Associated Physics of America, LLC

EverGreen Gasification Technology, LLC

Gasification Systems for Process Heating

EverGreen Gasification Technology, LLC

The Company

EverGreen Gasification. Technology, LLC (EGT) is a wholly-owned subsidiary of Associated Physics of America, LLC (APA). EGT manufactures, markets and services gasification technology developed by APA. In conjunction with affiliated partners, EGT can provide turnkey gasification plant Engineering and Construction (E & C) Services.

EGT can also assist Clients in procuring feed stocks, analyzing biomass samples, and test gasification for feasibility studies.

EGT and APA's team of Engineers, Scientists, and Technicians can assist Clients in auditing and optimizing process heat systems.

Key Concepts of “Gasification”

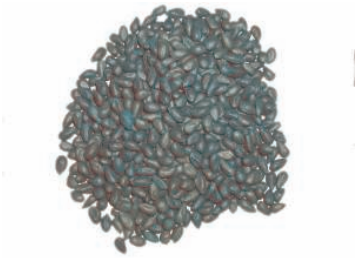
- **“Gasification” is the Process of Converting Low-Cost Solid Feedstock into a Clean, Combustible Gas Stream (180 – 600 btu / cu. ft.)**
- “Solid Feed stocks” can be any flowable organic material with a Net Heat of Combustion > 4,500 btu/lb and a total moisture content < 40%
  - ✓ Biomass – Commercial Woodchip, Timber and Crop Residues, Manure
  - ✓ Coal and Petroleum Coke
  - ✓ Ag-based Industrial Wastes – Scrap Wood, Bark, Paper, Sludges, Municipal Sorted Waste (MSW)
- APA’s gasifiers are *Pressurized Downdraft s*tyle, which provides high gasification efficiency, low power consumption and long operating life
- Since the Combustible Gases can be “piped,” the gasifiers can be located at a distance away from the process.

BIOMASS FEEDSTOCK

WOOD CHIP

COTTON SEED HULLS

ETHANOL WASTE PELLETS



WHOLE COTTON SEED

MSW- FLUFF

COTTON STALK

FURNITURE WASTE

SOYBEAN STUBBLE

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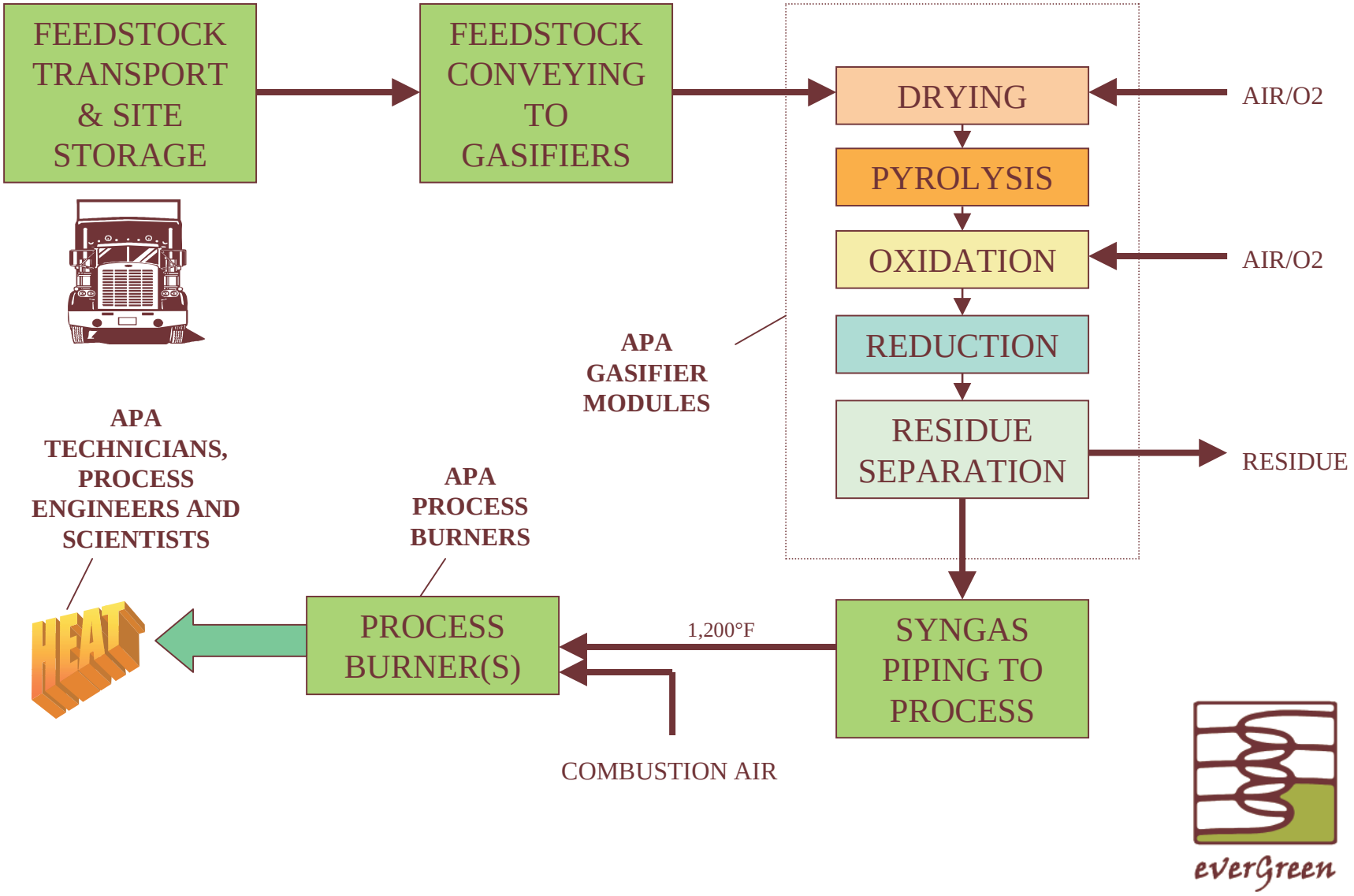
Elements of a Process Heat Gasification System

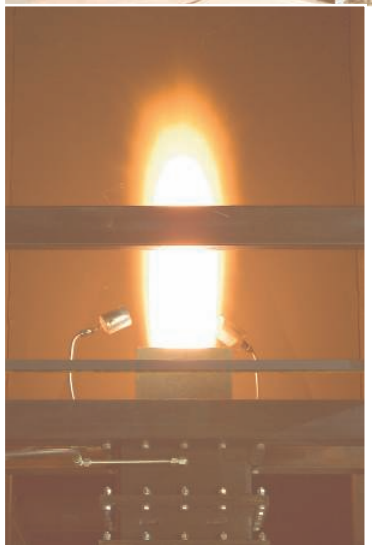


The Beta Project

- PROJECT OBJECTIVE: Design, build and test a “Beta” Gasifier specially for brick kilns.
- Over 1,700 hours of operation over 3 month period, over 550,000 lbs of commercial-grade woodchips gasified.
- 2.6 Billion Btu’s delivered to one zone of a Tunnel Kiln (equivalent to 2.6 Million Cubic Feet of Natural Gas).
- 17% Increase in production with no additional increase in Natural Gas usage.
- Hardwood and pine chips tested.
- Estimated less than 5,000 lbs of Residue generated (blended with plant feed clay).
- Operational and mechanical reliability of the gasifier and control systems were tested.
- 27 new features in both the mechanical and software design are now incorporated into the production units to: 1) maximize heat output, 2) maximize mechanical reliability and 3) minimize maintenance requirements.

EverGreen Gasification Technology, LLC.

Model PHG-005 Process Heat Gasifier



Picture: PHG-01B Synthesis gas combustion

- Rated for 650 lbs/hr of Biomass Feed Throughput Using Air (~3 MMbtu/hr net thermal output)
- Modular Design – Multiple Units can be connected together for larger heat loads
- Fully-automated Controls using Allen-Bradley PLC's and Wonderware™ HMI Software
- 24/7 Remote Tech Support and Field Services (Start-up / Shutdown)
- Eligible for Bioenergy Tax Credits
- Complete Turnkey Installation, Start-up, and Operation Services Available

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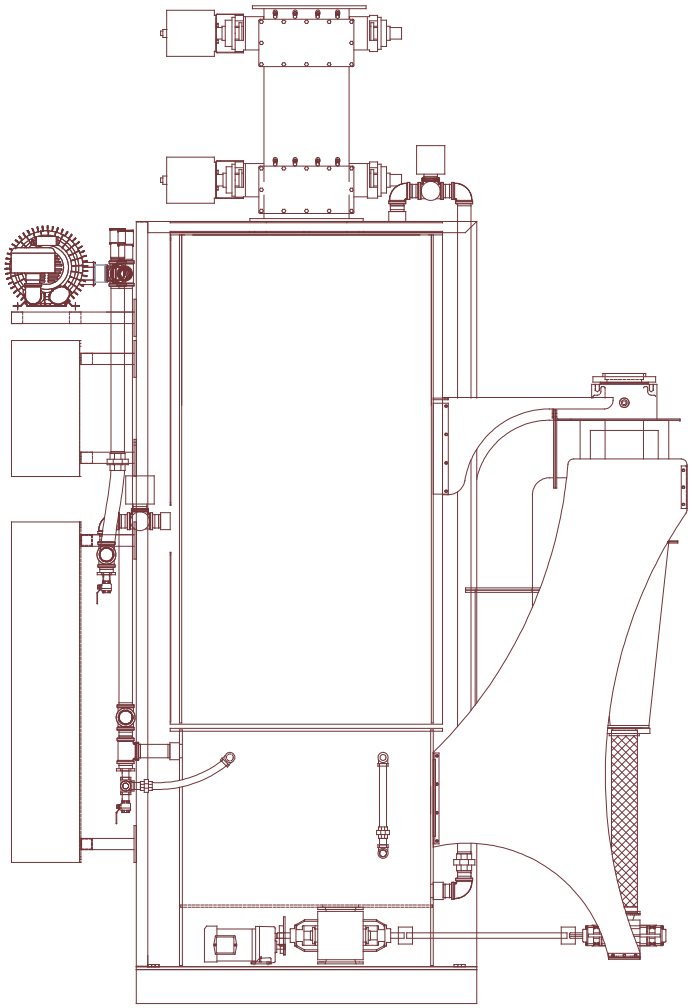
PHG005 Model Drawing



- Modular design
- Up to 100 MMbtu/hr delivered
- Small footprint
- Fully-automated / Wonderware™
- Multiple Feedstock capable
- 20 years + design life
- Constructed of 304SS with more than 3 tons of high-density refractory

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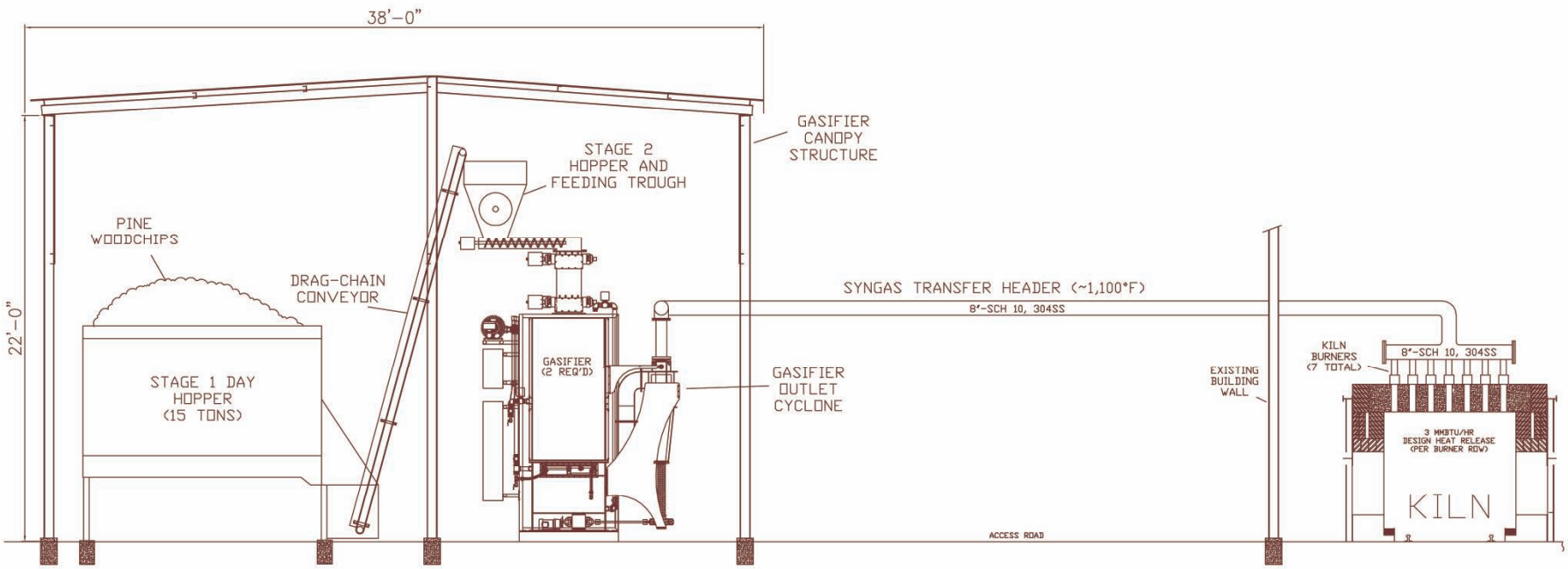

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							SCALE	DESIGNED BY	CHECKED BY	DRAWING NO. SK-001 SHEET 1 OF 1 SHEETS
							DATE	DRAWN BY	APPROVED BY	REV. A

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10/3/2006

DALSON ENERGY

MODEL PHG-05 MASS / ENERGY BALANCE CALCULATIONS

Number of Gasifier Modules	**1**	
Design Heat Release Per Module	**3.76**	**MMbtu/hr**
Biomass Feed Rate Per Module	**650**	**lbs/hr (wet)**
FEED STREAMS		
Fuel Water =	25	% by wt.
Wet Fuel Rate =	650	lbs/hr
Wet Fuel Cp =	1.34	btu/lb-F
Wet Fuel Temp. In =	70	F
Wet Fuel Enthalpy =	0.009	MMbtu/hr
Gasifier Air Volume Rate =	223	SCFM
Gasifier Air Mass Rate =	1,034	lbs/hr
Gasifier Air Cp =	0.64	btu/lb-F
Gasifier Air Inlet Temp. =	90	F
Gasifier Air Inlet Enthalpy =	0.020	MMbtu/hr
Combustion Air Volume Rate =	499	SCFM
Combustion Air Mass Rate =	2,315	lbs/hr
Combustion Air Cp =	0.64	btu/lb-F
Combustion Air Inlet Temp. =	70	F
Combustion Air Inlet Enthalpy =	0.015	MMbtu/hr
Total Feed Enthalpy	0.043	MMbtu/hr
FUEL HEAT RELEASE		
Wet Biomass Feed Rate =	650	lbs/hr
Wet Biomass Lower Heating Value (LHV) =	5,788	btu/lb
Gross Biomass Heat Release Potential =	3.76	MMbtu/hr
EFFLUENT STREAMS		
Producer Gas Mass Rate =	1,644	lbs/hr
Producer Gas Volume Rate =	422	SCFM
Producer Gas Cp =	0.339	btu/lb-F
Producer Gas Temp. =	1,100	F
Producer Gas Gross Enthalpy =	0.58	MMbtu/hr
Producer Gas Gross Hcomb. (by Enthalpy Diff.) =	3.18	MMbtu/hr
Residue Mass Rate =	3.1	lbs/hr
Residue Cp =	0.385	
Residue Temp. =	500	F
Residue Gross Enthalpy =	0.001	MMbtu/hr
AMBIENT HEAT LOSS		
Ambient Temp. =	70	F
Average Ambient Skin Temp. =	140	F
Equipment Surface Area =	240	Sq. Ft.
Estimated Piping Surface Area (insulated) =	321	Sq. Ft.
Est. Ambient Heat Loss =	0.12	MMbtu/hr
Heat Loss % of Fuel Heat Release =	3.13	%

Enthalpy Basis = 0 btu/hr @ 60F, H = M * Cp * (T - 60)

PRODUCER GAS - Generating Conditions

Temperature **1,100** **F** **Pressure** **14.9** **PSIA**

Component	Mole Weight	Mass Rate lbs/hr	Mass %	Mole Rate Lbmol/hr	Molar / Volume Fract.	SCFM	ACFM	Flowing Density lbs/ft3	Standard Density lbs/ft3	Heat Capacity btu/lb-F
CO =	28	482	29.3%	17	25.3%	109	322	0.025	0.074	0.25
CO2 =	44	57	3.5%	1	1.9%	8	24	0.039	0.116	0.29
CH4 =	16	40	2.4%	3	3.7%	16	47	0.014	0.042	0.94
H2 =	2	12	0.7%	6	8.6%	37	110	0.002	0.005	3.57
H2O =	18	223	13.5%	12	18.1%	78	231	0.016	0.047	0.52
N2 =	28	770	46.8%	28	40.4%	174	515	0.025	0.074	0.27
NO2 =	46	47	2.9%	1	1.5%	6.52	19	0.041	0.121	0.27
Ar =	40	13	0.8%	0	0.5%	2.07	6	0.036	0.105	0.19
TOTAL / AVG.		1,644	100.0%	68.1	100.0%	422	1,250	0.021	0.064	0.339

PRODUCER GAS Theoretical Heat Value Calculations

Component	Mole Weight	Mass Rate lbs/hr	Mole Rate lbmol/hr	Heat of Combustion (Gross) kJ/gmol	btu/lbmole	btu/lb	(@ Std. Cond.) btu/ft3	
CO =	28	482	17	282.99	121,765	4,349	320.9	
CO2 =	44	57	1	0	-	-	-	
CH4 =	16	40	3	978.38	420,977	26,311	1,109.5	
H2 =	2	12	6	329.85	141,928	70,964	374.1	
H2O =	18	223	12	0	-	-	-	
N2 =	28	770	28	0	-	-	-	
NO2 =	46	47	1	0	-	-	-	
Ar =	40	13	0	0	-	-	-	**Stream (Btu/ft3)**
TOTAL / AVG.		**1,644**	68				**157**	**Average Heat Value (Wet)**
							193	**Average Heat Value (Dry)**

FLUE GAS Volumetric Calculations

Temperature **2,244** **F** **Pressure** **14.7** **PSIA**

Component	Mole Weight	Mass Rate lbs/hr	Mass %	Mole Rate Lbmol/hr	Molar / Volume Fract.	SCFM	ACFM	Flowing Density lbs/ft3	Standard Density lbs/ft3	Heat Capacity btu/lb-F
CO2 =	44	925	20.6%	21	13.7%	133	692	0.022	0.116	0.32
H2O =	18	449	10.0%	25	16.2%	158	140	0.009	0.047	0.51
N2 =	28	2,495	55.6%	89	58.0%	564	502	0.014	0.074	0.30
O2 =	32	529	11.8%	17	10.8%	105	224	0.016	0.084	0.26
NO2 =	46	47	1.1%	1	0.7%	7	15	0.023	0.121	0.29
Ar =	40	42	0.9%	1	0.7%	7	7	0.020	0.105	0.21
TOTAL / AVG.	29.2	4,489	100.0%	154	100.0%	972	1,579	0.016	0.082	0.318

* - Note: This data is provided fopr purposes of engineering design of auxiliary systems. Actual compositions of gas streams will vary depending on operating temperatures, pressures, and