P009	Large Piece Spraybooth				No
P010	Paintline Spraybooth				No

P011	PPS Spray Booth				No
P012A	Dip Proces Paint System				No
P014	Annealing / Heat Treat Operation				No
P016	Core Room Operations				Yes
P018	Burn-Off Oven				No

Complete Table 2 or 3 if the facility is a major NOx or VOC emitting facility. For the column with the title “How do you intend to comply”, compliance options are:

- Presumptive RACT requirement under §129.112 (**PRES**),
- Facility-wide averaging (**FAC**) §129.113,
- System-wide averaging (**SYS**) §129.113, or
- Case by case determination §129.114 (**CbC**).

Please provide the applicable subsection if source will comply with the presumptive requirement under §129.112.

Table 2 – Method of RACT III Compliance, NOx

Source ID	Source Name	NOx PTE TPY	Exempt from RACT III (yes or no)	How do you intend to comply? (PRES, CbC, FAC or SYS)	Specific citation of rule if presumptive option is chosen

Please complete Table 3 if the facility is a major VOC emitting facility. Please provide the applicable section if a source is complying with any RACT regulation listed in 25 Pa Code §§ 129.51, 129.52(a)—(k) and Table I categories 1—11, 129.52a—129.52e, 129.54—129.63a, 129.64—129.69, 129.71—129.73, 129.75 129.71—129.75, 129.77 and 129.101—129.107.

Table 3 – Method of RACT III Compliance, VOC

Source ID	Source Name	VOC PTE TPY	Exempt from RACT III (yes or no)	How do you intend to comply?	Specify citation of rule or subject to 25 Pa Code RACT regulation, (list the applicable sections)
P005	Pouring / Casting Operations	9.43	No / Subject to RACT II	CbC	N/A
P008	Sand Handling (Casting Shakeout)	80.87	No / Subject to RACT II	CbC	N/A
P016	Core Room Operations	9.22	No / Subject to RACT II	CbC	N/A
P009	Large Piece Spraybooth		Yes	Pres	129.52
P012A	Dip Process Paint System		Yes	Pres	129.52