From:	Air.Pollution Control
To:	APC Permitting
Subject:	FW: Additional information submitted - Site 84-0124-01/Permit No. 977924
Date:	Tuesday, February 25, 2020 7:53:46 AM
Attachments:	VES Additional Info Submission 2020-02-24 signed.pdf Letter Certified from TNDEC with information requests_20200203.pdf

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From: stephen scott [mailto:stephen.scott@res-ses.com]
Sent: Monday, February 24, 2020 4:49 PM
To: Air.Pollution Control
Cc: Justin Dolzen; Lloyd Lipman; David Gray (dgray@covingtontn.com); Michael Janus
Subject: [EXTERNAL] Additional information submitted - Site 84-0124-01/Permit No. 977924

***** This is an EXTERNAL email. Please exercise caution. DO NOT open attachments or click links from unknown senders or unexpected email - STS-Security. *****

Hello Mr. Dolzen,

As per our conversation, please see attached the information that was requested in the letter dated January 29, 2020.

Also check out this video - https://ariescleanenergy.com/video-biochar-from-the-lebanon-gasification-plant-a-byproduct-diverted-from-the-landfill-could-soon-enhance-tennessee-farmland-and-row-crops/

And https://youtu.be/E_-dXjvjTgs

Thank You,

Stephen Scott
President
Volunteer Environmental Services
901-666-9330

DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF AIR POLLUTION CONTROL
William R. Snodgrass Tennessee Tower
312 Rosa L. Parks Avenue, 15th Floor, Nashville, TN 37243
Telephone: (615) 532-0554, Email: Air.Pollution.Control@TN.gov

NON-TITLE V PERMIT APPLICATION
EMISSION POINT DESCRIPTION

Type or print and submit for each stack or air contaminant source. Submit with the APC 100.

GENERAL IDENTIFICATION AND DESCRIPTION

1. Organization's legal name and SOS control number [as registered with the TN Secretary of State (SOS)]
Volunteer Environmental Services, LLC #001059764

2. Unique Source ID (name/number/letter which uniquely identifies this air contaminant source, like Boiler #1)
Gasifier GS-200

3. Unique Emission Point ID (name/number/letter which uniquely identifies this emission point, like Stack #1)
Stack #1 (only one)

4. Brief description of air contaminant source (Attach a diagram if appropriate):
The thermal oxidizer accepts producer gas exiting the gasifier after passing through a cyclone and completely combusts the gas (<1500 degrees F, 1 second residence time). The flue gas then passes through two indirect heat exchangers which provide heat for a heated oil organic Rankine cycle generator . The outside air (non-flue gas) side of the second heat exchanger goes through a cyclone, then joins the flue gas and exits through the stack.

5. Emission point location	Latitude	Longitude	6. Distance to nearest property line (Ft.)
	35.620247	-89.611795	208'

STACK AND EMISSION DATA

7. Stack or emission point data: →	Height above grade (Ft.)	Diameter (Ft.)	Temperature (°F)	% of time over 125°F	Direction of exit (Up, down or horizontal)
	50'	24"	125-400	100	Up

Data at exit conditions: →	Flow (actual Ft.^{3}/Min.)	Velocity (Ft. /Sec.)	Moisture (Grains/Ft.^{3})	Moisture (Percent)
	2800-4000	19	40	5-7
Data at standard conditions: →	Flow (Dry std. Ft.^{3}/Min.)	Velocity (Ft. /Sec.)	Moisture (Grains/Ft.^{3})	Moisture (Percent)
	2800-3000	15	40	5-7

8. Monitoring device and recording instrument (check all that apply):

Opacity monitor	SO_2 monitor	NO_x monitor	Strip chart	Electronic data logger	Other (specify in comments)	No monitor (none)
☐	☐	☐	☐	☐	☐	☑

9. Control device. Description of proposed monitoring, recordkeeping, and reporting to assure compliance with emission limits. Include operating parameters of control device (flow rate, temperature, pressure drop, etc.).
As specified by TN DEC regulations.

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10. Air contaminants. Emission estimates for each air contaminant emitted from this point should be based on stack sampling results or engineering calculations. Calculations should be attached on a separate sheet. (see instructions for more details)

Air contaminants	Average Emissions (Lbs./Hr.)	Maximum Emissions (Lbs./Hr.)	Concen-tration	Average Emissions (Ton/Yr.)	Potential Emissions (Ton/Yr.)	Emissions Estimation Method Code *	Control Devices *	Control Effi-ciency %
Particulate matter (PM)	0.011	1.58	**	0.05	6.9204	2	000	
Sulfur dioxide (SO_2)	0.583	2.81	***	2.5767	12.3078	2	000	
Carbon monoxide (CO)	1.0	3.0	PPM	4.38	13.14	2	000	
Volatile organic compounds (VOC)			PPM					
Nitrogen oxides (NO_X)	2.854	3.92	PPM	12.6106	17.1696	2	000	
Hydrogen fluoride (HF)								
Hydrogen chloride (HCl)	0.089	0.9		0.3922	3.942	2	000	
Lead (Pb)								
Greenhouse gases (CO_2 equivalents)								
Hazardous air pollutant (specify)								
Hazardous air pollutant (specify) Dioxins/Furans	0.0003	.003		0.0014	.01314	2	000	
Hazardous air pollutant (specify)								
Hazardous air pollutant (specify)								
Hazardous air pollutant (specify)								
Other (specify) Mercury (Hg)	0.00009	0.157		0.0004	0.6877	2	000	
Other (specify)								
Other (specify)								
Other (specify)								

11. Comments

See attached files from FC&E Engineering, LLC for calculations.

SIGNATURE

If this form is being submitted at the same time as an APC 100 form, then a signature is not required on this form. Date this form regardless of whether a signature is provided. If this form is NOT being submitted at the same time as an APC 100 form, then a signature is required.

Based upon information and belief formed after a reasonable inquiry, I, as the responsible person of the above mentioned facility, certify that the information contained in this application is accurate and true to the best of my knowledge. As specified in TCA Section 39-16-702(a)(4), this declaration is made under penalty of perjury.

12. Signature		**Date**
Stephen Scott Digitally signed by Stephen Scott DN: cn=Stephen Scott, o, ou, email=stephen.scott@fcs-oes.com, c=US Date: 2020.02.24 18:33:08 -08'00'		02/24/2020
Signer's name (type or print)	**Title**	**Phone number with area code**
Stephen Scott	President	901-666-9330

* Refer to the tables in the instructions for estimation method and control device codes.

** Exit gas particulate matter concentration units: Process – Grains/Dry Standard Ft^3 (70^0F), Wood fired boilers - Grains/Dry Standard Ft^3 (70^0F), all other boilers – Lbs. /Million BTU heat input.

*** Exit gas sulfur dioxide concentrations units: Process – PPM by volume, dry bases, and boilers – Lbs. /Million BTU heat input

DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF AIR POLLUTION CONTROL
William R. Snodgrass Tennessee Tower
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Telephone: (615) 532-0554, Email: Air.Pollution.Control@TN.gov

NON-TITLE V PERMIT APPLICATION
PROCESS OR FUEL BURNING SOURCE DESCRIPTION

Type or print. Submit with the APC 100.

GENERAL IDENTIFICATION AND DESCRIPTION

1. **Organization's legal name and SOS control number** [as registered with the TN Secretary of State (SOS)]	2. **Emission Source Reference Number**
Volunteer Environmental Services, LLC #001059764	84-0124-01

3. Is this air contaminant source subject to an NSPS or NESHAP rule? Yes ☐ No ☑
If Yes, list rule citation, including Part, Subpart, and applicable Sections:

4. **Unique Source ID** (see instructions)	5. **Unique Emission Point ID** (see instructions)
Gasifier GS-200	Stack #1 (only one)

6. Description of air contaminant source
Flue gas from a gasifier/thermal oxidizer process. The feedstock to the gasifier is 80-100% Medical waste and 0-20% Pharmaceutical waste. The fuel gas exiting the gasifier passes through a cyclone and then is fully oxidized in a thermal oxidizer (>1,500°F, 1 sec. residence time). Heat from the hot flue is extracted into hot oil, which is used drive an organic Rankine Cycle (ORC) electrical generator. The cooled flue gas then passes through a second heat exchanger where it is cooled to under 300°F before it is vented to the atmosphere throuth a stack.

7. Type of air contaminant source (Check only one option to the right)

Process Emission Source: For each process emission source, submit a separate application. (Check at right and complete lines 8, 9, and 14)	☑
Process Emission Source with in process fuel: Products of combustion contact materials heated. For each process emission source, submit a separate application. (Check at right and complete lines 8 through 14)	☐
Non-Process fuel burning source: Products of combustion do not contact materials heated. Complete this form for each boiler or fuel burner and complete a Non-Title V Emission Point Description Form (APC 101) for each stack. (Check at right and complete lines 10 through 14)	☐

PROCESS EMISSION SOURCE DESCRIPTION AND DATA

8. **Type of operation:** Continuous ☑ Batch ☐	Normal batch time	Normal batches/day

9. **Process material inputs and in-process solid fuels**	Diagram reference	Input rates (pounds/hour) Design	Actual
A. Regulated Medical Waste		5,333.34	5,333.34
B.			
C.			
D.			
E.			
F.			
G.			
Totals			

* A simple process flow diagram must be attached.

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DESCRIPTION OF BOILER, BURNER, ENGINE, OR OTHER FUEL BURNING SOURCE

10. Boiler or burner data: (Complete lines 10 through 14 using a separate form for each boiler, burner, etc.)

Serial Number	Type of firing*** Thermal Oxidizer

Rated horsepower	Rated input capacity (10^6 BTU/Hr.) 8	Other rating (specify capacity and units)

Date constructed	Date manufactured	Date of last modification (explain in comments below)

** Source with a common stack will have the same stack number.
*** Cyclone, spreader (with or without reinjection), pulverized (wet or dry bottom, with or without reinjection), other stoker (specify type, hand fired, automatic, or other type (describe below in comments).

FUEL USED IN BOILER, BURNER, ENGINE, OR OTHER FUEL BURNING SOURCE

11. Fuel data: (Complete for a process emission source with in process fuel or a non-process fuel burning source)

Primary fuel type (specify)						Standby fuel type(s) (specify)		
Fuels used	Annual usage	Hourly usage		% Sulfur	% Ash	BTU value of fuel		(For APC use only) SCC code
		Design	Average					
Natural gas:	10^6 Cu. Ft. 14	Cu. Ft. 8	Cu. Ft. 8	////////// //////////	///// /////	1,000		
#2 Fuel oil:	10^3 Gal.	Gal.	Gal.		///// /////			
#5 Fuel oil:	10^3 Gal.	Gal.	Gal.		///// /////			
#6 Fuel oil:	10^3 Gal.	Gal.	Gal.		///// /////			
Coal:	Tons	Lbs.	Lbs.					
Wood:	Tons	Lbs.	Lbs.	////////// //////////	///// /////			
Liquid propane:	10^3 Gal.	Gal.	Gal.	//////// ////////	///// /////	85,000		
Other (specify type & units): Producer Gas	2.2mcf	250	250	<1	<5	130		

12. If Wood is used as a fuel, specify types and estimate percent by weight of bark

NA

13. If Wood is used with other fuels, specify percent by weight of wood charged to the burner.

NA

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14. Comments

This process gasifies the feed stock in one piece of equipment and transfers the resulting fuel gas (called producer gas) to a thermal oxidizer where it is fully combusted. The producer gas is injected into the oxidizer through a Remiz burner and the oxidizer operates at a minimum of 1,500 degrees fahrenheit and a residence time of at least 1 second. The hot flue gas passes through a heat exchanger that contains a circulating bath of heat transfer oil (liquid state only). The heated oil is pumped into an organic Rankin Cycle (ORC) electrical power generator.

The waste stream is to be Regulated Medical Waste as defined by the EPA as follows:

Medical waste is a subset of wastes generated at health care facilities, such as hospitals, physicians' offices, dental practices, blood banks, and veterinary hospitals/clinics, as well as medical research facilities and laboratories. Generally, medical waste is healthcare waste that that may be contaminated by blood, body fluids or other potentially infectious materials and is often referred to as regulated medical waste.

EPA url address for definition of medical waste. ----> https://www.epa.gov/rcra/medical-waste

SIGNATURE

If this form is being submitted at the same time as an APC 100 form, then a signature is not required on this form. Date this form regardless of whether a signature is provided. If this form is NOT being submitted at the same time as an APC 100 form, then a signature is required.

Based upon information and belief formed after a reasonable inquiry, I, as the responsible person of the above mentioned facility, certify that the information contained in this application is accurate and true to the best of my knowledge. As specified in TCA Section 39-16-702(a)(4), this declaration is made under penalty of perjury.

15. Signature		**Date**
Stephen Scott — Digitally signed by Stephen Scott DN: cn=Stephen Scott, o, ou, email=stephen.scott@rea-aea.com, c=US Date: 2020.02.24 16:33:28 -06'00'		02/24/2020
Signer's name (type or print)	**Title**	**Phone number with area code**
Stephen Scott	President	901-666-9330

FC&E Engineering, LLC
Water • Soils • Air • Compliance

February 11, 2020

Mr. Stephen Scott
President, Volunteer Environmental Services, LLC
549 East Pass Rd
Suite F
Gulfport, MS 39507

Re: Air Emissions Calculations for Volunteer Services, LLC
Medical Waste Gasifier Unit

Dear Mr. Scott,

As requested, FC&E Engineering has completed the emissions calculations for your medical waste gasification unit, located in Covington, TN. Please find attached a PDF document which contains a summary of both the calculated average and maximum short-term (lbs/hr) and long-term emissions (tons/yr) for particulate matter (PM), Nitrogen Oxides (NOx), Sulfur Oxides (SOx), and Carbon Monoxide (CO). The PDF document also includes the individual pollutant calculations to support the summary table.

The average emission calculations are based on emission factors taken from the test conducted on the Entech Renewal Energy Technologies, Kuznica, Poland unit. The stack parameters used to complete these calculations were obtained from the non-TV application submitted to the state of TN for this unit:

- Volumetric Flowrate = 3000 DSCFM
- Maximum exit temperature from the unit's stack: 400F

The maximum emission rates were calculated using the Tennessee air quality emission standards for each of the pollutants listed above.

Finally, a regulatory applicability determination was completed for the following NESHAP and NSPS subparts:

40 CFR 63 National Emission Standards for Hazardous Air Pollutants for source categories
There are no promulgated NESHAPs that apply to incineration or gasification of medical waste.

40 CFR 60 Subpart Ce- Emission Guidelines and Compliance Times for Hospital/Medical/Infectious Waste Incinerators

This unit is not subject to the requirements of this subpart, as the construction and modification of the unit falls outside the applicability dates outlines in 40 CFR 60.32e

40 CFR 60 Subpart Ec- Standards of Performance for New Stationary Sources: Hospital/Medical/Infectious Waste Incinerators

This unit is not subject to the requirements of this subpart, as the unit meets the definition of pyrolysis unit as defined in 40 CFR 60.51(c) and is therefore exempt.

- *Pyrolysis means the endothermic gasification of hospital waste and/or medical waste using external energy. (40 CFR 60.51c)*

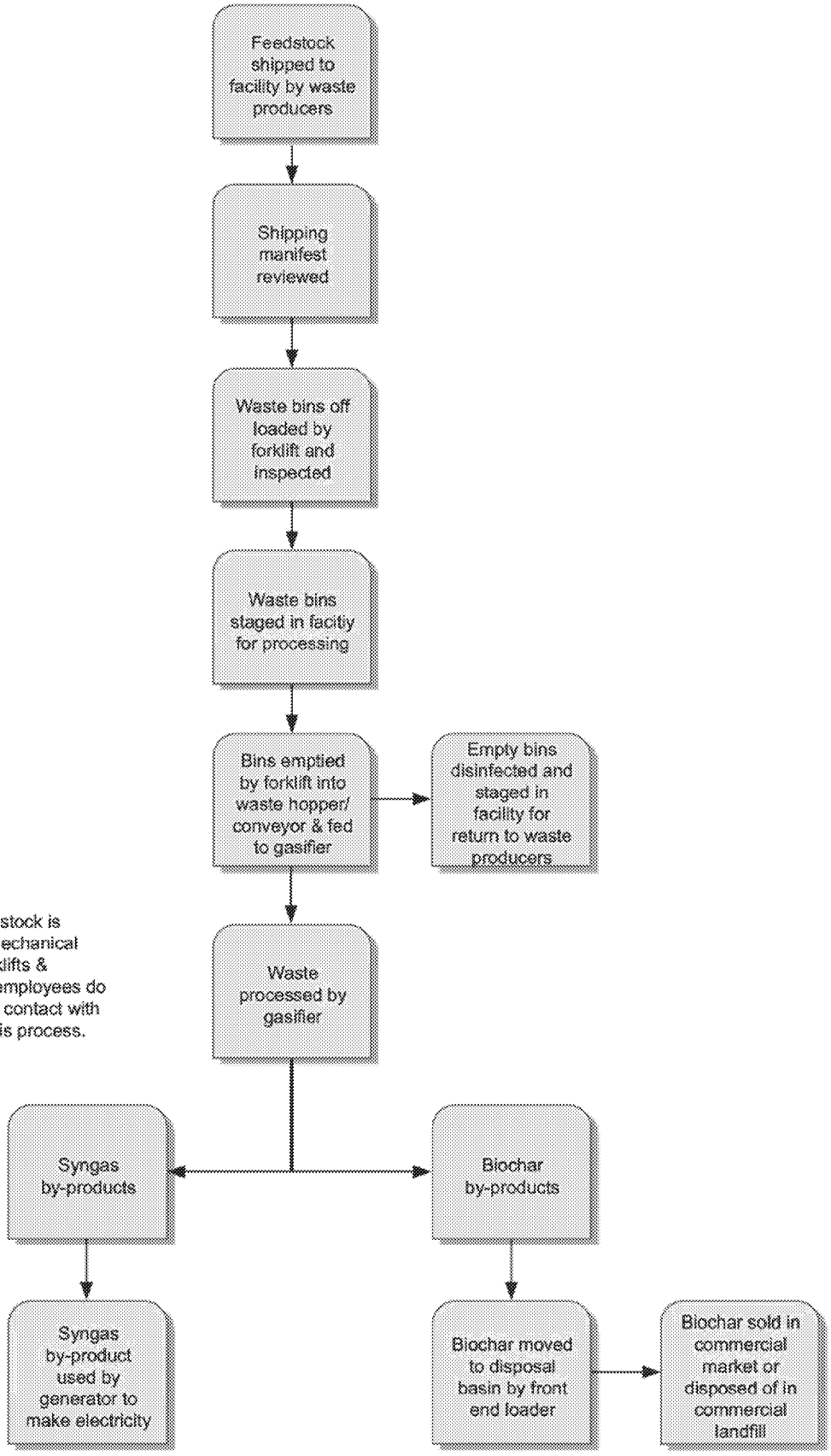
If you have any questions regarding the emissions calculations or the NSPS and NESHAP regulatory analysis, please advise.

Sincerely,

Kayra Johnson, P.E., BCEE
FC&E Engineering, LLC

Attachments

VES Flow Diagram of Feedstock and By-Products from Receipt to Final Disposal



NOTE: All handling of feedstock is accomplished by mechanical means such as forklifts & conveyors so that employees do not have any direct contact with feedstock during this process.

02/17/2020
by JKW

Volunteer Environmental Services, LLC
Covington, TN Medical Waste Disposal Facility

Medical Waste Origin, Handling, & Chain of Custody

Medical waste will be supplied by large and small medical waste generators via individual contracts. Large waste generators are hospitals and small waste generators are clinics, labs, dental offices, etc.

Compliance with all state & federal regulations for handling & transport of these wastes will remain the responsibility of the waste generators and/or the waste shipping transporters as appropriate. Volunteer Environmental Services (VES) will assume responsibility for these wastes upon receipt and acceptance at the site in accordance with VES procedures as stipulated in individual contracts with each generator and/or shipping transporter. Waste will be received on site via truck in regulatory approved waste containers and transporters will comply with all state & federal regulations as required by law.

Handling, Storage, & Disposal of Wastes Accepted by VES On Site

Upon VES acceptance of wastes on site, containers will be off loaded by forklift and staged on site in our facility for disposal. The facility is an existing commercially constructed prefabricated metal building on a concrete slab. Wastes will not be directly exposed to sunlight nor inclement weather conditions such as rain and wind, etc. All handling of wastes will be by mechanical methods such as forklifts, conveyors, etc. so that direct handling of wastes by personal will not be required. The disposal of wastes via this unit will produce two byproducts: syngas and biochar.

Syngas:
The syngas will be used to generate electricity via the on-site organic generator. This generation will be used to offset some of the site operational expenses such as electric utility costs, and any excess electrical power will be sold to utility companies or municipalities by specific contracts in accordance with state & federal laws governing power generation.

Biochar:
The biochar is ash that contains unexpended carbon and it is not a controlled waste. It may be disposed of in any commercial landfill. However, this ash also has commercial value and may be sold on the open market or donated to local organizations. It is typically used to enhance the soil properties in farming operations, etc.

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Emissions Calculations for Volunteer Services LLC

Medical Waste Gasifier-Covington Wastewater

These emissions were calculated using the emission factors obtained from the following document: Evaluations of Emissions from processing Municipal Solid Waste and Biomass- Final Report - University of California-Riverside 2004

These were obtained for a medical waste gasifier, Entech Renewal Energy Technologies, Kuznica, Poland.

Pollutant	EF (mg/Nm3)
PM	0.98
HCl	7.9
NOx	254
Sox	51.9
Hg	0.008
Dioxin/Furan	0.028

Particulate Matter (PM)		units	Source
Emission Factor	0.98	mg/m3	Emission factor-Entech Energy Technologies-Poland- Calculated for a charging rate of 65 tons/day of medical waste
Volumetric Flowrate	3000	DSCFM	Maximum Volumetric Flowrate- Non-Title V Application submitted to TN DEC for this unit
Temperature	400	°F	Maximum Exit Temperature- Non Title V Application submitted to TN DEC for this unit
Charging Rate	65	tons/day	Data found in the Non-Title V Permit Modification Application for Permit No. 072620 submitted to TN DEC

lb/hr = E.F. * volumetric flow rate* conversion factor				
PM	0.011010444	lb/hr		
	0.048225746	tons/year		
Nitrogen Oxides (NOx)			**Units**	**Source**
Emission Factor		254.00	mg/m3	Emission factor-Entech Energy Technologies-Poland
Volumetric Flowrate		3000	DSCFM	Maximum Volumetric Flowrate- Non-Title V Application submitted to TN DEC for this unit
Charging Rate		65	tons/day	Data found in the Non-Title V Permit Modification Application for Permit No. 072620 submitted to TN DEC
lb/hr = E.F. * volumetric flow rate* conversion factor				
NOx	2.853727372	lb/hr		
	12.49932589	tons/year		
Mercury (Hg)			**Units**	**Source**
Emission Factor		0.008	mg/m3	Emission factor-Entech Energy Technologies-Poland
Volumetric Flowrate		3000	DSCFM	Maximum Volumetric Flowrate- Non-Title V Application submitted to TN DEC for this unit
Charging Rate		65	tons/day	Data found in the Non-Title V Permit Modification Application for Permit No. 072620 submitted to TN DEC
lb/hr = E.F. * volumetric flow rate* conversion factor				

Hg	8.98812E-05	lb/hr		
	0.00039368	tons/year		
Dioxin/Furans			**units**	
Emission Factor		0.03	mg/m3	Emission factor-Entech Energy Technologies-Poland
Volumetric Flowrate		3000	DSCFM	Maximum Volumetric Flowrate- Non-Title V Application submitted to TN DEC for this unit
Charging Rate		65	tons/day	Data found in the Non-Title V Permit Modification Application for Permit No. 072620 submitted to TN DEC
lb/hr = E.F. * volumetric flow rate* conversion factor				
Dioxin/Furans	0.000314584	lb/hr		
	0.001377878	tons/year		
HCL			**units**	
Emission Factor		7.90	mg/m3	Emission factor-Entech Energy Technologies-Poland
Volumetric Flowrate		3000	DSCFM	Maximum Volumetric Flowrate- Non-Title V Application submitted to TN DEC for this unit
Charging Rate		65	tons/day	Data found in the Non-Title V Permit Modification Application for Permit No. 072620 submitted to TN DEC
lb/hr = E.F. * volumetric flow rate* conversion factor				
HCL	0.088757662	lb/hr		
	0.388758561	tons/year		

SOx			**units**	
Emission Factor		51.90	mg/m3	
Volumetric Flowrate		3000	DSCFM	Maximum Volumetric Flowrate- Non-Title V Application submitted to TN DEC for this unit
Charging Rate		65	tons/day	Data found in the Non-Title V Permit Modification Application for Permit No. 072620 submitted to TN DEC
lb/hr = E.F. * volumetric flow rate* conversion factor				
SOx	0.583104136	lb/hr		
	2.553996117	tons/year		
The emission factors are the concentrations reported from the Poland Study, at 3.5 tons/day of waste				
There are no emission factors in the Poland Study for Carbon Monoxide (CO)				

Emissions Calculations for Volunteer Services LLC
Medical Waste Gasifier-Covington Wastewater Treatment Plant

Particulate Matter (PM)		units	Source
Emission Factor	0.1	gr/dscf	Emission Standard for infectious waste incinerators- TN Air Pollution Control Regulations
Volumetric Flowrate	3000	DSCFM	Maximum Volumetric Flowrate- Non-Title V Application submitted to TN DEC for this unit
Temperature	400	°F	Maximum Exit Temperature- Non Title V Application submitted to TN DEC for this unit
lb/hr = E.F. * conversion factor gr/lb * volumetric flow rate			All variable All variables have been converted to appropriate units
PM	1.584718	lb/hr	
	6.941063	tons/year	

Nitrogen Oxides (NOx)		Units	Source
Emission Factor	67	ppmv	40 CFR 60 Subpart Ee- Standards of Performance for New stationary sources: Hospital/Medical/Infectious Waste Incinerators
	136	mg/m3	
lb/hr= E.F. *volumetric flow rate			All variables have been converted to appropriate units
NOx	1.52798	lb/hr	
	6.692552	tons/year	

Mercury (Hg)		Units	Source
Emission Factor	0.0061	gr/dscf	40 CFR 60 Subpart Ee- Standards of Performance for New stationary sources: Hospital/Medical/Infectious Waste
lb/hr=E.F.*conversion factor gr/lb* volumetric flowrate			All variables have been converted to appropriate Units
Hg	0.156857	lb/hr	
	0.687034	tons/year	

Carbon Monoxide (CO)		Units	Source
Emission Factor	20	ppmv	40 CFR 60 Subpart Ee-
	24	mg/m3	Standards of Performance for New stationary sources: Hospital/Medical/Infectious Waste
lb/hr= E.F. *volumetric flow rate*conversion factors			All variables have been converted to appropriate Units
CO	0.269644	lb/hr	
	1.181039	tons/year	

Dioxin/Furans			
Emission Factor	0.0057	gr/10^9 dscf	40 CFR 60 Subpart Ee-
			Standards of Performance for New stationary sources: Hospital/Medical/Infectious Waste
lb/hr= E.F. *volumetric flow rate*conversion factors			
Dioxin/Furans	1.46571E-10	lb/hr	
	6.41983E-10	tons/year	

Notes:
1. State and Federal emission standards for medical waste incinerators were used to calculate emissions.
2. The following references were used in these calculations
   - Air Calculations and Conversion Guide-Air & Waste Management Association- Iowa Chapter-1994
   - TN Air Pollution Control Regulations, Chapter 1200-03-25 Standards for Infectious Waste Incinerators
   - 40 CFR 60 Subpart Ee, Standards of Performance for New Stationary Sources: Hospital/Medical/Infectious Waste Incinerators
   - Data found in the Non-Title V Permit Modification Application for Permit No. 072620 submitted to TN DEC

Air Contaminants Calculations

	Emissions (lb/hr)		Concentration		
Pollutant	**Average (1)**	**Maximum (2)**	**mg/Nm3 (1)**	**gr/SCF-dry**	**Avg Tons/year (1)**
PM	0.011	1.58	0.98	0.0004	0.05
NOx	2.854	3.92	254	0.1110	12.50
SO2	0.583	58.81 (3)	51.9	0.0227	2.55
HCl	0.089	N/A	7.9	0.0035	0.39
Dioxins/Furan	0.0003	1.46571E-10	0.028	1.2234E-05	0.0014
Hg	8.988E-05	0.157	0.008	3.4954E-06	0.0004
CO	N/A	0.27	24	0.0105	N/A

No emission standard in TN regulations for HCl emission from medical waste incineration

Footnotes

(1) Emissions calculated based on factors obtained from a medical waste gasifier, Entech Renewal Energy Technologies, Kuznica, Poland.

(2) Calculations based TN Air Pollution Control Regulations, Chapter 1200-03-25 Standards for Infectious Waste Incinerators

(3) Calculations based on TN Air Pollution Control Regulations, Chapter 1200-03-14.03 Process Emission Standards for SO2 = 2000 ppmv

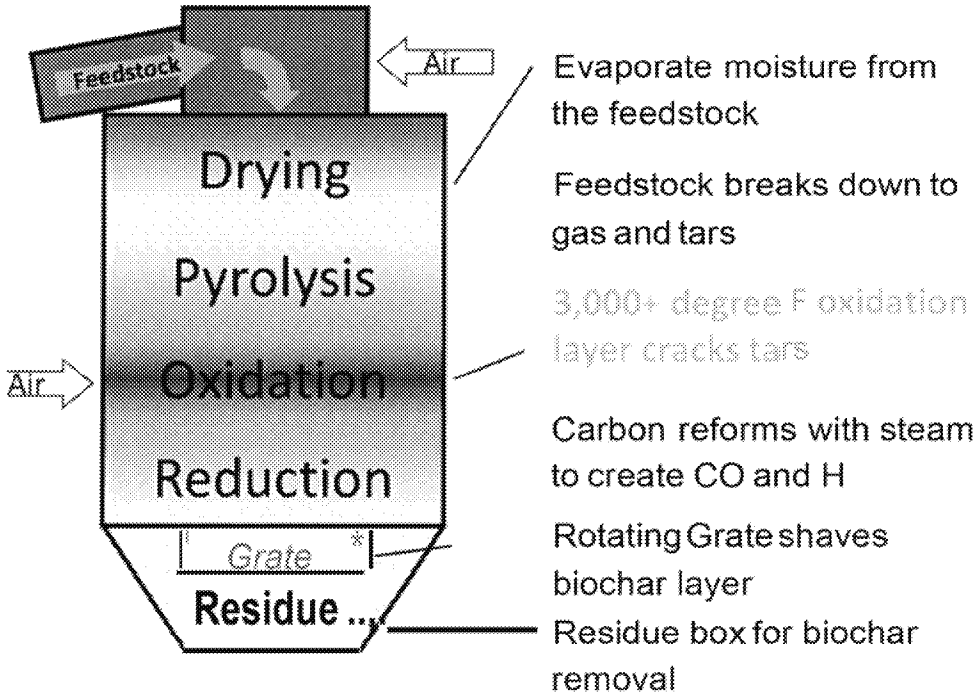
Attachment IA

GASIFICATION PROCESS

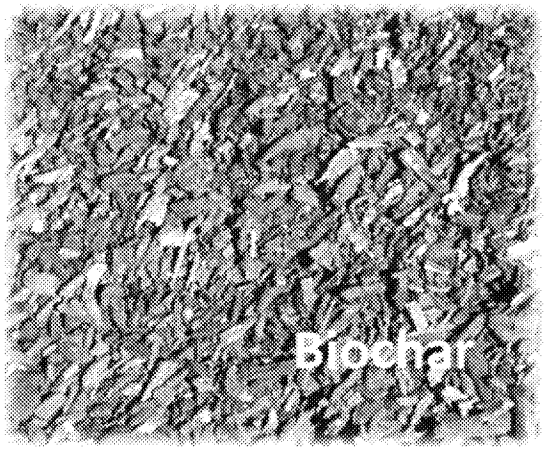
PHG GASIFIER SYSTEM DESIGN

PHGE has three gasifier models, including the PHG-8, PHG-12, and the PHG-LF. These gasifiers are state-of-the-art alternative fuel systems and utilize a proprietary downdraft design. The downdraft design also provides the highest conversion efficiencies possible in gasification technology at a low operating cost. To date, PHGE gasifiers have over 40,000 hours of combined commercial operation.

Feedstock, such as medical waste is converted to a commodity called producer gas. The producer gas is generated through thermo-chemical processes called pyrolysis and partial oxidation. It is an extremely clean burning fuel characterized as a mixture of CO, CH_4 and H_2 that can easily and efficiently be used to supplement or replace natural gas, propane or fuel oil in thermal processes.



Biochar is a byproduct of the process and is comprised of the inorganic ash from the original feedstock as well as varying amounts of unreacted solid carbon. The biochar helps to produce a clean burning gas because the producer gas must pass through the biochar prior to exiting the PHGE reactor. Biochar production equals 3-7% of the feedstock mass entering the gasifier and has significant potential secondary value.

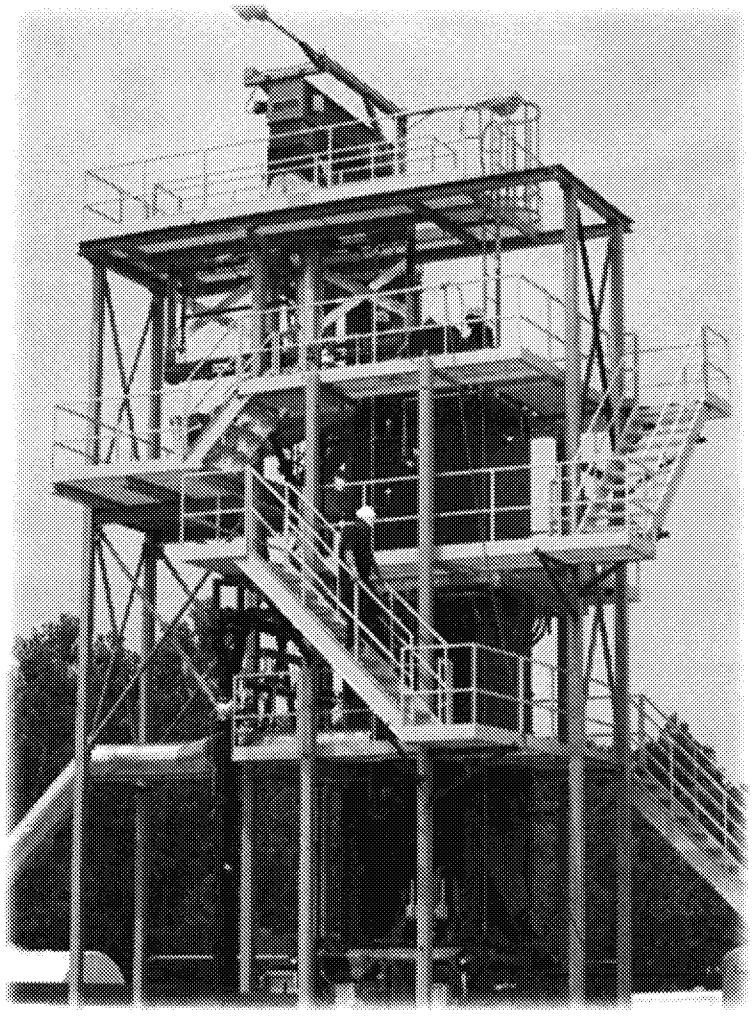


Gasification relies on a low-oxygen, intense-heat environment. In such conditions, instead of combusting completely, which would happen in an oxygen-rich environment such as open atmosphere, the biomass breaks down into simpler constituent molecules such as CH_4, CO, and H_2 that comprise the main combustible portion of the produced gas. The result is a gas that has not only cleaner-burning characteristics, but also a wider variety of applications than traditional biomass incineration.

The PHG system is a dynamic and versatile technology allowing the utilization of a wide assortment of differing biomasses; blending different biomass can further add to the versatility of the gasifier. Since 2005 many of these differing biomasses have been used successfully to generate producer gas, with testing of new biomasses continually being conducted. Among tested biomass materials are wood chips, urban wood waste, bark/hog fuel, tire derived fuel (blend), paper cubes, waste glycerol (blend), and cotton stalks. Each biomass is different, but PHG Energy can help determine the best blend for optimal performance and ease of system operation.

The gasifier can operate over a wide range of biomass parameters, including size distribution, moisture content, ash content and energy value. Additionally, other impurities like grit, sand, nails, or small metal scraps that might be associated with certain biomass types are not detrimental to the operation of the system. In most cases these impurities simply pass through the system and end up in the biochar or ash byproduct.

The PHG Energy biomass gasifier is a fully automated modular system designed for ease of installation, maintenance and operation. The standard scope of supply for the gasifier includes the inlet airlock, feed auger, gasifier reactor, gas exhaust horns, residue box and an integrated PLC-based control system.



Large Format Gasifier - Greenwood, MS

Airlock:

Biomass is first introduced into the PHG gasifier system through the airlock. The airlock is a pipe section at the top of the unit that has knife gate valves at the top and bottom. This two-valve arrangement provides a positive airlock into the system and allows biomass feeding while maintaining the positive pressure environment.

The heavy duty construction of the slide gate valves help to ensure reliable, long-term operation.

Feed Auger:

Feed stock is delivered from the airlock directly into the inclined auger to move the biomass into the top of the reactor housing. The offset of the interim hopper and inclined auger system prevents fugitive emissions from escaping as the slide gate valves operate.

Positive-pressure air is applied to the interim hopper to further prevent the escape of fugitive emissions.

Gasifier Module:

The PHG reactor is of industrial-grade construction; material thickness ranges from Yi" to 1' mild steel fabrication. Internal to the reactor is over 3 tons of heavy duty silica carbide refractory insulation designed to retain the high temperature of the pyrolysis and oxidation reactions and also prevent loss of heat through the shell of the reactor.

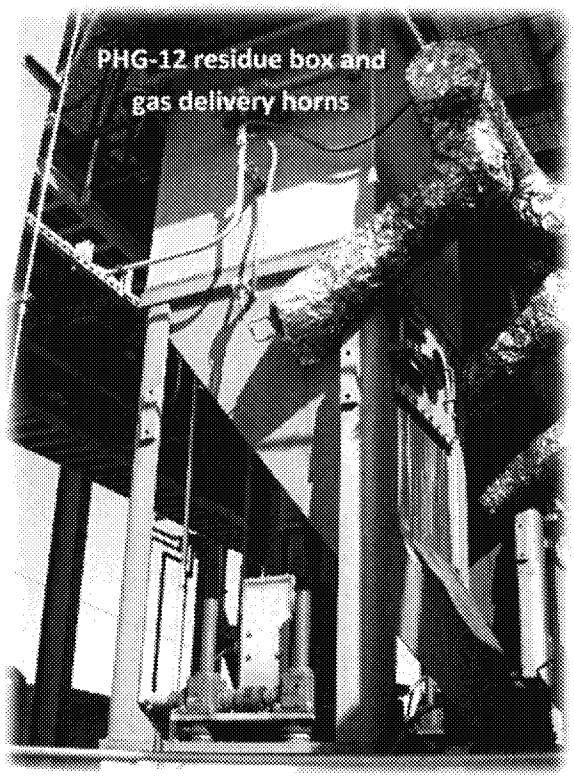
A rotating grate at the bottom of the gasifier supports the biomass/residue and grinds the biochar level to move the biomass and residue through the system. The rotating grate is supported by four jack screws underneath the residue box with a center shaft that connects the grate to the drive motor, allowing it to be tailored to the needs of the biomass being used.

Gas Horns:

The gas horns shown below are installed on each side of the residue box just below the rotating grate. Gas horns allow producer gas to exit the system in a uniform manner and help maintain a constant gas flow.

Residue Box:

Biochar, a byproduct of the pyrolysis reactions, is continuously collected in the residue box and exits the system through an auger/pocket valve arrangement. This seal maintains system pressure while providing a robust mechanism for continuous biochar removal from the pressurized environment.



Attachment 1B

COMBUSTION SYSTEM

PROCESS CONDITIONS

Producer gas entering
burner Flow = 1659 lb/hr
Composition – as supplied in project specs
Gas temperature entering – 1OOOF

Flue gas from combustor at 1500F operating temperature
Flow = 9748 lb/hr
Nominal composition

Component	mol%
C02	6.82
H20	10.67
N2	70.97
02	11.55

COMBUSTOR

Because of the quantity of tars and particulate matter in the producer gas, we have designed the combustor for approx. 2 seconds residence time of the flue gas in the combustion chamber at the 1500F operating temperature. This sizing is 2x the normal sizing for a unit designed for 99.9% destruction efficiency, but the added residence time of the flue gas at operating temperature is necessary to insure destruction of the tar compounds and the carbon portion of the particulates.

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Re: PHO Energy
12-10-12

The combustor is 6 ft. OD x 20 ft. long inside the chamber. The last 6 ft. of length is formed into an eccentric reducer that will have a nominal OD of 27", ID of 15" and a flange OD of 31" to match the diverter valve (by ACT) which is attached to the outlet of the combustor.

The combustor shell material is 3/8" carbon steel. The large flanges on the unit are *Yi"* carbon steel. Standard support saddles, flame scanner connections, thermowell ports and an insulated 24" nominal diameter manway with davit are included.

Refractory is 3" of 3000F rated, 60% alumina gunned-on refractory as the hot face material and 3" of 2200F rated, 40% alumina gunned-on insulating refractory as the back-up layer. Suitable anchors are included as part of the refractory scope of supply. The refractory will be

shop installed and dried to 500F to eliminate all free water. At 1800F operating temperature, the combustor shell temperature calculates at 240F. At 1500F operating, the shell temperature calculates at 200F. An expanded metal personnel shield installed on 3" high stand-offs will be included for personnel protection.

BURNER

The burner is a UCC type DGR-5-SP dual gas burner designed to handle the producer gas and natural gas through the burner. The producer gas gun is an open ended 6" sch. 40, 304 SS pipe to allow the passage of the gas, tars and particulates without any obstruction that would cause buildup of material inside the gas gun. The 6" pipe is externally insulated and mounted in an 8" pipe to minimize temperature loss of the gas in the pipe. The producer gas connection is a 6" 150RF flange which will be insulated with a removable flexible "boot" to further prevent gas temperature loss.

Producer gas firing rate is calculated at 4 MMBtu/hr and the burner is sized to handle up to 5 MMBtu/hr fired duty based on the nominal producer gas composition.

Burner block is 3000F rated refractory mounted in the burner mounting nozzle in the inlet end of the combustor.

Start-up and auxiliary gas firing tips are located around the I.D. of the burner block and have a single 1.5" NPT gas connection on the outside of the burner air housing. Burner is designed to deliver 4 MMBtu/hr with auxiliary gas firing. Turndown is 5 to 1 from design.

Pilot is an electric ignition gas fired pilot designed for pressurized gas and air supply to the pilot. Pilot is designed for a nominal 100,000 Btu/hr heat input on natural gas fuel. Pilot can be operated continuously or intermittently. Preferred gas flow and pressure is 100 scfh natural gas at 10 psig supply pressure. Preferred air flow and pressure is 900 scfh of plant air at 10 psig supply pressure.

Burner housing is carbon steel and all parts that handle the producer gas and/or are in the firing zone are 304/310 SS. Housing and all parts are designed for easy access for maintenance.

COMBUSTION AIR FAN

Fan is a Twin Cities type TBR-R25V, Arrangement 4, high pressure unit rated at 3400 scfm at 28" w.c. supply pressure. This flow and pressure represent 20% over design compared to the actual design requirement of the system.

The fan is a direct drive unit with a 40 HP, 3600 RPM, 460VAC, 3 phase motor. Motor is TEFC, set up for VFD control and electrically rated for Class 1, Div. 2 locations with Groups B, C and D atmospheres.

Fan is supplied complete with inlet and outlet flanged connections, shaft seals, drain with plug,

inlet venturi and bolted access door. An inlet silencer is included along with an inlet screen. With the silencer, the fan noise level is 85 dbA at 3 ft. from the inlet.

COMBUSTION CONTROL SYSTEM

Overall burner management system logic and auxiliary fuel gas valving is based on NFPA 86 guidelines which allow the system to be insured by IRI. System will include NEMA 4X panel enclosures, Allen-Bradley Contrologix Flex 110 base and will have sufficient 1/0 channels for connection SCADA system via Ethernet port. Control system will include sufficient capacity to control the hot oil system operation. The system panels and valving will be rack mounted on galvanized racks.

There are detailed operational issues which will require our co-ordination of the system design as the project moves forward.

EMISSIONS

For the design firing rate with either natural gas, producer gas or any combination of the two, the thermal NOx should be 0.5 lb/hr at the 1500F operating temperature and 0.6 lb/hr at the 1800F operating temperature. Fuel-created NOx due to nitrogen bearing compounds in the producer gas is based on a 25% conversion of the fuel bound nitrogen to NOx. This should amount to approximately 1.5 lb/hr.

CO emissions will be 0.04 lb/hr or less for any operating temperature above 1500F. Sox and Halogen emissions follow the dictum, "Pounds of sulfur/halogens entering will equal pounds of sulfur/halogens exiting".