Checking In 3/21/2024

Wednesday, March 27, 2024 2:09 PM

Andrews, Edward S <edward.s.andrews@wv.gov>

Checking In

1 message

Wood, Katie <katie.wood@tetratech.com> Thu, Mar 21, 2024 at 1:23 PM
To: Edward Andrews <edward.s.andrews@wv.gov>

Hey Ed,

Just wanted to check in and see if you needed anything further for Empire.

Thanks,

Katie

Katie Wood* | Environmental Scientist
Direct **+1 (740) 298-9062** | Mobile **+1 (304) 559-9980** | katie.wood@tetratech.com
Formerly Katie Pugh, please note name change
Tetra Tech | *Leading with Science®* | OGA
47443 National Rd Suite 3 | St. Clairesville, OH 43950 | tetratech.com

Further Discussion 3/11/2024

Wednesday, March 27, 2024 2:08 PM

Andrews, Edward S <edward.s.andrews@wv.gov>

Re: Empire Discussion

1 message

Andrews, Edward S <edward.s.andrews@wv.gov> Mon, Mar 11, 2024 at 1:26 PM
To: "Farley R. Wood, P.E." <fwood@empirede.com>
Cc: "Wood, Katie" <katie.wood@tetratech.com>, Malcolm Kingston <design@technotherm.co.za>

Thanks for the follow up with my concerns about the process.

I will provide either a my understanding of the decay of PVC and formation of HCl with recovery or an illustration/flow diagram with which we can have a discussion about.

Thanks
Ed

On Mon, Mar 11, 2024 at 1:15 PM Farley R. Wood, P.E. <fwood@empirede.com> wrote:

> Ed,
>
> See my comments below:
>
> 
>
>
> Farley R. Wood, P.E.
> Vice President of Engineering
>
> Main Office (304) 935-5851
> Mobile: (304) 650-2023
> Teams: Click Here
>
> fwood@empirede.com
> www.empirediversifiedenergy.com
>
> **From:** Wood, Katie <katie.wood@tetratech.com>
> **Sent:** Friday, March 8, 2024 3:15 PM
> **To:** Farley R. Wood, P.E. <fwood@empirede.com>
> **Subject:** FW: Empire Discussion
>
>

From: Andrews, Edward S <edward.s.andrews@wv.gov>
Sent: Friday, March 8, 2024 3:10 PM
To: Wood, Katie <katie.wood@tetratech.com>
Subject: Re: Empire Discussion

Katie,

I have looked over the latest request to my questions.

Some things are making sense(e.g, formation of HCl from the pyrolysis unit).

However, I am still a little confused on how the gaseous HCl in the synthetic gas is going to be stripped out with the gas cleaning trains without a significant amount of water being entrained into the cleaned synthetic gas stream.

The Cl gas will be liberated in the pre-pyrolysis unit and removed before the feed enters the pyrolysis unit, where the syngas is produced.

I saw that there was some HCl estimated from the scrubber in the revised application but I did not receive any attachments in your February 21 email (tanks/HCl calculations).

Katie will forward to you.

Here are some of my concerns/questions that I still have:

A)1) Make up the PVC in the plastic feedstock. At 100% PVC, about 15.5 gallons per minute of 20% HCl could potentially be produced. At this rate, the storage capacity would be exceeded in one day.

We cannot run 100% PVC feed to the plant. We are limited to 15%, and should produce a maximum of 5,500 gallons per day of HCl.

We also have the option of running less than 15% to reduce HCl production, or not run any PVC to effectively stop HCl production.

A)2) Operating temperature range of the pyrolysis unit.

The pre-pyrolysis units operating temperature is 320° C (608° F). The operating temperature of the pyrolysis unit is 830° C (1,526° F).

A)3) Will oils/tars still be produced? One of the references in the provided paper noted the formation of methane, ethane, ethyne, 1-butane, hydrogen, chlorine, and benzene, which are in the form of CnHm. None of these compounds

are close to C14

Oils/tars will be produced. We have an oil/water separator on the HCl circuit, and a larger oil/water separator on each of the three gas cleanup trains.

The collected oil/tars are pumped to a central collection tank where the product is used as fuel in the combustion chamber of the pyrolysis units.

B) I am assuming the gas cleaning trains are going to be used to extract the gaseous HCl out of the synthetic gas. How does EGG plan on doing this and what properties are going to be monitored?

I am envisioning that the scrubber would be blown down once the circulating water reached a HCl conc of 20% or sg of 1.1. This needs to be spelled out.

The Cl gas will be collected and removed from the system prior to the generation of syngas.

C) Venting the HCl scrubber to the RTO might be the simplest approach. Operating pressures and water/HCl carryover might adversely affect the life and performance of the RTO. Please see Note 3 on DWG Poly Scrub Basis 5'x5' scrubber that the vessel is designed for 1.9 SpG Mat'l @ 100 F/Atmos Pressure.

The HCl fumes will pass through the scrubber which is 99% efficient. There will not be any water carryover.

There will be high dilution of the very low concentration HCl fumes returning to the RTO that the designers of the system feel any adverse effects to life cycle or performance would be negligible.

Stipping gasous HCl with water is going to generate a significant amount of heat energy.

The HCl system has two chiller units included in the circuit. One for the gasses entering the spray tower, and a second for the liquid leaving the tower.

Plus connecting the vent line to the RTO is going to reduce the operating pressure below atmospheric (negative pressure).

That is correct. We want negative pressure from the HCl scrubber to the RTO to prevent leakage.

D) Classification of the plastic feedstock is either a fuel/raw ingredient in accordance with 40 CFR 241.

Good

On Fri, Mar 1, 2024 at 10:23 AM Wood, Katie <katie.wood@tetratech.com> wrote:

> Ed,
>
> We have some answers to your questions below in red. Please let me know if you would like to discuss.
>
> Thanks,
>
> Katie
>
> ---
>
> **From:** Andrews, Edward S <edward.s.andrews@wv.gov>
> **Sent:** Friday, February 23, 2024 2:24 PM
> **To:** Wood, Katie <katie.wood@tetratech.com>; Farley Wood <fwood@empirede.com>
> **Subject:** Re: Empire Discussion
>
> ⚠ **CAUTION:** This email originated from an external sender. Verify the source before opening links or attachments. ⚠
>
> Using Chlorine gas and water reaction to produce HCl also produces a by-product of HOCl (hypochlorous acid). https://www.bing.com/search?q=chlorine+gas+water+reaction&qs=UT&pq=chlorine+gas+water+reaction&sc=10-27&cvid=1D306673308642F9BCEE5D950B9BFB08&FORM=QBRE&sp=1&ghc=1&lq=0 The process does not produce any Chlorine gas, it produces Chloride gas so no HOCL is produced. I have attached a paper provided by Technotherm for futher information
>
> Question is: Will Empire separate hypochlorous acid from the HCl or send it out as it? As per above no HOCL will be produced
>
> Will the emissions of HCl go through a separate release point than the RTO stack? If it is a separate stack, I need the stack id and stack parameters of this point. No all emissions will go through the RTO
>
> Also, I will need the calculations to support your emission estimate of HCl and concentration of HCl in the effluent release to the atmosphere from the production/storage/loading out of HCl. Calculations attached, these were included in the last submittal
>
> Ed
>
> On Thu, Feb 22, 2024 at 1:00 PM Wood, Katie <katie.wood@tetratech.com> wrote:
>
> > ---

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Phone Conference ID: 114 016 353#

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--
Edward Andrews, P.E.
Engineer
WVDEP/Division of Air Quality
304-926-0499 Ext 41244
601 57th Street, SE
Charleston, WV 25304

--
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Charleston, WV 25304

External Email. Please make sure you trust this sender before clicking on any links or opening attachments. Learn why this is important

--
Edward Andrews, P.E.
Engineer
WVDEP/Division of Air Quality
304-926-0499 Ext 41244
601 57th Street, SE
Charleston, WV 25304

Scrubber Forms 3/11/2024

Wednesday, March 27, 2024 2:05 PM

Andrews, Edward S <edward.s.andrews@wv.gov>

RE: Empire Discussion

1 message

Wood, Katie <katie.wood@tetratech.com> Mon, Mar 11, 2024 at 1:09 PM
To: "Andrews, Edward S" <edward.s.andrews@wv.gov>
Cc: Farley R Wood <fwood@empirede.com>

Ed,

Attached is the emission control sheet for the scrubber. Farley is pulling together answers for you questions below and will be sending over shortly.

Thanks,

Katie

From: Andrews, Edward S <edward.s.andrews@wv.gov>
Sent: Friday, March 8, 2024 3:10 PM
To: Wood, Katie <katie.wood@tetratech.com>
Subject: Re: Empire Discussion

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A)2) Operating temperature range of the pyrolysis unit.

A)3) Will oils/tars still be produced? One of the references in the provided paper noted the formation of methane, ethane, ethyne, 1-butane, hydrogen, chlorine, and benzene, which are in the form of CnHm. None of these compounds are close to C14

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Stipping gasous HCl with water is going to generate a significant amount of heat energy.

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D) Classification of the plastic feedstock is either a fuel/raw ingredient in accordance with 40 CFR 241.

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> Thanks,
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> Katie

From: Andrews, Edward S <edward.s.andrews@wv.gov>
Sent: Friday, February 23, 2024 2:24 PM
To: Wood, Katie <katie.wood@tetratech.com>; Farley Wood <fwood@empirede.com>
Subject: Re: Empire Discussion

⚠ **CAUTION:** This email originated from an external sender. Verify the source before opening links or attachments.
⚠

Using Chlorine gas and water reaction to produce HCl also produces a by-product of HOCl (hypochlorous acid). https://www.bing.com/search?q=chlorine+gas+water+reaction&qs=UT&pq=chlorine+gas+water+reaction&sc=10-27&cvid=1D306673308642F9BCEE5D950B9BFB08&FORM=QBRE&sp=1&ghc=1&lq=0 The process does not produce any Chlorine gas, it produces Chloride gas so no HOCL is produced. I have attached a paper provided by Technotherm for futher information

Question is: Will Empire separate hypochlorous acid from the HCl or send it out as it? As per above no HOCL will be produced

Will the emissions of HCl go through a separate release point than the RTO stack? If it is a separate stack, I need the stack id and stack parameters of this point. No all emissions will go through the RTO

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Ed

On Thu, Feb 22, 2024 at 1:00 PM Wood, Katie <katie.wood@tetratech.com> wrote:

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M-3.pdf
2632K

M-3

Attachment M
Air Pollution Control Device Sheet
(WET COLLECTING SYSTEM-SCRUBBER)

Control Device ID No. (must match Emission Units Table):

Equipment Information

1. Manufacturer: Poly Processing
   Model No. 5' X 5" Scrubber

2. Method: ☐ Packed Bed ☐ Venturi ☐ Spray Tower ☐ Cyclone ☐ Mechanical ☐ Orifice ☒ Other, specify

3. Provide diagram(s) of unit describing capture system with duct arrangement and size of duct, air volume, capacity, horsepower of movers. If applicable, state hood face velocity and hood collection efficiency.

4. Provide a scale diagram of the scrubber showing internal construction. Please include packing type and size, spray configurations, baffle plates, and mist eliminators.

5. What type of liquid entrainment eliminators or system will be used? Submit a schematic diagram showing thickness, mesh, and material of construction.

6. Describe the scrubber's construction material:
   Polyethelene (XLPE tank with PVC internals and exterior piping. Water with NaOH is added to the vessel above the set level. Vent gas from the HCl tank passes through the gas diffuser where HCl fumes are neutralized before the scrubbed gas is vented from the top.

7. What will be the power requirements of the collector?
   Fan NO HP Inlet scrubbing liquid pump: NA HP

8. What type of fan(s) will be used?
   Type of fan blade: None Number of blades: None Diameter of blade: None in.
   Also supply a fan curve for each fan to be used.

9. Estimated gas pressure drop at maximum flow rate: 1 inches H_2O

Scrubbing Liquor Characteristics

10. Scrubbing Liquor

Composition	Weight %
1 Water	99
2 NaOH	1
3	
4	

11. Scrubbing liquor losses (evaporation, etc.): 0.5 gal/1000 ACF gas

12. Liquor pressure to scrubber: 0.25 PSIA

13. Pressure drop through scrubber: 6 in. H_2O

14. Source of liquor (explain):
    Batch liquid added to tank

15. Liquor flow rates to scrubber:
    Design maximum: 1,000 gal/min
    Average expected: 500 gal/min

16. Describe system to be used to supply liquor to collector:
    Manual drain and re-fill process

17. Give the expected solids content of the liquor:
    No suspended solids will be created. The ssystem will convert HCl gas vaporst will react with NaOH to form water (H2O) and sald (NaCl). Water will be changed out well before NaCl concentration reaches saturation.

18. If the liquor is to be recirculated, describe any treatment performed:

19. Data for Venturi Scrubber:

Throat Dimensions: NA (Specify Units)

Throat Velocity: Na ft/sec

20. Data for Packed Towers:

Type of Packing: NA

Superficial Gas Velocity through Bed:

Gas Stream Characteristics

21. Gas flow into the collector:

1000 ACF @ 20 °F and 14.2 PSIA

22. Gas stream temperature:

Inlet: ambient °F

Outlet: ambinet °F

23. Gas flow rate:

Design Maximum: 135 ACFM

Average Expected: 67 ACFM

24. Particulate Grain Loading in grains/scf:

Inlet: NA

Outlet: NA

25. Emission rate of each pollutant (specify) into and out of collector:

Pollutant	IN		OUT		Guaranteed Minimum Collection Efficiency
	lb/hr	grains/acf	lb/hr	grains/acf	
A HCl	0.03lb/hr		0.0003lb/hr		99
B					
C					
D					
E					

26. Type of pollutant(s) controlled: ☐ SO_x ☐ Odor

☐ Particulate (type): ☒ Other: HCl

27. By what method were the uncontrolled emissions calculated? ☒ Material Balance ☐ Stack Test

☐ Pilot Test ☐ Other:

28. Dimensions of stack: Height 4'-9" ft. Diameter 5'-1" ft

29. Supply an equilibrium curve and/or solubility data (at various temperatures) for the proposed system.

30. Supply a curve showing proposed collection efficiency versus gas volume from 25 to 100 percent of design rating of collector.

Particulate Distribution

31. Complete the table:	Particle Size Distribution at Inlet to Collector	Fraction Efficiency of Collector
Particulate Size Range (microns)	**Weight % for Size Range**	**Weight % for Size Range**
0 – 2	NA, vapor to liquid solvent converstion.	
2 – 4		
4 – 6		
6 – 8		
8 – 10		
10 – 12		
12 – 16		
16 – 20		
20 – 30		
30 – 40		
40 – 50		
50 – 60		
60 – 70		
70 – 80		
80 – 90		
90 – 100		
>100		

32. Describe any air pollution control device inlet and outlet gas conditioning processes (e.g., gas cooling, gas reheating, gas humidification):

33. Describe the collection material disposal system:
Neutralized HCl gas will become a salt brine that will be disposed of in accordance with local, state (PADEP), and federal regulations.

34. Have you included ***Wet Collecting (Scrubber) Control Device*** in the Emissions Points Data Summary Sheet? Yes

35. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING:	RECORDKEEPING:
REPORTING:	TESTING:

MONITORING:	Please list and describe the process parameters and ranges that are proposed to be monitored in order to demonstrate compliance with the operation of this process equipment or air control device.
RECORDKEEPING:	Please describe the proposed recordkeeping that will accompany the monitoring.
REPORTING:	Please describe any proposed emissions testing for this process equipment on air pollution control device.
TESTING:	Please describe any proposed emissions testing for this process equipment on air pollution control device.

36. Manufacturer's Guaranteed Capture Efficiency for each air pollutant.

37. Manufacturer's Guaranteed Control Efficiency for each air pollutant.
0.99%

38. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty.

Attachment L
EMISSIONS UNIT DATA SHEET
BULK LIQUID TRANSFER OPERATIONS

Furnish the following information for each new or modified bulk liquid transfer area or loading rack, as shown on the *Equipment List Form* and other parts of this application. This form is to be used for bulk liquid transfer operations such as to and from drums, marine vessels, rail tank cars, and tank trucks.

Identification Number (as assigned on *Equipment List Form*):	
1. Loading Area Name:	
2. Type of cargo vessels accommodated at this rack or transfer point (check as many as apply): ☐ Drums ☐ Marine Vessels ☐ Rail Tank Cars ☒ Tank Trucks	
3. Loading Rack or Transfer Point Data:	
Number of pumps	
Number of liquids loaded	2
Maximum number of marine vessels, tank trucks, tank cars, and/or drums loading at one time	1
4. Does ballasting of marine vessels occur at this loading area? ☐ Yes ☐ No ☑ Does not apply	
5. Describe cleaning location, compounds and procedure for cargo vessels using this transfer point:	
6. Are cargo vessels pressure tested for leaks at this or any other location? ☐ Yes ☐ No If YES, describe:	

7. Projected Maximum Operating Schedule (for rack or transfer point as a whole):

Maximum	Jan. - Mar.	Apr. - June	July - Sept.	Oct. - Dec.
hours/day				
days/week				

weeks/quarter				

8. Bulk Liquid Data *(add pages as necessary):*							
Pump ID No.							
Liquid Name	HCL						
Max. daily throughput (1000 gal/day)	5k						
Max. annual throughput (1000 gal/yr)	1300						
Loading Method [1]	sub						
Max. Fill Rate (gal/min)	1000						
Average Fill Time (min/loading)	500						
Max. Bulk Liquid Temperature (°F)	75						
True Vapor Pressure [2]							
Cargo Vessel Condition [3]							
Control Equipment or Method [4]							
Minimum control efficiency (%)							
Maximum Emission Rate — Loading (lb/hr)							
Maximum Emission Rate — Annual (lb/yr)							
Estimation Method [5]							

[1] BF = Bottom Fill SP = Splash Fill SUB = Submerged Fill

[2] At maximum bulk liquid temperature

[3] B = Ballasted Vessel, C = Cleaned, U = Uncleaned (dedicated service), O = other (describe)

[4] List as many as apply (complete and submit appropriate *Air Pollution Control Device Sheets*):CA = Carbon Adsorption LOA = Lean Oil AdsorptionCO = Condensation SC = Scrubber (Absorption)CRA = Compressor-Refrigeration-Absorption TO = Thermal Oxidation or Incineration
CRC = Compression-Refrigeration-Condensation VB = Dedicated Vapor Balance (closed system)
O = other (descibe)

[5] EPA = EPA Emission Factor as stated in AP-42
MB = Material Balance

TM = Test Measurement based upon test data submittal
O = other (describe)

9. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
REPORTING	TESTING

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty

V-SYSTEMS
COMMERCIAL | INDUSTRIAL | MUNICIPAL

101 Fairview Avenue
Pittsburgh, PA 15238

Email: sales@v-syst.com
Web: www.v-syst.com

Telephone: 412-826-9200
Fax: 412-826-8168

Quote #2023-560-H-R

July 26, 2023

Mr. Farley R. Wood, P.E.
Vice President of Engineering
Empire Diversified Energy
1400 Main Street
Follansbee, WV 26037

Subject: Chemical System - Scrubber -- Quote #2023-560-H-R

Dear Mr. Wood,

Please find attached our proposal for the above referenced equipment/project. We appreciate the opportunity to provide a quote for this opportunity.

You will also find our most recent line card attached for your reference. I hope you will think of us during your next project. If you would have any questions or require additional information, please give us a call at (412) 826-9200.

Sincerely,

Russell C. Huffmyer
President & CEO
V-Systems, Inc.
101 Fairview Avenue
Pittsburgh, PA 15238

Enclosure
arsr

V-SYSTEMS
COMMERCIAL | INDUSTRIAL | MUNICIPAL

101 Fairview Avenue
Pittsburgh, PA 15238

Email: sales@v-syst.com
Web: www.v-syst.com

Telephone: 412-826-9200
Fax: 412-826-8168

Quotation:

Project Name:	Chemical System - Scrubber	**Contact Name:**	Farley Wood
Company Name:	Empire Diversified Energy	**Email/Fax:**	fwood@empirede.com
		Phone:	304-914-2624
Address/Street:	1400 Main Street	**Date:**	July 21, 2023 / Revised July 26, 2023
City/State/Zip:	Follansbee, WV 26037	**Quote Number:**	2023-560-H-R

Thank you for the opportunity to provide you with the following quote:

Quantity	Item Description	Net Price Each	Total Net Price
Tag: Scrubber Tank			
1	PolyScrub Scrubber Tank, 700 Open Top, Rated: 1.90 Specific Gravity Wall Thickness, Material: Crosslinked Polyethylene (XLPE)✦, Color: Natural (yellowish white) • (1) Lid/Manway - 61" Cover Assembly Open Top /Stainless Steel/Pe • (1) Vent - 6" U-Vent PVC • (1) Outlet / Overflow - 1" Scrubber Outlet/Overflow PVC/litharge Viton /c-276 • (1) Scrubber - 6" Scrubber Assembly PVC/litharge Viton • (1) Fill - 1" Bulkhead Fitting Assembly Socket x thread PVC/litharge Viton • Warranty - 5 Years, Full Replacement, Non-Prorated Includes Product Engineering / Permitting Support for Permit Application	$16,500.00	$16,500.00
Tag: Tank			
1	10,305-Gallon Vertical Tank, Rated: 1.90 Specific Gravity Wall Thickness, Material: Crosslinked Polyethylene (XLPE)✦, Color: Natural (yellowish white) • (1) Lid/Manway - 24" Manway Cover 24" Fume Tight /Stainless Steel/pe • (1) Fill - 2" Bulkhead Fitting Assembly Socket x thread PVC/EPDM • (2) Dome Fitting - 2" Bulkhead Fitting Assembly Socket x thread PVC/EPDM • (3) Sidewall Fitting - 2" Bolted Flange Fitting Socket PVC/c-276/EPDM • (1) Vent - 6" U-vent with Bolted Flange PVC/c-276/EPDM • WARRANTY:5 Years, Full Replacement, Non-Prorated	$39,675.00	$39,675.00

V-SYSTEMS
COMMERCIAL | INDUSTRIAL | MUNICIPAL

101 Fairview Avenue
Pittsburgh, PA 15238

Email: sales@v-syst.com
Web: www.v-syst.com

Telephone: 412-826-9200
Fax: 412-826-8168

Tag: Pump			
2	March Model # TE-10K-MD 3PH 10 HP - Inlet: 3"MPT, Outlet: 2"MPT, Wet End: Natural Kynar (Front Housing, Rear Housing), Glass Filled Kynar (Impeller) with 6.625" Impeller Trim, Viton (Gasket), Carbon (Bushing), Ceramic (Shaft, Thrust Washers), and driven by a 10 HP, 3500 RPM, 3/60/230/460, TEFC Motor **Note**: • Lead Time is currently 1 Week, A.R.O. • FOB out of March in IL (must ship by LTL due to size and weight)	$7,920.00	$15,840.00
Tag: VFD(s)			
2	Xylem, Variable Frequency Drives, 10 HP, 460-3-60, NEMA 3R, BACnet **Note**: • Lead Time is currently at 7 Weeks, A.R.O.	$7,780.00	$15,560.00
Tag: Chem Feed Skid			
1	SS1-C_FLOOR_050_PVCEPDM_PD PP/PE Prominent Skid for solenoid driven pumps, (20"W x 18"D x 40"H) 1/2" PVC/EPDM socket weld pipe and fittings Wye strainer 500ml PVC calibration column 164ml CPVC/EPDM pulsation dampeners Pressure relief valves Pressure gauge with isolator Back pressure valve Plumbing and components rated at 150 PSI regardless of pump pressure. • (1) GMXA0708PVT2Q000UDC1300EN Prominent Gamma/X 2 GPH/102PSI, PVDF/PTFE, bleed valve w/spring, 4-20mA output • (1) Prominent CP1 ONE PUMP 120VAC SCADA PANEL	$21,505.00	$21,505.00
		Total Quoted Amount:	$109,080.00

QUOTED BY: RUSS HUFFMYER

If you need further information concerning the products that have been included in the quote, please feel free to contact me at 412-826-9200 and/or rhuffmyer@v-syst.com.

We appreciate the opportunity to provide you with this quote and look forward to working with you on this important project.

Thank you,

Russell C. Huffmyer
President & CEO

arsr

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101 Fairview Avenue
Pittsburgh, PA 15238

Email: sales@v-syst.com
Web: www.v-syst.com

Telephone: 412-826-9200
Fax: 412-826-8168

THIS QUOTATION OR SELLER'S ACCEPTANCE OF THIS ORDER IS EXPRESSLY LIMITED TO, AND EXPRESSLY MADE CONDITIONAL ON, BUYER'S ACCEPTANCE OF THE V-SYSTEMS-TEC, INC. STANDARD TERMS AND CONDITIONS OF SALE. A COPY OF THESE TERMS AND CONDITIONS IS AVAILABLE AT https://v-syst.com/terms-and-conditions-of-sale-and-service. SELLER OBJECTS TO ANY DIFFERENT OR ADDITIONAL TERMS.

General Comments

Warranty applies per Sales & Service Terms and Conditions if the following are met:

- Equipment installed per industry standards and manufacturer instruction manual.
- Operation of equipment in accordance with manufacturer instruction manual.
- Maintenance and lubrication per manufacturer instruction manual. Note, maintenance log showing dates required.
- Equipment must be stored per manufacturer instruction manual and protected from the weather.

If warranty items occur, V-Systems needs to be contacted in writing before any repairs are made, whereas a mutual course of action will be performed. Equipment cannot be disassembled without V-Systems being present.

Acknowledged and Accepted by Buyer:

Name: _____ *Tax Exempt? Yes____ No____

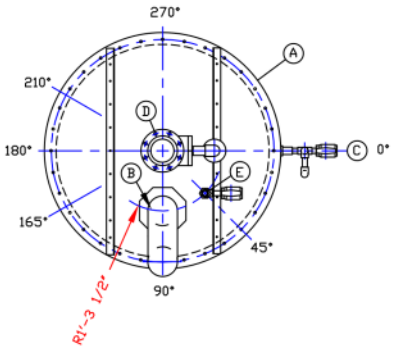
Signature: _____ PO #: _____

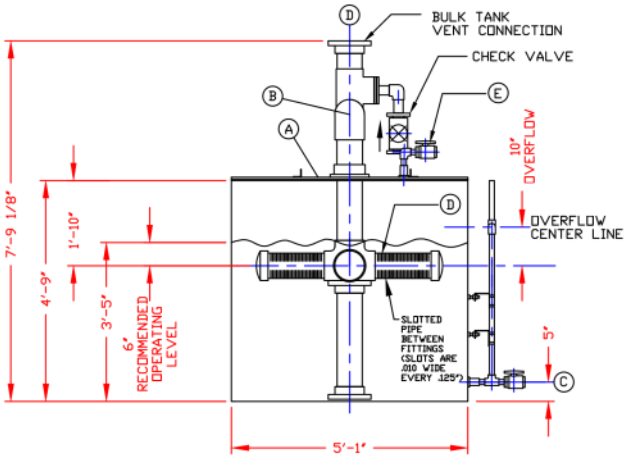
Date: _____ Ship To: _____

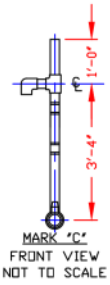
_____

_____

*IF APPLICABLE, please send a copy of your company's tax-exempt form. Otherwise, our accounting department will assume that this order is taxable.







CALCULATED CAPACITY TO OPERATING LEVEL
~515 GALLONS

NOTE: INCOMING VENT PIPE MUST BE INDEPENDENTLY SUPPORTED

ELEVATIONS ONLY--
NOZZLES & ACCESSORIES
ROTATED INTO VIEW--
FOR TRUE ORIENTATION
SEE PLAN VIEW

NOTES
1. THIS IS A COMPUTER GENERATED DWG. DO NOT REVISE BY HAND.
2. DIMENSIONS WILL VARY ±3% DUE TO VARIATIONS IN MULTIPLE MOLDS & CONDITIONS PREVALENT DURING MANUFACTURE & USAGE.
3. TANK DESIGNED FOR 1.9 SpG MAT'L @ 100°F/ATMOS PRESSURE.

DWG TITLE: POLYSCRUB BASIC 5' X 5' SCRUBBER			
SERVICE: SCRUBBER MEDIA		1.9 SpG/XLPE/NATURAL	
SCALE: 1/2"=1'-0"	POLYPROCESSING SOLUTIONS, SIMPLIFIED.	DR: B. HARPER	
DATE: 4/12/2021		CK:	
	SHEET: 1 OF 1	COMPUTER FILE: POLYSCRUB BASIC	REV

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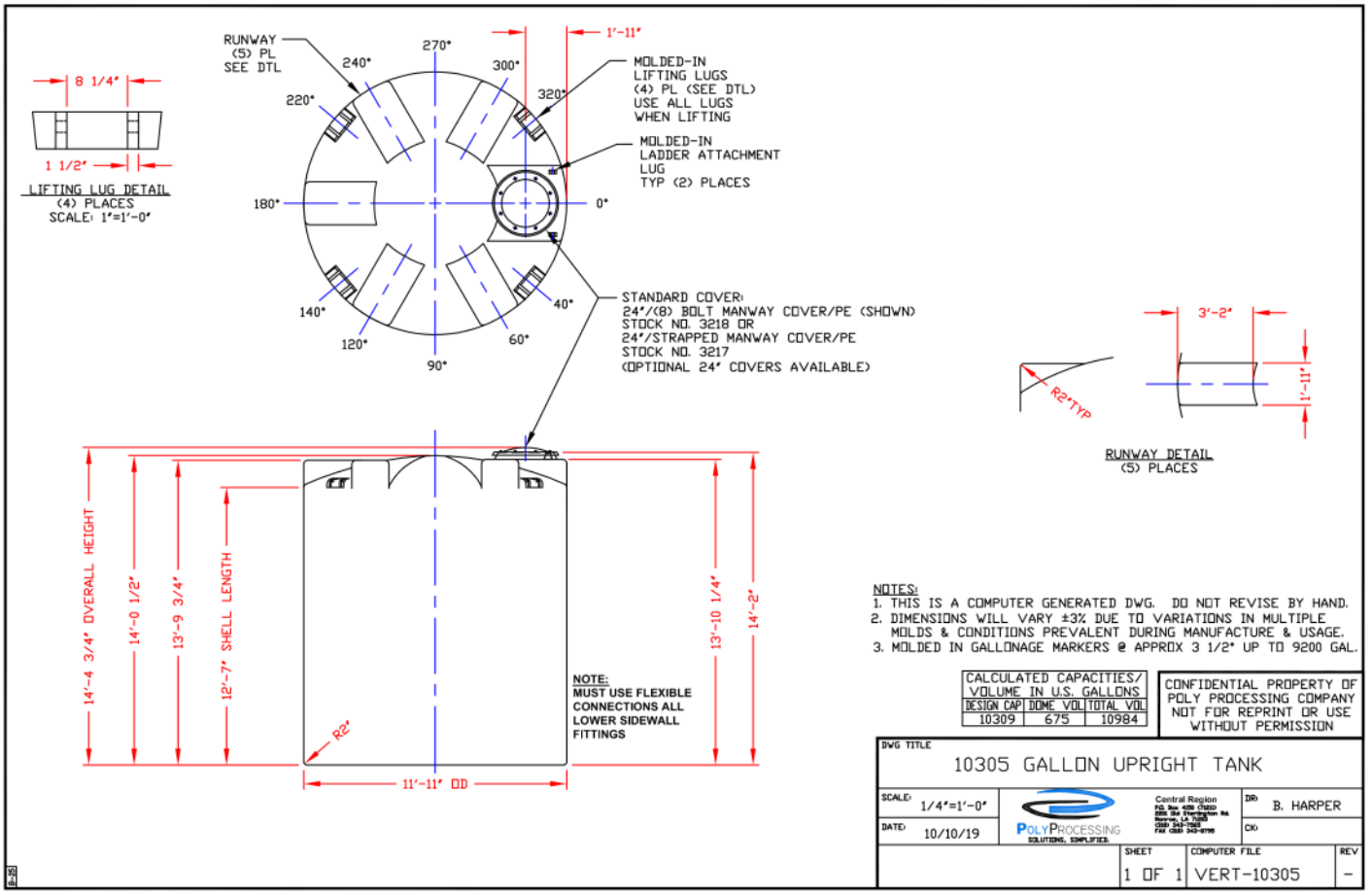


NOTES:
1. THIS IS A COMPUTER GENERATED DWG. DO NOT REVISE BY HAND.
2. DIMENSIONS WILL VARY ±3% DUE TO VARIATIONS IN MULTIPLE MOLDS & CONDITIONS PREVALENT DURING MANUFACTURE & USAGE.
3. MOLDED IN GALLONAGE MARKERS @ APPROX 3 1/2" UP TO 9200 GAL.

CALCULATED CAPACITIES/ VOLUME IN U.S. GALLONS		
DESIGN CAP	DOME VOL	TOTAL VOL
10309	675	10984

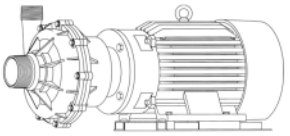
DWG TITLE: 10305 GALLON UPRIGHT TANK

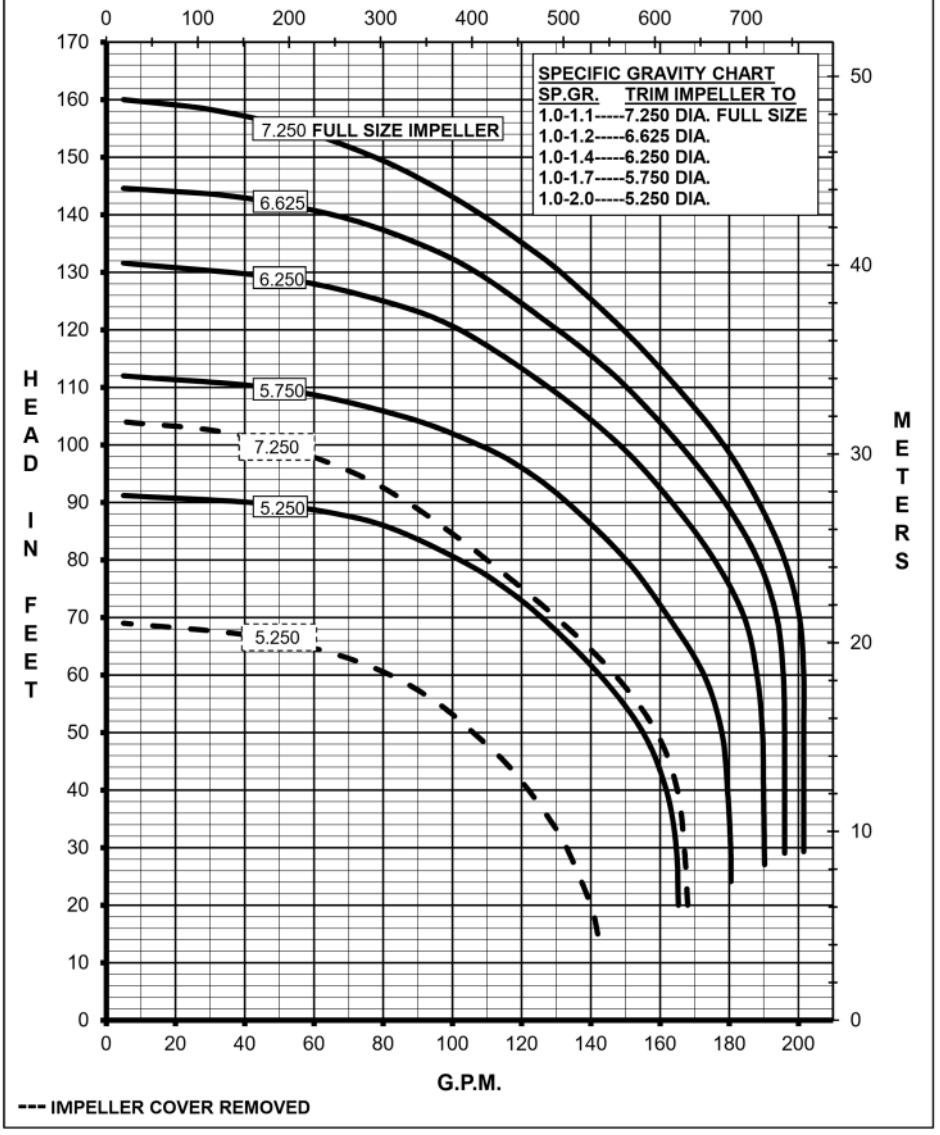
SCALE: 1/4"=1'-0"	PolyProcessing SOLUTIONS. SIMPLIFIED.	Central Region	DR: B. HARPER
DATE: 10/10/19			CK:
	SHEET: 1 OF 1	COMPUTER FILE: VERT-10305	REV: -

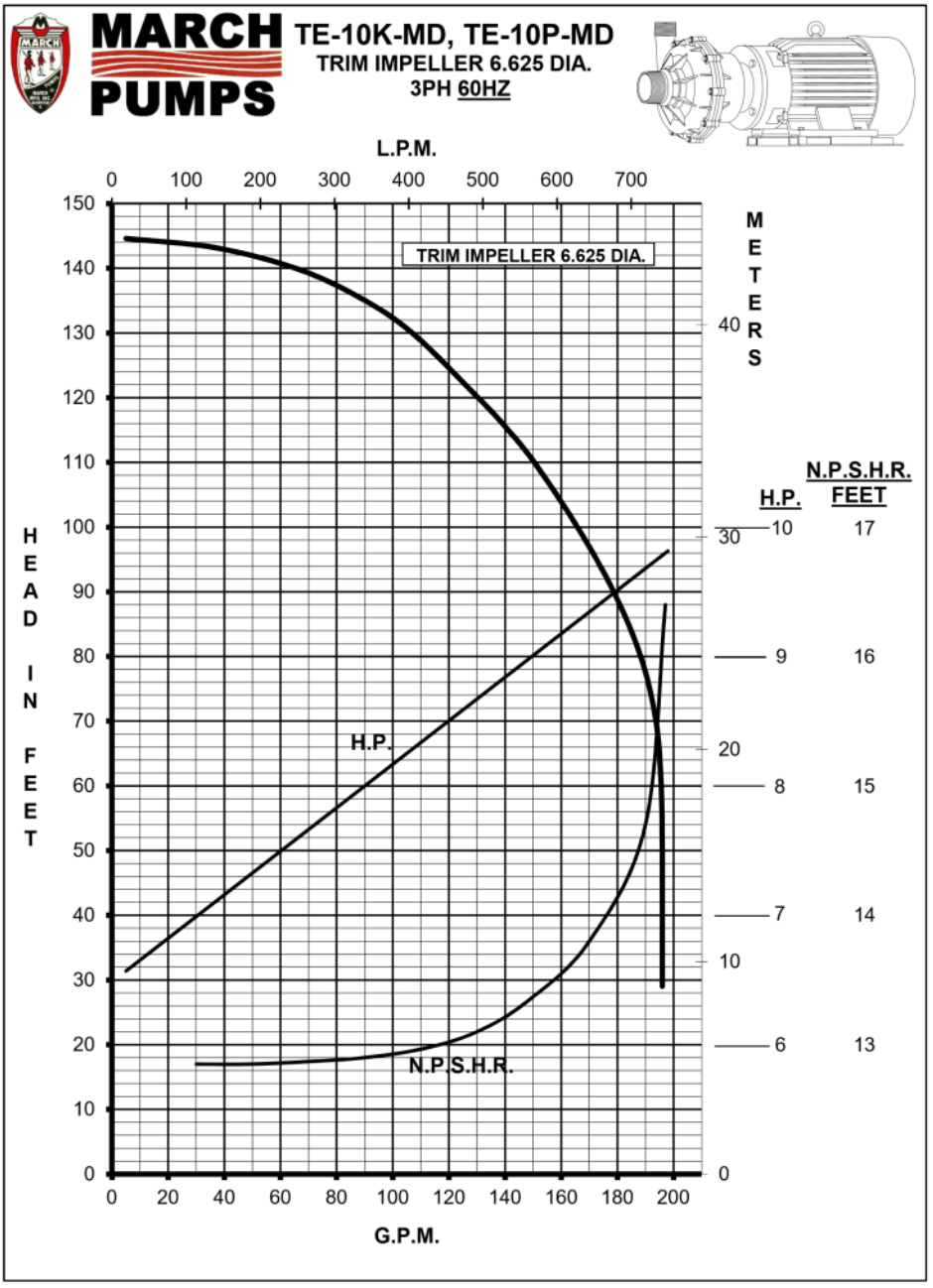
MARCH PUMPS

TE-10K-MD, TE-10P-MD

3PH 60HZ TRIM CURVES






MARCH PUMPS
TE-10K-MD, TE-10P-MD
TRIM IMPELLER 6.625 DIA.
3PH 60HZ
L.P.M.
0 100 200 300 400 500 600 700
TRIM IMPELLER 6.625 DIA.
METERS
40
H.P.
N.P.S.H.R. FEET
10 17
30
9 16
20
8 15
7 14
10
6 13
0
HEAD IN FEET
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
H.P.
N.P.S.H.R.
0 20 40 60 80 100 120 140 160 180 200
G.P.M.

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- Low Pressure & High Pressure Applications
- Firetube Design
- Natural Gas, Propane, #2 Fuel Oil, True Duel Fuel (NG & #2 Oil)
- Size Range: 4 to 2500 HP

Hydronic Boilers
- Efficiencies up to 99.1%
- Condensing, Neo-Condensing, & Non-Condensing Boilers
- Firetube & Watertube Designs
- Natural Gas, Propane, #2 Fuel Oil, True Duel Fuel (MG & #2 Oil)
- Size Range from 55,000 to 12,000,000 BTU(s)

Additional Offerings:
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- Ancillary Equipment
- Custom Engineered Systems

Lochinvar

Hydronic Boilers
- Models from 55,000 to 6.0 Million Btu/Hr
- Up to 96.2% Thermal Efficiency
- Up to 25:1 Turndown Ratio
- Featuring CON·X·US® Remote Connectivity and SMART TOUCH™ Operating Control

Thermal Fluid Heaters
- Models from 125,000 to 4,000,000 Btu/Hr
- Up to 99% Thermal Efficiency
- Up to 10:1 Turndown Ratio
- Direct Vent Flexibility up to 150 Ft.
- SMART TOUCH™ Operating Control and CON·X·US® Remote Connect

Additional Offerings:
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- Non– Condensing Boilers
- Pool Heaters
- Buffer Tanks, Storage Tanks
- Ancillary Equipment
- Custom Engineered Systems

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Pumps: (Commercial)
- Base Mounted
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- Dual Arm
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Fire Pumps: (Commercial)
- Electric & Diesel Driven Systems
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- Vertical In-Line
- Vertical Turbine
- Skid & House System Packages
- Design Envelope Fire Pump Unit

Performance Range:
- Up to 28,000 US GPM flow
- Up to 500 Ft. head

Temperature:
- 300 Degrees Fahrenheit

Power Range/Sizes:
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- 3/4" to 20"
- Fire Pump Systems of 50 GPM up to 3,000 GPM

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security

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wessels company

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TCH TWIN CITY HOSE, INC.

Products: Metal Hoses, Expansion Joints, Seismic Connectors, Expansion Loops, and Pipe Guides

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HOLBY VALVE CO.

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Whaley Products, Inc. WPI Since 1993

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- Barmesa Pumps
- Carter Pump
- CRANE Pumps
- EBARA Pumps
- Xylem / G & L Pumps
- Hydroflo Pumps (Taco Group)
- LMI
- MTH Pumps
- Pioneer Pumps
- Pumps 2000
- SHIPCO Pumps
- Syncroflo
- Stancor / Flow Solutions
- Tigerflow

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- Fulton
- Lochinvar
- RECO USA

ELECTRICAL

- Anchor Scientific
- Baldor Motors (ABB)
- CSI Controls
- Danfoss
- Nidec Motor Corporation
- Ohio Electric Control, Inc.
- Deltatherm
- SEE Water Controls
- Square D by Schneider
- TECO © Westinghouse
- WEG © Motors

TANKS, BASINS, & SEPARATORS

- AK Industries
- American Wheatley
- Containment Solutions
- Elbi of America
- Highland Tank
- John Wood Company
- Niles Steel Tank
- Spirotherm
- TOPP Industries
- Wessels Company

VALVES

- Apollo Valves
- Flo-Tite
- Flomatic Valves
- Holby Valve Co.
- Macon Controls
- Milwaukee Valve
- Ohio Valve Company
- Sure Flow Company
- Titan Flow Control

GAUGES

- Trerice
- Weiss Instruments

HYDRONICS

- Gerand Engineering
- Pro Hydronic Specialties
- Tunstall

FIRE PROTECTION

- Armstrong
- Tornatech

PIPING

- Energy Task Force (Underground Piping Solutions)

WATER / WASTEWATER TREATMENT

- AquaPhoenix Scientific / GTP
- Aqua Turbo Systems
- Active Water Solutions
- Concord Screen
- Custom Conveyor Corp.
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- EcoVerde
- Equip Water
- Modular Water Systems
- Neptune

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Warren, OH 44485

(330) 394-4747, Ext. 1502

About Us	Facilities & Equipment	Bottom Line
Warren Design & Build is a multi-disciplined machine shop and engineering design services company. We specialize in emergency repairs of part and machines, as well as building custom machines. Our team is comprised of 10 machinists, 4 welders, 4 mechanical and electrical design engineers with in-house PLC and computer systems programming capability.	Located in Warren Ohio, WDB's 38,000 square foot corporate facility houses a variety of engineering, machining, assembly, and fabricating capabilities. Our large assembly area can handle everything from a single station to a full assembly line with all utilities available utilizing ceiling drops from electrical bus bar and pneumatic lines covering most of the floor space. Located in the Northeast Ohio Manufacturing Corridor we also have the availability to outsource many special processes that can be brought onboard on short notice to assist in peak design periods or on special projects.	With WDB's unique position of having all Design, Machining, Paint, Mechanical and Electrical Assembly under one roof, our engineering team has the ability to assist in all aspects of the program build cycle to ensure design integrity; and when necessary, capture all changes and updates as required by manufacturing, and/or requested by the customer, in a very economical time frame. With some of Northeast Ohio's most talented, experienced, and highly trained engineering and manufacturing staff we can help guide you with suggestions and input that will help maximize your project's efficiency, while often lowering costs.

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(412) 771-5160

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AJ Drgon, a subsidiary of Custom Machine and Design is a multi-disciplined machine shop and engineering design services company. We specialize in emergency machining services and repairs of parts and machines, as well as building custom machines. Our team is comprised of 4 machinists, 1 welder and 1 mechanical design engineer. Additionally, we partner with our sister company, Warren Design & Build for many other services.	Located in McKees Rocks PA, AJ Drgon's 8,000 square foot facility houses a variety of engineering, machining, assembly, and fabricating capabilities. Located near downtown Pittsburgh, we also have the availability to outsource many special processes that can be brought onboard on short notice to assist in peak design periods or on special projects.	With AJ Drgon's unique position of having all Design, Machining, Paint, Mechanical and Electrical Assembly under one roof, our engineering team has the ability to assist in all aspects of the program build cycle to ensure design integrity; and when necessary, capture all changes and updates as required by manufacturing, and/or requested by the customer, in a very economical time frame. With some of Pittsburgh's most talented, experienced, and highly trained engineering and machining staff we can help guide you with suggestions and input that will help maximize your project's efficiency, while often lowering costs.

Capabilities

- Emergency Repair: We fix all electro-mechanical devices. We have field tech service and in-house staff that will repair all forms of equipment.
- Water Jet: We have a water jet for cutting all types of material in almost any shape.
- Design Engineering: Senior mechanical designers. Each is ready to provide support from concept to build, installation and runoff of the solution to your manufacturing or operational bottleneck.
- Electrical Engineering: Electrical engineers ready to design electrical solutions, write control programming, and perform data analytics.
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- Machining: We offer a wide variety of precision machining capabilities, including CNC turning and milling, general machining, grinding, and boring mill work. Our machining capabilities may be used for both short-run and sustained production work.
- Fabrication: We can meet all your prototyping and production needs with complete sheet metal and welding services that include quick delivery on small quantity prototypes, close tolerance fabrications and high-volume production runs.
- Assembly: We can meet your entire contract manufacturing needs with our diverse assembly capabilities and wide range of electrical, mechanical, and electro-mechanical assembly services, ranging from special, one-of-a-kind automation machinery to ongoing, low to medium volume production assembly. Our assembly capability includes turn-key production of build-to-print assembly work, including full management of key suppliers. WDB is capable of handling full production volumes.
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A team of experienced and talented engineers will design a solution to your biggest problem or any bottleneck in your factory.

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We can support your engineering with control programming support.

ON-SITE AUTOMATION DESIGN

We will come to your site to build solutions or support your existing staff.

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We have a complete machine shop and assemblers to build or rebuild equipment for your factory.

COMPLETE MACHINE SHOP

Our machine shop has experienced machinists that use CNC vertical machining centers and lathes to make complex parts in very quick turnaround times.

AUTOMATION

We create automation for your manufacturing bottlenecks.

NHSM Response to RIR 3/7/2024

Wednesday, March 27, 2024 2:03 PM

Andrews, Edward S <edward.s.andrews@wv.gov>

RE: Regulatory Interpretation Request - EGG

2 messages

Morrison, Jacqueline <Morrison.Jacqueline@epa.gov> Thu, Mar 7, 2024 at 3:32 PM
To: "edward.s.andrews@wv.gov" <edward.s.andrews@wv.gov>
Cc: "Supplee, Gwendolyn" <Supplee.Gwendolyn@epa.gov>

Hi Ed,

Thanks for sending. We will get back to you, but I'd assume that the response from the waste perspective will be similar to when we last considered this facility last year.

Thank you.

Jacquie

Jacqueline Morrison

RCRA Programs Section, Hazardous Waste

Land, Chemicals, & Redevelopment Division

Mail Code 3LD31

US EPA Mid-Atlantic Region

Address: Four Penn Center,

1600 John F. Kennedy Boulevard,

Philadelphia, PA 19103-2852

Phone: 215-814-5664

Email: **morrison.jacqueline@epa.gov**

From: Andrews, Edward S <edward.s.andrews@wv.gov>
Sent: Wednesday, March 06, 2024 3:35 PM
To: Willson, Matthew (he/him/his) <Willson.Matthew@epa.gov>; Morrison, Jacqueline <Morrison.Jacqueline@epa.gov>
Subject: Fwd: Regulatory Interpretation Request - EGG

Caution: This email originated from outside EPA, please exercise additional caution when deciding whether to open attachments or click on provided links.

FYI on a Regulatory Interpretation Request

Thanks,

Ed

---------- Forwarded message ---------
From: **Andrews, Edward S** <edward.s.andrews@wv.gov>
Date: Wed, Mar 6, 2024 at 2:54 PM
Subject: Regulatory Interpretation Request - EGG
To: Cristina Fernandez <fernandez.cristina@epa.gov>, Supplee, Gwendolyn <supplee.gwendolyn@epa.gov>, Marycate Opila <opila.marycate@epa.gov>
Cc: Beverly D Mckeone <beverly.d.mckeone@wv.gov>, Crowder, Laura M <laura.m.crowder@wv.gov>

Please see the attached file (Reg_Inter_Req_for_EGG) from the WVDEP/DAQ Regulatory Interpretation Request regarding Empire Green Generation's proposed pyrolysis units processing plastic feedstock.

Should you or your staff have any questions about this request, please let me know.

Thanks,

Ed

--

Edward Andrews, P.E.

Engineer

WVDEP/Division of Air Quality

304-926-0499 Ext 41244

601 57th Street, SE

Charleston, WV 25304

--

Edward Andrews, P.E.

Engineer

WVDEP/Division of Air Quality

304-926-0499 Ext 41244

601 57th Street, SE

Charleston, WV 25304

Andrews, Edward S <edward.s.andrews@wv.gov> Fri, Mar 8, 2024 at 7:38 AM
Draft To: "Morrison, Jacqueline" <Morrison.Jacqueline@epa.gov>
Cc: "Supplee, Gwendolyn" <supplee.gwendolyn@epa.gov>, Krystal <Stankunas.Krystal@epa.gov>

Please keep in mind that the facility has elected to change from processing medical waste to plastic feedstock. I have been trying to get them to perform a waste/non-waste determination of this plastic feedstock in accordance with Part 241.

EGG keeps pushing back with a State House bill that defined "advance recycling" and 'high temperature under WV
[Quoted text hidden]

Follow-up on Timing for the RIR 3/7/2024

Wednesday, March 27, 2024 2:02 PM

Andrews, Edward S <edward.s.andrews@wv.gov>

Re: Regulatory Interpretation Request - EGG

1 message

Andrews, Edward S <edward.s.andrews@wv.gov> Thu, Mar 7, 2024 at 2:32 PM
To: "Supplee, Gwendolyn" <Supplee.Gwendolyn@epa.gov>
Cc: Beverly D Mckeone <beverly.d.mckeone@wv.gov>, "Stankunas, Krystal" <Stankunas.Krystal@epa.gov>

Gwen,

We understand that this is fairly complicated and that we expected multiple different offices to be called on to provide input to our request.

Please keep in mind that EGG has a permit to process medical waste using the same equipment. The other real changes to the process is adding the HCl tanks and loadout station.
So, EGG will be applying pressure at some point to get their application moving forward in the near future.

We expect to send EGG an additional information request based on your office's response.

At some point, we will have to move this application forward to some sort of decision with or without a response.

Please provide us some sort of response by no later than March 29.

Thanks,
Ed

On Thu, Mar 7, 2024 at 1:11 PM Supplee, Gwendolyn <Supplee.Gwendolyn@epa.gov> wrote:

> Hi Ed,
>
> We need to coordinate with our RCRA program as well as potentially Headquarters (either for RCRA or CAA requirements) and that coordination can take some time. Since the application hasn't been deemed complete yet, would it be OK if we try to get a response to West Virginia by the end of March? We'll try to get a response sooner if we can.
>
> Many thanks.
>
> -gwen
>
> **Gwendolyn K. Supplee (She, her, hers)**
> **Senior Permit Specialist/Life Scientist**
> **U.S. Environmental Protection Agency, Region 3**
> **Permits Branch (3AD10)**

Air & Radiation Division

Phone 215-814-2763

Email supplee.gwendolyn@epa.gov

From: Andrews, Edward S <edward.s.andrews@wv.gov>
Sent: Thursday, March 07, 2024 10:54 AM
To: Supplee, Gwendolyn <Supplee.Gwendolyn@epa.gov>
Cc: Beverly D Mckeone <beverly.d.mckeone@wv.gov>; Stankunas, Krystal <Stankunas.Krystal@epa.gov>
Subject: Re: Regulatory Interpretation Request - EGG

Gwendolyn,

WVDEP/DAQ received the initial application on December 1, 2023, and a revised application was received January 23, 2024. Currently, this application has not been deemed complete at this time.

Therefore, the regulatory clock has not started yet.

We would like some sort of response from your office within 2 weeks. A response to our request will dictate our future request for additional information from this applicant (EGG).

Should you have any questions about this, please do not hesitate to contact me.

Thanks

Ed

On Thu, Mar 7, 2024 at 10:30 AM Supplee, Gwendolyn <Supplee.Gwendolyn@epa.gov> wrote:

> Ed-
>
> Can you tell us when the application was received and what date the permitting decision must be made by? In looking at WV's R13 rule, it looks like a permit must be issued within 90 days of the completeness determination? Is my interpretation correct? We're trying to determine when WV needs a response by.

Many thanks,

-gwen

Gwendolyn K. Supplee (She, her, hers)

Senior Permit Specialist/Life Scientist

U.S. Environmental Protection Agency, Region 3

Permits Branch (3AD10)

Air & Radiation Division

Phone 215-814-2763

Email supplee.gwendolyn@epa.gov

From: Andrews, Edward S <edward.s.andrews@wv.gov>
Sent: Wednesday, March 06, 2024 2:55 PM
To: Fernandez, Cristina <Fernandez.Cristina@epa.gov>; Supplee, Gwendolyn <Supplee.Gwendolyn@epa.gov>; Opila, MaryCate <Opila.MaryCate@epa.gov>
Cc: Beverly D Mckeone <beverly.d.mckeone@wv.gov>; Crowder, Laura M <laura.m.crowder@wv.gov>
Subject: Regulatory Interpretation Request - EGG

Please see the attached file (Reg_Inter_Req_for_EGG) from the WVDEP/DAQ Regulatory Interpretation Request regarding Empire Green Generation's proposed pyrolysis units processing plastic feedstock.

Should you or your staff have any questions about this request, please let me know.

Thanks,

Ed

--

Edward Andrews, P.E.

Engineer

WVDEP/Division of Air Quality

304-926-0499 Ext 41244

601 57th Street, SE

Charleston, WV 25304

--
Edward Andrews, P.E.
Engineer
WVDEP/Division of Air Quality
304-926-0499 Ext 41244
601 57th Street, SE
Charleston, WV 25304

Regulatory Interpretation Request 3/6/2024

Wednesday, March 27, 2024 2:00 PM

Andrews, Edward S <edward.s.andrews@wv.gov>

Regulatory Interpretation Request - EGG

1 message

Andrews, Edward S <edward.s.andrews@wv.gov> Wed, Mar 6, 2024 at 2:54 PM
To: Cristina Fernandez <fernandez.cristina@epa.gov>, "Supplee, Gwendolyn" <supplee.gwendolyn@epa.gov>, Marycate Opila <opila.marycate@epa.gov>
Cc: Beverly D Mckeone <beverly.d.mckeone@wv.gov>, "Crowder, Laura M" <laura.m.crowder@wv.gov>
Bcc: Brian S Tephabock <Brian.S.Tephabock@wv.gov>, Eric Blend <eric.n.blend@wv.gov>

Please see the attached file (Reg_Inter_Req_for_EGG) from the WVDEP/DAQ Regulatory Interpretation Request regarding Empire Green Generation's proposed pyrolysis units processing plastic feedstock.

Should you or your staff have any questions about this request, please let me know.

Thanks,
Ed

--
Edward Andrews, P.E.
Engineer
WVDEP/Division of Air Quality
304-926-0499 Ext 41244
601 57th Street, SE
Charleston, WV 25304

2 attachments

R13-3555 Modification_Application_EGG - Redacted_Final Rev.pdf
22432K

Reg_Interp_Request_for_EGG.pdf
400K

Reg_Interp
_Request...

west virginia department of environmental protection

Division of Air Quality
601 57th Street, SE
Charleston, WV 25304
(304) 926-0475

Harold D. Ward, Cabinet Secretary
dep.wv.gov

March 6, 2023

Ms. Christina Fernandez
Director
U.S. EPA - Region 3
Air and Radiation Division
Four Penn Center
1600 John F. Kennedy Boulevard
Philadelphia, PA 19103-2852

Re: Regulatory Interpretation Request
Empire Green Generation LLC
Facility ID: 009-00141
Permit No.: R13-3555A
Follansebee, WV

Dear Director:

The West Virginia Department of Environmental Protection - Division of Air Quality (DAQ) respectfully requests an regulatory interpretation from the Administrator regarding Empire Green Generation's (EGG) proposed modification of their Follanbee, West Virginia Facility to any regulation developed under Section 129 of the Clean Air Act.

Specifically, the DAQ is requesting an regulatory interpretation as to whether all streams, or only the liquid and solid streams, exiting the pyrolysis process need to be evaluated under 40 CFR 241 to determine applicability under 40 CFR 60, Subpart CCCC, if the plastic feedstock to the pyrolysis process has been determined to be a fuel or raw material under 40 CFR 241.

The DAQ does not believe that EGG pyrolysis trains or downstream emission units (e.g., engines, dryer, and vitrifier) would be affected sources under Subpart AAAA and EEEE because the plastic feedstock does not meet the definition of municipal solid waste and the Follansbee Facility is not an institutional facility.

Promoting a healthy environment.

Background Information

In 2022, Empire Green Generation LLC (EGG) proposed to the DAQ to construct and operate two pyrolysis trains with gas cleaning sections to process and convert up to 70 tons per day of medical waste into tar (liquids), char (solids) and synthetic gas.

The DAQ issued Permit R13-3555 to EGG on March 2, 2023. During the DAQ review of the Application, the DAQ determined that EGG's proposed pyrolysis trains meet the criteria of a "pyrolysis unit" as defined in 40 CFR 60.51c and therefore the proposed pyrolysis trains are excluded emission units from Subpart Ec.

Proposed Modification

On December 1, 2023, EGG filed a modification application with the DAQ. EGG proposed to replace the medical waste feedstock with plastic feedstock. In a revised application (January 23, 2024, Submission), EGG noted that the feedstock will be sourced from recyclers, manufacturing, and plastic producers. This pre-processed plastic feedstock will be shipped to EGG's Follansbee, WV facility as feedstock for the pyrolysis trains.

EGG noted that this modification only requires the addition of a hydrochloric acid truck loading facility with associated scrubber system. This feedstock change will allow the pyrolysis trains to generate hydrochloric acid in addition to other products (tars, char, and synthetic gas).

The processing capacity of these pyrolysis trains will remain the same at 35 tons of plastic feedstock per day per pyrolysis train (70 Tons per day total).

Regulatory Considerations

EGG commenced construction of the pyrolysis trains in 2023, which is after the applicability date of Subparts AAAA (August 30, 1999); CCCC (June 4, 2010); and EEEE (December 9, 2004). Therefore, EGG's pyrolysis trains meet the definition of new affected units.

Given the design capacity of the two pyrolysis trains, these units do not meet the capacity criteria of a large municipal waste combustion unit as defined under Subpart Eb and therefore, the units are not subject to Subpart Ec.

The DAQ determined that the four spark ignition engines are affected sources with regard to Subpart JJJJ during the review of Permit R13-3555. However, the DAQ was unable to determine the applicable emission standard to which the permit engines were subject. Condition 5.1.1. of Permit R13-3555 required EGG to seek a determination from the EPA to determine which emission standard would be applicable for these four engines.

The vitrifiers (process heaters) for the pyrolysis trains may be affected sources under Subpart Dc of Part 60 and Subpart JJJJJJ of Part 63. Applicability status for these process heaters would be affected by the outcome of this determination. These units are designed to fire gaseous fuel (synthetic gas), liquid fuel (tars), propane for startup operations only, or a combination of synthetic gas and tars with a maximum heat input of 100 MMBtu/hr.

Past Determinations and Other Permitting Actions

Prior to submitting this determination, the DAQ searched the Applicability Determination Index (ADI) for similar determinations, and identified the following:

Table 1 - Similar Applicability Determinations

EPA Office	Control Number	Date	Reference
Region 5	9700062	10/11/1996	60.14, 60.15, 60.5, 60.51b,
Region 6	NR06	02/07/1985	52.21(b), 60.50, 60.51(b)
Region 7	9600096	12/02/1996	60.50b
Region 10	E010	04/12/1977	60.50, 60.51
DSSE	E009	01/19/1977	60.50
Region 1	M140002	12/04/2012	40 CFR 60, Subpart EEEE
Region 9	1000019	03/30/2010	40 CFR 60, Subpart AAAA
Region 10	1500025	08/31/2010	40 CFR 60, Subpart AAAA
Region 4	1700010	03/02/2017	40 CFR 60, Subpart CCCC
Region 5	1800003	01/22/2018	40 CFR 60, Subpart CCCC

The DAQ is aware of several determinations by other State Agencies, listed below:

Table 2 - List of Similar State Actions

State Agency	Company/Permittee Name	Permit No.	Date	Outcome
Indiana Department of Environmental Management	Fulcrum Centerpoint LLC	089-44042-00660	08/16/2022	Meet exemption under 60.1020(h)
North Carolina Environmental Quality	Braven Environmental LLC	10672R00	9/25/2020	No Reference
Indiana Department of Environmental Management	Brightmark Plastics Renewal Indiana 2 LLC	151-45294-00067	06/29/2022	Meet exemption under 60.1020(h)
Ohio Environmental Protection Agency	SOBE Thermal Energy Systems, LLC	P0132799	02/14/2024	Scrap Tires are classified as non-waste per 40CFR241. Not Applicable to any incinerator rules

The DAQ is aware of EPA's decision to not remove the phrase "pyrolysis/combustion unit" for the definition of *municipal waste combustion unit* in Subparts AAAA and EEEE of Part 60.[1]

The DAQ is working under the assumption that EGG's plastic feedstock is non-hazardous per 40 CFR 262.

First Question: *Should EGG's plastic feedstock be viewed as waste or non-waste?*

The DAQ believes that the proper way to answer this question is for EGG/EGG's plastic feedstock provider to make a waste/non-waste determination of this plastic feedstock in accordance with 40 CFR 241. Based on EGG's application and additional responses regarding this question, EGG may have determined or believe that the plastic feedstock is a non-waste. EGG has not provided any information that DAQ would view as an official determination in accordance with 40 CFR 241.

[1] Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Other Solid Waste Incineration Units Review; Withdrawal of Proposed Provision Removing Pyrolysis/Combustion Units, 88 Fed. Reg. 36524 (June 5, 2023).

DAQ looked at the definitions that pertain to waste under potentially applicable subparts, which are as follows:

"Solid waste" is defined under Subpart EEEE as

"means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, agricultural operations, and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges that are point sources subject to permits under section 402 of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1342), or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954, as amended (42 U.S.C. 2014)."

Subpart CCCC refers to "solid waste" as defined in 40 CFR 241.2, which refers to 40 CFR 258.2. 40 CFR 258.2 defines to *"means any garbage, or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved materials in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges that are point sources subject to permit under 33 U.S.C. 1342, or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923)."*

Subparts AAAA do not define *"solid waste"* or reference waste as determined under 40 CFR 241. This subpart defines *"municipal solid waste or municipal-type solid waste"*

"means household, commercial/retail, or institutional waste. Household waste includes material discarded by residential dwellings, hotels, motels, and other similar permanent or temporary housing. Commercial/retail waste includes material discarded by stores, offices, restaurants, warehouses, nonmanufacturing activities at industrial facilities, and other similar establishments or facilities. Institutional waste includes materials discarded by schools, by hospitals (nonmedical), by nonmanufacturing activities at prisons and government facilities, and other similar establishments or facilities. Household, commercial/retail, and institutional waste does include yard waste and refuse-derived fuel. Household, commercial/retail, and institutional waste does not include used oil; sewage sludge; wood pallets; construction, renovation, and demolition wastes (which include railroad ties and telephone poles); clean wood; industrial process or manufacturing wastes; medical waste; or motor vehicles (including motor vehicle parts or vehicle fluff)."

Both of these definitions, "solid waste" and "municipal solid waste", contain the phrase *"other discarded materials".* Therefore, a waste determination must be conducted on the plastic feedstock to be introduced into the pyrolysis trains in accordance with 40 CFR 241.3.

The concern the DAQ has with the plastic feedstock is that EGG did not generate the plastic feedstock and thus, the original end user and/or generator had discarded this plastic material at some point.

Second Question: If the plastic feedstock is determined to be fuel or ingredients in accordance with 40 CFR 241.3, then would the EGG pyrolysis trains be exempt from Section 129 of the CAA (e.g. subject to Subpart AAAA, CCCC, or Subpart EEEE)?

Initially, the DAQ does not believe the pyrolysis trains, (e.g., engines and process heaters) would be subject to Section 129 and therefore Subparts AAAA, CCCC and EEEE would not be applicable to EGG's emission units.

Given the plastic material was discarded by the original end user or generator, the initial waste determination only pertains to the cracking/decomposition of plastic feedstock from the pyrolysis trains and all streams exiting the pyrolysis train should be re-evaluated in accordance with 40 CFR 241.3.

This is the real question: Would EGG need to conduct a waste determination for each of the exiting streams from the pyrolysis trains (e.g., "tars", "oil", "ash and char", and "synthetic gas") in accordance with 40 CFR 241.3?

The definition of *"solid waste"* at 40 CFR 258.a states,

"Solid waste means any garbage, or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved materials in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges that are point sources subject to permit under 33 U.S.C. 1342, or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923)."

Thus, the DAQ does not believe that EGG's cleaned synthetic gas would need to be evaluated because the gas is not stored in a container. EGG's process consumes the synthetic gas as fuel to provide process heat for their process and generates electricity for the facility.

Third Question: EGG plans to route the ash and char stream to the vitrifier (process heater) to be oxidized into products of combustion. Would the vitrifier be subject to Subpart CCCC or EEEE?

The raw synthetic gas generated will exit the pyrolysis train through off-take with the ash and fixed carbon being collected in a deceleration chamber. The ash and fixed carbon, which is also referred to as "char", will be injected into the vitrifier. The vitrifier is best described as a retort or process heater with the purpose of providing process heat for the respective pyrolysis train. In the process description in EGG's modification application, the high temperatures in the vitrifier should be above the eutectic temperature of the ash and char to be combusted into CO_2 and H_2O.

The DAQ believes the synthetic gas stream and tar stream should be considered a fuel and the chlorine/chloride stream a raw ingredient for the production of hydrochloric acid. However, the injection of the ash and char into the vitrifiers should be viewed as incineration. The question is: because EGG generated the ash and char, would the vitrifiers be subject to Subpart CCCC as a CISWI unit.

The DAQ does not believe that the vitrifiers could be classified as an OWSI unit because the Follansbee facility is not an institutional facility generating this waste and the initial plastic feedstock does not meet the definition of "municipal solid waste." Therefore, based on the definitions under 40 CFR 60.2977 the vitrifier(s) is not an "other solid waste incineration unit".

Furthermore, the DAQ does not believe that EGG's vitrifiers qualify for any of the exclusions in Subpart CCCC (e.g. cogeneration facilities, small power production facilities).

Fourth Question, Would the vitrifiers be considered an "energy recovery unit" or a "commercial and industrial solid waste incineration unit" under Subpart CCCC?

The vitrifiers are required to provide process heat for the pyrolysis units with the exhaust used to dry the incoming plastic feedstock of excess moisture in the dryer section. EGG plans to use the generated "tars" and "cleaned synthetic gas" as fuels for the vitrifiers.

If EGG elected not to oxidize the ash and char stream in the vitrifiers (i.e, send the ash & char off-site for proper disposal), then would the vitrifiers be subject to Subpart CCCC?

To aid you and your staff in this determination, a redacted copy of EGG's modification application is attached. The DAQ's permit file for R13-3555, EGG's application on processing medical waste using pyrolysis, can be viewed in our Application Xtender at: https://documents.dep.wv.gov/AppXtender/DataSources/DEPAX16/account/login?ret=Lw==.

Instructions on using our Application Xtender are located at: https://dep.wv.gov/Data/Documents/AX-Instructions.pdf.

Should you need to discuss this matter further, please do not hesitate to contact me by email at edward.s.andrews@wv.gov or phone at 304-926-0499 extension 41244..

Sincerely,

Edward S. Andrews, P.E.

Digitally signed by: Edward S. Andrews, P.E.
DN: CN = Edward S. Andrews, P.E. email = edward.s.andrews@wv.gov C = AD O = WVDEP/Division of Air Quality OU = Permitting
Date: 2024.03.06 14:38:41 -05'00'

Edward S. Andrews, P.E.
Engineer

cc:
Laura Crowder, Director, WV DAQ
Berverly McKeone, NSR Program Manager, WV DAQ
MaryCate Oplia, opila.marycate@epa.gov
Gwendolyn Supplee, Supplee.Gwendolyn@epa.gov

HCl Discussion 3/1/2024

Wednesday, March 27, 2024 1:38 PM

Andrews, Edward S <edward.s.andrews@wv.gov>

RE: Empire Discussion

1 message

Wood, Katie <katie.wood@tetratech.com> Fri, Mar 1, 2024 at 10:23 AM
To: "Andrews, Edward S" <edward.s.andrews@wv.gov>
Cc: Farley Wood <fwood@empirede.com>

Ed,

We have some answers to your questions below in red. Please let me know if you would like to discuss.

Thanks,

Katie

From: Andrews, Edward S <edward.s.andrews@wv.gov>
Sent: Friday, February 23, 2024 2:24 PM
To: Wood, Katie <katie.wood@tetratech.com>; Farley Wood <fwood@empirede.com>
Subject: Re: Empire Discussion

Using Chlorine gas and water reaction to produce HCl also produces a by-product of HOCl (hypochlorous acid). https://www.bing.com/search?q=chlorine+gas+water+reaction&qs=UT&pq=chlorine+gas+water+reaction&sc=10-27&cvid=1D306673308642F9BCEE5D950B9BFB08&FORM=QBRE&sp=1&ghc=1&lq=0 The process does not produce any Chlorine gas, it produces Chloride gas so no HOCL is produced. I have attached a paper provided by Technotherm for futher information

Question is: Will Empire separate hypochlorous acid from the HCl or send it out as it? As per above no HOCL will be produced

Will the emissions of HCl go through a separate release point than the RTO stack? If it is a separate stack, I need the stack id and stack parameters of this point. No all emissions will go through the RTO

Also, I will need the calculations to support your emission estimate of HCl and concentration of HCl in the effluent release to the atmosphere from the production/storage/loading out of HCl. Calculations attached, these were included in the last submittal

Ed

On Thu, Feb 22, 2024 at 1:00 PM Wood, Katie <katie.wood@tetratech.com> wrote:

> ---
>
> # Microsoft Teams meeting
>
> **Join on your computer, mobile app or room device**
>
> Click here to join the meeting
>
> Meeting ID: 248 808 531 032
> Passcode: Gbfah4
>
> Download Teams | Join on the web
>
> **Or call in (audio only)**
>
> +1 213-357-2812,,114016353# United States, Los Angeles
>
> Phone Conference ID: 114 016 353#
>
> Find a local number | Reset PIN
>
> Learn More | Meeting options
>
> ---

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Edward Andrews, P.E.

Engineer

WVDEP/Division of Air Quality

304-926-0499 Ext 41244

601 57th Street, SE

Charleston, WV 25304

KINETIC STUDY OF THERMAL DE-CHLORINATION OF PVC-CONTAINING WASTE.pdf
248K

WASTES: Solutions, Treatments and Opportunities
1St International Conference
September 12th – 14th 2011

KINETIC STUDY OF THERMAL DE-CHLORINATION OF PVC-CONTAINING WASTE

A. Castro[1,2,a], C. Carneiro[1], C. Vilarinho[2], D. Soares[2], C. Maçães[3], C. Sousa[3] and F. Castro[2]
[1] CVR - Centre for Waste Valorization, Guimarães, Portugal
[2] CT2M - Centre for Mechanical and Materials Technologies, Mechanical Engineering Department, University of Minho, Guimarães, Portugal
[3] Endutex - textile coatings, SA
[a] acastro@cvresiduos.pt

ABSTRACT
With the increasing of plastics content in solid waste, both municipal and industrial, also increases the interest in its use as an energy source.
Some of these wastes are an important potential source of energy and might be valorized using the pyrolysis or gasification processes. However, the presence of high chlorine contents in its composition prevents its management by a thermal process, as consequence of toxic compounds production and their release to the atmosphere.
The present work asses a possible process for treating PVC-containing wastes in an environmentally friendly way. It is based on the effective de-chlorination of PVC-containing wastes through a pyrolysis process at low temperature before the carbonaceous residue from PVC-containing wastes being subject to a subsequent thermal treatment for energetic valorization.

Keywords: Pyrolysis, thermal degradation, PVC-containing waste, energy valorization;

INTRODUCTION

The presence of organic compounds on wastes, especially plastics, is considered an important source of energy. However, most of these plastics contain polyvinyl chloride (PVC), causing recycling problems when it is considered a thermal valorization process for its treatment [1], preventing the use of those residues on these processes, which main goal is the energy recovery [2,3]. A possible solution is to remove the chlorine from PVC-containing waste through a pyrolysis process before being subjected to a thermal treatment, for energetic valorization.

Pyrolysis is one of the applied techniques for energetic valorization and is defined as a process of irreversible chemical modification of compounds under the action of heat and in the absence of oxygen, causing thermal degradation [1]. The reaction involved in this process is endothermic and the characteristics of the obtained products are function of the waste composition and of several operating factors, such as the temperature, pressure and residence time in the pyrolysis reactor.

The pyrolysis process is considered by several authors [2 - 8] as a possible technique for the

operating factors, such as the temperature, pressure and residence time in the pyrolysis reactor.

The pyrolysis process is considered by several authors [2 - 8] as a possible technique for the energy recovery from PVC-containing wastes, through the thermal degradation of the chlorine molecule. PVC pyrolysis involves significant cross-linked reactions with the formation of polyaromatic structures (possibly chlorinated) and a carbonaceous residue (char) [9]. Thus, it is possible to break down this molecule, allowing the chlorine recovery as hydrochloric acid or chloride [10], with potential economic gains.

However, the presence of poly(vinyl chloride) in wastes composition confines their management by thermal valorization processes as consequence of environmental problems and corrosion of the equipment. In fact, high levels of chlorine in wastes composition are responsible for the formation of hydrochloric acid, chlorine gas and dioxins [11]. Therefore, a preview thermal treatment by a pyrolysis process to remove the chlorine from PVC-containing wastes will be a suitable step if done prior to an energy recovery process to produce a synthesis gas.

Considering thermogravimetric analysis, it is assumed that the degradation of PVC occurs between 200 and 400 ºC [2, 12]. At 250 ºC, the decomposition of PVC has already been initiated, reaching a maximum at approximately 300 ºC. At 350 ºC the amount of chlorine present in PVC waste is less than 0.1%, which means that at this temperature, 99.5% of the whole chlorine has already been released [2]. At the end of the process of chlorine removal, a residual amount of chlorine remains on the waste [9].

The C-Cl bonds in the structure of PVC have a relatively lower binding energy than the C-C and C-H bonds, which justifies that the bonds of chlorine are the first to be broken, thus starting the thermal degradation of PVC. The de-chlorination of PVC is a free radicals chain reaction therefore requiring low activation energy to start, occurring at low temperatures [4, 7].

De-chlorination of PVC wastes is a mandatory step for any treatment process, able to recover energy from these wastes. In fact, from the decomposition of PVC, one polymeric fraction can be obtained with high energetic value:

$$C_2H_3Cl \rightarrow HCl + C_2H_2 \qquad (I)$$

As a matter of fact, products from the decomposition will be of the type C_nH_n.

This work aims the contemplation of new valorization processes and use of PVC-containing wastes. For the PVC molecule de-chlorination, tests were performed at low temperature pyrolysis and subsequent gasification of the remaining fraction in order to produce a synthesis gas with high energetic potential.

EXPERIMENTAL WORK

In this work, the kinetics of thermal de-chlorination has been studied, by simultaneous DTA/TGA determinations, under inert atmosphere. With all the experimental data obtained a multivariate

In this work, the kinetics of thermal de-chlorination has been studied, by simultaneous DTA/TGA determinations, under inert atmosphere. With all the experimental data obtained a multivariate regression of ln (r) has been performed in function of 1/T and ln ([HCl]). The kinetic model has been calculated just for points where temperature was lower than 340 ºC, and the obtained model is:

$$\ln r = 31{,}3 - \frac{16100}{T} + 1{,}020 \ln[HCl]$$

with r^2 = 0,9912

This allows considering that reaction as a first order one with activation energy of 133800 J/mol ± 760 J/mol.

For the kinetic study, a DTA/TGA (SDT 2960 from TA Instruments) testing at different temperatures has been carried out in order to determine the relationship between the rate of PVC de-chlorination and the temperature of the thermal treatment, under an inert atmosphere. It was used a commercial pure PVC powder with the chemical formula C_2H_3Cl, in which 56,7% is chlorine. The reference is VICIR S 950 and it is a vinyl chloride homopolymer produced by a suspension polymerization process.

Experiments have conducted up to 5 different maximum temperatures: 250, 275, 300, 325 and 400 ºC, with a heating rate of 10 ºC per minute until the desired temperature is reached. After reaching this temperature, a stage has been done during 360 minutes. Heat flux (weight corrected heat flow in W/g) and weight of sample, has been continuously recorded.

DTA/TGA testing performed indicates that the temperature of 340 ºC enables the removal of 88 % of the chlorine present in the PVC material. The resulting de-chlorinated fraction, carbonaceous residue, has also been characterized and it is mainly constituted by carbon. This carbonaceous residue was testing up to 500ºC in DTA/DTA and was verified that the combustion reaction of the carbonaceous material is complete at 493ºC demonstrating potential as a fuel source to a following gasification in order to produce a synthesis gas with high energetic potential.

To characterize the sample of PVC used and the carbonaceous residue formed, it has been used an TruSpec Elemental Determinator, model TruSpec CHN, of Leco with a burn time of 452 seconds and an Philips Analytical sequential X-ray fluorescence (XRF) Spectrometer model X'Unique II.

Table 1. Comparison between the chemical composition (in wt%) of PVC sample used and the carbonaceous residue obtained from pyrolysis at 340 ºC.

	PVC (initial sample)	PVC (Carbonaceous residue)
Carbon	38,4	89
Hydrogen	4,8	3

	(Initial sample)	(Carbonaceous residue)
Carbon	38,4	89
Hydrogen	4,9	7
Chlorine	56,7	0,07

Through table 1, we are able to conclude that the de-chlorinated fraction obtained at 340ºC is mainly constituted by carbon presenting residual chlorine content, 0,07 %.

Tests were performed in the laboratory and pilot scale, where the variables temperature, pressure and residence time inside the reactor were studied, as well as its influence on the reaction products obtained.

The pilot plant consists in a reactor where the pyrolysis occurs, with a stainless steel body heated by electrical resistance and a column of water where the gas is bubbled, as exemplified in figure 1. Measuring instruments such as thermocouples and pressure gauges are used to control the conditions (temperature and pressure) inside the reactor.

The fixation of the released chlorine is obtained by water absorption, forming HCl (hydrochloric acid), CaCl2 (calcium chloride) and also NaCl (sodium chloride), when the aqueous solution, containing CaO (calcium oxide) or NaOH (sodium hydroxide), respectively.

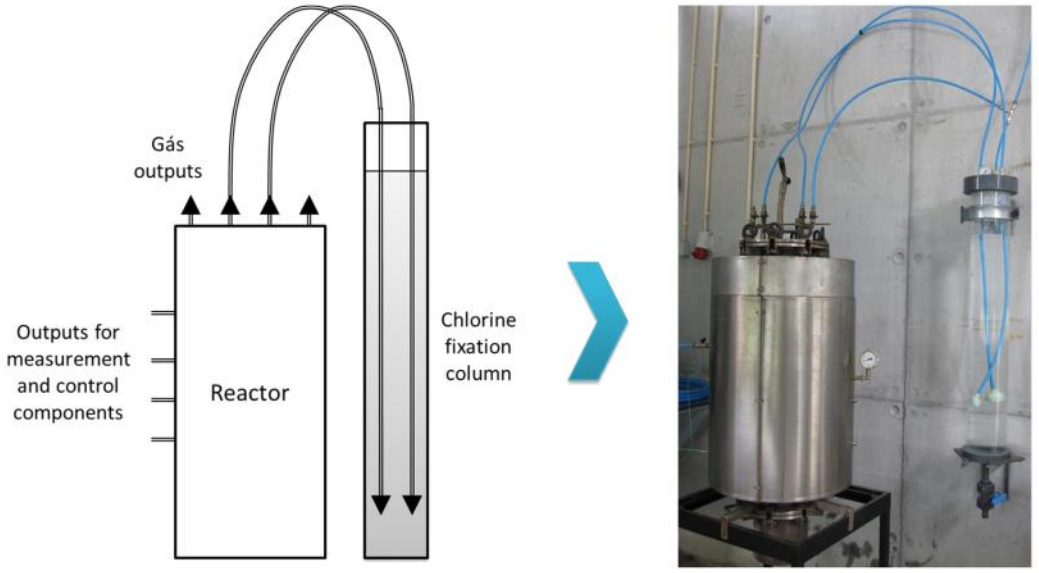

Figure 1: Scheme of pilot scale used for the tests.

Initially, a slight vacuum is created to remove the oxygen inside the reactor, then the test is initiated and divided into two stages. The first stage is a low-temperature pyrolysis or carbonization, where the de-chlorination of the PVC-containing waste reaction occurs, the released chlorine is recovered in the column in the form of hydrochloric acid, sodium chloride or calcium chloride. After the first

Initially, a slight vacuum is created to remove the oxygen inside the reactor, then the test is initiated and divided into two stages. The first stage is a low-temperature pyrolysis or carbonization, where the de-chlorination of the PVC-containing waste reaction occurs, the released chlorine is recovered in the column in the form of hydrochloric acid, sodium chloride or calcium chloride. After the first stage is completed, second stage, takes place, then the carbonaceous residue (without chlorine) resulting from the first stage, is energetically valorized, at temperatures above 550 º C.

The residence time in the reactor was tested by the pressure differences, viewed through the pressure gauge in the reactor. Thus, the reaction starts in vacuum and is assumed as completed when the pressure reaches zero, i.e. atmospheric pressure. During the reaction, when the pressure is 0,5 bar above atmospheric pressure, it is enough for the syngas formed inside the reactor can bubble in column. After all the gas is released, then the pressure drops to zero on the gauge, i.e., atmospheric pressure, thus giving the information that the reaction is complete.

All materials used in building a pilot plant must be well chosen, because of corrosion of materials and isolation. The absence of leakage or entry of gases must also be controlled, since the produced gases are toxic and cannot leak to the atmosphere, and also because as pyrolysis is a process that must take place in anoxic environment, thus it should be affected by any entry of oxidizing agents.

The main reaction product is a synthesis gas for burning to produce heat.

CONCLUSIONS

In this work, the kinetics of the reaction of thermal decomposition of PVC were studied, leading to the development of a kinetic model, with the expression ln r = 31,3 - 16100/T + 1,020 ln C (HCl). This model was obtained for the decomposition temperatures lower than 340 ºC, in which almost all chlorine is removed from the pure PVC through the chemical reaction described, with an activation energy of 133800 J/mol, value very close to the one obtained by others researchers [4].

The kinetic model was verified in laboratorial trials, and it was observed a reduction of 88 % of the chlorine contained in PVC, making it suitable to be used in a recovery process to obtain a synthesis gas.

During the pyrolysis treatment, released chlorine can be fixed in the form of aqueous solution of hydrochloric acid, calcium chloride or sodium chloride. This process shall constitute an attractive route, envisaging environmental benefits, thereby avoiding deleterious effects of toxic gas emissions.

In this study, we propose a methodology to remove chlorine from PVC-containing wastes allowing the valorization of the chlorine-free remaining fraction. A double benefit can thus be achieved as it not only saves the cost of landfilling but also produces an value added syngas.

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It is concluded that for PVC-containing waste, the solution can pass through a full treatment consisting of two phases. Where the first is to remove the chlorine from the PVC molecule and the second is to valorize the remaining fraction.

References

[1] Lewis, F.; Ablow, C. (1976) "Pyrogas From Biomass". Presented to a conference on capturing the sun through bioconversion, Washington, D.C., Shoreham Americana Hotel. Stanford research institute.

[2] Zevenhoven, R.; Axelsen, E.; Hupa, M. (2002) "Pyrolysis of waste-derived fuel mixtures containing PVC", Fuel, 81, pp 507-510.

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[4] Ma, S.; Lu, Gao, J. (2002) "Study of the Low Temperature Pyrolysis of PVC", Energy & Fuels, 16, pp 338-342.

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HCl Production Questions 3/1/2024

Wednesday, March 6, 2024 1:48 PM

Andrews, Edward S <edward.s.andrews@wv.gov>

RE: Empire Discussion

1 message

Wood, Katie <katie.wood@tetratech.com> Fri, Mar 1, 2024 at 10:23 AM
To: "Andrews, Edward S" <edward.s.andrews@wv.gov>
Cc: Farley Wood <fwood@empirede.com>

Ed,

We have some answers to your questions below in red. Please let me know if you would like to discuss.

Thanks,

Katie

From: Andrews, Edward S <edward.s.andrews@wv.gov>
Sent: Friday, February 23, 2024 2:24 PM
To: Wood, Katie <katie.wood@tetratech.com>; Farley Wood <fwood@empirede.com>
Subject: Re: Empire Discussion

⚠ **CAUTION:** This email originated from an external sender. Verify the source before opening links or attachments. ⚠

Using Chlorine gas and water reaction to produce HCl also produces a by-product of HOCl (hypochlorous acid). https://www.bing.com/search?q=chlorine+gas+water+reaction&qs=UT&pq=chlorine+gas+water+reaction&sc=10-27&cvid=1D306673308642F9BCEE5D950B9BFB08&FORM=QBRE&sp=1&ghc=1&lq=0 The process does not produce any Chlorine gas, it produces Chloride gas so no HOCL is produced. I have attached a paper provided by Technotherm for futher information

Question is: Will Empire separate hypochlorous acid from the HCl or send it out as it? As per above no HOCL will be produced

Will the emissions of HCl go through a separate release point than the RTO stack? If it is a separate stack, I need the stack id and stack parameters of this point. No all emissions will go through the RTO

Also, I will need the calculations to support your emission estimate of HCl and concentration of HCl in the effluent release to the atmosphere from the production/storage/loading out of HCl. Calculations attached, these were included in the last submittal

Ed

On Thu, Feb 22, 2024 at 1:00 PM Wood, Katie <katie.wood@tetratech.com> wrote:

Microsoft Teams meeting

Join on your computer, mobile app or room device

Click here to join the meeting

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Passcode: Gbfah4

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+1 213-357-2812,,114016353# United States, Los Angeles

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--

Edward Andrews, P.E.

Engineer

WVDEP/Division of Air Quality

304-926-0499 Ext 41244

601 57th Street, SE

Charleston, WV 25304

KINETIC STUDY OF THERMAL DE-CHLORINATION OF PVC-CONTAINING WASTE.pdf
248K

WASTES: Solutions, Treatments and Opportunities
1St International Conference
September 12th – 14th 2011

KINETIC STUDY OF THERMAL DE-CHLORINATION OF PVC-CONTAINING WASTE

A. Castro[1,2,a], C. Carneiro[1], C. Vilarinho[2], D. Soares[2], C. Maçães[3], C. Sousa[3] and F. Castro[2]
[1] CVR - Centre for Waste Valorization, Guimarães, Portugal
[2] CT2M - Centre for Mechanical and Materials Technologies, Mechanical Engineering Department, University of Minho, Guimarães, Portugal
[3] Endutex - textile coatings, SA
[a] acastro@cvresiduos.pt

ABSTRACT

With the increasing of plastics content in solid waste, both municipal and industrial, also increases the interest in its use as an energy source.
Some of these wastes are an important potential source of energy and might be valorized using the pyrolysis or gasification processes. However, the presence of high chlorine contents in its composition prevents its management by a thermal process, as consequence of toxic compounds production and their release to the atmosphere.
The present work asses a possible process for treating PVC-containing wastes in an environmentally friendly way. It is based on the effective de-chlorination of PVC-containing wastes through a pyrolysis process at low temperature before the carbonaceous residue from PVC-containing wastes being subject to a subsequent thermal treatment for energetic valorization.

Keywords: Pyrolysis, thermal degradation, PVC-containing waste, energy valorization;

INTRODUCTION

The presence of organic compounds on wastes, especially plastics, is considered an important source of energy. However, most of these plastics contain polyvinyl chloride (PVC), causing recycling problems when it is considered a thermal valorization process for its treatment [1], preventing the use of those residues on these processes, which main goal is the energy recovery [2,3]. A possible solution is to remove the chlorine from PVC-containing waste through a pyrolysis process before being subjected to a thermal treatment, for energetic valorization.

Pyrolysis is one of the applied techniques for energetic valorization and is defined as a process of irreversible chemical modification of compounds under the action of heat and in the absence of oxygen, causing thermal degradation [1]. The reaction involved in this process is endothermic and the characteristics of the obtained products are function of the waste composition and of several operating factors, such as the temperature, pressure and residence time in the pyrolysis reactor.

The pyrolysis process is considered by several authors [2 - 8] as a possible technique for the energy recovery from PVC-containing wastes, through the thermal degradation of the chlorine

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molecule. PVC pyrolysis involves significant cross-linked reactions with the formation of polyaromatic structures (possibly chlorinated) and a carbonaceous residue (char) [9]. Thus, it is possible to break down this molecule, allowing the chlorine recovery as hydrochloric acid or chloride [10], with potential economic gains.

However, the presence of poly(vinyl chloride) in wastes composition confines their management by thermal valorization processes as consequence of environmental problems and corrosion of the equipment. In fact, high levels of chlorine in wastes composition are responsible for the formation of hydrochloric acid, chlorine gas and dioxins [11]. Therefore, a preview thermal treatment by a pyrolysis process to remove the chlorine from PVC-containing wastes will be a suitable step if done prior to an energy recovery process to produce a synthesis gas.

Considering thermogravimetric analysis, it is assumed that the degradation of PVC occurs between 200 and 400 ºC [2, 12]. At 250 ºC, the decomposition of PVC has already been initiated, reaching a maximum at approximately 300 ºC. At 350 ºC the amount of chlorine present in PVC waste is less than 0.1%, which means that at this temperature, 99.5% of the whole chlorine has already been released [2]. At the end of the process of chlorine removal, a residual amount of chlorine remains on the waste [9].

The C-Cl bonds in the structure of PVC have a relatively lower binding energy than the C-C and C-H bonds, which justifies that the bonds of chlorine are the first to be broken, thus starting the thermal degradation of PVC. The de-chlorination of PVC is a free radicals chain reaction therefore requiring low activation energy to start, occurring at low temperatures [4, 7].

De-chlorination of PVC wastes is a mandatory step for any treatment process, able to recover energy from these wastes. In fact, from the decomposition of PVC, one polymeric fraction can be obtained with high energetic value:

$$C_2H_3Cl \rightarrow HCl + C_2H_2 \qquad (I)$$

As a matter of fact, products from the decomposition will be of the type C_nH_n.

This work aims the contemplation of new valorization processes and use of PVC-containing wastes. For the PVC molecule de-chlorination, tests were performed at low temperature pyrolysis and subsequent gasification of the remaining fraction in order to produce a synthesis gas with high energetic potential.

EXPERIMENTAL WORK

In this work, the kinetics of thermal de-chlorination has been studied, by simultaneous DTA/TGA determinations, under inert atmosphere. With all the experimental data obtained a multivariate regression of ln (r) has been performed in function of 1/T and ln ([HCl]). The kinetic model has been calculated just for points where temperature was lower than 340 ºC, and the obtained model is:

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$$\ln r = 31{,}3 - \frac{16100}{T} + 1{,}020 \ln[HCl]$$ with r^2 = 0,9912

This allows considering that reaction as a first order one with activation energy of 133800 J/mol ± 760 J/mol.

For the kinetic study, a DTA/TGA (SDT 2960 from TA Instruments) testing at different temperatures has been carried out in order to determine the relationship between the rate of PVC de-chlorination and the temperature of the thermal treatment, under an inert atmosphere. It was used a commercial pure PVC powder with the chemical formula C_2H_3Cl, in which 56,7% is chlorine. The reference is VICIR S 950 and it is a vinyl chloride homopolymer produced by a suspension polymerization process.

Experiments have conducted up to 5 different maximum temperatures: 250, 275, 300, 325 and 400 ºC, with a heating rate of 10 ºC per minute until the desired temperature is reached. After reaching this temperature, a stage has been done during 360 minutes. Heat flux (weight corrected heat flow in W/g) and weight of sample, has been continuously recorded.

DTA/TGA testing performed indicates that the temperature of 340 ºC enables the removal of 88 % of the chlorine present in the PVC material. The resulting de-chlorinated fraction, carbonaceous residue, has also been characterized and it is mainly constituted by carbon. This carbonaceous residue was testing up to 500ºC in DTA/DTA and was verified that the combustion reaction of the carbonaceous material is complete at 493ºC demonstrating potential as a fuel source to a following gasification in order to produce a synthesis gas with high energetic potential.

To characterize the sample of PVC used and the carbonaceous residue formed, it has been used an TruSpec Elemental Determinator, model TruSpec CHN, of Leco with a burn time of 452 seconds and an Philips Analytical sequential X-ray fluorescence (XRF) Spectrometer model X'Unique II.

Table 1. Comparison between the chemical composition (in wt%) of PVC sample used and the carbonaceous residue obtained from pyrolysis at 340 ºC.

	PVC (initial sample)	PVC (Carbonaceous residue)
Carbon	38,4	89
Hydrogen	4,9	7
Chlorine	56,7	0,07

Chlorine	56,7	0,07

Through table 1, we are able to conclude that the de-chlorinated fraction obtained at 340ºC is mainly constituted by carbon presenting residual chlorine content, 0,07 %.

Tests were performed in the laboratory and pilot scale, where the variables temperature, pressure and residence time inside the reactor were studied, as well as its influence on the reaction products obtained.

The pilot plant consists in a reactor where the pyrolysis occurs, with a stainless steel body heated by electrical resistance and a column of water where the gas is bubbled, as exemplified in figure 1. Measuring instruments such as thermocouples and pressure gauges are used to control the conditions (temperature and pressure) inside the reactor.

The fixation of the released chlorine is obtained by water absorption, forming HCl (hydrochloric acid), CaCl2 (calcium chloride) and also NaCl (sodium chloride), when the aqueous solution, containing CaO (calcium oxide) or NaOH (sodium hydroxide), respectively.

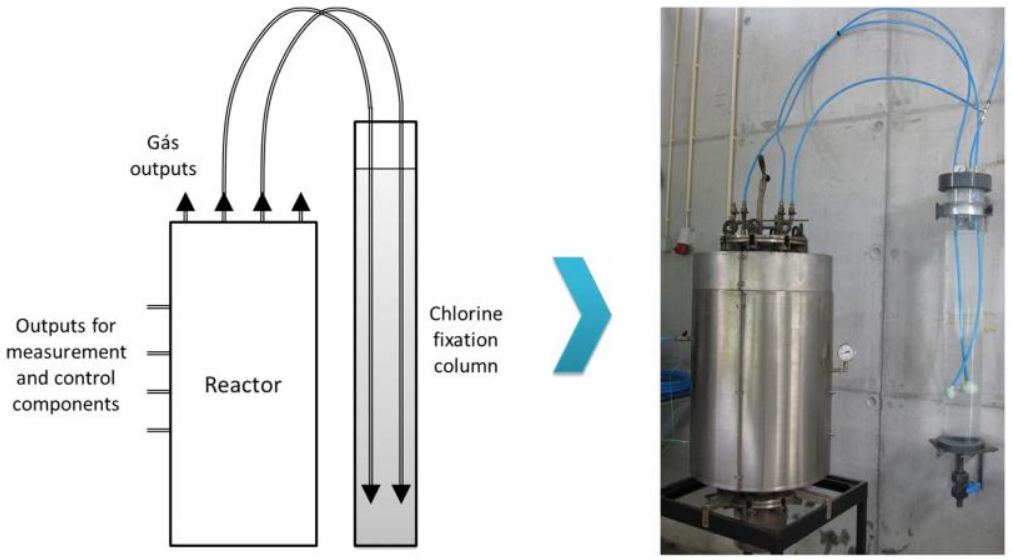

Figure 1: Scheme of pilot scale used for the tests.

Initially, a slight vacuum is created to remove the oxygen inside the reactor, then the test is initiated and divided into two stages. The first stage is a low-temperature pyrolysis or carbonization, where the de-chlorination of the PVC-containing waste reaction occurs, the released chlorine is recovered in the column in the form of hydrochloric acid, sodium chloride or calcium chloride. After the first stage is completed, second stage, takes place, then the carbonaceous residue (without chlorine) resulting from the first stage, is energetically valorized, at temperatures above 550 º C.

The residence time in the reactor was tested by the pressure differences, viewed through the pressure gauge in the reactor. Thus, the reaction starts in vacuum and is assumed as completed when the pressure reaches zero, i.e. atmospheric pressure. During the reaction, when the pressure

The residence time in the reactor was tested by the pressure differences, viewed through the pressure gauge in the reactor. Thus, the reaction starts in vacuum and is assumed as completed when the pressure reaches zero, i.e. atmospheric pressure. During the reaction, when the pressure is 0,5 bar above atmospheric pressure, it is enough for the syngas formed inside the reactor can bubble in column. After all the gas is released, then the pressure drops to zero on the gauge, i.e., atmospheric pressure, thus giving the information that the reaction is complete.

All materials used in building a pilot plant must be well chosen, because of corrosion of materials and isolation. The absence of leakage or entry of gases must also be controlled, since the produced gases are toxic and cannot leak to the atmosphere, and also because as pyrolysis is a process that must take place in anoxic environment, thus it should be affected by any entry of oxidizing agents.

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CONCLUSIONS

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HCl Spec

Friday, February 23, 2024 4:18 PM

Product Specifications

luriatic Acid, 20 DEG Baume (HCL 32)

Item	Specification
	APHA
Color, Max	15.0
Degrees Baume DEG Baume @60F	20.0-20.8
	Parts Per Million
Arsenic, Max (AS)	0.1
Bromide, Max (BR)	50.0
Calcium, Max (CA)	2.0
Free Chlorine, Max (CL2)	3.0
Fluoride, Max (F)	2.0
Iron, Max (FE)	0.5
Non-Volatile Residue, Max (NVR)	15.0
Organics, Max	1.0
Lead, Max (PB)	0.2
Sulfate, Max	10.0
	Percent by Weight
Hydrogen Chloride	31.5-32.9

Approved 07.12.199

Westlake Chemical

Response to HCl questions 2/21/2024

Wednesday, February 21, 2024 8:49 AM

Andrews, Edward S <edward.s.andrews@wv.gov>

FW: Empire's Revised Modification App

1 message

Wood, Katie <katie.wood@tetratech.com> Wed, Feb 21, 2024 at 8:33 AM
To: Edward Andrews <edward.s.andrews@wv.gov>

Ed,

Please see responses below for the HCL for the process. I will follow up on the plastic feedstock as fuel here shortly.

Thanks,

Katie

From: Farley R. Wood, P.E. <fwood@empirede.com>
Sent: Tuesday, February 20, 2024 2:14 PM
To: Wood, Katie <katie.wood@tetratech.com>
Subject: RE: Empire's Revised Modification App

⚠ **CAUTION:** This email originated from an external sender. Verify the source before opening links or attachments. ⚠

Katie,

Please see below:

Farley R. Wood, P.E.
Vice President of Engineering

Main Office (304) 935-5851
Mobile: (304) 650-2023
Teams: Click Here

fwood@empirede.com
www.empirediversifiedenergy.com

From: Wood, Katie <katie.wood@tetratech.com>
Sent: Tuesday, February 20, 2024 11:36 AM

To: Farley R. Wood, P.E. <fwood@empirede.com>
Subject: FW: Empire's Revised Modification App

You don't often get email from katie.wood@tetratech.com. Learn why this is important

---

From: Andrews, Edward S <edward.s.andrews@wv.gov>
Sent: Tuesday, February 20, 2024 10:16 AM
To: Wood, Katie <katie.wood@tetratech.com>
Subject: Re: Empire's Revised Modification App

⚠ **CAUTION:** This email originated from an external sender. Verify the source before opening links or attachments. ⚠

Katie,

I will need additional information about the HCl production/storage/loading out rack to develop the appropriate permit requirements.

How will the HCl be produced and at what concentration? Absorption and cooling of chlorine gas into demineralized water in a spray tower. The target concentration of hydrochloric acid is 31.45% (20° Baume').

How much HCl be stored on site (identify the tanks and dimensions of the tanks)? We will have two 10,305 gallon tanks for HCl storage. One for in spec HCl and one for out of spec HCL. Tank dimensions are 11' 11" diameter by 14' high.

The goal is to make in spec product, so the out of spec tank will hopefully be nearly empty most of the time. We will have a 1,500 gallon production tank (7'2" diameter by 5' 11" high) witch will be where quality analysis samples are regularly taken.

Based on the analysis the HCl will be routed to the in spec or out of spec tanks. HCl will be removed from the tanks on a daily basis by FSTI, an onsite tenant of the Port. Production and shipments will be roughly equal to minimize stored product.

Is the proposed scrubber going to be used to control the storage and loadout racks or just the loading rack? Both

Will the pyrolysis units need to process feedstock that contains PVC (polyvinyl chloride) type of plastic material to produce HCl? Yes, we have the ability to not produce HCl by keeping PVC out of the feed material.

Also, the reference to House Bill 4048 does not help me justify why the plastic feedstock should be treated as fuel?

Specifically, I need sufficient information from the application to indicate the plastic feedstock is not considered waste and therefore the facility (pyrolysis units) are not subject to Subpart AAAA, CCCC, and Subpart EEEE because the feedstock material is not waste.

Ed

On Wed, Feb 7, 2024 at 8:55 AM Wood, Katie <katie.wood@tetratech.com> wrote:

> Thanks Ed,
>
> Let me dive into this a little more and talk to them and I will reach out to discuss.
>
> Thanks,
>
> Katie
>
> ---
>
> **From:** Andrews, Edward S <edward.s.andrews@wv.gov>
> **Sent:** Tuesday, February 6, 2024 9:08 AM
> **To:** Wood, Katie <katie.wood@tetratech.com>
> **Subject:** Empire's Revised Modification App
>
> ⚠ **CAUTION:** This email originated from an external sender. Verify the source before opening links or attachments. ⚠
>
> Katie,
>
> It is still unclear to me how HCl is going to be generated and seperate from the pyrolysis process.
>
> I am not sure if I can just accept WV House Bill 4048 as proof that the material being processed is non-waste.
>
> I would like to discuss these issues further in the near future.
>
> Ed
>
> --
>
> Edward Andrews, P.E.

Engineer

WVDEP/Division of Air Quality

304-926-0499 Ext 41244

601 57th Street, SE

Charleston, WV 25304

--

Edward Andrews, P.E.

Engineer

WVDEP/Division of Air Quality

304-926-0499 Ext 41244

601 57th Street, SE

Charleston, WV 25304

Notary Public 2/5/24

Monday, February 5, 2024 1:43 PM

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an official State of Florida website

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Remote Online Notary			
First Name:	PAMELA	**Address:**	4213 LAKE RICHMON DR
Middle Name:		**City:**	ORLANDO
Last Name:	BAEZ	**State:**	Florida
Notary ID:	1051095	**Zip:**	32811
Commission:	HH 186700	**Email:**	P.BAEZ820@GMAIL.C
RON Issue Date:	6/7/2023	**Phone:**	407-491-3362
Expire Date:	10/14/2025		

Service Provider		
Name	**Start Date**	**End Date**
NOTARIZE, INC.	Jun 01, 2023	

Secure Repository			
Name	**Start Date**	**End Date**	**Preferred Contact**

Questions or comments? Please contact us

R.A. Gray Building
500 South Bronough St
Tallahassee FL, 32399-0250
850-245-6500

Response to Inc lt 1/23/24

Thursday, January 25, 2024 9:36 AM

Andrews, Edward S <edward.s.andrews@wv.gov>

RE: Incomplete App Email for Permit App R13-3555A

1 message

Wood, Katie <katie.wood@tetratech.com> Tue, Jan 23, 2024 at 4:28 PM
To: "Andrews, Edward S" <edward.s.andrews@wv.gov>
Cc: Beverly D Mckeone <beverly.d.mckeone@wv.gov>, Brian S Tephabock <Brian.S.Tephabock@wv.gov>, Eric Bland <eric.r.bland@wv.gov>, Bernard Brown <bbrown@empireda.com>, Farley Wood <fwood@empireda.com>

Ed,

Please find attached the revised modification application for Empire Green Generation. Please find the response to your comments below in blue. Please don't hesitate to reach out if you have any questions.

Thank you,

Katie Wood* | Environmental Scientist
Direct +1 (740) 266-9062 | Mobile +1 (304) 550-0580 | katie.wood@tetratech.com
Formerly Katie Pugh, please note name change
Tetra Tech | Leading with Science® | OGA
47443 National Rd Suite 3 | St. Clairesville, OH 43950 | tetratech.com

From: Andrews, Edward S <edward.s.andrews@wv.gov>
Sent: Wednesday, December 20, 2023 2:34 PM
To: Bernard Brown <bbrown@empireda.com>; Farley Wood <fwood@empireda.com>; Wood, Katie <Katie.Pugh@tetratech.com>
Cc: Beverly D Mckeone <beverly.d.mckeone@wv.gov>; Brian S Tephabock <Brian.S.Tephabock@wv.gov>; Eric Bland <eric.r.bland@wv.gov>
Subject: Incomplete App Email for Permit App R13-3555A

RE: Application Status: Incomplete
Empire Green Generation
Permit Application No. R13-3555A
Plant ID No. 009-00141

Mr. Brown:

Your application for a modification permit for a plastic recycling by pyrolysis facility was received by this Division on December 1, 2023, and assigned to the writer for review. Upon initial review of said application, it has been determined that the application as submitted is incomplete based on the following items:

1. Affidavit of Publication of Class I Legal Ad. Included in pdf

2. Discussion of the proposed physical change(s), if applicable, and/or change in the method of operation. Specifically, this discussion needs to either outline or go into detail regarding proposed/suggested changes to the permit, if applicable; type and source(s)/origin of the plastic feedstock going to be process by the facility; any processing/pretreating/sorting going to be conduct on the plastic prior to being introduce into the pyrolysis unit(s), if those preprocessing is going to occur off-site, it still needs to be identified and discussed; a discussion how the facility will switch back and forth in processing medical waste and plastic feedstock; and a discussion why processing the proposed plastic feedstock is not viewed as waste disposal through incineration in the context of the Clean Air Act and meet the criteria as a fuel(s) within the requirements and procedures of 40 CFR 241 - SOLID WASTES USED AS FUELS OR INGREDIENTS IN COMBUSTION UNITS. The only physical change is the in feedstock, there is no change in the process. Additional information about the pre-processing handling was added to section G process description. There will be no switching back and forth of feedstock, the facility will only be recycling plastics. A discussion of the regulatory requirements has been added to section D regulatory discussion.

3. Plot plan (Attachment E) needs to be updated to identify emission units and emission points. Emission units included in plot plan

4. Attachment J needs to be complete for each emission point. No additional emission points have been added

5. Attachments K and L need to be completed. The potential for leaking equipment (e.g., valves, pumps, compressors, connectors, pressure relief devices) needs to be quantified and documented in these two attachments. Attachments completed and incorporated in PDF

6. Each of the redacted pages that contain confidential business information (CBI) needs to be remarks "redacted copy - claim of confidentiality" in accordance with 45CSR31-3.4. Redacted pages updated to conform

In addressing issues 2 through 6 needs to be reflective within the redacted application as a single PDF file.

The emissions estimates appear to be identical to the emission estimates for processing medical waste with the same pyrolysis unit. Please review these estimates and revise as necessary and/or justify in detail why the emission will not change given the change in feedstocks. The emissions are not expected to change, the majority of the medical waste feedstock was anticipated to be plastics. There is not change to the process, just feedstock so the emission estimates remain the same.

Please address the above deficiencies in writing by no later than January 16, 2024. Application review will not commence until the application has been deemed to be technically complete. Failure to respond to this request in a timely manner may result in the denial of the application.

Should you have any questions, please contact Ed Andrews at (304) 926-0499 ext. 41244 or reply to this email.

--

Edward Andrews, P.E.
Engineer
WVDEP/Division of Air Quality
304-926-0499 Ext 41244
601 57th Street, SE
Charleston, WV 25304

R13-3555 Modification_Application_EGG - Redacted_Final Rev.pdf
224324

R13-3555 Modificati...

NSR (45CSR13) APPLICATION FORM

t

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF AIR QUALITY
601 57th Street, SE
Charleston, WV 25304
(304) 926-0475
www.dep.wv.gov/daq

APPLICATION FOR NSR PERMIT AND TITLE V PERMIT REVISION (OPTIONAL)

PLEASE CHECK ALL THAT APPLY TO **NSR (45CSR13)** (IF KNOWN):
☐ **CONSTRUCTION** ☒ **MODIFICATION** ☐ **RELOCATION**
☐ **CLASS I ADMINISTRATIVE UPDATE** ☐ **TEMPORARY**
☐ **CLASS II ADMINISTRATIVE UPDATE** ☐ **AFTER-THE-FACT**

PLEASE CHECK TYPE OF **45CSR30** (TITLE V) REVISION (IF ANY):
☐ **ADMINISTRATIVE AMENDMENT** ☐ **MINOR MODIFICATION**
☐ **SIGNIFICANT MODIFICATION**
IF ANY BOX ABOVE IS CHECKED, INCLUDE TITLE V REVISION INFORMATION AS **ATTACHMENT S** TO THIS APPLICATION

FOR TITLE V FACILITIES ONLY: Please refer to "Title V Revision Guidance" in order to determine your Title V Revision options (Appendix A, "Title V Permit Revision Flowchart") and ability to operate with the changes requested in this Permit Application.

Section I. General

1. Name of applicant (as registered with the WV Secretary of State's Office): Empire Green Generation, LLC
2. Federal Employer ID No. **(FEIN)**: 87-3167526
3. Name of facility (if different from above): Follansbee Operations
4. The applicant is the: ☐ **OWNER** ☐ **OPERATOR** ☒ **BOTH**
5A. Applicant's mailing address: 1480 Main Street, Follansbee, WV 26037
5B. Facility's present physical address: 881 Koppers Rd, Follansbee, WV 26037
6. **West Virginia Business Registration.** Is the applicant a resident of the State of West Virginia? ☒ **YES** ☐ **NO**
– If **YES,** provide a copy of the **Certificate of Incorporation/Organization/Limited Partnership** (one page) including any name change amendments or other Business Registration Certificate as **Attachment A.**
– If **NO,** provide a copy of the **Certificate of Authority/Authority of L.L.C./Registration** (one page) including any name change amendments or other Business Certificate as **Attachment A.**
7. If applicant is a subsidiary corporation, please provide the name of parent corporation:
8. Does the applicant own, lease, have an option to buy or otherwise have control of the proposed site? ☒ **YES** ☐ **NO**
– If **YES,** please explain: Own and Operate
– If **NO,** you are not eligible for a permit for this source.
9. Type of plant or facility (stationary source) to be **constructed, modified, relocated, administratively updated** or **temporarily permitted** (e.g., coal preparation plant, primary crusher, etc.): Plastics Recycling By Pyrolysis
10. North American Industry Classification System **(NAICS)** code for the facility: 562920
11A. DAQ Plant ID No. (for existing facilities only): 009 – 00141
11B. List all current 45CSR13 and 45CSR30 (Title V) permit numbers associated with this process (for existing facilities only): R13-3555

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

12A.
– For **Modifications, Administrative Updates** or **Temporary permits** at an existing facility, please provide directions to the present location of the facility from the nearest state road. Include a **MAP** as **Attachment B.**
– For **Construction** or **Relocation permits**, please provide directions to the proposed new site location from the nearest state road. Include a **MAP** as **Attachment B.**

Turn off of WV-2 onto Veterans Drive (0.6 miles). Turn right onto Koppers Road (0.2 miles). Facility location will be on the right.

12.B. New site address (if applicable):
12C. Nearest city or town: Follansbee
12D. County: Brooke
12.E. UTM: Northing (KM): 48.338866
12F. UTM Easting (KM): 48.805429
12G. UTM Zone: 17T

13. Briefly describe the proposed change(s) at the facility:
The facility will be recycling plastics via pyrolysis instead of medical waste as originally permitted.

14A. Provide the date of anticipated installation or change: 1/3/2024
– If this is an **After-The-Fact** permit application, provide the date upon which the proposed change did happen: / /
14B. Date of anticipated Start-Up if a permit is granted: 1/3/2024
14C. Provide a **Schedule** of the planned **Installation** of/**Change** to and **Start-Up** of each of the units proposed in this permit application as **Attachment C** (if more than one unit is involved).
15. Provide maximum projected **Operating Schedule** of activity/activities outlined in this application:
Hours Per Day 24 Days Per Week 7 Weeks Per Year 52
16. Is demolition or physical renovation at an existing facility involved? ☐ **YES** ☒ **NO**
17. **Risk Management Plans.** If this facility is subject to 112(r) of the 1990 CAAA, or will become subject due to proposed changes (for applicability help see www.epa.gov/ceppo), submit your **Risk Management Plan (RMP)** to U. S. EPA Region III.
18. **Regulatory Discussion.** List all Federal and State air pollution control regulations that you believe are applicable to the proposed process (*If Known*). A list of possible applicable requirements is also included in Attachment S of this application (Title V Permit Revision Information). Discuss applicability and proposed demonstration(s) of compliance (*If known*). Provide this information as **Attachment D.**

Section II. Additional attachments and supporting documents.

19. Include a check payable to WVDEP – Division of Air Quality with the appropriate **application fee** (per 45CSR22 and 45CSR13).
20. Include a **Table of Contents** as the first page of your application package.
21. Provide a **Plot Plan,** e.g. scaled map(s) and/or sketch(es) showing the location of the property on which the stationary source(s) is or is to be located as **Attachment E** (Refer to **Plot Plan Guidance**).
– Indicate the location of the nearest occupied structure (e.g. church, school, business, residence).
22. Provide a **Detailed Process Flow Diagram(s)** showing each proposed or modified emissions unit, emission point and control device as **Attachment F.**
23. Provide a **Process Description** as **Attachment G.**
– Also describe and quantify, to the extent possible all changes made to the facility since the last permit review (if applicable).

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

24. Provide **Material Safety Data Sheets (MSDS)** for all materials processed, used or produced as **Attachment H.**
For chemical processes, provide a MSDS for each compound emitted to the air.

25. Fill out the **Emission Units Table** and provide it as **Attachment I.**

26. Fill out the **Emission Points Data Summary Sheet (Table 1 and Table 2)** and provide it as **Attachment J.**

27. Fill out the **Fugitive Emissions Data Summary Sheet** and provide it as **Attachment K.**

28. Check all applicable **Emissions Unit Data Sheets** listed below:

- ☒ Bulk Liquid Transfer Operations
- ☒ Chemical Processes
- ☐ Concrete Batch Plant
- ☐ Grey Iron and Steel Foundry
- ☐ General Emission Unit, specify
- ☒ Haul Road Emissions
- ☐ Hot Mix Asphalt Plant
- ☐ Incinerator
- ☒ Indirect Heat Exchanger
- ☐ Quarry
- ☐ Solid Materials Sizing, Handling and Storage Facilities
- ☐ Storage Tanks

Fill out and provide the **Emissions Unit Data Sheet(s)** as **Attachment L.**

29. Check all applicable **Air Pollution Control Device Sheets** listed below:

- ☐ Absorption Systems
- ☐ Adsorption Systems
- ☐ Afterburner
- ☐ Baghouse
- ☐ Condenser
- ☐ Electrostatic Precipitator
- ☒ Flare
- ☐ Mechanical Collector
- ☒ Wet Collecting System
- ☐ Other Collectors, specify

Fill out and provide the **Air Pollution Control Device Sheet(s)** as **Attachment M.**

30. Provide all **Supporting Emissions Calculations** as **Attachment N**, or attach the calculations directly to the forms listed in Items 28 through 31.

31. **Monitoring, Recordkeeping, Reporting and Testing Plans.** Attach proposed monitoring, recordkeeping, reporting and testing plans in order to demonstrate compliance with the proposed emissions limits and operating parameters in this permit application. Provide this information as **Attachment O.**

- Please be aware that all permits must be practically enforceable whether or not the applicant chooses to propose such measures. Additionally, the DAQ may not be able to accept all measures proposed by the applicant. If none of these plans are proposed by the applicant, DAQ will develop such plans and include them in the permit.

32. **Public Notice.** At the time that the application is submitted, place a **Class I Legal Advertisement** in a newspaper of general circulation in the area where the source is or will be located (See 45CSR§13-8.3 through 45CSR§13-8.5 and ***Example Legal Advertisement*** for details). Please submit the **Affidavit of Publication** as **Attachment P** immediately upon receipt.

33. **Business Confidentiality Claims.** Does this application include confidential information (per 45CSR31)?

☐ YES ☐ NO

- If **YES**, identify each segment of information on each page that is submitted as confidential and provide justification for each segment claimed confidential, including the criteria under 45CSR§31-4.1, and in accordance with the DAQ's ***Precautionary Notice – Claims of Confidentiality"*** guidance found in the ***General Instructions*** as **Attachment G.**

Section III. Certification of Information

34. **Authority/Delegation of Authority.** Only required when someone other than the responsible official signs the application. Check applicable **Authority Form** below:

- ☐ Authority of Corporation or Other Business Entity
- ☐ Authority of Governmental Agency
- ☐ Authority of Partnership
- ☒ Authority of Limited Partnership

Submit completed and signed **Authority Form** as **Attachment R.**

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

35A. **Certification of Information.** To certify this permit application, a Responsible Official (per 45CSR§13-2.22 and 45CSR§30-2.28) or Authorized Representative shall check the appropriate box and sign below.

Certification of Truth, Accuracy, and Completeness

I, the undersigned ☒ **Responsible Official** / ☐ **Authorized Representative**, hereby certify that all information contained in this application and any supporting documents appended hereto, is true, accurate, and complete based on information and belief after reasonable inquiry. I further agree to assume responsibility for the construction, modification and/or relocation and operation of the stationary source described herein in accordance with this application and any amendments thereto, as well as the Department of Environmental Protection, Division of Air Quality permit issued in accordance with this application, along with all applicable rules and regulations of the West Virginia Division of Air Quality and W.Va. Code § 22-5-1 et seq. (State Air Pollution Control Act). If the business or agency changes its Responsible Official or Authorized Representative, the Director of the Division of Air Quality will be notified in writing within 30 days of the official change.

Compliance Certification

Except for requirements identified in the Title V Application for which compliance is not achieved, I, the undersigned hereby certify that, based on information and belief formed after reasonable inquiry, all air contaminant sources identified in this application are in compliance with all applicable requirements.

SIGNATURE: Bernard R. Brown (Please use blue ink) DATE: 11/30/2023 (Please use blue ink)

35B. Printed name of signee: Bernard Brown		35C. Title: Chief Operating Officer
35D. E-mail: bbrown@empiregde.com	36E. Phone: 681-387-5083	36F. FAX:
36A. Printed name of contact person (if different from above):		36B. Title:
36C. E-mail:	36D. Phone:	36E. FAX:

PLEASE CHECK ALL APPLICABLE ATTACHMENTS INCLUDED WITH THIS PERMIT APPLICATION:

- ☒ Attachment A: Business Certificate
- ☒ Attachment B: Map(s)
- ☐ Attachment C: Installation and Start Up Schedule
- ☐ Attachment D: Regulatory Discussion
- ☐ Attachment E: Plot Plan
- ☐ Attachment F: Detailed Process Flow Diagram(s)
- ☒ Attachment G: Process Description
- ☐ Attachment H: Material Safety Data Sheets (MSDS)
- ☒ Attachment I: Emission Units Table
- ☒ Attachment J: Emission Points Data Summary Sheet
- ☐ Attachment K: Fugitive Emissions Data Summary Sheet
- ☒ Attachment L: Emissions Unit Data Sheet(s)
- ☐ Attachment M: Air Pollution Control Device Sheet(s)
- ☒ Attachment N: Supporting Emissions Calculations
- ☒ Attachment O: Monitoring/Recordkeeping/Reporting/Testing Plans
- ☐ Attachment P: Public Notice
- ☐ Attachment Q: Business Confidential Claims
- ☒ Attachment R: Authority Forms
- ☐ Attachment S: Title V Permit Revision Information
- ☐ Application Fee

Please mail an original and three (3) copies of the complete permit application with the signature(s) to the DAQ, Permitting Section, at the address listed on the first page of this application. Please DO NOT fax permit applications.

FOR AGENCY USE ONLY – IF THIS IS A TITLE V SOURCE:

- ☐ *Forward 1 copy of the application to the Title V Permitting Group and:*
- ☐ *For Title V Administrative Amendments:*
  - ☐ *NSR permit writer should notify Title V permit writer of draft permit.*
- ☐ *For Title V Minor Modifications:*
  - ☐ *Title V permit writer should send appropriate notification to EPA and affected states within 5 days of receipt.*
  - ☐ *NSR permit writer should notify Title V permit writer of draft permit.*
- ☐ *For Title V Significant Modifications processed in parallel with NSR Permit revision:*
  - ☐ *NSR permit writer should notify a Title V permit writer of draft permit,*
  - ☐ *Public notice should reference both 45CSR13 and Title V permits,*
  - ☐ *EPA has 45 day review period of a draft permit.*

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

WEST VIRGINIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF AIR QUALITY
601 57th Street, SE
Charleston, WV 25304
Phone: (304) 926-0475
www.dep.wv.gov/daq

PERMIT DETERMINATION FORM (PDF)

FOR AGENCY USE ONLY: PLANT I.D. # _____
PDF # _____ PERMIT WRITER _____

1. NAME OF APPLICANT (AS REGISTERED WITH THE WV SECRETARY OF STATE'S OFFICE):
Empire Green Generation, LLC

2. NAME OF FACILITY (IF DIFFERENT FROM ABOVE):
Follansbee Operations

3. NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM (**NAICS**) CODE: 562920

4A. MAILING ADDRESS: 1480 Main Street, Follansbee, WV 26037

4B. PHYSICAL ADDRESS: 801 Koppers Rd, Follansbee WV 26037

5A. DIRECTIONS TO FACILITY (PLEASE PROVIDE **MAP** AS **ATTACHMENT A**): Turn off of WV-2 onto Veterans Drive (0.6 miles). Turn right onto Koppers Rd (0.2 miles). Facility on the right

5B. NEAREST ROAD: WV-2	5C. NEAREST CITY OR TOWN: Follansbee, WV	5D. COUNTY: Brooke
5E. UTM NORTHING (KM): 43.33800	5F. UTM EASTING (KM): 493.80429	5G. UTM ZONE: 17
6A. INDIVIDUAL TO CONTACT IF MORE INFORMATION IS REQUIRED: Bernard Brown		6B. TITLE: Chief Technology Officer
6C. TELEPHONE: 681-387-5083	6D. FAX:	6E. E-MAIL: bbrown@empiregde.com

7A. DAQ PLANT I.D. NO. (FOR AN EXISTING FACILITY ONLY): 009 – 00141

7B. PLEASE LIST ALL CURRENT 45CSR13, 45CSR14, 45CSR19 AND/OR TITLE V (45CSR30) PERMIT NUMBERS ASSOCIATED WITH **THIS** PROCESS (FOR AN EXISTING FACILITY ONLY):
R13-3555

7C. IS THIS PDF BEING SUBMITTED AS THE RESULT OF AN ENFORCEMENT ACTION? IF YES, PLEASE LIST:

8A. TYPE OF EMISSION SOURCE (CHECK ONE):
☐ **NEW SOURCE** ☐ **ADMINISTRATIVE UPDATE**
☒ **MODIFICATION** ☐ **OTHER** (PLEASE EXPLAIN IN 11B)

8B. IF ADMINISTRATIVE UPDATE, DOES DAQ HAVE THE APPLICANT'S CONSENT TO UPDATE THE EXISTING PERMIT WITH THE INFORMATION CONTAINED HEREIN?
☐ **YES** ☐ **NO**

9. IS DEMOLITION OR PHYSICAL RENOVATION AT AN EXISTING FACILITY INVOLVED? ☐ **YES** ☒ **NO**

10A. DATE OF ANTICIPATED INSTALLATION OR CHANGE: 1 / 15 / 24 (mm/dd/yy)

10B. DATE OF ANTICIPATED START-UP: 2 / 15 / 24 (mm/dd/yy)

11A. PLEASE PROVIDE A **DETAILED PROCESS FLOW DIAGRAM** SHOWING EACH PROPOSED OR MODIFIED PROCESS EMISSION POINT AS **ATTACHMENT B.**

11B. PLEASE PROVIDE A **DETAILED PROCESS DESCRIPTION** AS **ATTACHMENT C.**

12. PLEASE PROVIDE **MATERIAL SAFETY DATA SHEETS (MSDS)** FOR ALL MATERIALS PROCESSED, USED OR PRODUCED AS **ATTACHMENT D.** FOR CHEMICAL PROCESSES, PLEASE PROVIDE A MSDS FOR EACH COMPOUND EMITTED TO AIR.

13A. **REGULATED AIR POLLUTANT EMISSIONS.**

(a) **FOR A NEW FACILITY**, PLEASE PROVIDE PLANT WIDE EMISSIONS BASED ON THE POTENTIAL TO EMIT (PTE) FOR THE FOLLOWING AIR POLLUTANTS INCLUDING ALL PROCESSES.

(b) **FOR AN EXISTING FACILITY**, PLEASE PROVIDE THE PROPOSED CHANGE IN EMISSIONS BASED ON THE PTE OF ALL PROCESS CHANGES FOR THE FOLLOWING AIR POLLUTANTS.

PTE FOR A GIVEN POLLUTANT IS TYPICALLY BEFORE AIR POLLUTION CONTROL DEVICES AND IS COLLECTED BASED ON THE MAXIMUM DESIGN CAPACITY OF PROCESS EQUIPMENT.

POLLUTANT	HOURLY PTE (LB/HR)	YEARLY PTE (TON/YR) (HOURLY PTE MULTIPLIED BY 8760 HR/YR) DIVIDED BY 2000 LB/TON
PM	5.7	25.0
PM_{10}	3.20	14.0
VOCs	5.48	24.0
CO	22.60	99.0
NO_x	5.48	24.0
SO_2	8.90	39.0
Pb	NA	NA
HAPs (AGGREGATE AMOUNT)	0.46	2.0
TAPs (INDIVIDUALLY)*	0.46	2.0
OTHER (INDIVIDUALLY)*	0.17	0.75

* ATTACH ADDITIONAL PAGES AS NEEDED

13B. PLEASE PROVIDE ALL **SUPPORTING CALCULATIONS** AS **ATTACHMENT E**.

CALCULATE AN HOURLY AND YEARLY PTE OF EACH PROCESS EMISSION POINT (SHOWN IN YOUR DETAILED PROCESS FLOW DIAGRAM) FOR ALL AIR POLLUTANTS LISTED ABOVE INCLUDING INDIVIDUAL HAPS (LISTED IN SECTION I (3)N OF THE WW-2AA), TAPS (LISTED IN 45CSR27), AND OTHER AIR POLLUTANTS (E.G. POLLUTANTS LISTED IN TABLE 45-13A OF 45CSR13, MINERAL ACIDS PER 45CSR7, ETC.).

14. **CERTIFICATION OF DATA**

I, Bernard Brown, (TYPE NAME) ATTEST THAT ALL THE REPRESENTATIONS CONTAINED IN THIS APPLICATION, OR APPENDED HERETO, ARE TRUE, ACCURATE, AND COMPLETE TO THE BEST OF MY KNOWLEDGE BASED ON INFORMATION AND BELIEF AFTER REASONABLE INQUIRY, AND THAT I AM A **RESPONSIBLE OFFICIAL**** (PRESIDENT, VICE PRESIDENT, SECRETARY OF TREASURER, GENERAL PARTNER OR SOLE PROPRIETOR) OF THE APPLICANT.

SIGNATURE OF RESPONSIBLE OFFICIAL: Bernard R. Brown

TITLE: Chief Technology Officer DATE: 11 / 30 / 2023

** THE DEFINITION OF THE PHRASE **RESPONSIBLE OFFICIAL** CAN BE FOUND AT 45CSR13, SECTION 2.23.

NOTE: PLEASE CHECK ENCLOSED ATTACHMENTS

☐ ATTACHMENT A ☒ ATTACHMENT B ☒ ATTACHMENT C ☒ ATTACHMENT D ☒ ATTACHMENT E

RECORDS ON ALL CHANGES ARE REQUIRED TO BE KEPT AND MAINTAINED ON-SITE FOR TWO (2) YEARS.

THE PERMIT DETERMINATION FORM WITH THE INSTRUCTIONS CAN BE FOUND ON DAQ'S PERMITTING SECTION WEB SITE: **www.dep.wv.gov/daq**

ATTACHMENT A

Business Certificate

City of Follansbee

CITY LICENSE

Follansbee, West Virginia

This is to certify that the undersigned, in pursuance of the authority vested in him by law has this day granted to:

Name of Establishment: **EMPIRE GREEN GENERATION LLC**

Address: **1400 MAIN ST**

FOLLANSBEE WV 26037-1218

Name of Owner: **FRANK ROSSO**

Address: **401 EAST LAS OLAS BLVD SUITE 1400**

FORT LAUDERDALE FL 33301-2218

a license to engage in, conduct or operate the business of, or devices for which license tax has been assessed and paid as shown in license schedule herein.

Date Issued: **28-Jul-2022**

Expiration Date: **30-Jun-2023**

WV Contractors #

PAID

07/28/2022

City of Follansbee

Any automatic device licensed herein is that which is not a gambling device under city ordinance or the laws of the State of West Virginia

LICENSE No : 280

John G McIntosh

City Manager

DISPLAY IN A CONSPICUOUS PLACE

State of West Virginia

Certificate

I, Mac Warner, Secretary of State of the State of West Virginia, hereby certify that

EMPIRE GREEN GENERATION, LLC

was duly authorized under the laws of this state to transact business in West Virginia as a foreign limited liability company on December 09, 2021.

The company is filed as an at-will company, for an indefinite period.

I further certify that the company has not been revoked or administratively dissolved by the State of West Virginia nor has the West Virginia Secretary of State issued a Certificate of Cancellation or Termination to the company.

Accordingly, I hereby issue this Certificate of Authorization

CERTIFICATE OF AUTHORIZATION

Validation ID:8WV3R_YA3BM

Given under my hand and the Great Seal of the State of West Virginia on this day of

January 07, 2022

Mac Warner

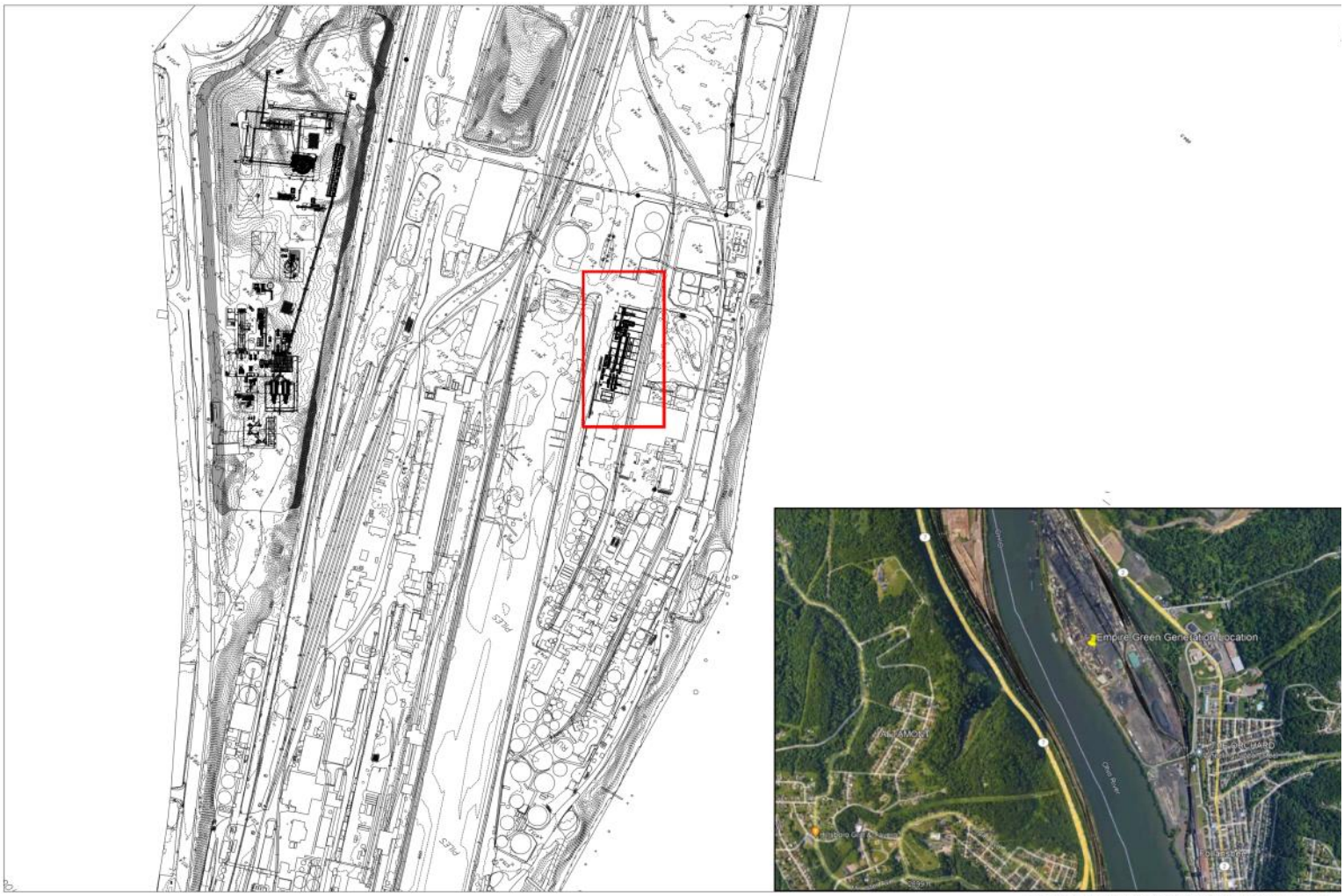
Secretary of State

11

ATTACHMENT B

Maps

11



EMPIRE GREEN GENERATION, LLC
FOLLANSBEE, WV
SITE MAP AND LAYOUT

12

ATTACHMENT C

Installation and Startup Schedule

13


Google Earth

ATTACHMENT C: INSTALLATION AND START UP SCHEDULE

Unit	Start of Installation	Approximate Start of Operations
900 & 1000 (Thermal Oxidizer and Stack Exhaust)	October 2022	February 2024

ATTACHMENT D

Regulatory Discussion

1.1 West Virginia State Requirements

The Facility will be a minor source of emissions under the NSR Program as well as the Title V Operating Permit program under §45CSR30. However, the potential uncontrolled emissions for the Facility will exceed the permitting threshold of 6 pounds per hour (lb/hr) and/or 144 pounds per day (lb/day) in accordance with WVDEP §45CSR13-2.24. Accordingly, Empire Green Generation, LLC is submitting this application for a minor source permit to install and operate.

In addition to regulations, state regulations that pertain to this Facility are listed in Table 1-1. Titles shown in capital letters in the table are permits, notifications, and/or reports that will be needed for construction and operation of the Facility.

Federal authority is delegated to the State of West Virginia, and all permit applications will be submitted to West Virginia Department of Environmental Protection (WVDEP). The following list of air permits is applicable to the proposed facility:

Table 1-1 West Virginia DEP Applicable Regulations

Rule	Description
45CSR02	Control of visible and particulate emissions from stationary sources
45CSR08	Ambient Air Quality Standards
45CSR10	General emission limit provisions for sulfur dioxide
45CSR11	Prevention Of Air Pollution Emergency Episodes
45CSR13	Permits-to-Install New Sources and Permit-to-Install and Operate Program
45CSR17	Restrictions of emissions of fugitive dust
45CSR21	Control of emissions of VOCs from stationary sources

1.1.1 Permit Applicability

Air pollution control regulations have been established by the WVDEP for air emissions associated with stationary sources and fugitive emissions resulting from material transfer activities.

To determine permit applicability for the Facility's emission sources, the Potential-to-Emit (PTE) emissions have been presented in Attachment J and Permit Determination Form, the proposed Facility will be considered a minor source with potential uncontrolled PM emissions greater than 25 tons per year (tpy) and less than major source thresholds. Therefore, the Facility will need to obtain a permit to construct and operate. Applicable federal regulations present in Table 1-2 below.

Table 1-2 Federal Applicable Regulations

Rule	Description
40 CFR Part 63 Subpart JJJJ	Standards of Performance for Stationary Spark Ignition Internal Combustion Engines
40 CFR 60 Subpart A	General Provisions
40 CFR 68.10	General control device and work practice requirements

1.1.2 Criteria For Fuel

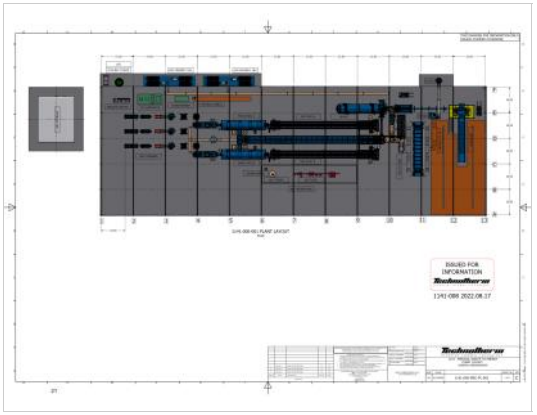
Processing the plastic feed stock is not viewed as a waste disposal through incineration, the plastics are being used as a fuel to create a syngas. The process for producing the syngas is through pyrolysis which is classified as an advanced recycling in West Virginia's House Bill 4048.

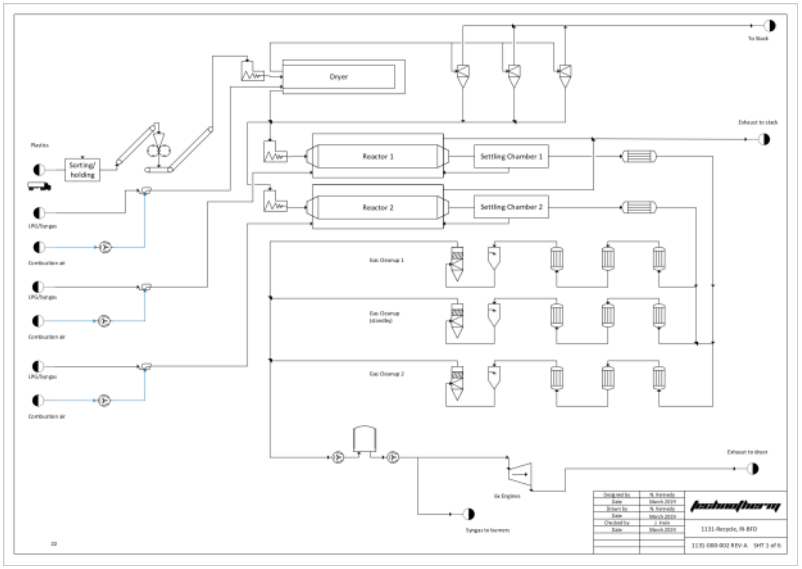
ATTACHMENT E

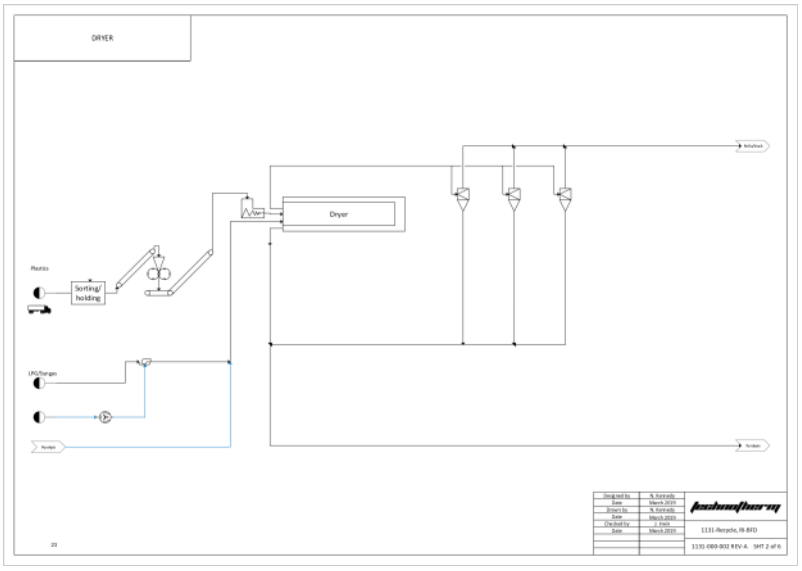
Plot Plan

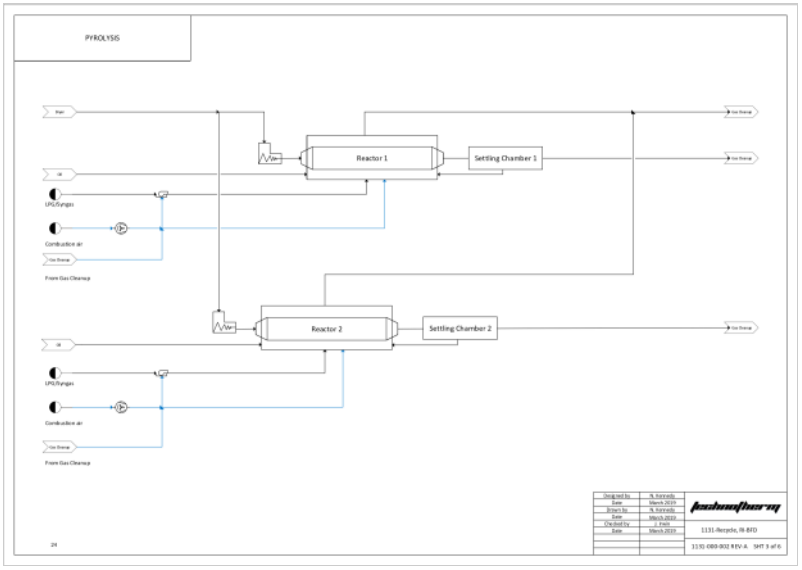
ATTACHMENT F

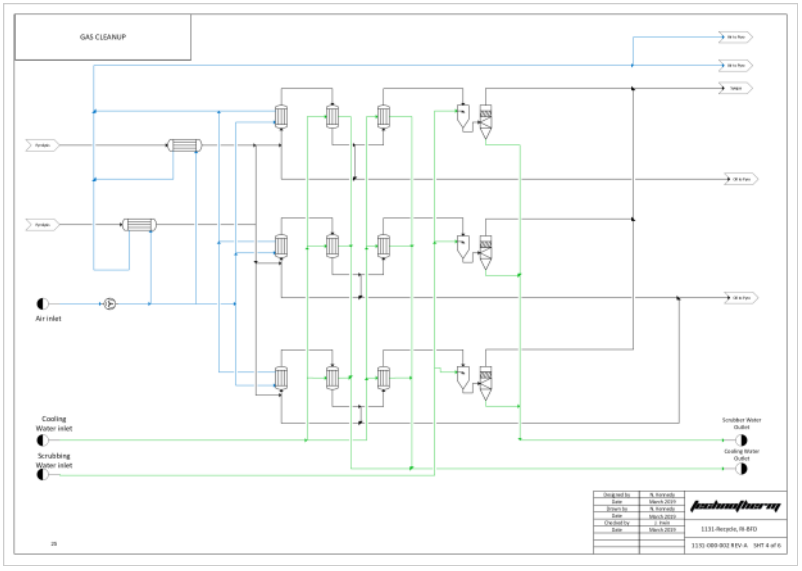
Process Flow Diagram

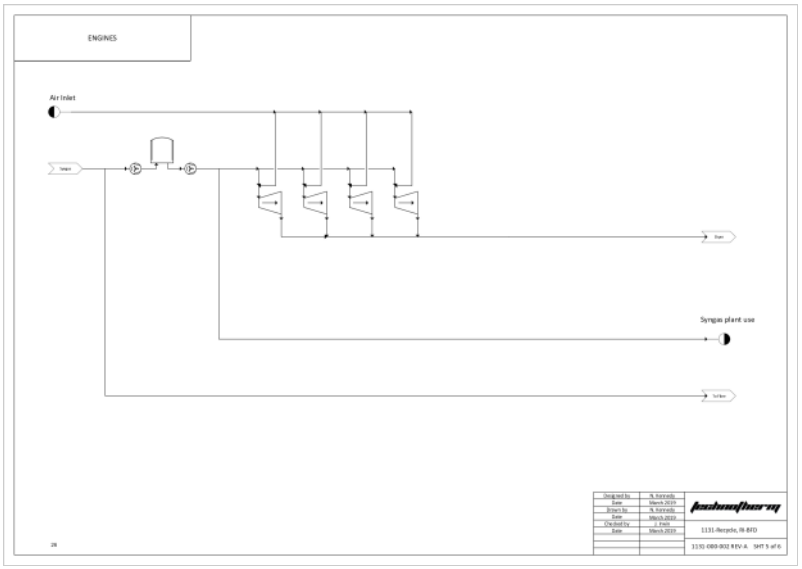


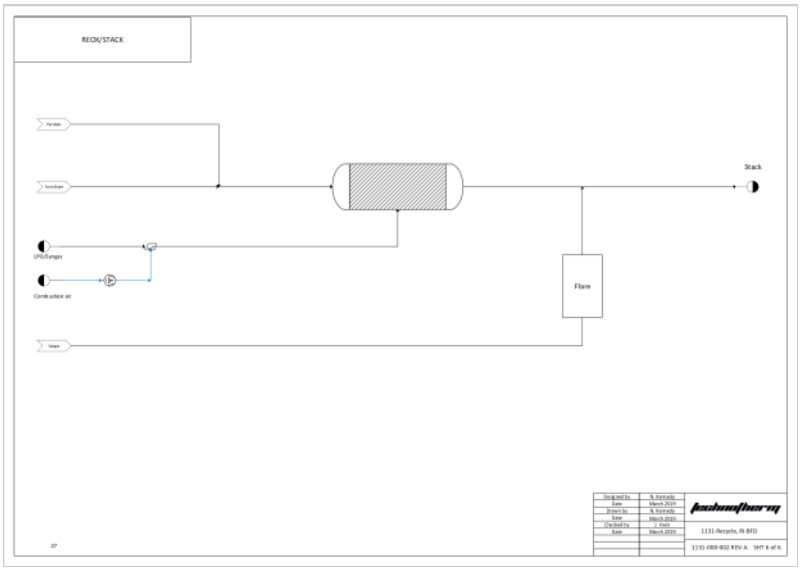



DRYER
Dryer
Sorting/
holding
Plastics
LPG/Syngas
Air/Inlet
Air/Outlet
Designed by
N. Kenneally
Date
March 2019
Drawn by
N. Kenneally
Date
March 2019
Checked by
J. Finch
Date
March 2019
1131-Recycle, IN-BFD
1131-000-002 REV-A SHT 2 of 6


PYROLYSIS
Reactor 1
Settling Chamber 1
Reactor 2
Settling Chamber 2
Oil
LPG/Syngas
Combustion air
From Gas Cleanup
Designed by
N. Kenneally
Date
March 2019
Drawn by
N. Kenneally
Date
March 2019
Checked by
J. Finch
Date
March 2019
1131-Recycle, IN-BFD
1131-000-002 REV-A SHT 3 of 6


GAS CLEANUP
Air/Inlet
Cooling
Water inlet
Scrubbing
Water inlet
Scrubber Water
Outlet
Cooling Water
Outlet
Designed by
N. Kenneally
Date
March 2019
Drawn by
N. Kenneally
Date
March 2019
Checked by
J. Finch
Date
March 2019
1131-Recycle, IN-BFD
1131-000-002 REV-A SHT 4 of 6





ATTACHMENT G

Process Description

REQUESTED REVISIONS

The following revisions from the original permit submittal are the following:

- All feedstock is now plastics, no medical waste will be processed through this system.
- Calorific value of the feed stock
- Plastics will be staged at a separate facility and brough on site as needed.
- Hydrochloric Acid (HCL) truck loading and associated scrubber system details added.

1. ***PRE-PROCESSING HANDLING***

Feedstock will be sourced from recyclers, manufacturing, and plastic producers. Referring to Figure 1, Plastics will be received at an offsite location located in the state of Ohio. The plastics will be sorted by hand and sent to a shredder, the shredder is a diesel-powered generator which will be covered under an Ohio EPA General Air Permit 9.14. The plastics will be shredded to 1"to 4" these pieces will then be baled or placed into super sacks and loaded onto trucks for delivery to the facility as needed. The trucks into the site will be controlled by Empire Green Generation and the anticipated truck traffic is to be 4-6 trucks a day entering into the site via Route 2 from the north.

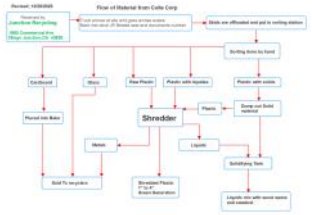


Figure 1. Flow Diagram for Pre-Processing Handling

2. ***GENERAL PROCESS DESCRIPTION***

Overall process takes plastics, received by a transporting company, and thermally processes it in a pyrolysis system operating at 500°C - 900°C (1,472°F - 2,1652°F). Waste composition will consist of plastics with resin numbers one through seven. Organic matter and hydrocarbons from the plastics are thermally decomposed without oxygen forming a syngas that can directly be used as a fuel source for electrical generating engines. Oil and tar are produced where the oil is recycled through the pyrolysis system to make more syngas and the tar is used to heat a vitrification system in which solids from the process are vitrified and made inert. The electrical generator's exhausts from the engines are sent to a drying unit where the plastic is dried prior to be introduced into the pyrolysis system. All exhaust gasses are sent to a Thermal Oxidizer where they are conditioned for release to atmosphere via a stack at a temperature of 650°C (1,562°F).

3. ***DETAILED PROCESS DESCRIPTION***

Referring to Figure 2 below, a detailed description of the process follows where Plastics (#100) is received, sent to Staging (#120) and then to the Macerator (#200). Macerator (#200) operating at negative pressure of -0.024 kilopascals (kPa) reduces the Plastics to less than or equal to 20 mm (0.78-inch). Plastics (#100) moves from the Macerator (#200) to the Dryer (#220) and is dried from the exhaust of the four (4) Engines (#900). Once the Plastics (#100) is dried, it moves to the Feed Silo (#240) through load lock valves. When the Pyrolysis (#300) system is ready to accept feed, load locking valves are actuated such that the feed in put into the Pre-Pyrolysis (#300) system. Coordinated valve actuation is used to keep oxygen level from air below 2.0% in the Pre-Pyrolysis (#300) and Pyrolysis (#350) system. Chlorides are driven off in the Pre- Pyrolysis (#300) and processed into hydrochloric acid to be sold. As plastics (#100) is being processed in the Pyrolysis (#350) system, organic matter and hydrocarbons are thermally decomposed forming syngas and moves to the Gas Cleanup (#400). The Gas Cleanup (#400) removes particulate matter and performs the bulk of neutralizing acid forming gases. Next, the gas passes to the Scrubber (#420) where any acid gasses are further removed from the syngas. The syngas then proceeds to the Gascenter (#500) which helps regulate the pressure in the Engine (#900). Syngas is combusted in the Engine (#900) and the exhaust is sent to Dryer (#220). Exhaust from the dryer is diverted through the Cyclone (#620) and then to the Feed Silo (#240). The Vitrifier (#800) exhaust flows to the Pyrolysis (#300) system, then makes a single pass through the outer chamber of the Pyrolyser (#350) system where additional heat is provided. Next the gases flow through the Dryer (#220). Gases from the Dryer (#220) outlet is sent to the Thermal Oxidizer (TO) (#900) through Cyclone (#620). Tar (#720) is mixed with Air (#820) and heats the Vitrifier (#800) sufficiently to make an inert solid product (#840) which is ready for disposal. Oil (#700) is continuously recycled through the Pyrolysis (#300) system. Offgas from the Thermal Oxidizer (#900) are sent through the Stack (#1000), which includes and emergency fans, prior to being released into the atmosphere.

Figure 2. Block flow diagram for detailed process description.

SUB-SYSTEM OPERATION PRIME EQUIPMENT DETAIL

Prime Equipment & Systems

The following descriptions supplements the Process Flow Diagrams (PFDs) shown in Figure 1.

1. **Delivery of Plastics**

   The material will be offloaded from five (5) tractor-trailers per day and tipped onto the receiving conveyor with the use of bin tipping stations as shown in Figure 2.

Figure 3: Illustration of typical bin tipping station

The waste operator will record the weight of each load prior to tipping. Additionally, a weighbridge operator records the weight of the trucks as they enter and exit the plant.

The material will automatically feed the Macerator required and dictated by the plant control philosophy.

An air extraction system is built into the Macerator with an extraction fan pulling from the topside of the Macerator at a rate of 1.2 m³/sec. Macerator will be under negative pressure of -0.024 kPa at all times during operations.

Figure 4. Negative Pressure from Macerator to Thermal Oxidizer.
Note all areas prior to thermal degradation are sealed and under negative pressure

Further detail, qualifying waste is prepared sealed containers are delivered to the plant and placed on an input conveyor. After placing on the conveyor operator has no further involvement with the waste.

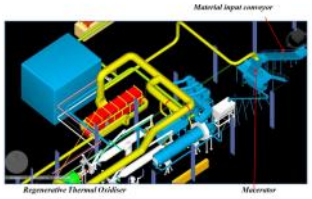


Figure 5.

2. **Materials input conveyor to Macerator under negative pressure to Thermal Oxidizer.**

   The shredder / macerator has a single opening that is sealed, allowing the waste to enter as presented through a single entry point under suction that is closed when waste is not presented for an extended period or during shut down mode.

   The entire facility is closed to the operating environment and operates under a negative pressure (-0.024 kPa), ensuring no escape of odors or pathogens.

   Transfer from the Macerator to the dryer and from the dryer to the thermal pre-pyroliser is also sealed to the environment operating under a negative pressure.

Progression to the high temperature pyrolysis unit (Fig. 3) is again sealed.

The main item that is creating a negative pressure is an Induced Draft Fan. This fan is connected to the regenerative thermal oxidizer, from the thermal oxidizer to the Macerator, dryer and all material interfaces.

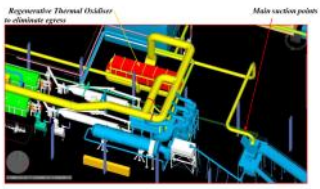


Figure 6. The Regenerative thermal oxidizer is maintained at 850°C.

2.1 Interlocks: The plant cannot be energized unless the ID fan is on and the Thermal oxidizer at temperature. There is no possibility of odors.

If the Thermal Oxidize goes below a predetermined temperature, the plant goes into shut down mode. In the event of a power failure the main control functions are connected via UPS. At this time a normally closed solenoid valve will have closed the only orifice on the plant which is where the waste is admitted.
In the unlikely event of an ID fan failure (never had one in 25 years) the plant will again default to shut down mode.

2.2 Macerator Negative Pressure

Macerator material (feed stock) is conveyed to the thermal dryer feed hopper. Figure 6 shows a typical Macerator system.

Figure 7. Picture of a typical Macerator/Shredder system.

3. Thermal Dryer

The drying of the feed stock is carried out in a direct heated, parallel flow, rotary twin drum type dryer using a combination of: engine exhaust and, if necessary during start-up or unusual operating conditions, syngas and, as a last resort, propane.

Feed stock is transported from the dryer feed hopper into the dryer by means of a screw conveyor. Upon entering the dryer inner retort, the moist feed stock comes into direct contact with the parallel stream of hot

flue gases.

Lifters and progression plates ensure intimate contact between the feed stock and flue gas therefore facilitating efficient drying, sterilization and movement of feed stock along the retort. Once both feed stock and flue gases reach the closed end of the dryer they are discharged from the inner concentric retort into the outer retort and return to the entry end of the dryer, discharging 10% moisture level feed stock into an expansion chamber. Coarse dry feed stock falls to the bottom of the chamber forming a heap on the belt conveyor located beneath.

The flue gas exhaust, contaminated with light particulate feed stock material, is also discharged from the expansion chamber and ducted to a bank of cyclones where separation occurs. Fine particulate falls to the bottom of each cyclone and is discharged via rotary valves into a common screw conveyor. The screw conveyor discharges the fine product onto the belt conveyor joining the dryer exit material and fine product. This conveyor transfers the combined dry feed stock streams onto a conveyor feeding an intermediate storage hopper that feeds both Pyrolyzers.

The cooled flue gas stream from the cyclones is directed to the Thermal

Oxidizer. 7 and 8 shows photos of a typical dryer in operation.

Figure 8. Photo of a typical dryer in operation from first floor level.

Figure 9. Photo of a typical dryer in operation from ground floor level.

4. Pyrolyser & Vitrification Furnace

Overview

The Pyrolyser train is fed dried feed stock from a thermal dryer as described in the previous section. The Pyrolysis train consists of two identical Pyrolyzers. Per unit, the source of indirect heat is primarily hot exhaust flue gas from a vitrification furnace located beneath the pyrolysis retort. These hot flue gasses exit the Pyrolysis Retorts and then progress to the medium grade heat applications (Thermal Dryer and during start up Syngas Cooler and Tar Condenser). Supplemental heating of the pyrolysis retort is being provided by firing a portion of the cleaned syngas. Natural gas / LPG is available for initial start-up or any start-up where insufficient syngas is available. After passing through the dryers the gas is progressed to the Thermal Oxidizer.

Detailed Description

Feed stock is transferred from the dryer to a live bottom screw hopper, which feed an inlet hopper complete with horizontal material feed screw. Material is fed from a gas-tight, storage hopper into the horizontal, conically shaped, rotary drum Pyrolyser Retort by a rotary screw.

As the material passes through the pyrolysis retort, it undergoes thermal degradation releasing volatile organic syngas compounds that are discharged from the retort. The crude syngas off-takes are collected into a common manifold that transfers the syngas to the syngas cleaning system.

The heavier particles, mainly comprising of ash and fixed carbon, collect in a specially designed high temperature de-acceleration chamber where the particles are collected and returned to the vitrification furnace.

The Pyrolyzers must be designed and arranged such that no propensity for harmonic vibrations shall exist under any load condition and shall be complete with all ancillary equipment for safe, reliable and efficient operation, and be of proven design capable of the required continuous, intermittent and transient operation and be suitable for its intended location. The design and materials of construction shall take fully into account the location.

Ash and carbonaceous residue produced by the Pyrolyzers drops off the dust from the aforementioned de-acceleration chamber screw conveyors, together with the main residue collected from the base of the Pyrolyzer into a Vitrifier, a refractory lined furnace fired by recovered tars (described below in the syngas cleaning equipment). The heat liberated by burning the tars and oils is sufficient to heat the ash from the Pyrolysis units above their eutectic temperature with excess, preheated air to burn off the tars. The char is completely combusted into $CO_2^{}$ and H_2O.

Figure 10, 11 and 2 show photos of Pyrolyzers in operation.

Figure 10. Photo A of typical high temperature pyrolysis unit.

Figure 11. Photo B of typical high temperature pyrolysis unit.

Figure 12. Photo of typical low temperature pyrolysis unit.

5. Syngas Cleanup

Particulate Matter (PM) Cleanup

Raw syngas is removed from the Pyrolysis Retorts, as described above, and passes through a de-acceleration chamber and then hot cyclones. The cyclones are arranged for parallel flow to ensure maximum PM removal efficiency during start-up and shutdown as the flow varies. PM drops to specially designed hot screw conveyors and from there is directed to the vitrification furnaces described above.

Syngas Coolers

The partially cleaned, still hot, flue gas flows next through stainless steel tubular syngas coolers. The cooler is in essence a Heat Exchanger which indirectly transfers heat from syngas to the combustion air heaters.

Tar Condensers

The syngas from the coolers described above flows to a stainless-steel shell & tube Heat Exchanger/cooler that is cooled by an air blower system. Tars are condensed out and drop into heated troughs, the heat source of which is engine exhaust. Hot condensed tar is pumped to the vitrification furnaces described above. The common installed spare set of coolers uses engine exhaust fluegas to heat the heat exchangers and thereby cause the tars to drop into the heated trough below.

Oil Condensers

The syngas from the tar condensers described above flows to a shell & tube Heat Exchangers/cooler that are cooled by water cooling system. Condensed oils, which also contain condensed water, are collected and is pumped to the vitrification furnace described previously. The common installed spare set of coolers uses engine exhaust flue gas to heat the heat exchangers and thereby cause the oils to drop into the heated trough below.

Venturi Scrubbers

From the oil condensers the syngas flows through a high pressure drop Venturi Scrubber to remove any remaining PM.

Figure 13 and 14 show photos of a typical gas cleanup system in operation.

Figure 13. Photo A of a typical gas cleanup system in operation

Figure 14. Photo B of a typical gas clean up system in operation

Gas Bladder (Syngas Storage Tank)

The syngas storage tank provides surge capacity of cleaned syngas to level out flow and composition variations. It shall be a bladder contained within a demarcated area. The bladder will operate with an internal pressure of 30 to 40 millibar gauge.

Figure 15 shows a typical gas bladder in operation.

Figure 15. Picture of typical gas bladder

Stack

The hot gasses progress through the stack in to the atmosphere after passing through the Thermal Oxidizer (discussed in next section).

6. **Thermal Oxidizer**

After passing through a scrubber the flue gasses enter a Thermal Oxidizer comprising of a rectangular box shaped furnace. The internal dimensions are determined by the total volume that needs to be raised to 850 °C and maintained for 2 seconds.

Figure 16 shows a typical Thermal Oxidizer in operation. Please refer to the technical specification file for more details if required.

Figure 16 Photo of a typical Thermal Oxidizer in operation

7. **Syngas Engines**

Each syngas engine shall be a fully packaged unit complete with all associated components and auxiliaries. These engines are of robust design and have been proven on low and medium calorific value gas fuels.

The engine package will be complete to allow the engine to start, synchronize, operate continuously at base or part load and shut down.

The syngas engines shall be assembled in containers as indicated on the plant layout. The containerized engines shall conform to a sound pressure level of 80 dBA (2005 Noise Regulations 1st Action Level) as measured one meter from the enclosure at two meter above floor level.

Notwithstanding the syngas clean up equipment and systems described in the Syngas Clean up Section above, the syngas engine exhaust systems shall be designed and installed such that they meet emissions standards as of the Commencement Date.

The Engine cooling will be by means of external radiators, they shall be designed and constructed with sufficient margin and spare surface area for the maximum heat rejection duty under all operational conditions.

The radiators shall incorporate features to minimize corrosion and erosion on the air and waterside and suitable provisions for cleaning and core replacement.

The radiators and all of their component parts shall be of proven design and arranged so as to minimize maintenance work.

Figure 17 and Figure 18 illustrates the containerized engines in production.

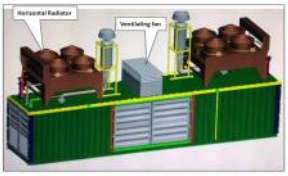


Figure 17. Illustration A of containerized engines in production

ATTACHMENT H

Material Data Safety Sheets (MSDSs)
Safety Data Sheets (SDSs)

DAKOTA GASIFICATION COMPANY

SAFETY DATA SHEET

RESPONSIBLE CARE®

Section 1: Identification

Product identifier

Product Name • Synthetic Natural Gas

Relevant identified uses of the substance or mixture and uses advised against

Recommended use • Fuel for combustion applications, raw material for chemical reactions

Details of the supplier of the safety data sheet

Manufacturer • Dakota Gasification
420 County Road 26
Beulah, ND 58523-8400
United States
www.dakotagas.com

Telephone (General) • 701-873-2100

Emergency Contact Information

Email • DGCEmergency@bwpc.com
Manufacturer • (701) 873-6600
CHEMTREK • 800-424-9300

Section 2: Hazard Identification

United States (US)
According to OSHA 29 CFR 1910.1200 HCS

Classification of the substance or mixture

OSHA HCS 2012 • Flammable Gases 1 - H220
Compressed Gas - H280
Simple Asphyxiant

Label elements

OSHA HCS 2012

DANGER

Hazard statements • Extremely flammable gas - H220
Contains gas under pressure; may explode if heated - H280
May displace oxygen and cause rapid suffocation.

Precautionary statements

Prevention • Keep away from heat, sparks, open flames and/or hot surfaces. - No smoking. - P210
Response • Leaking gas fire: Do not extinguish, unless leak can be stopped safely. - P377
Eliminate all ignition sources if safe to do so. - P381
Storage/Disposal • Protect from sunlight. Store in a well-ventilated place. - P410+P403

Other hazards

OSHA HCS 2012 • Under United States Regulations (29 CFR 1910.1200 - Hazard Communication Standard), this product is considered hazardous.

Canada
According to WHMIS

Classification of the substance or mixture

WHMIS • Compressed Gas - A
Flammable Gases - B1

Label elements

WHMIS

• Compressed Gas - A
Flammable Gases - B1

Other hazards

WHMIS • This material is a simple asphyxiant. May displace or reduce oxygen available for breathing especially in confined spaces.
In Canada, the product mentioned above is considered hazardous under the Workplace Hazardous Materials Information System (WHMIS).

Section 3 - Composition/Information on Ingredients

Substances

• Material does not meet the criteria of a substance.

Mixtures

Composition

Chemical Name	Identifiers	%	LD50/LC50	Classifications According to Regulation/Directive	Comments
Methane	CAS:74-82-8	66%	NDA	OSHA HCS 2012: Flam. Gas 1, Press. Gas - Comp., Simp. Asphyx.	NDA

Hydrogen	CAS:1333-74-0	3.1%	NDA	OSHA HCS 2012: Flam. Gas 1, Press. Gas - Comp., Simp. Asphyx.	NDA
Carbon dioxide	CAS:124-38-9	1 - 1.1%	Inhalation-Rat LC50 = 470000 ppm 30 Minute(s)	OSHA HCS 2012: Press. Gas - Comp., Simp. Asphyx.	NDA

Section 4: First-Aid Measures

Description of first aid measures

Inhalation • IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Administer oxygen if breathing is difficult. Give artificial respiration if victim is not breathing. If signs/symptoms continue, get medical attention.

Skin • IF ON SKIN: Wash with plenty of soap and water. If skin irritation occurs: Get medical advice/attention. Wash contaminated clothing before reuse.

Eye • IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.

Ingestion • Ingestion is not anticipated to be a likely route of exposure to this product.

Most important symptoms and effects, both acute and delayed

• Refer to Section 11 - Toxicological Information.

Indication of any immediate medical attention and special treatment needed

Notes to Physician • All treatments should be based on observed signs and symptoms of distress in the patient. Consideration should be given to the possibility that overexposure to materials other than this product may have occurred.

Other information

• Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves. RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO GASES WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus must be worn. Victim(s) who experience any adverse effect after over-exposure to this gas mixture must be taken for medical attention. Rescuers should be taken for medical attention if necessary. Take a copy of the label and the MSDS to physician or other health professional with victim(s).

Section 5: Fire-Fighting Measures

Extinguishing media

Suitable Extinguishing Media • SMALL FIRES: Dry chemical or CO2.
LARGE FIRES: Water spray or fog.

Unsuitable Extinguishing Media • No data available

Special hazards arising from the substance or mixture

Unusual Fire and Explosion Hazards • EXTREMELY FLAMMABLE
Will form explosive mixtures with air.
Vapors may travel to source of ignition and flash back.
Cylinders exposed to fire may vent and release flammable gas through pressure relief devices.
Containers may explode when heated.
Ruptured cylinders may rocket.

Burns with a pale, faintly luminous flame; air containing more than 14% methane burns without noise.

Hazardous Combustion Products
- No data available

Advice for firefighters
- Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.
Wear positive pressure self-contained breathing apparatus (SCBA).
DO NOT EXTINGUISH A LEAKING GAS FIRE UNLESS LEAK CAN BE STOPPED
Move containers from fire area if you can do it without risk.
FIRE: If tank, rail car or tank truck is involved in a fire, ISOLATE for 1800 meters (1 mile) in all directions; also, consider initial evacuation for 1800 meters (1 mile) in all directions.
FIRE INVOLVING TANKS: ALWAYS stay away from tanks engulfed in fire.
FIRE INVOLVING TANKS: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
FIRE INVOLVING TANKS: Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
FIRE INVOLVING TANKS: Cool containers with flooding quantities of water until well after fire is out.
FIRE INVOLVING TANKS: Do not direct water at source of leak or safety devices; icing may occur.
FIRE INVOLVING TANKS: For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Section 6 - Accidental Release Measures

Personal precautions, protective equipment and emergency procedures

Personal Precautions
- Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Do not walk through spilled material. Ventilate the area before entry.

Emergency Procedures
- ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). As an immediate precautionary measure, isolate spill or leak area for at least 100 meters (330 feet) in all directions. Stop leak if you can do it without risk. Keep unauthorized personnel away. Keep out of low areas. Stay upwind. LARGE SPILL: Consider initial downwind evacuation for at least 800 meters (1/2 mile) if uncontrolled leakage is encountered which cannot be stopped by shutting off the closest appropriate valve or main supply valve (without risk), implement a plan for evacuation and quickly contact the local fire department.

Environmental precautions
- Prevent spreading of vapors through sewers, ventilation systems and confined areas.

Methods and material for containment and cleaning up

Containment/Clean-up Measures
- All equipment used when handling the product must be grounded.
Stop leak if you can do it without risk.
If possible, turn leaking containers so that gas escapes rather than liquid.
Use water spray to reduce vapors; do not put water directly on leak, spill area or inside container.
Do not direct water at spill or source of leak.
Isolate area until gas has dispersed.

Section 7 - Handling and Storage

Precautions for safe handling

Handling
- Keep away from heat and ignition sources – No Smoking. Take precautionary measures against static charges. All equipment used when handling the product must be grounded. Use only non-sparking tools. Use only with adequate ventilation. Ventilate closed spaces before entering. Be aware of any signs of dizziness or fatigue, especially if work is done in a poorly ventilated area; exposures to fatal concentrations of this gas mixture could occur without any significant warning symptoms, due to olfactory fatigue or oxygen deficiency. Cylinders should be firmly secured to prevent falling or being knocked-over. Use explosion-proof - electrical, ventilating and/or lighting equipment. Do not attempt to repair, adjust, or in any other way modify cylinders. If there is a malfunction or another type of operational problem, contact nearest distributor immediately. Empty containers retain product residue and can be hazardous. Do not cut, weld, puncture or incinerate container.

Conditions for safe storage, including any incompatibilities

Storage
- Cylinders should be stored in dry, well-ventilated areas away from sources of heat, ignition and direct sunlight. Do not allow area where cylinders are stored to exceed 52C (125F). Cylinders must be protected from the environment, and preferably kept at room temperature approximately 21C (70F). Protect cylinders against physical damage. Cylinders should be firmly secured to prevent falling or being knocked-over. Store locked up.

Section 8 - Exposure Controls/Personal Protection

Control parameters

		Exposure Limits/Guidelines		
	Result	ACGIH	NIOSH	OSHA
Carbon dioxide (124-38-9)	TWA	5000 ppm TWA	5000 ppm TWA; 9000 mg/m3 TWA	5000 ppm TWA; 9000 mg/m3 TWA
	STELs	30000 ppm STEL	28080 ppm STEL; 54000 mg/m3 STEL	Not established
Methane (74-82-8)	TWAs	1000 ppm TWA (listed under Alkylcyclic hydrocarbon gases, Alkane C1-4)	Not established	Not established

Exposure controls

Engineering Measures/Controls
- Good general ventilation should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Use explosion-proof - electrical, ventilating and/or lighting equipment.

Personal Protective Equipment

Respiratory
- Follow the OSHA respirator regulations found in 29 CFR 1910.134.Use a NIOSH/MSHA approved respirator if exposure limits are exceeded or symptoms are experienced.

Eye/Face
- Wear safety glasses.

Skin/Body
- Wear leather gloves when handling cylinders.

Environmental Exposure Controls
- Follow best practice for site management and disposal of waste. Controls should be engineered to prevent release to the environment, including procedures to prevent spills, atmospheric release and release to waterways.

Key to abbreviations
ACGIH = American Conference of Governmental Industrial Hygiene
NIOSH = National Institute of Occupational Safety and Health
OSHA = Occupational Safety and Health Administration
STEL = Short Term Exposure Limits are based on 15-minute exposures
TWA = Time-Weighted Averages are based on 8h/day, 40h/week exposures

Section 9 - Physical and Chemical Properties

Information on Physical and Chemical Properties

Material Description			
Physical Form:	Gas	Appearance/Description:	Colorless gas with a mild sweet odor.
Color	Colorless	Odor	Mild, sweet
Odor Threshold	200 ppm		
General Properties			
Boiling Point	-258.52 Fl (-161.4 C)	Melting Point	-296.5 Fl (-182.5 C)
Decomposition Temperature	No data available	pH	Not relevant
Specific Gravity/Relative Density	0.422 Water=1 @ -160 C (-256 F) (liquid)	Bulk Density	No data available
Water Solubility	Slightly Soluble	Viscosity	No data available
Explosive Properties	No data available	Oxidizing Properties	No data available
Volatility			
Vapor Pressure	Very high	Vapor Density	0.416 to 0.55 Air=1
Evaporation Rate	No data available	Volatiles (VM)	100 %
Flammability			
Flash Point	-306 Fl (-187.778 C)	LEL	15 %
UEL	5 %	Autoignition	999 Fl (537.2222 C)
Flammability (solid, gas)	Flammable Gas.		
Environmental			
Octanol/Water Partition coefficient	No data available		

Section 10: Stability and Reactivity

Reactivity
- No dangerous reaction known under conditions of normal use.

Chemical stability
- Stable

Possibility of hazardous reactions
- Hazardous polymerization will not occur.

Conditions to avoid
- Incompatible materials. Avoid contact with heat and ignition sources. Excess heat.

Incompatible materials
- Reacts violently with powerful oxidizers (e.g. bromine pentafluoride, chlorine trifluoride, chlorine, fluorine, iodine heptafluoride, dioxygenyl tetrafluoroborate, dioxygen difluoride, trioxygen difluoride, liquid oxygen.

Hazardous decomposition products
- No data available

Section 11 - Toxicological Information

Information on toxicological effects

Components		
Methane (95%)	74-82-8	**Acute Toxicity:** Inhalation-Mouse LC50 = 326 g/m³ 2 Hour(s)
Carbon dioxide (1.1%)	124-38-9	**Acute Toxicity:** Inhalation-Rat LC50 = 470000 ppm 30 Minute(s). Inhalation-Human TCLo = 7 ppb *Behavioral* **Irritability**; *Brain and Coverings* **Other degenerative changes**; *Nutritional and Gross Metabolic Changes* **Hypothermia or Temperature Body temperature decrease**. **Reproductive:** Inhalation-Rat TCLo = 8 ppm 24 Hour(s) 100 preg). *Reproductive Effects Specific Developmental Abnormalities* **Musculoskeletal system**; *Reproductive Effects Specific Developmental Abnormalities* **Cardiovascular (circulatory) system**; *Reproductive Effects Specific Developmental Abnormalities* **Respiratory system**

GHS Properties	Classification
Acute toxicity	OSHA HCS 2012 • Data lacking
Aspiration Hazard	OSHA HCS 2012 • Data lacking
Carcinogenicity	OSHA HCS 2012 • Data lacking
Germ Cell Mutagenicity	OSHA HCS 2012 • Data lacking
Skin corrosion/irritation	OSHA HCS 2012 • Data lacking
Skin sensitization	OSHA HCS 2012 • Data lacking
STOT-RE	OSHA HCS 2012 • Data lacking
STOT-SE	OSHA HCS 2012 • Data lacking
Toxicity for Reproduction	OSHA HCS 2012 • Data lacking
Respiratory sensitization	OSHA HCS 2012 • Data lacking
Serious eye damage/irritation	OSHA HCS 2012 • Data lacking

Potential Health Effects

Inhalation

Acute (Immediate) • This material is a simple asphyxiant. May displace or reduce oxygen available for breathing especially in confined spaces. If this material is released in a small, poorly ventilated area (i.e. an enclosed or confined space), an oxygen-deficient environment may occur. Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of over-exposure, death may occur. The following effects associated with decreased levels of oxygen: increase in breathing and pulse rate, emotional upset, abnormal fatigue, nausea, vomiting, collapse, loss of consciousness, convulsive movements, respiratory collapse and death.

Chronic (Delayed) • No data available

Skin

Acute (Immediate) • Under normal conditions of use, no health effects are expected.

Chronic (Delayed) • No data available

Eye

Acute (Immediate) • Under normal conditions of use, no health effects are expected.

Chronic (Delayed) • No data available

Ingestion

Acute (Immediate) • Under normal conditions of use, no health effects are expected.

Chronic (Delayed) • No data available

Key to abbreviations
LC = Lethal Concentration
TC = Toxic Concentration

Section 12 - Ecological Information

Toxicity

• Material data lacking.

Persistence and degradability

• Material data lacking.

Bioaccumulative potential

• Material data lacking.

Mobility in Soil

• Material data lacking.

Results of PBT and vPvB assessment

• PBT and vPvB assessment has not been conducted for this material.

Other adverse effects

• No studies have been found.

Section 13 - Disposal Considerations

Waste treatment methods

Product waste • Dispose of content and/or container in accordance with local, regional, national, and/or international regulations.

Packaging waste • Dispose of content and/or container in accordance with local, regional, national, and/or international regulations.

Section 14 - Transport Information

	UN number	UN proper shipping name	Transport hazard class(es)	Packing group	Environmental hazards
DOT	UN1954	Compressed gas, flammable, n.o.s. (Methane and Hydrogen)	2.1	NDA	NDA
TDG	UN1954	COMPRESSED GAS, FLAMMABLE, N.O.S.(Methane and Hydrogen)	2.1	NDA	Potential Marine Pollutant
IATA/ICAO	UN1954	Compressed gas, flammable, n.o.s. (Methane and Hydrogen)	2.1	NDA	NDA

Special precautions for user • Cylinders should be transported in a secure position, in a well-ventilated vehicle. The transportation of compressed gas cylinders in automobiles or in closed-body vehicles can present serious safety hazards. If transporting these cylinders in vehicles, ensure these cylinders are not exposed to extremely high temperatures (as may occur in an enclosed vehicle on a hot day). Additionally, the vehicle should be well-ventilated during transportation.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code • No data available

Section 15 - Regulatory Information

Safety, health and environmental regulations/legislation specific for the substance or mixture

SARA Hazard Classifications • Acute, Fire, Pressure(Sudden Release of)

Inventory						
Component	CAS	Canada DSL	Canada NDSL	EU EINECS	EU ELINCS	Korea KECL
Carbon dioxide	124-38-9	Yes	No	Yes	No	Yes
Hydrogen	1333-74-0	Yes	No	Yes	No	Yes
Methane	74-82-8	Yes	No	Yes	No	Yes

Canada

Labor

Canada - WHMIS - Classifications of Substances
•Hydrogen — 1333-74-0 — A, B1
•Carbon dioxide — 124-38-9 — A; Uncontrolled product according to WHMIS classification criteria (solid)
•Methane — 74-82-8 — A, B1
Canada - WHMIS - Ingredient Disclosure List
•Hydrogen — 1333-74-0 — Not Listed
•Carbon dioxide — 124-38-9 — 1 %
•Methane — 74-82-8 — Not Listed

Environment

Canada - CEPA - Priority Substances List
•Hydrogen — 1333-74-0 — Not Listed
•Carbon dioxide — 124-38-9 — Not Listed
•Methane — 74-82-8 — Not Listed

United States

Labor

U.S. - OSHA - Process Safety Management - Highly Hazardous Chemicals
•Hydrogen — 1333-74-0 — Not Listed
•Carbon dioxide — 124-38-9 — Not Listed
•Methane — 74-82-8 — Not Listed
U.S. - OSHA - Specifically Regulated Chemicals
•Hydrogen — 1333-74-0 — Not Listed
•Carbon dioxide — 124-38-9 — Not Listed
•Methane — 74-82-8 — Not Listed

Environment

U.S. - CAA (Clean Air Act) - 1990 Hazardous Air Pollutants
•Hydrogen — 1333-74-0 — Not Listed
•Carbon dioxide — 124-38-9 — Not Listed

•Methane	74-82-8	Not Listed
U.S. - CERCLA/SARA - Hazardous Substances and their Reportable Quantities		
•Hydrogen	1333-74-0	Not Listed
•Carbon dioxide	124-38-9	Not Listed
•Methane	74-82-8	Not Listed
U.S. - CERCLA/SARA - Radionuclides and Their Reportable Quantities		
•Hydrogen	1333-74-0	Not Listed
•Carbon dioxide	124-38-9	Not Listed
•Methane	74-82-8	Not Listed
U.S. - CERCLA/SARA - Section 302 Extremely Hazardous Substances EPCRA RQs		
•Hydrogen	1333-74-0	Not Listed
•Carbon dioxide	124-38-9	Not Listed
•Methane	74-82-8	Not Listed
U.S. - CERCLA/SARA - Section 302 Extremely Hazardous Substances TPQs		
•Hydrogen	1333-74-0	Not Listed
•Carbon dioxide	124-38-9	Not Listed
•Methane	74-82-8	Not Listed
U.S. - CERCLA/SARA - Section 313 - Emission Reporting		
•Hydrogen	1333-74-0	Not Listed
•Carbon dioxide	124-38-9	Not Listed
•Methane	74-82-8	Not Listed
U.S. - CERCLA/SARA - Section 313 - PBT Chemical Listing		
•Hydrogen	1333-74-0	Not Listed
•Carbon dioxide	124-38-9	Not Listed
•Methane	74-82-8	Not Listed
Inventory - United States - Section 8(b) Inventory (TSCA) - PMN Number to EPA Accession Number Link		
•Hydrogen	1333-74-0	Not Listed
•Carbon dioxide	124-38-9	Not Listed
•Methane	74-82-8	Not Listed

United States - California

Environment

U.S. - California - Proposition 65 - Carcinogens List		
•Hydrogen	1333-74-0	Not Listed
•Carbon dioxide	124-38-9	Not Listed
•Methane	74-82-8	Not Listed
U.S. - California - Proposition 65 - Developmental Toxicity		
•Hydrogen	1333-74-0	Not Listed
•Carbon dioxide	124-38-9	Not Listed
•Methane	74-82-8	Not Listed
U.S. - California - Proposition 65 - Maximum Allowable Dose Levels (MADL)		
•Hydrogen	1333-74-0	Not Listed
•Carbon dioxide	124-38-9	Not Listed
•Methane	74-82-8	Not Listed
U.S. - California - Proposition 65 - No Significant Risk Levels (NSRL)		
•Hydrogen	1333-74-0	Not Listed
•Carbon dioxide	124-38-9	Not Listed
•Methane	74-82-8	Not Listed
U.S. - California - Proposition 65 - Reproductive Toxicity - Female		
•Hydrogen	1333-74-0	Not Listed
•Carbon dioxide	124-38-9	Not Listed
•Methane	74-82-8	Not Listed
U.S. - California - Proposition 65 - Reproductive Toxicity - Male		
•Hydrogen	1333-74-0	Not Listed
•Carbon dioxide	124-38-9	Not Listed
•Methane	74-82-8	Not Listed

Section 16 - Other Information

Last Revision Date • 02/October/2019
Preparation Date • 01/October/2014

Key to abbreviations
NDA = No data available

Disclaimer/Statement of Liability • The information contained in this Safety Data Sheet (SDS) is believed to be correct since it was obtained from sources we believe are reliable. However no representation, guarantees or warranties of any kind are made as to its accuracy, suitability for particular applications, hazards connected with the use of the material, or the results to be obtained from the use thereof. User assumes all risks and liability of any use, processing or handling of any material, variations in methods, conditions and equipment used to store, handle, or process the material and hazards connected with the use of the material are solely the responsibility of the user and remain at his sole discretion. Compliance with all applicable federal, state, and local laws and regulations remains the responsibility of the user, and the user has the responsibility to provide a safe work place to examine all aspects of its operation and to determine if or where precautions, in addition to those described herein, are required.

MATHESON
The Gas Professionals

Safety Data Sheet

Material Name: Propane – UN1075 Specific **SDS ID: 003405010**

Section 1 - PRODUCT AND COMPANY IDENTIFICATION

Material Name
Propane – UN1075 Specific
Synonyms
INDUSTRIAL PROPANE; ATG MSDS 76; S-PROPANE; DIMETHYLMETHANE; PROPYL HYDRIDE; R-290; PROPYLHYDRIDE; LIQUEFIED PETROLEUM GAS; LPG; >96% NATURAL GRADE; >99.9% PURE GRADE; UN 1978; C3H8
Chemical Family
Hydrocarbons, aliphatic
Product Description
Classification determined in accordance with Compressed Gas Association standards.
Product Use
Industrial and Specialty Gas Applications.
Restrictions on Use
None known.
Details of the supplier of the safety data sheet
MATHESON TRI-GAS, INC.
909 Lake Carolyn Parkway
Suite 1100
Irving, TX 75039
General Information: 1-800-416-2505
Emergency #: 1-800-424-9300 (CHEMTREC)
Outside the US: 703-527-3887 (Call collect)

Section 2 - HAZARDS IDENTIFICATION

Classification in accordance with paragraph (d) of 29 CFR 1910.1200.
Flammable Gases - Category 1
Gases Under Pressure - Liquefied gas
Simple Asphyxiant
GHS Label Elements
Symbol(s):

Signal Word
Danger
Hazard Statement(s)
Extremely flammable gas.
Contains gas under pressure; may explode if heated.
May displace oxygen and cause rapid suffocation.
Precautionary Statement(s)
Prevention
Keep away from heat/sparks/open flame/hot surfaces - No smoking.
Response

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Safety Data Sheet

Material Name: Propane – UN1075 Specific **SDS ID: 003405010**

Mexico:	1000 ppm TWA [VLE-PPT]

ACGIH - Threshold Limit Values - Biological Exposure Indices (BEI)
There are no biological limit values for any of this product's components.
Engineering Controls
Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits. Use a back flow preventive device in the piping.
Individual Protection Measures, such as Personal Protective Equipment
Eye/face protection
For the gas: Eye protection not required, but recommended. For the liquid: Wear splash resistant safety goggles. Contact lenses should not be worn. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.
Skin Protection
For the gas: Protective clothing is not required. For the liquid: Wear appropriate protective, cold insulating clothing.
Respiratory Protection
The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA. 2100 ppm. Any supplied-air respirator. Any self-contained breathing apparatus with a full facepiece. Emergency or planned entry into unknown concentrations or IDLH conditions: -. Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode. Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. Escape -. Any appropriate escape-type, self-contained breathing apparatus.
Glove Recommendations
Wear insulated gloves.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance	colorless gas	**Physical State**	gas
Odor	gasoline oder	**Color**	colorless
Odor Threshold	5800 - 20000 ppm	**pH**	Not available
Melting Point	-190 °C (-310 °F)	**Boiling Point**	-40 °C (-40 °F)
Boiling Point Range	Not available	**Freezing point**	Not available
Evaporation Rate	Not available	**Flammability (solid, gas)**	Flammable gas
Autoignition Temperature	450 °C (842 °F)	**Flash Point**	-105 °C (-157 °F)
Lower Explosive Limit	2.1 %	**Decomposition temperature**	Not available
Upper Explosive Limit	9.5 %	**Vapor Pressure**	6388 mmHg @ 21.1 °C
Vapor Density (air=1)	1.55	**Specific Gravity (water=1)**	0.5853 at -45 °C

Water Solubility	(Very slightly soluble)	**Partition coefficient: n-octanol/water**	Not available
Viscosity	Not available	**Kinematic viscosity**	Not available
Solubility (Other)	Not available	**Density**	Not available
Log KOW	2.36	**Physical Form**	Liquefied gas
Molecular Formula	C-H3-C-H2-C-H3	**Molecular Weight**	44.11
Critical Temperature	96.74 °C		

Solvent Solubility
Soluble
absolute alcohol, ether, chloroform, benzene, turpentine

Section 10 - STABILITY AND REACTIVITY

Reactivity
No reactivity hazard is expected.
Chemical Stability
Stable at normal temperatures and pressure.
Possibility of Hazardous Reactions
Will not polymerize.
Conditions to Avoid
Avoid heat, flames, sparks and other sources of ignition. Minimize contact with material. Containers may rupture or explode if exposed to heat.
Incompatible Materials
combustible materials, oxidizing materials
Hazardous decomposition products
Oxides of carbon

Section 11 - TOXICOLOGICAL INFORMATION

Information on Likely Routes of Exposure
Inhalation
nausea, suffocation, vomiting, irregular heartbeat, headache, drowsiness, dizziness, disorientation, mood swings, loss of coordination, convulsions, unconsciousness, coma
Skin Contact
blisters, frostbite
Eye Contact
frostbite, blurred vision
Ingestion
ingestion of a gas is unlikely
Acute and Chronic Toxicity
Component Analysis - LD50/LC50
The components of this material have been reviewed in various sources and the following selected endpoints are published:
Propane (74-98-6)
Inhalation LC50 Rat >800000 ppm 15 min

Product Toxicity Data
Acute Toxicity Estimate

Inhalation - Gas	> 20000 ppm

Immediate Effects
frostbite, suffocation
Delayed Effects
No information on significant adverse effects.
Irritation/Corrosivity Data
No data available.
Respiratory Sensitization
No data available.
Dermal Sensitization
No data available.
Component Carcinogenicity
None of this product's components are listed by ACGIH, IARC, NTP, DFG or OSHA.
Germ Cell Mutagenicity
No data available.
Teratogenic Data
No data available.
Reproductive Toxicity
No data available.
Specific Target Organ Toxicity - Single Exposure
No target organs identified.
Specific Target Organ Toxicity - Repeated Exposure
No target organs identified.
Aspiration hazard
Not applicable.
Medical Conditions Aggravated by Exposure
None known.
Additional Data
Simulants such as epinephrine may induce ventricular fibrillation.

Section 12 - ECOLOGICAL INFORMATION

Component Analysis - Aquatic Toxicity
No LOLI ecotoxicity data are available for this product's components.
Persistence and Degradability
This material is expected to biodegrade.
Bioaccumulative Potential
Bioconcentration potential in aquatic organisms is low based on a BCF value of 13.
Mobility
Expected to have moderate mobility in soil.
Other Toxicity
No additional information is available.

Section 13 - DISPOSAL CONSIDERATIONS

Disposal Methods
Dispose in accordance with all applicable regulations.
Component Waste Numbers

The U.S. EPA has not published waste numbers for this product's components.

Section 14 - TRANSPORT INFORMATION

US DOT Information:
Shipping Name: PETROLEUM GASES, LIQUEFIED
Hazard Class: 2.1
UN/NA #: UN1075
Required Label(s): 2.1

IMDG Information:
Shipping Name: PETROLEUM GASES, LIQUEFIED
Hazard Class: 2.1
UN#: UN1075
Required Label(s): 2.1
International Bulk Chemical Code
This material does not contain any chemicals required by the IBC Code to be identified as dangerous chemicals in bulk.

Section 15 - REGULATORY INFORMATION

U.S. Federal Regulations
None of this product's components are listed under SARA Sections 302/304 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65), CERCLA (40 CFR 302.4), TSCA 12(b), or require an OSHA process safety plan.
SARA Section 311/312 (40 CFR 370 Subparts B and C) reporting categories
Flammables; Gas Under Pressure; Simple Asphyxiant
U.S. State Regulations
The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA
Propane	**74-98-6**	No	Yes	Yes	Yes	Yes

California Safe Drinking Water and Toxic Enforcement Act (Proposition 65)
Not listed under California Proposition 65.
Component Analysis - Inventory
Propane (74-98-6)

US	CA	AU	CN	EU	IP - ENCS	IP - ISHL	KR KECI - Annex 1	KR KECI - Annex 2
Yes	DSL	Yes	Yes	EIN	Yes	Yes	Yes	No

KR - REACH CCA	MX	NZ	PH	TH-TICI	TW- CN	VN (Draft)
No	Yes	Yes	Yes	Yes	Yes	Yes

Section 16 - OTHER INFORMATION

NFPA Ratings
Health: 2 Fire: 4 Instability: 0
Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe
Preparation Date
New SDS: 09/09/2018

MATHESON
The Gas Professionals

Safety Data Sheet

Material Name: Propane – UN1075 Specific **BDS ID: 002405010**

Key - Legend

ACGIH - American Conference of Governmental Industrial Hygienists; ADR - European Road Transport; AU - Australia; BOD - Biochemical Oxygen Demand; C - Celsius; CA - Canada; CA/MA/MN/NJ/PA - California Massachusetts/Minnesota/New Jersey/Pennsylvania*; CAS - Chemical Abstracts Service; CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act; CFR - Code of Federal Regulations (US); CLP - Classification, Labelling, and Packaging; CN - China; CPR - Controlled Products Regulations; DFG - Deutsche Forschungsgemeinschaft; DOT - Department of Transportation; DSD - Dangerous Substance Directive; DSL - Domestic Substances List; EC - European Commission; EEC - European Economic Community; EIN - European Inventory of (Existing Commercial Chemical) Substances); EINECS - European Inventory of Existing Commercial Chemical Substances; ENCS - Japan Existing and New Chemical Substance Inventory; EPA - Environmental Protection Agency; EU - European Union; F - Fahrenheit; F - Background (for Venezuela Biological Exposure Indices); IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; ICAO - International Civil Aviation Organization; IDL - Ingredient Disclosure List; IDLH - Immediately Dangerous to Life and Health; IMDG - International Maritime Dangerous Goods; ISHL - Japan Industrial Safety and Health Law; IUCLID - International Uniform Chemical Information Database; JP - Japan; Kow - Octanol-water partition coefficient; KR KECI Annex 1 - Korea Existing Chemicals Inventory (KECI) / Korea Existing Chemicals List (KECL); KR KECI Annex 2 - Korea Existing Chemicals Inventory (KECI) / Korea Existing Chemicals List (KECL); KR - Korea; LD50/LC50 - Lethal Dose/ Lethal Concentration; KR REACH CCA - Korea Registration and Evaluation of Chemical Substances Chemical Control Act; LEL - Lower Explosive Limit; LLV - Level Limit Value; LOLI - List Of Lists™ - ChemADVISOR's Regulatory Database; MAK - Maximum Concentration Value in the Workplace; MEL - Maximum Exposure Limits; MX - Mexico; Nc- Non-specific; NFPA - National Fire Protection Agency; NIOSH - National Institute for Occupational Safety and Health; NTTSR - New Jersey Trade Secret Registry; Ns - Non-quantitative; NSL - Non-Domestic Substance List (Canada); NTP - National Toxicology Program; NZ - New Zealand; OSHA - Occupational Safety and Health Administration; PEL - Permissible Exposure Limit; PH - Philippines; RCRA - Resource Conservation and Recovery Act; REACH - Registration, Evaluation, Authorization, and restriction of Chemicals; RID - European Rail Transport; SARA - Superfund Amendments and Reauthorization Act. Sc - Semi-quantitative; STEL - Short-term Exposure Limit; TCCA - Korea Toxic Chemicals Control Act; TDG - Transportation of Dangerous Goods; TH-TECI - Thailand - FDA Existing Chemicals Inventory (TECI); TLV - Threshold Limit Value; TSCA - Toxic Substances Control Act; TW – Taiwan; TWA - Time Weighted Average; UEL - Upper Explosive Limit; UN/NA - United Nations/ North American; US - United States; VLE - Exposure Limit Value (Mexico); VN (Draft) - Vietnam (Draft); WHMIS - Workplace Hazardous Materials Information System (Canada).

Other Information

Disclaimer:

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Safety Data Sheet
according to 29CFR1910/1200 and GHS Rev. 3

Effective date : 01.08.2015

Hydrochloric Acid,ACS

SECTION 1 : Identification of the substance/mixture and of the supplier

Product name : **Hydrochloric Acid,ACS**

Manufacturer/Supplier Trade name:

Manufacturer/Supplier Article number: **S25358**

Recommended uses of the product and uses restrictions on use:

Manufacturer Details:

Aqua Phoenix Scientific
9 Barnhart Drive, Hanover, PA 17331

Supplier Details:

Fisher Science Education
15 Jet View Drive, Rochester, NY 14624

Emergency telephone number:

Fisher Science Education Emergency Telephone No.: 800 535 5053

SECTION 2 : Hazards identification

Classification of the substance or mixture:

Corrosive
Serious eye damage, category 1
Corrosive to metals, category 1
Skin corrosion, category 1B

Irritant
Specific target organ toxicity following single exposure, category 3

Corr. Metals 1
Corr. Skin 1B
Eye Damage 1
STOT. SE 3

Signal word: Danger

Hazard statements:
May be corrosive to metals
Causes severe skin burns and eye damage
May cause respiratory irritation
Precautionary statements:
If medical advice is needed, have product container or label at hand
Keep out of reach of children
Read label before use
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Keep only in original container
Do not get in eyes, on skin, or on clothing
Wash skin thoroughly after handling
IF SWALLOWED: Rinse mouth. Do NOT induce vomiting

Safety Data Sheet
according to 29CFR1910/1200 and GHS Rev. 3

Effective date : 01.08.2015

Hydrochloric Acid,ACS

IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing
Immediately call a POISON CENTER or doctor/physician
Specific treatment (see supplemental first aid instructions on this label)
Wash contaminated clothing before reuse
Absorb spillage to prevent material damage
Store in a well-ventilated place. Keep container tightly closed
Store locked up
Store in corrosive resistant stainless steel container with a resistant inner liner
Dispose of contents and container to an approved waste disposal plant

Other Non-GHS Classification

WHMIS

D2A

E

NFPA/HMIS

NFPA SCALE (0-4)

HMIS RATINGS (0-4)

SECTION 3 : Composition/information on ingredients

Ingredients:		
CAS: 7647-01-0	Hydrochloric Acid, ACS:	30-50 %
CAS: 7732-18-5	Water	50-70 %
		Percentages are by weight

SECTION 4 : First aid measures

Description of first aid measures

After inhalation: Move exposed individual to fresh air. Loosen clothing as necessary and position individual in a comfortable position.Seek medical attention if irritation or coughing persists.

After skin contact: Wash affected area with soap and water. Immediately remove contaminated clothing and shoes.Rinse thoroughly with plenty of water for at least 15 minutes.Immediately seek medical attention.

After eye contact: Protect unexposed eye. Flush thoroughly with plenty of water for at least 15

minutes.Remove contact lenses while rinsing.Continue rinsing eyes during transport to hospital.

After swallowing: Rinse mouth thoroughly. Do not induce vomiting. Have exposed individual drink sips of water. Immediately seek medical attention.

Most important symptoms and effects, both acute and delayed:

Inhalation may cause irritation to nose and upper respiratory tract, ulceration, coughing, chest tightness and shortness of breath. Higher concentrations cause tachypnoea, pulmonary oedema and suffocation . Ingestion may cause corrosion of lips, mouth, oesophagus and stomach, dysphagia and vomiting.Pain, eye ulceration, conjunctival irritation, cataracts and glaucoma may occur following eye exposure.Erythema and skin irritation, as well as chemical burns to skin and mucous membranes may arise following skin exposure.Potential sequelae following ingestion of hydrochloric acid include perforation, scarring of the oesophagus or stomach and stricture formation causing dysphagia or gastric outlet obstruction. In some cases, RADS may develop. Respiratory symptoms may take up to 36 hours to develop.Symptoms of burning sensation, cough, wheezing, laryngitis, shortness of breath, spasm, inflammation, edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin.

Indication of any immediate medical attention and special treatment needed:

Provide SDS to Physician.Physician should treat symptomatically.

SECTION 5 : Firefighting measures

Extinguishing media

Suitable extinguishing agents: Use water, dry chemical, chemical foam, carbon dioxide, or alcohol-resistant foam.

For safety reasons unsuitable extinguishing agents:

Special hazards arising from the substance or mixture:

Combustion products may include carbon oxides or other toxic vapors.If in contact with metals toxic fumes may be released.

Advice for firefighters:

Protective equipment: Wear protective eyewear, gloves, and clothing. Refer to Section 8. Wear respiratory protection.

Additional information (precautions): Thermal decomposition can produce poisoning chlorine. Hydrochloric acid reacts also with many organic materials with liberation of heat.Avoid inhaling gases, fumes, dust, mist, vapor, and aerosols. Avoid contact with skin, eyes, and clothing.

SECTION 6 : Accidental release measures

Personal precautions, protective equipment and emergency procedures:

Ensure adequate ventilation. Ensure that air-handling systems are operational.

Environmental precautions:

Should not be released into environment. Prevent from reaching drains, sewer, or waterway.

Methods and material for containment and cleaning up:

Always obey local regulations. If necessary use trained response staff or contractor. Evacuate personnel to safe areas. Containerize for disposal. Refer to Section 13. Keep in suitable closed containers for disposal. Soak up with inert absorbent material and dispose of as hazardous waste. Cover spill with soda ash or calcium carbonate. Mix and add water to form slurry.Wear protective eyewear, gloves, and clothing. Refer to Section 8.

Reference to other sections:

SECTION 7 : Handling and storage

Precautions for safe handling:

Prevent formation of aerosols. Never use hot water and never add water to the acid.Do not allow contact between hydrochloric acid, metal-, and organics.Follow good hygiene procedures when handling chemical materials. Refer to Section 8. Prevent contact with skin, eyes, and clothing. Follow proper disposal methods. Refer to Section 13. Do not eat, drink, smoke, or use personal products when handling chemical substances. Use only in well-ventilated areas.Avoid splashes or spray in enclosed areas.

Conditions for safe storage, including any incompatibilities:

Store in a cool location. Keep away from food and beverages. Protect from freezing and physical damage. Store away from incompatible materials. Provide ventilation for containers. Keep container tightly sealed.Containers for hydrochloric acid must be made from corrosion-resistant materials: glass, polyethylene, polypropylene, polyvinyl chloride, carbon steel lined with rubber or chloride.

SECTION 8 : Exposure controls/personal protection

Control Parameters: 7647-01-0, Hydrochloric Acid, ACGIH: 2 ppm Ceiling
7647-01-0, Hydrochloric Acid, NIOSH: 5 ppm Ceiling; 7 mg/m3 Ceiling

Appropriate Engineering controls: Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapor and mists below the applicable workplace exposure limits (Occupational Exposure Limits-OELs) indicated above. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of handling.

Respiratory protection: Not required under normal conditions of use. Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. When necessary use NIOSH-approved breathing equipment.

Protection of skin: Select glove material impermeable and resistant to the substance. Select glove material based on rates of diffusion and degradation. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Use proper glove removal technique without touching outer surface. Avoid skin contact with used gloves. Wear protective clothing.

Eye protection: Faceshield (8-inch minimum).Tightly fitting safety goggles.

General hygienic measures: Perform routine housekeeping. Wash hands before breaks and immediately after handling the product. Avoid contact with skin, eyes, and clothing. Before reswearing wash contaminated clothing.

SECTION 9 : Physical and chemical properties

Appearance (physical state,color):	Clear, colorless liquid	**Explosion limit lower/ Explosion limit upper:**	Non Explosive / Non Explosive
Odor:	Pungent odor	**Vapor pressure:**	5.7mmHg @ 0C
Odor threshold:	0.5 - 34.9 mg/m3	**Vapor density:**	1.27 (Air=1)
pH-value:	< 1	**Relative density:**	1.0 - 1.2

Melting/Freezing point:	14 C	**Solubilities:**	Miscible
Boiling point/Boiling range:	81.5 - 110 C	**Partition coefficient (n-octanol/water):**	Not Determined
Flash point (closed cup):	Not Applicable	**Auto/Self-ignition temperature:**	Not Determined
Evaporation rate:	>1.00	**Decomposition temperature:**	Not Determined
Flammability (solid,gaseous):	non combustible	**Viscosity:**	a. Kinematic:Not Determined b. Dynamic: Not Determined
Density: Not Determined **Hydrochloric Acid:**PPM is36.46			

SECTION 10 : Stability and reactivity

Reactivity: Reacts violently with bases and is corrosive.
Chemical stability: No decomposition if used and stored according to specifications.
Possible hazardous reactions: Attacks many metals in the presence of water forming flammable explosive gas (hydrogen).Reacts violently with oxidants forming toxic gas (chlorine).
Conditions to avoid: Incompatible materials.
Incompatible materials: Bases, Amines, Alkali metals, Metals, permanganates (potassium permanganate), Fluorine, Metal acetylides, Hexafluorium disilicide.
Hazardous decomposition products:hydrogen chloride gas,Carbon oxides.

SECTION 11 : Toxicological information

Acute Toxicity:		
Inhalation:	7647-01-0	LD50 Rat 3124 ppm/hour
Oral:	7647-01-0	LD50 Rat 238 - 277 mg/kg
Dermal:	7647-01-0	LD50 Rabbit >5010 mg/kg
Chronic Toxicity: No additional information.		
Corrosion Irritation:		
Dermal:	7647-01-0	Skin - rabbit Result: Causes burns.
Ocular:	7647-01-0	Eyes - rabbit Result: Corrosive to eyes
Sensitization:		No additional information.
Single Target Organ (STOT):		7647-01-0: The substance or mixture is classified as specific target organ toxicant, single exposure, category 3 with respiratory tract irritation.
Numerical Measures:		No additional information.
Carcinogenicity:		No additional information.
Mutagenicity:		No additional information.

Reproductive Toxicity	No additional information.

SECTION 12 : Ecological information

Ecotoxicity
7647-01-0 Toxicity to fish LC50 - Gambusia affinis (Mosquito fish) - 282 mg/l - 96 h (Hydrochloric acid)
Persistence and degradability:
Bioaccumulative potential:
Mobility in soil:
Other adverse effects:

SECTION 13 : Disposal considerations

Waste disposal recommendations:
Do not allow product to reach sewage system or open water.It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities (US 40CFR262.11). Contact a licensed professional waste disposal service to dispose of this material. Dispose of empty containers as unused product. Product or containers must not be disposed together with household garbage. Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations. Ensure complete and accurate classification.

SECTION 14 : Transport information

UN-Number:
1789
UN proper shipping name
HYDROCHLORIC ACID
Transport hazard class(es)
Class:
8 Corrosive substances
Packing group:II
Environmental hazard:
Transport in bulk:
Special precautions for user:

SECTION 15 : Regulatory information

United States (USA)
SARA Section 311/312 (Specific toxic chemical listings):
Acute
SARA Section 313 (Specific toxic chemical listings):
7647-01-0 Hydrochloric Acid
RCRA (hazardous waste code):
None of the ingredients is listed
TSCA (Toxic Substances Control Act):
All ingredients are listed.

CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act):
7647-01-0 Hydrochloric Acid 5000 lbs

Proposition 65 (California):

Chemicals known to cause cancer:
None of the ingredients is listed
Chemicals known to cause reproductive toxicity for females:
None of the ingredients is listed
Chemicals known to cause reproductive toxicity for males:
None of the ingredients is listed
Chemicals known to cause developmental toxicity:
None of the ingredients is listed

Canada

Canadian Domestic Substances List (DSL):
All ingredients are listed.
Canadian NPRI Ingredient Disclosure list (limit 0.1%):
None of the ingredients is listed
Canadian NPRI Ingredient Disclosure list (limit 1%):
7647-01-0 Hydrochloric Acid

SECTION 16 : Other information

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations.Note: The responsibility to provide a safe workplace remains with the user.The user should consider the health hazards and safety information contained herein as a guide and should take these precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment.The information contained herein is, to the best of our knowledge and belief, accurate.However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material.It is the responsibility of the user to comply with all applicable laws and regulations applicable to this material.
GHS Full Text Phrases:

Abbreviations and acronyms:
IMDG: International Maritime Code for Dangerous Goods
PNEC: Predicted No-Effect Concentration (REACH)
CFR: Code of Federal Regulations (USA)
SARA: Superfund Amendments and Reauthorization Act (USA)
RCRA: Resource Conservation and Recovery Act (USA)
TSCA: Toxic Substances Control Act (USA)
NPRI: National Pollutant Release Inventory (Canada)
DOT: US Department of Transportation
IATA: International Air Transport Association
GHS: Globally Harmonized System of Classification and Labelling of Chemicals
ACGIH: American Conference of Governmental Industrial Hygienists
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)

HMIS: Hazardous Materials Identification System (USA)
WHMIS: Workplace Hazardous Materials Information System (Canada)
DNEL: Derived No-Effect Level (REACH)

Effective date : 01.08.2015
Last updated : 03.28.2015

ATTACHMENT I

Emission Units Table

55

Attachment I
Emission Units Table
(includes all emission units and air pollution control devices that will be part of this permit application review, regardless of permitting status)

Emission Unit ID[1]	Emission Point ID[2]	Emission Unit Description	Year Installed/ Modified	Design Capacity	Type[3] and Date of Change	Control Device[4]
980	1080	Thermal Oxidizer (Re-Ox)	2024	3.7 MMBTU/hr	New	1C
1080	1080	Emergency Flare (Stack)	2024	12,247 lmcfhr	New	2C
280	1080	Macerator/Shredder	2024	3,542.7lb/hr	New	N/A
320	1080	Dryer	2024	7,700 lb/hr	New	1C/2C
380	300	Pyrolysers	2024	70 tpd	New	1C/2C
400	1080	Gas Cleanup System	2024		New	1C/2C
680	1080	Engines	2024	539 kW	New	1C/2C

[1] For Emission Units (or Sources) use the following numbering system: 1S, 2S, 3S, ... or other appropriate designation
[2] For Emission Points use the following numbering system: 1E, 2E, 3E, ... or other appropriate designation
[3] New, modification, removal
[4] For Control Devices use the following numbering system: 1C, 2C, 3C, ... or other appropriate designation

56

Page _____ of _____

Emission Units Table
03/2007

ATTACHMENT J

Emission Points Data Summary Sheet

57

ATTACHMENT K

Fugitive Emissions Data Summary Sheet

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Attachment K

FUGITIVE EMISSIONS DATA SUMMARY SHEET

The FUGITIVE EMISSIONS SUMMARY SHEET provides a summation of fugitive emissions. Fugitive emissions are those emissions which could not reasonably pass through a stack, chimney, vent or other functionally equivalent opening. Note that uncaptured process emissions are not typically considered to be fugitive, and must be accounted for on the appropriate EMISSIONS UNIT DATA SHEET and on the EMISSION POINTS DATA SUMMARY SHEET.

Please note that total emissions from the source are equal to all vented emissions, all fugitive emissions, plus all other emissions (e.g. uncaptured emissions).

APPLICATION FORMS CHECKLIST - FUGITIVE EMISSIONS
1.) Will there be haul road activities? ☑ Yes ☐ No ☐ If YES, then complete the HAUL ROAD EMISSIONS UNIT DATA SHEET.
2.) Will there be Storage Piles? ☐ Yes ☑ No ☐ If YES, complete Table 1 of the NONMETALLIC MINERALS PROCESSING EMISSIONS UNIT DATA SHEET.
3.) Will there be Liquid Loading/Unloading Operations? ☑ Yes ☐ No ☐ If YES, complete the BULK LIQUID TRANSFER OPERATIONS EMISSIONS UNIT DATA SHEET.
4.) Will there be emissions of air pollutants from Wastewater Treatment Evaporation? ☐ Yes ☑ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET.
5.) Will there be Equipment Leaks (e.g. leaks from pumps, compressors, in-line process valves, pressure relief devices, open-ended valves, sampling connections, flanges, agitators, cooling towers, etc.)? ☑ Yes No ☐ If YES, complete the LEAK SOURCE DATA SHEET section of the CHEMICAL PROCESSES EMISSIONS UNIT DATA SHEET.
6.) Will there be General Clean-up VOC Operations? ☐ Yes ☑ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET.
7.) Will there be any other activities that generate fugitive emissions? ☑ Yes ☐ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET or the most appropriate form.
If you answered "NO" to all of the items above, it is not necessary to complete the following table, "Fugitive Emissions Summary."to

Inc App Email 12/20/2024

Tuesday, February 6, 2024 1:30 PM

Andrews, Edward S <edward.s.andrews@wv.gov>

Incomplete App Email for Permit App R13-3555A

1 message

Andrews, Edward S <edward.s.andrews@wv.gov> Wed, Dec 20, 2023 at 2:33 PM
To: Bernard Brown <bbrown@empirede.com>, Farley Wood <fwood@empirede.com>, "Pugh, Katie" <Katie.Pugh@tetratech.com>
Cc: Beverly D Mckeone <beverly.d.mckeone@wv.gov>, Brian S Tephabock <Brian.S.Tephabock@wv.gov>, Eric Blend <eric.n.blend@wv.gov>

RE: Application Status: Incomplete
Empire Green Generation
Permit Application No. R13-3555A
Plant ID No. 009-00141

Mr. Brown:

Your application for a modification permit for a plastic recycling by pyrolysis facility was received by this Division on December 1, 2023, and assigned to the writer for review. Upon initial review of said application, it has been determined that the application as submitted is incomplete based on the following items:

1. Affidavit of Publication of Class I Legal Ad.

2. Discussion of the proposed physical change(s), if applicable, and/or change in the method of operation. Specifically, this discussion needs to either outline or go into detail regarding proposed/suggested changes to the permit, if applicable; type and source(s)/origin of the plastic feedstock going to be process by the facility; any processing/pretearting/sorting going to be conduct on the plastic prior to being introduce into the pyrolysis unit(s), if these preprocessing is going to occur of off-site, it still needs to be identified and discussed; a discussion how the facility will switch back and forth in processing medical waste and plastic feedstock; and a discussion why processing the proposed plastic feedstock is not viewed as waste disposal through incineration in the content of the Clean Air Act and meet the criteria as a fuel(s) within the requirements and procedures of 40 CFR 241 - SOLID WASTES USED AS FUELS OR INGREDIENTS IN COMBUSTION UNITS.

3. Plot plan (Attachment E) needs to be updated to identify emission units and emission points.

4. Attachment J needs to be complete for each emission point.

5. Attachments K and L need to be completed. The potential for leaking equipement (e.g., valves, pumps, compressors, connectors, pressure relief devices) needs to be quantified and documented in these two attachments.

6. Each of the redacted pages that contain confidential business information (CBI) needs to be remarks "redacted copy - claim of confidentiality" in accordance with 45CSR31-3.4.

In addressing issues 2 through 6 needs to be reflective within the redacted application as a single PDF file.

The emissions estimates appear to be identical to the emission estimates for processing medical waste with the same pyrolysis unit. Please review these estimates and revise as necessary and/or justify in detail why the emission will not change given the change in feedstocks.

Please address the above deficiencies in writing by no later than January 16, 2024. Application review will not commence until the application has been deemed to be technically complete. Failure to respond to this request in a timely manner may result in the denial of the application.

Should you have any questions, please contact Ed Andrews at (304) 926-0499 ext. 41244 or reply to this email.

--
Edward Andrews, P.E.
Engineer
WVDEP/Division of Air Quality
304-926-0499 Ext 41244
601 57th Street, SE
Charleston, WV 20304

Parcel Notice 12-5-2023

Wednesday, December 6, 2023 8:03 AM

Andrews, Edward S <edward.s.andrews@wv.gov>

You received a parcel! Please come pick it up

1 message

ilobby@ilobbycloud.com <ilobby@ilobbycloud.com> Tue, Dec 5, 2023 at 10:26 AM
To: edward.s.andrews@wv.gov

DeliveryOS

ilobby®

Parcel Pending Pick Up

Shipping Label	Date Received	Tracking #	Site Name
	Dec 05, 2023	0077429849	WV Department of Environmental Protection

Note: AIR

Mark as picked up

App Submittal 12/1/2023

Wednesday, December 6, 2023 8:00 AM

Andrews, Edward S <edward.s.andrews@wv.gov>

Empire Green Generation Permit Modification Application

1 message

Wood, Katie <Katie.Pugh@tetratech.com> Fri, Dec 1, 2023 at 4:09 PM
To: Edward Andrews <edward.s.andrews@wv.gov>
Cc: Farley R Wood <fwood@empirede.com>

Ed,

Please find attached Empire Green Generations (EGG) permit modification application attached. EGG is making a claim for confidentiality so the attached file is redacted and the pages that are confidential will arrive via FedEx next week. Please feel free to reach out to me with any questions or concerns.

Thank you,

Katie Wood* | Environmental Scientist
Direct **+1 (740) 298-9062** | Mobile **+1 (304) 559-9980** | katie.wood@tetratech.com
Formerly Katie Pugh, please note name change
Tetra Tech | *Leading with Science®* | OGA
47443 National Rd Suite 3 | St. Clairesville, OH 47443 | tetratech.com

R13-3555 Modification_Application_EGG - Redacted_Final 12-1-23.pdf
21661K