Appendix A.
Abbreviations

ACFB	atmospheric circulating fluidized bed
AF	as fed
B&W	Babcock & Wilcox
CFD Model	computer fluid dynamic model
COE	cost of energy
DB	dry basis
DOE	Department of Energy
EPC	engineer, procure, and construct
FIR	Forced Internal Recirculation
GTI	Gas Technology Institute
HHV	high heating value
LCV	low caloric value gas
LHV	low heating value
MF	moisture free
NEPA	National Environmental Protection Act
NOx	nitrogen oxides
O&M	operating and maintenance
psia	pounds per square inch - absolute
VOC	volatile organic carbon

Appendix B
List of Specifications Developed

Gasifier (including cyclone and startup heater)
Fuel Feed
Limestone Feed
Gasifier Ash Removal
Process Air
Product Gas Ducting
Product Gas Cooling
Product Gas Filtering
Filter Ash Removal
Flare
High Pressure Cooling Water
Nitrogen Distribution
Biomass Dryer Specification
Biomass Feed Prep
Inert Gas Generation System
Waste Heat Boiler
Startup Gas Supply

Appendix C
Analytical Data

GAS TECHNOLOGY INSTITUTE
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gti

Analytical Report

Batch # : 011049
March 16, 2001

Prepared for:

Dave Stopek, Process Engineering
Phone: (847) 768-0853

Kentucky Co-gasification Project

Project #: 61129-01

Received Date: 2/5/2001

In April 2000, the Institute of Gas Technology (IGT) and the Gas Research Institute (GRI) combined to form the Gas Technology Institute (GTI).

Submitted by: Karen Crippen, (847) 768-0604
Chemical Research Services

Technical contact for this report: _____
Alan G. Janos (847) 768-0603

GAS TECHNOLOGY INSTITUTE
1700 South Mount Prospect Road | Des Plaines, Illinois | 60018
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gti℠

Sample Login No: 011049-002 Date: February 19, 2001
Sample Description: Estill County Saw Mill Dust

Air-Dry Moisture, %	48.93

Proximate Analysis	(As received)	(As received) w/SO3 correction	(Dry basis)
Moisture, %	50.52	50.52	
Ash, % (550° C)	0.46	0.46	

Ultimate Analysis	(Dry basis)
Ash, % (550° C)	0.92
Carbon, %	49.07
Hydrogen, %	6.00
Nitrogen, %	0.27
Sulfur, %	0.13
Oxygen, % (by difference)	43.61

Fusion Temperature of Ash (ASTM D1857), °F

	Reducing	*Oxidizing*
Initial Deformation (IT)		
Softening (ST)		
Hemispherical (HT)		
Fluid (FT)		

Heating Value	(Dry basis)
BTU/lb.	8,990

Analyst: NJP

Bulk Density: 20.8 lbs/ft^3

Analyst: AGJ

(Per submitter's request, this analysis was performed on the "as-received" sample, which was NOT air-dried, chopped, or ground into any smaller pieces than were originally received. The graduated cylinder used for the volume measurement was approximately 2¼" in diameter. No significant void spaces were noted in the packed sample at the end of the analysis.)

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Login No.: 01-1049-002
Sample ID: Estill County Saw Mill Dust

MAJOR / MINOR OXIDES IN ASH (ASTM D-2795)

% ash at 750 degrees C = 0.74

% Element		% Oxide		% Oxide, Normalized
Na	0.17	Na_2O	0.23	0.24
Mg	2.35	MgO	3.90	4.12
Al	1.86	Al_2O_3	3.52	3.72
Si	10.3	SiO_2	22.0	23.3
P	1.06	P_2O_5	2.43	2.57
S	0.41	SO_3	1.02	1.08
K	12.6	K_2O	15.2	16.1
Ca	31.5	CaO	44.1	46.6
Ti	0.15	TiO_2	0.25	0.26
Fe	1.31	Fe_2O_3	1.87	1.98
		TOTAL	94.53	100.0

Values reported on an ash basis.
Ash concentration calculated on a dry basis with SO_3 correction and no VM cycle.
Chloride and/or carbonate may be present, resulting in a total % less than 100.

Analyst: KC

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FAX: (708) 333-3060

March 1, 2001

INSTITUTE OF GAS TECHNOLOGY
1700 S. Mt. Prospect Road
Des Plaines, IL 60018
Attn: Norman J. Petrulis

Sample identification by
Institute of Gas Technology

Kind of sample reported to us Wood Ash

Sample ID: 011049-002
Estill County Saw Dust

Sample taken at G.T.I.

Sample taken by G.T.I.

Date sampled February 16, 2001

Date received February 27, 2001

P.O No. PF8847

Analysis Report No. 71-144427

FUSION TEMPERATURE OF ASH, (°F)

	Reducing	Oxidizing
Initial Deformation (IT)	2540	2565
Softening (ST)	2555	2580
Hemispherical (HT)	2570	2600
Fluid (FT)	2585	2620

METHOD
Fusion Temperature of Ash: ASTM D 1857

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

South Holland Laboratory

MEMBER ACIL

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1700 South Mount Prospect Road | Des Plaines, Illinois | 60018
T: 847 768 0500 | F: 847 768 0501 | www.gastechnology.org

gti SM

Sample Login No: 011049-003 Date: February 19, 2001
Sample Description: Estill County Saw Mill Slabs/Bark

Air-Dry Moisture, % 38.33

Proximate Analysis	(As received)	(As received) w/SO3 correction	(Dry basis)
Moisture, %	40.55	40.55	
Ash, % (550° C)	6.49	6.46	

Ultimate Analysis	(Dry basis)
Ash, % (550° C)	10.87
Carbon, %	46.34
Hydrogen, %	5.38
Nitrogen, %	0.40
Sulfur, %	0.03
Oxygen, % (by difference)	36.97

Fusion Temperature of Ash (ASTM D1857), °F

	Reducing	*Oxidizing*
Initial Deformation (IT)		
Softening (ST)		
Hemispherical (HT)		
Fluid (FT)		

Heating Value	(Dry basis)
BTU/lb.	7,630

Analyst: NJP

Bulk Density: 16.5 lbs/ft^3

Analyst: AGJ

(Per submitter's request, this analysis was performed on the "as-received" sample, which was NOT air-dried but was chopped into pieces of < 1½" in length. The graduated cylinder used for the volume measurement was approximately 3" in diameter. Void spaces were noted which were not removed by additional tapping. Total sample volume measured includes these voids.)

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gti

Login No.: 01-1049-003
Sample ID: Estill County Saw Mill Slabs/Bark

MAJOR / MINOR OXIDES IN ASH (ASTM D-2795)

% ash at 750 degrees C = 7.93

% Element			% Oxide	% Oxide, Normalized
Na	0.09	Na_2O	0.12	0.12
Mg	0.68	MgO	1.13	1.15
Al	2.43	Al_2O_3	4.59	4.68
Si	15.6	SiO_2	33.4	34.0
P	0.30	P_2O_5	0.69	0.70
S	0.16	SO_3	0.41	0.42
K	2.66	K_2O	3.21	3.3
Ca	37.4	CaO	52.3	53.3
Ti	0.22	TiO_2	0.37	0.37
Fe	1.32	Fe_2O_3	1.89	1.92
		TOTAL	98.09	100.0

Values reported on an ash basis.
Ash concentration calculated on a dry basis with SO_3 correction and no VM cycle.
Chloride and/or carbonate may be present, resulting in a total % less than 100.

Analyst: KC

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FAX: (708) 333-3060

March 1, 2001

INSTITUTE OF GAS TECHNOLOGY
1700 S. Mt. Prospect Road
Des Plaines, IL 60018
Attn: Norman J. Petrulis

Sample identification by
Institute of Gas Technology

Kind of sample reported to us Wood Ash

Sample taken at G.T.I.

Sample taken by G.T.I.

Date sampled February 16, 2001

Date received February 27, 2001

Sample ID: 011049-003
Estill County Bark

P.O No. PF8847

Analysis Report No. 71-144428

FUSION TEMPERATURE OF ASH, (°F)

	Reducing	Oxidizing
Initial Deformation (IT)	2550	2385
Softening (ST)	2560	2410
Hemispherical (HT)	2575	2425
Fluid (FT)	2600	2440

METHOD
Fusion Temperature of Ash: ASTM D 1857

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

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gti SM

Sample Login No: 011049-001 Date: February 19, 2001
Sample Description: Estill County Prep. Plant coal sample

Air-Dry Moisture, % 6.63

Proximate Analysis	(As received)	(As received) w/SO3 correction	(Dry basis)
Moisture, %	7.62	7.62	
Volatile Matter, %	32.94	32.94	35.66
Ash, % (750° C)	5.56	5.40	
Fixed Carbon, % (by difference)	53.87	54.04	

Ultimate Analysis	(Dry basis)
Ash, % (750° C)	5.85
Carbon, %	78.83
Hydrogen, %	5.30
Nitrogen, %	1.83
Sulfur, %	0.96
Oxygen, % (by difference)	7.24

Fusion Temperature of Ash (ASTM D1857), °F

	Reducing	*Oxidizing*
Initial Deformation (IT)		
Softening (ST)		
Hemispherical (HT)		
Fluid (FT)		

Heating Value	(Dry basis)
BTU/lb.	14,140

Analyst: NJP

Bulk Density: 45.5 lbs/ft^3

Analyst: AGJ

(Per submitter's request, this analysis was performed on the "as-received" sample, which was NOT air-dried, crushed, or ground into any smaller pieces than were originally received. The graduated cylinder used for the volume measurement was approximately P/8" in diameter. No visible void spaces were noted in the packed sample at the end of the analysis.)

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Login No.: 01-1049-001
Sample ID: Estill County Prep. Plant coal sample

MAJOR / MINOR OXIDES IN ASH (ASTM D-2795)

% ash at 750 degrees C = 6.29

% Element		% Oxide		% Oxide, Normalized
Na	0.41	Na_2O	0.55	0.55
Mg	0.85	MgO	1.41	1.40
Al	14.4	Al_2O_3	27.2	27.0
Si	24.6	SiO_2	52.6	52.2
P	0.21	P_2O_5	0.48	0.48
S	1.31	SO_3	3.26	3.24
K	2.13	K_2O	2.57	2.55
Ca	2.59	CaO	3.62	3.60
Ti	1.01	TiO_2	1.68	1.67
Fe	5.14	Fe_2O_3	7.35	7.29
		TOTAL	100.8	100.0

Values reported on an ash basis.
Ash concentration calculated on a dry basis with SO_3 correction and no VM cycle.

Analyst: KC

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March 1, 2001

INSTITUTE OF GAS TECHNOLOGY
1700 S. Mt. Prospect Road
Des Plaines, IL 60018
Attn: Norman J. Petrulis

Sample identification by
Institute of Gas Technology

Kind of sample reported to us Coal Ash

Sample taken at G.T.I.

Sample taken by G.T.I.

Date sampled February 16, 2001

Date received February 27, 2001

Sample ID: 011049-001
Estill County Coal

P.O No. PF8847

Analysis Report No. 71-144426

FUSION TEMPERATURE OF ASH, (°F)

	Reducing	Oxidizing
Initial Deformation (IT)	2485	2640
Softening (ST)	2515	2675
Hemispherical (HT)	2570	2700+
Fluid (FT)	2610	2700+

METHOD
Fusion Temperature of Ash: ASTM D 1857

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

South Holland Laboratory

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gti

Analytical Report

Batch # : 021478
December 18, 2002

Prepared for:

Andrew Kramer, Process Engineering
Phone: (847) 768-0612

Project #: 61129-08

Received Date: 12/4/2002

Submitted by: Karen Crippen, (847) 768-0604
Chemical Research Services

Technical contact for this report: Alan G. Janos (847) 768-0603

GAS TECHNOLOGY INSTITUTE
1700 South Mount Prospect Road | Des Plaines, Illinois | 60018
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gti

Sample Login No: 021478-001 Date: December 18, 2002
Sample Description: Activated coconut charcoal, -4+8 mesh, Springfield Scientific #TC4716

Proximate Analysis	(As received)	(As received) w/SO3 correction	(Dry basis)
Moisture, %	3.28	3.28	
Volatile Matter, %	4.98	4.98	5.15
Ash (750°F), %	2.06	2.02	
Fixed Carbon, % (by difference)	89.68	89.72	

Ultimate Analysis	(Dry basis)
Ash (750°F), %	2.09
Carbon, %	94.62
Hydrogen, %	0.23
Nitrogen, %	0.61
Sulfur, %	0.04
Oxygen, % (by difference)	2.40

Screen Analysis

Retained on	Wt. %
3	0.0%
4	5.8%
6	47.6%
8	34.1%
PAN	12.5%
Total	100.0%

Heating Value	(Dry basis)
BTU/lb.	14,050

Analyst: NJP

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February 6, 2003

INSTITUTE OF GAS TECHNOLOGY
1700 S. Mount Prospect Road
Des Plaines, IL 60018
Attn: Norman Petrulis

Sample identification by
Institute of Gas Technology

Kind of sample reported to us Activated Coconut Charcoal

Sample taken at ------

Sample taken by ------

Date sampled ------

Date received February 3, 2003

Sample ID: 021478-001
Activated Coconut Charcoal

P.O No. PF00020103

Analysis Report No. 71-198925

FUSION TEMPERATURE OF ASH, (°F)

	Reducing	Oxidizing
Initial Deformation (IT)	2400	2445
Softening (ST)	2415	2460
Hemispherical (HT)	2430	2485
Fluid (FT)	2450	2505

METHOD
Fusion Temperature of Ash: ASTM D 1857

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

South Holland Laboratory

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Sample Login No: 021478-002 Date: December 18, 2002

Sample Description: Calla Energy, Mill #1 sawdust, 8/29/02; (air-dried and shredded to <8mm, then fines <1mm, amounting to 38.3wt% of total, were removed before analysis)

Air-Dry Moisture, % 33.42

Proximate Analysis	(As received)	(As received) w/SO3 correction	(Dry basis)
Moisture, %	39.23	39.23	
Volatile Matter, %	49.35	49.35	81.20
Ash (750°F), %	0.39	0.38	
Fixed Carbon, % (by difference)	11.03	11.04	

Ultimate Analysis	(Dry basis)
Ash (750°F), %	0.63
Carbon, %	49.51
Hydrogen, %	5.88
Nitrogen, %	0.11
Sulfur, %	0.02
Oxygen, % (by difference)	43.85

Heating Value	(Dry basis)
BTU/lb.	8,440

Screen Analysis

Retained on	Wt. %
3	0.0%
4	0.2%
6	4.0%
8	16.3%
10	20.2%
12	19.4%
14	25.4%
16	8.6%
PAN	5.9%
Total	100.0%

Analyst: NJP

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February 6, 2003

INSTITUTE OF GAS TECHNOLOGY
1700 S. Mount Prospect Road
Des Plaines, IL 60018
Attn: Norman Petrulis

Sample identification by
Institute of Gas Technology

Kind of sample reported to us Sawdust

Sample taken at ------

Sample taken by ------

Date sampled ------

Date received February 3, 2003

Sample ID: 021478-002
Wood Mill #1 Sawdust

P.O No. PF00020103

Analysis Report No. 71-198921 Page 1 of 1

FUSION TEMPERATURE OF ASH, (°F)

	Reducing	Oxidizing
Initial Deformation (IT)	2700+	2655
Softening (ST)	2700+	2670
Hemispherical (HT)	2700+	2680
Fluid (FT)	2700+	2695

looks backwards

METHOD
Fusion Temperature of Ash: ASTM D 1857

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

South Holland Laboratory

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gti

Sample Login No: 021478-003 Date: December 18, 2002

Sample Description: Calla Energy, Mill #2 sawdust, 8/29/02; (air-dried and shredded to <8mm, then fines <1mm, amounting to 18.1wt% of total, were removed before analysis)

Air-Dry Moisture, % 21.83

Proximate Analysis	(As received)	(As received) w/SO3 correction	(Dry basis)
Moisture, %	35.96	35.96	
Volatile Matter, %	53.21	53.21	83.09
Ash (750°F), %	0.27	0.26	
Fixed Carbon, % (by difference)	10.56	10.57	

Ultimate Analysis	(Dry basis)
Ash (750°F), %	0.41
Carbon, %	49.82
Hydrogen, %	5.84
Nitrogen, %	0.09
Sulfur, %	0.01
Oxygen, % (by difference)	43.82

Heating Value	(Dry basis)
BTU/lb.	8,430

Screen Analysis

Retained on	Wt. %
3	0.0%
4	0.9%
6	7.2%
8	33.5%
10	19.5%
12	14.4%
14	15.9%
16	5.4%
PAN	3.2%
Total	100.0%

Analyst: NJP

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February 6, 2003

INSTITUTE OF GAS TECHNOLOGY
1700 S. Mount Prospect Road
Des Plaines, IL 60018
Attn: Norman Petrulis

Sample identification by
Institute of Gas Technology

Kind of sample reported to us Sawdust

Sample taken at ------

Sample taken by ------

Date sampled ------

Date received February 3, 2003

Sample ID: 021478-003
Mill #2 Sawdust

P.O No. PF00020103

Analysis Report No. 71-198922

FUSION TEMPERATURE OF ASH, (°F)

	Reducing	Oxidizing
Initial Deformation (IT)	2655	2560
Softening (ST)	2670	2575
Hemispherical (HT)	2680	2590
Fluid (FT)	2690	2625

METHOD
Fusion Temperature of Ash: ASTM D 1857

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

South Holland Laboratory

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GAS TECHNOLOGY INSTITUTE
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T: 847 768 0500 | F: 847 768 0501 | www.gastechnology.org

gti℠

Sample Login No: 021478-004 Date: December 18, 2002
Sample Description: Bush Ind. chipboard waste, composite of 2 containers; (shredded to <8mm, then fines <1mm, amounting to 25.4wt% of total, were removed before analysis)

Proximate Analysis	(As received)	(As received) w/SO3 correction	(Dry basis)
Moisture, %	5.53	5.53	
Volatile Matter, %	74.85	74.85	79.23
Ash (750°F), %	0.73	0.67	
Fixed Carbon, % (by difference)	18.89	18.96	

Ultimate Analysis	(Dry basis)
Ash (750°F), %	0.71
Carbon, %	48.90
Hydrogen, %	6.04
Nitrogen, %	3.02
Sulfur, %	0.07
Oxygen, % (by difference)	41.27

Heating Value	(Dry basis)
BTU/lb.	8,480

Screen Analysis

Retained on	Wt. %
3	0.0%
4	3.5%
6	19.5%
8	28.5%
10	14.0%
12	10.1%
14	13.1%
16	6.3%
PAN	5.0%
Total	100.0%

Analyst: NJP

COMMERCIAL TESTING & ENGINEERING CO.

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TEL: (708) 331-2900
FAX: (708) 333-3060
www.comteco.com

February 6, 2003

INSTITUTE OF GAS TECHNOLOGY
1700 S. Mount Prospect Road
Des Plaines, IL 60018
Attn: Norman Petrulis

Sample identification by
Institute of Gas Technology

Kind of sample reported to us Chipboard Waste

Sample taken at ------

Sample taken by ------

Date sampled ------

Date received February 3, 2003

Sample ID: 021478-004
Chipboard Waste

P.O No. PF00020103

Analysis Report No. 71-198923

FUSION TEMPERATURE OF ASH, (°F)

	Reducing	Oxidizing
Initial Deformation (IT)	2460	2560
Softening (ST)	2470	2570
Hemispherical (HT)	2485	2585
Fluid (FT)	2500	2595

METHOD
Fusion Temperature of Ash: ASTM D 1857

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

South Holland Laboratory

MEMBER ACIL

GAS TECHNOLOGY INSTITUTE
1700 South Mount Prospect Road | Des Plaines, Illinois | 60018
T: 847 768 0500 | F: 847 768 0501 | www.gastechnology.org

gti SM

Sample Login No: 021478-005 Date: December 18, 2002
Sample Description: Bush Ind. wood pellets, 8/21/02

Proximate Analysis	(As received)	(As received) w/SO3 correction	(Dry basis)
Moisture, %	6.89	6.89	
Volatile Matter, %	73.29	73.29	78.71
Ash (750°F), %	0.84	0.76	
Fixed Carbon, % (by difference)	18.98	19.06	

Ultimate Analysis	(Dry basis)
Ash (750°F), %	0.82
Carbon, %	48.65
Hydrogen, %	6.03
Nitrogen, %	3.75
Sulfur, %	0.08
Oxygen, % (by difference)	40.66

Screen Analysis

Retained on	Wt. %
3/8"	0.0%
3	89.0%
PAN	11.0%
Total	100.0%

Heating Value	(Dry basis)
BTU/lb.	8,540

Analyst: NJP

COMMERCIAL TESTING & ENGINEERING CO.

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FAX: (708) 333-3060
www.comteco.com

February 6, 2003

INSTITUTE OF GAS TECHNOLOGY
1700 S. Mount Prospect Road
Des Plaines, IL 60018
Attn: Norman Petrulis

Sample identification by
Institute of Gas Technology

Kind of sample reported to us Wood Pellets

Sample taken at ------

Sample taken by ------

Date sampled ------

Date received February 3, 2003

Sample ID: 021478-005
Wood Pellets
Bush Industries

P.O No. PF00020103

Analysis Report No. 71-198924

FUSION TEMPERATURE OF ASH, (°F)

	Reducing	Oxidizing
Initial Deformation (IT)	2400	2380
Softening (ST)	2415	2405
Hemispherical (HT)	2430	2430
Fluid (FT)	2445	2465

METHOD
Fusion Temperature of Ash: ASTM D 1857

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

South Holland Laboratory

MEMBER ACIL

GAS TECHNOLOGY INSTITUTE
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Sample Login No: 021506-001
Sample Description: Wood pellets (from Menard's)

Date: December 31, 2002

Menard's

Proximate Analysis	(As received)	(As received) w/SO3 correction	(Dry basis)
Moisture, %	<0.05	<0.05	
Volatile Matter, %	80.61	80.61	80.61
Ash (750°F), %	0.46	0.44	
Fixed Carbon, % (by difference)	18.93	18.95	

Ultimate Analysis	(Dry basis)
Ash (750°F), %	0.44
Carbon, %	47.84
Hydrogen, %	6.14
Nitrogen, %	0.10
Sulfur, %	0.01
Oxygen, % (by difference)	45.47

Heating Value	(Dry basis)
BTU/lb.	8,060

Analyst: NJP

No binder

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February 6, 2003

INSTITUTE OF GAS TECHNOLOGY
1700 S. Mount Prospect Road
Des Plaines, IL 60018
Attn: Norman Petrulis

Sample identification by
Institute of Gas Technology

Kind of sample reported to us Wood Pellets

Sample ID: 021506-001
Wood Pellets - Menard's

Sample taken at ------

Sample taken by ------

Date sampled ------

Date received February 3, 2003

P.O No. PF00020103

Analysis Report No. 71-198920

FUSION TEMPERATURE OF ASH, (°F)

	Reducing	Oxidizing
Initial Deformation (IT)	2700+	2700+
Softening (ST)	2700+	2700+
Hemispherical (HT)	2700+	2700+
Fluid (FT)	2700+	2700+

METHOD
Fusion Temperature of Ash: ASTM D 1857

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

South Holland Laboratory

MEMBER ACIL

Customer Sample Request
Certificate of Analysis

CARBO CERAMICS, INC.
McIntyre Operations
2295 Wriley Rd.
McIntyre, GA 31054 U.S.A.
ph. (478) 943-6500
fax. (478) 943-6570
972 401 0090
972 401 0100

Request To:	Alan Conger		
Request Via:	Steve Canova/Brandi Thayer		
Date Rec'd:	12/3/2002		
Date Shipped:	12/3/2002		
Product:	CARBOPROP	**Size:**	30/60
Quantity:	10 - 20 lbs		
Ship From Loc. :	McIntyre		
Ship To :	Andy Kramer		
	Gas Technology Institute		
	1700 South Mount Prospect Rd		
	Desplaines, IL 60018		

Method of Shipment:	Ground	Next day	2nd day
Phone No.	847-768-0612		
Fax No.			

Purpose of use : Fluidization Bed Media

☑ **SIEVE DISTRIBUTION**

S-1	20 mesh	0.0
S-2	30 mesh	0.0
S-3	40 mesh	80.9
S-4	50 mesh	18.6
S-5	60 mesh	0.5
S-6	70 mesh	0.0
S-7	100 mesh	0.0
	Pan	0.0
	Total	100.0

☑ **ASG** 3.23
☑ **BD (g/cc)** 1.84
☐ **API CRUSH @ 10 Kpsi**
☐ **OTHER**

APPROVAL Steve Canova

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Analytical Report

Batch # : 031306
July 11, 2003

Prepared for:

Andrew Kramer, Process Engineering
Phone: (847) 768-0612

Project #: 61129-08

Received Date: 6/26/2003

Submitted by: Karen Crippen, (847) 768-0604
Chemical Research Services

Technical contact for this report: _____
Russell Bora (847) 768-0693

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Major Component Gas Analysis By Gas Chromatography

Report Date: 11-Jul-03
Client Name: 61129-08
GTI Sample Number: 031306-001
Sample Description: Gas Sample 1 6/20/2003
Date Analyzed: 27-Jun-03 **Analyst:** MAD

Component	Mol %	Det. Limit	Weight %
Helium		0.1%	
Hydrogen	**12.7%**	0.1%	**0.94%**
Carbon Dioxide	**17.4%**	0.03%	**28.2%**
Oxygen/Argon	**0.88%**	0.03%	**1.05%**
Nitrogen	**52.6%**	0.03%	**54.2%**
Carbon Monoxide	**11.6%**	0.03%	**11.9%**
Methane	**3.82%**	0.002%	**2.25%**
Ethane	**0.080%**	0.002%	**0.088%**
Ethene	**0.689%**	0.002%	**0.711%**
Ethyne		0.002%	
Propane		0.002%	
Propene	**0.006%**	0.002%	**0.009%**
Propadiene		0.002%	
Propyne		0.002%	
i-Butane		0.002%	
n-Butane		0.002%	
1-Butene		0.002%	
i-Butene		0.002%	
trans-2-Butene		0.002%	
cis-2-Butene		0.002%	
1,3-Butadiene	**0.003%**	0.002%	**0.006%**
i-Pentane		0.002%	
n-Pentane		0.002%	
neo-Pentane		0.002%	
1-Pentene		0.002%	
Hexane Plus	**0.173%**	0.002%	**0.549%**
Hydrogen Sulfide	**0.0164%**	0.0001%	**0.0206%**
Carbonyl Sulfide	**0.0013%**	0.0001%	**0.0029%**
Total	**100.0%**		**100.0%**

Calculated Real Gas Properties per ASTM D3588-98

Temp. (°F) =	**60.0**	**60.0**
Press. (psia) =	**14.696**	**14.73**
Compressibility Factor [z] (Dry) =	0.99924	0.99924
Compressibility Factor [z] (Sat.) =	0.99903	0.99903
Relative Density (Dry) =	0.9389	0.9389
Gross HV (Dry) (Btu/ft³) =	138.0	138.3
Gross HV (Sat.) (Btu/ft³) =	135.6	135.9
Wobbe Index =	142.4	142.7
Net HV (Dry) (Btu/ft³) =	126.3	126.6
Net HV (Sat.) (Btu/ft³) =	124.1	124.4

Notes: All blank values are below detection limit
N.A. - Not Analyzed

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TRACE SULFUR DETERMINATION BY ASTM D6228-98

Report Date: 11-Jul-03
Client Name: 61129-08
GTI Sample Number: 031306-001
Sample Description: Gas Sample 1 6/20/2003
Date Analyzed: 27-Jun-03
Analyst: MAD

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	164	Thiophene	4.40
Sulfur Dioxide		C1-Thiophenes	0.07
Carbonyl Sulfide	13.2	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan		Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	182
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As molar PPM	182
Di-t-Butyl Disulfide		As Grains/100 SCF @ STP	11.4
Dimethyl Trisulfide		As Grains/100 SCF @ 14.73	10.8
Diethyl Trisulfide		psia, 60°F	
Di-t-Butyl Trisulfide			

Notes:

Component Detection Limit:
1 ppmv for H2S, COS, and SO2
0.05 ppmv for all other compounds per sulfur
All blank values are below detection limit.
STP= 14.696psia, 0°C

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Major Component Gas Analysis By Gas Chromatography

Report Date: 11-Jul-03
Client Name: 61129-08
GTI Sample Number: 031306-002
Sample Description: Gas Sample 2 6/20/2003
Date Analyzed: 27-Jun-03 **Analyst:** MAD

Component	Mol %	Det. Limit	Weight %
Helium		0.1%	
Hydrogen	**11.8%**	0.1%	**0.86%**
Carbon Dioxide	**17.9%**	0.03%	**28.7%**
Oxygen/Argon	**1.07%**	0.03%	**1.25%**
Nitrogen	**55.9%**	0.03%	**56.8%**
Carbon Monoxide	**9.37%**	0.03%	**9.53%**
Methane	**3.21%**	0.002%	**1.87%**
Ethane	**0.065%**	0.002%	**0.071%**
Ethene	**0.503%**	0.002%	**0.512%**
Ethyne		0.002%	
Propane		0.002%	
Propene	**0.004%**	0.002%	**0.006%**
Propadiene		0.002%	
Propyne		0.002%	
i-Butane		0.002%	
n-Butane		0.002%	
1-Butene		0.002%	
i-Butene		0.002%	
trans-2-Butene		0.002%	
cis-2-Butene		0.002%	
1,3-Butadiene		0.002%	
i-Pentane		0.002%	
n-Pentane		0.002%	
neo-Pentane		0.002%	
1-Pentene		0.002%	
Hexane Plus	**0.122%**	0.002%	**0.383%**
Hydrogen Sulfide	**0.0137%**	0.0001%	**0.0169%**
Carbonyl Sulfide	**0.0012%**	0.0001%	**0.0026%**
Total	**100.0%**		**100.0%**

Calculated Real Gas Properties per ASTM D3588-98

Temp. (°F) =	**60.0**	**60.0**
Press. (psia) =	**14.696**	**14.73**
Compressibility Factor [z] (Dry) =	0.99925	0.99924
Compressibility Factor [z] (Sat.) =	0.99903	0.99903
Relative Density (Dry) =	0.9515	0.9515
Gross HV (Dry) (Btu/ft³) =	116.0	116.3
Gross HV (Sat.) (Btu/ft³) =	114.0	114.3
Wobbe Index =	118.9	119.2
Net HV (Dry) (Btu/ft³) =	105.8	106.0
Net HV (Sat.) (Btu/ft³) =	104.0	104.2

Notes: All blank values are below detection limit
N.A. - Not Analyzed

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TRACE SULFUR DETERMINATION BY ASTM D6228-98

Report Date: 11-Jul-03
Client Name: 61129-08
GTI Sample Number: 031306-002
Sample Description: Gas Sample 2 6/20/2003
Date Analyzed: 27-Jun-03
Analyst: MAD

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	137	Thiophene	3.18
Sulfur Dioxide		C1-Thiophenes	0.05
Carbonyl Sulfide	11.7	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan		Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	152
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As molar PPM	152
Di-t-Butyl Disulfide		As Grains/100 SCF @ STP	9.50
Dimethyl Trisulfide		As Grains/100 SCF @ 14.73 psia, 60°F	9.01
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes:
Component Detection Limit:
1 ppmv for H2S, COS, and SO2
0.05 ppmv for all other compounds per sulfur
All blank values are below detection limit.
STP= 14.696psia, 0°C

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Chemical Research Services

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Analytical Report

Batch #: 031307.doc
Date: July 18, 2003

Prepared for:

Andrew Kramer
X5612

Gas Technology Institute
1700 S. Mt Prospect Rd.
Des Plaines, IL 60018

Project # 61129-08

Received Date: 6/26/2003

Disclaimer:

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In April 2000, the Institute of Gas Technology (IGT) and the Gas Research Institute (GRI) combined to form the Gas Technology Institute (GTI).

Submitted by: Karen Crippen, (847) 768-0604
Chemical Research Services

Technical Contact: Alan G. Janos, (847) 768-0603

GAS TECHNOLOGY INSTITUTE
Chemical Research Services

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Analytical Report

Batch #: 031307.doc
Date: July 18, 2003

Liquid Sample #1, 6/20/03 (031307-001)

Phase separation:

Organic phase (oil) recovered:	0.3 g	0.07 wt%
Aqueous phase recovered:	414.4 g	98.41 wt%
Solid phase recovered:	0.3 g	0.07 wt%
Loss (by difference):	6.1 g	1.45 wt%
Total sample received:	421.1 g	

Analyst: AGJ

Oil phase analyses (031307-003): (GC work only per A.K.)

Water phase analyses (031307-002):

Total Carbon:	2.41 wt%
Kjeldahl Nitrogen:	4.82 wt%
Ammonia:	5.52 wt%

Analyst: NJP, JS, AGJ

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Hydrocarbon Analysis in Oil Phase

GTI Sample Number: 031307-003

Sample Description: Liquid #1 6/20/03 Oil Phase

Tentative Component ID	Estimated mg recovered
Hydroxymethylpentanone	0.548
Ethylbenzene	0.083
m,p-Xylene	0.338
o-Xylene	0.221
Phenol	0.815
Benzeneamine	0.077
Benzonitrile	0.357
Methyl phenols/Indene	0.977
Methylbenzonitriles	0.161
Tetramethylpiperidinone	<0.020
Methylbenzofuran	0.112
Dimethylphenols	0.178
Methylindenes	0.246
Methylbenzaldehydes	0.228
Naphthalene	5.18
Quinoline	2.01
Isoquinoline	1.04
Indole	1.16
2-Methylnaphthalene	1.40
1-Methylnaphthalene	1.07
Methylquinolines	0.200
Methylindoles	0.075
1,1'-Biphenyl	1.39
Ethylnaphthalenes	0.221
Dihydroacenaphthylene	0.147
Indazole	<0.020

Tentative Component ID	Estimated mg recovered
Methoxypropenylphenol/Dimethylnaphthalenes	0.670
Ethenylnaphthalene	0.836
Acenaphthylene	5.39
Methyl-1,1'-biphenyl	0.309
Naphthalenecarbonitriles	1.03
Acenaphthene	0.402
Dibenzofuran	0.867
Phenalene	0.430
Fluorene	1.73
Methyldibenzofuran	0.212
Methylfluorenes	0.535
Fluorenone	0.370
Phenanthrene	3.47
Anthracene	0.804
Carbazole	0.130
Benzoquinoline	0.212
Phenylnaphthalenes	0.542
Benzo[c]cinnoline	0.198
Methylphenanthrene or Methylanthracene	0.192
Methylphenanthrene or Methylanthracene	0.198
4H-Cyclopenta[d,e,f]phenanthrene	0.517
Fluoranthene	0.568
Pyrene	0.592
Methylpyrenes	0.282
Additional Unidentified Components	**6.29**
Total :	**45.0**

Notes: Detection Limit = 0.020 mg

All components were tentatively identified by comparing the mass spectra of each component to a mass spectral reference library.

Estimated concentrations of all components were calculated as naphthalene by GC-FID.

GAS TECHNOLOGY INSTITUTE
Chemical Research Services

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Analytical Report

Batch #: 031307.doc
Date: July 18, 2003

Liquid Sample #2, 6/20/03 (031307-004)

Phase separation:

Organic phase (oil) recovered:	0.2 g	0.04 wt%
Aqueous phase recovered:	548.9 g	98.74 wt%
Solid phase recovered:	0.3 g	0.05 wt%
Loss (by difference):	6.5 g	1.17 wt%
Total sample received:	555.9 g	

Analyst: AGJ

Oil phase analyses (031307-006): (GC work only per A.K.)

Water phase analyses (031307-005):

Total Carbon:	2.18 wt%
Kjeldahl Nitrogen:	4.24 wt%
Ammonia:	4.93 wt%

Analyst: NJP, JS, AGJ

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Hydrocarbon Analysis in Oil Phase

GTI Sample Number: 031307-006

Sample Description: Liquid #2 6/20/03 Oil Phase

Tentative Component ID	Estimated mg recovered
Hydroxymethylpentanone	0.213
Ethylbenzene	0.231
m,p-Xylene	0.923
o-Xylene	0.507
Phenol	0.501
Benzeneamine	0.076
Benzonitrile	0.575
Methyl phenols/Indene	1.08
Methylbenzonitriles	0.191
Tetramethylpiperidinone	<0.020
Methylbenzofuran	0.098
Dimethylphenols	0.163
Methylindenes	0.410
Methylbenzaldehydes	0.194
Naphthalene	9.02
Quinoline	3.46
Isoquinoline	1.63
Indole	1.74
2-Methylnaphthalene	2.40
1-Methylnaphthalene	1.78
Methylquinolines	0.296
Methylindoles	0.110
1,1'-Biphenyl	2.06
Ethylnaphthalenes	0.350
Dihydroacenaphthylene	0.185
Indazole	<0.020

Tentative Component ID	Estimated mg recovered
Methoxypropenylphenol/Dimethylnaphthalene	1.14
Ethenylnaphthalene	1.26
Acenaphthylene	7.69
Methyl-1,1'-biphenyl	0.483
Naphthalenecarbonitriles	1.70
Acenaphthene	0.617
Dibenzofuran	1.28
Phenalene	0.686
Fluorene	2.47
Methyldibenzofuran	0.329
Methylfluorenes	1.14
Fluorenone	0.531
Phenanthrene	5.02
Anthracene	1.19
Carbazole	0.215
Benzoquinoline	0.310
Phenylnaphthalenes	1.02
Benzo[c]cinnoline	0.302
Methylphenanthrene or Methylanthracene	0.297
Methylphenanthrene or Methylanthracene	0.324
4H-Cyclopenta[d,e,f]phenanthrene	0.836
Fluoranthene	0.737
Pyrene	0.711
Methylpyrenes	0.346
Additional Unidentified Components	**10.9**
Total :	**59.1**

Notes: Detection Limit = 0.020 mg

All components were tentatively identified by comparing the mass spectra of each component to a mass spectral reference library.

Estimated concentrations of all components were calculated as naphthalene by GC-FID.

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Sample Login No: 031307-007 Date: July 15, 2003
Sample Description: Solids, 6/20/03

Proximate Analysis	(As received)	(As received) w/SO3 correction	(Dry basis)
Moisture, %	5.58	5.58	
Volatile Matter, %	16.82	16.82	17.81
Ash, %	45.91	45.84	
Fixed Carbon, % (by difference)	31.71	31.77	

Ultimate Analysis	(Dry basis)
Ash, %	48.54
Carbon, %	43.76
Hydrogen, %	0.46
Nitrogen, %	0.74
Sulfur, %	0.05
Oxygen, % (by difference)	6.44

Analyst: NJP

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Analytical Report

Batch # : 031308
August 06, 2003

Prepared for:

Andrew Kramer, Process Engineering
Phone: (847) 768-0612

Project #: 61129-08

Received Date: 6/26/2003

Submitted by: Karen Crippen, (847) 768-0604
Chemical Research Services

Technical contact for this report: _____
Russell Bora (847) 768-0693

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Major Component Gas Analysis By Gas Chromatography

Report Date: 11-Jul-03
Client Name: 61129-08
GTI Sample Number: 031308-001
Sample Description: Gas Sample 1 6/24/2003
Date Analyzed: 27-Jun-03 **Analyst:** MAD

Component	Mol %	Det. Limit	Weight %
Helium		0.1%	
Hydrogen	**9.5%**	0.1%	**0.68%**
Carbon Dioxide	**17.9%**	0.03%	**28.0%**
Oxygen/Argon	**0.80%**	0.03%	**0.92%**
Nitrogen	**57.4%**	0.03%	**57.1%**
Carbon Monoxide	**9.47%**	0.03%	**9.41%**
Methane	**3.49%**	0.002%	**1.99%**
Ethane	**0.185%**	0.002%	**0.197%**
Ethene	**0.895%**	0.002%	**0.891%**
Ethyne	**0.021%**	0.002%	**0.019%**
Propane	**0.009%**	0.002%	**0.014%**
Propene	**0.105%**	0.002%	**0.157%**
Propadiene		0.002%	
Propyne	**0.008%**	0.002%	**0.011%**
i-Butane		0.002%	
n-Butane		0.002%	
1-Butene		0.002%	
i-Butene	**0.005%**	0.002%	**0.011%**
trans-2-Butene	**0.004%**	0.002%	**0.007%**
cis-2-Butene	**0.002%**	0.002%	**0.004%**
1,3-Butadiene	**0.031%**	0.002%	**0.059%**
i-Pentane		0.002%	
n-Pentane		0.002%	
neo-Pentane		0.002%	
Pentenes	**0.004%**	0.002%	**0.011%**
Hexane Plus	**0.160%**	0.002%	**0.490%**
Hydrogen Sulfide	**0.0082%**	0.0001%	**0.0099%**
Carbonyl Sulfide	**0.0009%**	0.0001%	**0.0020%**
Total	**100.0%**		**100.0%**

Calculated Real Gas Properties per ASTM D3588-98

Temp. (°F) =	**60.0**	**60.0**
Press. (psia) =	**14.696**	**14.73**
Compressibility Factor [z] (Dry) =	0.99919	0.99918
Compressibility Factor [z] (Sat.) =	0.99896	0.99896
Relative Density (Dry) =	0.9730	0.9730
Gross HV (Dry) (Btu/ft³) =	126.2	126.5
Gross HV (Sat.) (Btu/ft³) =	124.0	124.3
Wobbe Index =	127.9	128.2
Net HV (Dry) (Btu/ft³) =	115.9	116.1
Net HV (Sat.) (Btu/ft³) =	113.9	114.1

Notes: All blank values are below detection limit
N.A. - Not Analyzed

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TRACE SULFUR DETERMINATION BY ASTM D6228-98

Report Date: 11-Jul-03
Client Name: 61129-08
GTI Sample Number: 031308-001
Sample Description: Gas Sample 1 6/24/2003
Date Analyzed: 27-Jun-03
Analyst: MAD

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	81.6	Thiophene	3.20
Sulfur Dioxide		C1-Thiophenes	0.40
Carbonyl Sulfide	9.34	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan	1.11	Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	95.7
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As molar PPM	95.7
Di-t-Butyl Disulfide		As Grains/100 SCF @ STP	5.98
Dimethyl Trisulfide		As Grains/100 SCF @ 14.73	5.67
Diethyl Trisulfide		psia, 60°F	
Di-t-Butyl Trisulfide			

Notes:
Component Detection Limit:
1 ppmv for H2S, COS, and SO2
0.05 ppmv for all other compounds per sulfur
All blank values are below detection limit.
STP= 14.696psia, 0°C

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Major Component Gas Analysis By Gas Chromatography

Report Date: 11-Jul-03
Client Name: 61129-08
GTI Sample Number: 031308-002
Sample Description: Gas Sample 2 6/24/2003
Date Analyzed: 27-Jun-03 **Analyst:** MAD

Component	Mol %	Det. Limit	Weight %
Helium		0.1%	
Hydrogen	**10.5%**	0.1%	**0.76%**
Carbon Dioxide	**18.5%**	0.03%	**29.1%**
Oxygen/Argon	**0.79%**	0.03%	**0.91%**
Nitrogen	**54.9%**	0.03%	**55.1%**
Carbon Monoxide	**9.72%**	0.03%	**9.74%**
Methane	**3.98%**	0.002%	**2.28%**
Ethane	**0.232%**	0.002%	**0.249%**
Ethene	**0.945%**	0.002%	**0.949%**
Ethyne	**0.016%**	0.002%	**0.015%**
Propane	**0.011%**	0.002%	**0.017%**
Propene	**0.128%**	0.002%	**0.192%**
Propadiene	**0.002%**	0.002%	**0.003%**
Propyne	**0.008%**	0.002%	**0.012%**
i-Butane		0.002%	
n-Butane		0.002%	
1-Butene	**0.002%**	0.002%	**0.004%**
i-Butene	**0.007%**	0.002%	**0.013%**
trans-2-Butene	**0.004%**	0.002%	**0.008%**
cis-2-Butene	**0.003%**	0.002%	**0.005%**
1,3-Butadiene	**0.037%**	0.002%	**0.071%**
i-Pentane		0.002%	
n-Pentane		0.002%	
neo-Pentane		0.002%	
Pentenes	**0.005%**	0.002%	**0.013%**
Hexane Plus	**0.180%**	0.002%	**0.554%**
Hydrogen Sulfide	**0.0119%**	0.0001%	**0.0145%**
Carbonyl Sulfide	**0.0010%**	0.0001%	**0.0022%**
Total	**100.0%**		**100.0%**

Calculated Real Gas Properties per ASTM D3588-98

Temp. (°F) =	**60.0**	**60.0**
Press. (psia) =	**14.696**	**14.73**
Compressibility Factor [z] (Dry) =	0.99916	0.99916
Compressibility Factor [z] (Sat.) =	0.99893	0.99893
Relative Density (Dry) =	0.9654	0.9654
Gross HV (Dry) (Btu/ft³) =	138.7	139.1
Gross HV (Sat.) (Btu/ft³) =	136.3	136.7
Wobbe Index =	141.2	141.5
Net HV (Dry) (Btu/ft³) =	127.2	127.5
Net HV (Sat.) (Btu/ft³) =	125.0	125.3

Notes: All blank values are below detection limit
N.A. - Not Analyzed

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TRACE SULFUR DETERMINATION BY ASTM D6228-98

Report Date: 11-Jul-03
Client Name: 61129-08
GTI Sample Number: 031308-002
Sample Description: Gas Sample 2 6/24/2003
Date Analyzed: 27-Jun-03
Analyst: MAD

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	119	Thiophene	3.23
Sulfur Dioxide		C1-Thiophenes	0.47
Carbonyl Sulfide	10.4	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan	1.85	Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	135
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As molar PPM	135
Di-t-Butyl Disulfide		As Grains/100 SCF @ STP	8.44
Dimethyl Trisulfide		As Grains/100 SCF @ 14.73	8.00
Diethyl Trisulfide		psia, 60°F	
Di-t-Butyl Trisulfide			

Notes:

Component Detection Limit:
1 ppmv for H2S, COS, and SO2
0.05 ppmv for all other compounds per sulfur
All blank values are below detection limit.
STP= 14.696psia, 0°C

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Hydrocarbon Analysis in Xylene Wash

GTI Sample Number: 031308-003

Sample Description: Xylene Cleanout 6/24/2003

Tentative Component ID	Estimated mg recovered
Hydroxymethylpentanone	4.83
i-Propylbenzene	2,820
Phenol/n-Propylbenzene	1,750
Benzeneamine	<2.12
Benzonitrile/1-Ethyl-3-methylbenzene	1,900
1-Ethyl-4-methylbenzene	501
1-Ethyl-2-methylbenzene	162
Trimethylbenzenes	319
Methyl phenols/Indene	367
Methylbenzonitriles	27.1
Tetramethylpiperidinone	<2.12
Methylbenzofuran	20.8
Dimethylphenols	22.3
Methylindenes	28.4
Methylbenzaldehydes	56.1
Naphthalene	632
Quinoline	57.8
Isoquinoline	41.2
Indole	67.5
2-Methylnaphthalene	210
1-Methylnaphthalene	149
Methylquinolines	14.4
Methylindoles	9.84
1,1'-Biphenyl	86.2
Ethylnaphthalenes	28.3
Dihydroacenaphthylene	19.3

Tentative Component ID	Estimated mg recovered
Indazole	<2.12
Methoxypropenylphenol/Dimethylnaphthalenes	74.9
Ethenylnaphthalene	95.9
Acenaphthylene	323
Methyl-1,1'-biphenyl	26.2
Naphthalenecarbonitriles	91.0
Acenaphthene	35.7
Dibenzofuran	69.0
Phenalene	45.7
Fluorene	164
Methyldibenzofuran	21.2
Methylfluorenes	101
Fluorenone	41.1
Phenanthrene	557
Anthracene	127
Carbazole	17.3
Benzoquinoline	26.8
Phenylnaphthalenes	72.3
Benzo[c]cinnoline	22.1
Methylphenanthrene or Methylanthracene	22.0
Methylphenanthrene or Methylanthracene	25.4
4H-Cyclopenta[d,e,f]phenanthrene	71.6
Fluoranthene	128
Pyrene	124
Methylpyrenes	39.1
Additional Unidentified Components	**1,200**
Total :	**12,815**

Total Filtered Solids (Dry Weight): 1.2 g (0.13% wt.)

Notes: Detection Limit = 2.12 mg

All components were tentatively identified by comparing the mass spectra of each component to a mass spectral reference library.

Toluene and Ethylbenzene were found in large quantities but not calculated, based on the assumption that the source of these components were from the Xylene solvent.

Due to the lack of a solvent blank to identify additional solvent impurites, all additional components found have been reported.

Estimated concentrations of all components were calculated as naphthalene by GC-FID.

Results are based on a total volume of 1060 mLs.

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Chemical Research Services

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Analytical Report

Batch #: 031309.doc
Date: July 18, 2003

Prepared for:

Andrew Kramer
X5612

Gas Technology Institute
1700 S. Mt Prospect Rd.
Des Plaines, IL 60018

Project # 61129-08

Received Date: 6/26/2003

In April 2000, the Institute of Gas Technology (IGT) and the Gas Research Institute (GRI) combined to form the Gas Technology Institute (GTI).

Submitted by: Karen Crippen, (847) 768-0604
Chemical Research Services

Technical Contact: Alan G. Janos, (847) 768-0603

GAS TECHNOLOGY INSTITUTE
Chemical Research Services

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Analytical Report

Batch #: 031309.doc
Date: July 18, 2003

Liquid Sample #1, 6/24/03 (031309-001)

Phase separation:

Organic phase (oil) recovered:	1.1 g	0.16 wt%
Aqueous phase recovered:	703.5 g	99.31 wt%
Solid phase recovered:	0.3 g	0.04 wt%
Loss (by difference):	3.5 g	0.49 wt%
Total sample received:	708.4 g	

Analyst: AGJ

Oil phase analyses (031309-003): (GC work only per A.K.)

Water phase analyses (031309-002):

Total Carbon:	2.80 wt%
Kjeldahl Nitrogen:	4.69 wt%
Ammonia:	5.67 wt%

Analyst: NJP, JS, AGJ

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Hydrocarbon Analysis in Oil Phase

GTI Sample Number: 031309-003

Sample Description: Liquid #1 6/24/03 Oil Phase

Tentative Component ID	Estimated mg recovered
Hydroxymethylpentanone	0.18
Ethylbenzene	<0.09
m,p-Xylene	0.29
o-Xylene	0.12
Phenol	27.9
Benzeneamine	0.82
Benzonitrile	1.26
Methylphenols/Indene	24.3
Methylbenzonitriles	2.26
Tetramethylpiperidinone	<0.09
Methylbenzofuran	1.39
Dimethylphenols	2.80
Methylindenes	3.52
Methylbenzaldehydes	6.53
Naphthalene	36.4
Quinoline	6.94
Isoquinoline	5.20
Indole	8.16
2-Methylnaphthalene	18.0
1-Methylnaphthalene	13.6
Methylquinolines	2.07
Methylindoles	1.36
1,1'-Biphenyl	9.12
Ethylnaphthalenes	3.11
Dihydroacenaphthylene	1.99
Indazole	0.53

Tentative Component ID	Estimated mg recovered
Methoxypropenylphenol/Dimethylnaphthalenes	8.78
Ethenylnaphthalene	10.7
Acenaphthylene	34.8
Methyl-1,1'-biphenyl	3.25
Naphthalenecarbonitriles	12.7
Acenaphthene	4.08
Dibenzofuran	8.14
Phenalene	5.30
Fluorene	20.1
Methyldibenzofuran	2.40
Methylfluorenes	5.62
Fluorenone	3.57
Phenanthrene	56.7
Anthracene	10.6
Carbazole	1.65
Benzoquinoline	2.39
Phenylnaphthalenes	6.98
Benzo[c]cinnoline	1.71
Methylphenanthrene or Methylanthracene	2.06
Methylphenanthrene or Methylanthracene	2.36
4H-Cyclopenta[d,e,f]phenanthrene	6.19
Fluoranthene	7.84
Pyrene	7.14
Methylpyrenes	2.32
Additional Unidentified Components	**102**
Total :	**507**

Notes: Detection Limit = 0.09 mg

All components were tentatively identified by comparing the mass spectra of each component to a mass spectral reference library.

Estimated concentrations of all components were calculated as naphthalene by GC-FID.

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Sample Login No: 031309-004
Sample Description: Solids, 6/24/03

Date: July 15, 2003

Proximate Analysis	(As received)	(As received) w/SO3 correction	(Dry basis)
Moisture, %	3.44	3.44	
Volatile Matter, %	12.99	12.99	13.45
Ash, %	33.38	33.18	
Fixed Carbon, % (by difference)	50.19	50.39	

Ultimate Analysis	(Dry basis)
Ash, %	34.36
Carbon, %	60.79
Hydrogen, %	1.04
Nitrogen, %	1.28
Sulfur, %	0.14
Oxygen, % (by difference)	2.38

Analyst: NJP

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Analytical Report

Batch # : 031324
August 06, 2003

Prepared for:

Andrew Kramer, Process Engineering
Phone: (847) 768-0612

Project #: 61129-08

Received Date: 7/2/2003

Submitted by: Karen Crippen, (847) 768-0604
Chemical Research Services

Technical contact for this report: Russell Bora (847) 768-0693

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Major Component Gas Analysis By Gas Chromatography

Report Date: 17-Jul-03
Client Name: 61129-08
GTI Sample Number: 031324-001
Sample Description: Gas Sample #1 6/26/2003 15:35
Date Analyzed: 15-Jul-03 **Analyst:** MAD

Component	Mol %	Det. Limit	Weight %
Helium		0.1%	
Hydrogen	**7.0%**	0.1%	**0.50%**
Carbon Dioxide	**16.2%**	0.03%	**25.1%**
Oxygen/Argon	**1.37%**	0.03%	**1.56%**
Nitrogen	**56.5%**	0.03%	**55.7%**
Carbon Monoxide	**12.5%**	0.03%	**12.3%**
Methane	**4.52%**	0.002%	**2.55%**
Ethane	**0.160%**	0.002%	**0.169%**
Ethene	**1.30%**	0.002%	**1.28%**
Ethyne	**0.057%**	0.002%	**0.052%**
Propane		0.002%	
Propene	**0.033%**	0.002%	**0.048%**
Propadiene		0.002%	
Propyne	**0.004%**	0.002%	**0.006%**
i-Butane		0.002%	
n-Butane		0.002%	
1-Butene		0.002%	
i-Butene		0.002%	
trans-2-Butene		0.002%	
cis-2-Butene		0.002%	
1,3-Butadiene	**0.015%**	0.002%	**0.029%**
i-Pentane		0.002%	
n-Pentane		0.002%	
neo-Pentane		0.002%	
1-Pentene		0.002%	
Hexane Plus	**0.220%**	0.002%	**0.665%**
Hydrogen Sulfide	**0.00225%**	0.00005%	**0.00270%**
Carbonyl Sulfide		0.00005%	
Total	**100.0%**		**100.0%**

Calculated Real Gas Properties per ASTM D3588-98

Temp. (°F) =	**60.0**	**60.0**
Press. (psia) =	**14.696**	**14.73**
Compressibility Factor [z] (Dry) =	0.99918	0.99918
Compressibility Factor [z] (Sat.) =	0.99895	0.99895
Relative Density (Dry) =	0.9824	0.9824
Gross HV (Dry) (Btu/ft³) =	145.0	145.3
Gross HV (Sat.) (Btu/ft³) =	142.5	142.8
Wobbe Index =	146.3	146.6
Net HV (Dry) (Btu/ft³) =	134.5	134.8
Net HV (Sat.) (Btu/ft³) =	132.2	132.5

Notes: All blank values are below detection limit
N.A. - Not Analyzed

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TRACE SULFUR DETERMINATION BY ASTM D6228-98

Report Date: 17-Jul-03
Client Name: 61129-08
GTI Sample Number: 031324-001
Sample Description: Gas Sample #1 6/26/2003 15:35
Date Analyzed: 2-Jul-03
Analyst: MAD

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	22.5	Thiophene	1.38
Sulfur Dioxide		C1-Thiophenes	0.05
Carbonyl Sulfide		C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan		Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
		Compound #1	0.04
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.04
i-Propyl n-Propyl Disulfide		Total Identified:	23.9
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As molar PPM	24.0
Di-t-Butyl Disulfide		As Grains/100 SCF @ STP	1.50
Dimethyl Trisulfide		As Grains/100 SCF @ 14.73	1.42
Diethyl Trisulfide		psia, 60°F	
Di-t-Butyl Trisulfide			

Notes:

Component Detection Limit:
0.5 ppmv for H2S, COS, and SO2
0.05 ppmv for all other compounds per sulfur
Underlined numbers are below standard detection limits, and are included for information only.
All blank values are below detection limit.
STP= 14.696psia, 0°C

Core Lab
PETROLEUM SERVICES

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CORE LABORATORIES

KAREN CRIPPEN
GAS TECHNOLOGY INSTITUTE
1700 S MOUNT PROSPECT RD
DES PLAINES, IL 60018

Sample Number: 132956-001
Sample Date: 6/26/03 3:35:00 PM
Date Reported: 7/24/03
Date Received: 7/18/03
Sample ID: Sample # 1 (06-26-03)
Description:

Analytical Report

Test	Result	Units	Method	Date	Analyst
Nitrogen Compounds,Comprehensive					
Ammonia	1	ppm v / v	GC-Chemiluminesci	7/24/03	JB
Nitric Oxide	< 1	ppm v / v			
Nitrous Oxide	< 1	ppm v / v			
Hydrogen Cyanide	< 1	ppm v / v			
Methyl amine	< 1	ppm v / v			
Dimethyl amine	< 1	ppm v / v			
Acetonitrile	< 1	ppm v / v			
Acrylonitrile	< 1	ppm v / v			
Ethyl amine	< 1	ppm v / v			
Diethyl amine	< 1	ppm v / v			
Isopropyl Amine	< 1	ppm v / v			
Propionitrile	2	ppm v / v			
Tert-Butyl Amine	< 1	ppm v / v			
Isobutyl nitrile	< 1	ppm v / v			
Butyl nitrile	< 1	ppm v / v			
Pyridine	< 1	ppm v / v			
Pyrrole	< 1	ppm v / v			
Pentane nitrile	< 1	ppm v / v			
2-Methyl pyridine	< 1	ppm v / v			
2-Methyl pyrrole	< 1	ppm v / v			
3-Methyl pyrrole	< 1	ppm v / v			
3 & 4-Methyl pyridine	< 1	ppm v / v			
2,6-Dimethyl pyridine	< 1	ppm v / v			
2-Ethyl pyridine	< 1	ppm v / v			
2-Ethyl pyrrole	< 1	ppm v / v			
2,4-Dimethyl pyridine	< 1	ppm v / v			
2,4 Dimethyl pyrrole	< 1	ppm v / v			

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CORE LABORATORIES

KAREN CRIPPEN
GAS TECHNOLOGY INSTITUTE
1700 S MOUNT PROSPECT RD
DES PLAINES, IL 60018

Sample Number: 132956-001
Sample Date: 6/26/03 3:35:00 PM
Date Reported: 7/24/03
Date Received: 7/18/03
Sample ID: Sample # 1 (06-26-03)
Description:

Analytical Report

Test	Result	Units	Method	Date	Analyst
2,3-Dimethyl pyridine	< 1	ppm v / v			
4-Ethyl pyridine	< 1	ppm v / v			
3,5-Dimethyl pyridine	< 1	ppm v / v			
Aniline	< 1	ppm v / v			
Unidentified Nitrogen	< 1	ppm v / v			

Approved By: Jean Waits
Supervising Chemist

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gti SM

Major Component Gas Analysis By Gas Chromatography

Report Date: 17-Jul-03
Client Name: 61129-08
GTI Sample Number: 031324-002
Sample Description: Gas sample #2 6/26/2003 17:25
Date Analyzed: 15-Jul-03 **Analyst:** MAD

Component	Mol %	Det. Limit	Weight %
Helium		0.1%	
Hydrogen	8.1%	0.1%	0.58%
Carbon Dioxide	16.4%	0.03%	25.7%
Oxygen/Argon	1.42%	0.03%	1.63%
Nitrogen	56.2%	0.03%	55.8%
Carbon Monoxide	12.0%	0.03%	11.9%
Methane	4.57%	0.002%	2.60%
Ethane	0.11%	0.002%	0.12%
Ethene	0.92%	0.002%	0.92%
Ethyne	0.021%	0.002%	0.019%
Propane		0.002%	
Propene	0.007%	0.002%	0.010%
Propadiene		0.002%	
Propyne		0.002%	
i-Butane		0.002%	
n-Butane		0.002%	
1-Butene		0.002%	
i-Butene		0.002%	
trans-2-Butene		0.002%	
cis-2-Butene		0.002%	
1,3-Butadiene	0.005%	0.002%	0.010%
i-Pentane		0.002%	
n-Pentane		0.002%	
neo-Pentane		0.002%	
1-Pentene		0.002%	
Hexane Plus	0.216%	0.002%	0.661%
Hydrogen Sulfide	0.00176%	0.00005%	0.00213%
Carbonyl Sulfide		0.00005%	
Total	100.0%		100.0%

Calculated Real Gas Properties per ASTM D3588-98

Temp. (°F) =	60.0	60.0
Press. (psia) =	14.696	14.73
Compressibility Factor [z] (Dry) =	0.99920	0.99920
Compressibility Factor [z] (Sat.) =	0.99898	0.99898
Relative Density (Dry) =	0.9735	0.9735
Gross HV (Dry) (Btu/ft³) =	138.7	139.0
Gross HV (Sat.) (Btu/ft³) =	136.3	136.6
Wobbe Index =	140.5	140.9
Net HV (Dry) (Btu/ft³) =	128.1	128.4
Net HV (Sat.) (Btu/ft³) =	125.9	126.2

Notes: All blank values are below detection limit
N.A. - Not Analyzed

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TRACE SULFUR DETERMINATION BY ASTM D6228-98

Report Date: 17-Jul-03
Client Name: 61129-08
GTI Sample Number: 031324-002
Sample Description: Gas sample #2 6/26/2003 17:25
Date Analyzed: 2-Jul-03
Analyst: MAD

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	17.6	Thiophene	0.90
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide		C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan		Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
		Compound #1	0.03
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.03
i-Propyl n-Propyl Disulfide		Total Identified:	18.5
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As molar PPM	18.5
Di-t-Butyl Disulfide		As Grains/100 SCF @ STP	1.16
Dimethyl Trisulfide		As Grains/100 SCF @ 14.73 psia, 60°F	1.10
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes:

Component Detection Limit:
0.5 ppmv for H2S, COS, and SO2
0.05 ppmv for all other compounds per sulfur
Underlined numbers are below standard detection limits, and are included for information only.
All blank values are below detection limit.
STP= 14.696psia, 0°C

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CORE LABORATORIES

KAREN CRIPPEN
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Sample Number: 132956-002
Sample Date: 6/26/03 5:25:00 PM
Date Reported: 7/24/03
Date Received: 7/18/03
Sample ID: Sample # 2 (06-26-03)
Description:

Analytical Report

Test	Result	Units	Method	Date	Analyst
Nitrogen Compounds,Comprehensive					
Ammonia	1	ppm v / v	GC-Chemiluminesci	7/24/03	JB
Nitric Oxide	< 1	ppm v / v			
Nitrous Oxide	< 1	ppm v / v			
Hydrogen Cyanide	< 1	ppm v / v			
Methyl amine	< 1	ppm v / v			
Dimethyl amine	< 1	ppm v / v			
Acetonitrile	< 1	ppm v / v			
Acrylonitrile	< 1	ppm v / v			
Ethyl amine	< 1	ppm v / v			
Diethyl amine	< 1	ppm v / v			
Isopropyl Amine	< 1	ppm v / v			
Propionitrile	< 1	ppm v / v			
Tert-Butyl Amine	< 1	ppm v / v			
Isobutyl nitrile	< 1	ppm v / v			
Butyl nitrile	< 1	ppm v / v			
Pyridine	< 1	ppm v / v			
Pyrrole	< 1	ppm v / v			
Pentane nitrile	< 1	ppm v / v			
2-Methyl pyridine	< 1	ppm v / v			
2-Methyl pyrrole	< 1	ppm v / v			
3-Methyl pyrrole	< 1	ppm v / v			
3 & 4-Methyl pyridine	< 1	ppm v / v			
2,6-Dimethyl pyridine	< 1	ppm v / v			
2-Ethyl pyridine	< 1	ppm v / v			
2-Ethyl pyrrole	< 1	ppm v / v			
2,4-Dimethyl pyridine	< 1	ppm v / v			
2,4 Dimethyl pyrrole	< 1	ppm v / v			

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Sample Number: 132956-002
Sample Date: 6/26/03 5:25:00 PM
Date Reported: 7/24/03
Date Received: 7/18/03
Sample ID: Sample # 2 (06-26-03)
Description:

Analytical Report

Test	Result	Units	Method	Date	Analyst
2,3-Dimethyl pyridine	< 1	ppm v / v			
4-Ethyl pyridine	< 1	ppm v / v			
3,5-Dimethyl pyridine	< 1	ppm v / v			
Aniline	< 1	ppm v / v			
Unidentified Nitrogen	< 1	ppm v / v			

Approved By:

Jean Waits
Supervising Chemist

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Hydrocarbon Analysis in Xylene Wash

GTI Sample Number: 031324-003

Sample Description: Xylene Wash 6/26/2003

Tentative Component ID	Estimated mg recovered
Hydroxymethylpentanone	6.73
i-Propylbenzene	4,860
Phenol/n-Propylbenzene	2,430
Benzeneamine	<3.52
Benzonitrile/1-Ethyl-3-methylbenzene	3,930
1-Ethyl-4-methylbenzene	127
1-Ethyl-2-methylbenzene	260
Trimethylbenzenes	605
Methyl phenols/Indene	319
Methylbenzonitriles	3.94
Tetramethylpiperidinone	<3.52
Methylbenzofuran	13.6
Dimethylphenols	6.16
Methylindenes	44.3
Methylbenzaldehydes	22.8
Naphthalene	1,900
Quinoline	22.0
Isoquinoline	15.0
Indole	20.1
2-Methylnaphthalene	274
1-Methylnaphthalene	181
Methylquinolines	4.89
Methylindoles	<3.52
1,1'-Biphenyl	184
Ethylnaphthalenes	18.3
Dihydroacenaphthylene	20.9

Tentative Component ID	Estimated mg recovered
Indazole	<3.52
Methoxypropenylphenol/Dimethylnaphthalenes	66.2
Ethenylnaphthalene	131
Acenaphthylene	757
Methyl-1,1'-biphenyl	36.5
Naphthalenecarbonitriles	45.1
Acenaphthene	53.9
Dibenzofuran	99.6
Phenalene	59.8
Fluorene	267
Methyldibenzofuran	25.0
Methylfluorenes	81.0
Fluorenone	62.1
Phenanthrene	625
Anthracene	174
Carbazole	15.9
Benzoquinoline	21.3
Phenylnaphthalenes	96.2
Benzo[c]cinnoline	19.4
Methylphenanthrene or Methylanthracene	30.8
Methylphenanthrene or Methylanthracene	34.0
4H-Cyclopenta[d,e,f]phenanthrene	107
Fluoranthene	133
Pyrene	136
Methylpyrenes	65.6
Additional Unidentified Components	**2,045**
Total :	**20,456**

Total Filtered Solids (Dry Weight): 1.0 g (0.066% wt.)

Notes: Detection Limit = 3.52 mg

All components were tentatively identified by comparing the mass spectra of each component to a mass spectral reference library.

Toluene and Ethylbenzene were found in large quantities but not calculated, based on the assumption that the source of these components were from the Xylene solvent.

Due to the lack of a solvent blank to identify additional solvent impurites, all additional components found have been reported.

Estimated concentrations of all components were calculated as naphthalene by GC-FID.

Results are based on a total volume of 1760 mLs.

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Analytical Report

Batch #: 031326.doc
Date: July 22, 2003

Prepared for:

Andrew Kramer
X5612

Gas Technology Institute
1700 S. Mt Prospect Rd.
Des Plaines, IL 60018

Project # 61129-08

Received Date: 7/2/2003

Disclaimer:

Neither GTI nor any person acting on behalf of GTI assumes any liability with respect to the use of, or for damages resulting from the use of, any information presented in this report.

In April 2000, the Institute of Gas Technology (IGT) and the Gas Research Institute (GRI) combined to form the Gas Technology Institute (GTI).

Submitted by: Karen Crippen, (847) 768-0604
Chemical Research Services

Technical Contact: Alan G. Janos, (847) 768-0603

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Chemical Research Services

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Analytical Report

Batch #: 031326.doc
Date: July 22, 2003

Liquid Sample #1, 6/26/03 (031326-001)

Phase separation:

Organic phase (oil) recovered:	3.5 g	0.60 wt%
Aqueous phase recovered:	568.9 g	98.51 wt%
Solid phase recovered:	0.3 g	0.05 wt%
Loss (by difference):	4.8 g	0.83 wt%
Total sample received:	577.5 g	

Analyst: AGJ

Oil phase analyses (031326-003): (GC work only per A.K.)

Water phase analyses (031326-002):

Total Carbon:	0.38 wt%
Kjeldahl Nitrogen:	0.49 wt%
Ammonia:	0.28 wt%

Analyst: NJP, JS, AGJ

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Hydrocarbon Analysis in Oil Phase

GTI Sample Number: 031326-003

Sample Description: Liquid #1 6/26/03 Oil Phase

Tentative Component ID	Estimated mg recovered
Hydroxymethylpentanone	<0.317
Ethylbenzene	<0.317
m,p-Xylene	<0.317
o-Xylene	<0.317
Phenol	8.72
Benzeneamine	<0.317
Benzonitrile	<0.317
Methylphenols/Indene	10.2
Methylbenzonitriles	0.564
Tetramethylpiperidinone	<0.317
Methylbenzofuran	0.577
Dimethylphenols	1.62
Methylindenes	2.52
Methylbenzaldehydes	5.95
Naphthalene	234
Quinoline	6.01
Isoquinoline	4.61
Indole	5.19
2-Methylnaphthalene	72.2
1-Methylnaphthalene	49.4
Methylquinolines	3.18
Methylindoles	0.729
1,1'-Biphenyl	58.0
Ethylnaphthalenes	5.94
Dihydroacenaphthylene	6.67
Indazole	<0.317

Tentative Component ID	Estimated mg recovered
Methoxypropenylphenol/Dimethylnaphthalenes	19.5
Ethenylnaphthalene	42.4
Acenaphthylene	235
Methyl-1,1'-biphenyl	11.5
Naphthalenecarbonitriles	14.2
Acenaphthene	16.5
Dibenzofuran	32.9
Phenalene	17.5
Fluorene	97.8
Methyldibenzofuran	6.51
Methylfluorenes	18.8
Fluorenone	8.88
Phenanthrene	261
Anthracene	75.2
Carbazole	3.12
Benzoquinoline	3.96
Phenylnaphthalenes	20.1
Benzo[c]cinnoline	3.40
Methylphenanthrene or Methylanthracene	6.52
Methylphenanthrene or Methylanthracene	6.87
4H-Cyclopenta[d,e,f]phenanthrene	21.9
Fluoranthene	24.2
Pyrene	25.6
Methylpyrenes	11.4
Additional Unidentified Components	**204**
Total :	**1665**

Notes: Detection Limit = 0.317 mg

All components were tentatively identified by comparing the mass spectra of each component to a mass spectral reference library.

Estimated concentrations of all components were calculated as naphthalene by GC-FID.

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Analytical Report

Batch #: 031326.doc
Date: July 22, 2003

Liquid Sample #2, 6/26/03 (031326-005)

Phase separation:

Organic phase (oil) recovered:	2.7 g	0.29 wt%
Aqueous phase recovered:	924.0 g	98.70 wt%
Solid phase recovered:	0.2 g	0.02 wt%
Loss (by difference):	9.3 g	0.99 wt%
Total sample received:	936.2 g	

Analyst: AGJ

Oil phase analyses (031326-007): (GC work only per A.K.)

Water phase analyses (031326-006):

Total Carbon:	0.28 wt%
Kjeldahl Nitrogen:	0.30 wt%
Ammonia:	0.21 wt%

Analyst: NJP, JS, AGJ

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Hydrocarbon Analysis in Oil Phase

GTI Sample Number: 031326-007

Sample Description: Liquid #2 6/26/03 Oil Phase

Tentative Component ID	Estimated mg recovered
Hydroxymethylpentanone	<0.238
Ethylbenzene	<0.238
m,p-Xylene	<0.238
o-Xylene	<0.238
Phenol	7.53
Benzeneamine	<0.238
Benzonitrile	0.501
Methylphenols/Indene	16.3
Methylbenzonitriles	0.518
Tetramethylpiperidinone	<0.238
Methylbenzofuran	0.997
Dimethylphenols	1.02
Methylindenes	2.94
Methylbenzaldehydes	4.05
Naphthalene	295
Quinoline	4.27
Isoquinoline	3.13
Indole	4.00
2-Methylnaphthalene	56.1
1-Methylnaphthalene	37.5
Methylquinolines	2.07
Methylindoles	0.565
1,1'-Biphenyl	41.6
Ethylnaphthalenes	4.59
Dihydroacenaphthylene	4.51
Indazole	<0.238

Tentative Component ID	Estimated mg recovered
Methoxypropenylphenol/Dimethylnaphthalenes	13.9
Ethenylnaphthalene	29.4
Acenaphthylene	170
Methyl-1,1'-biphenyl	8.06
Naphthalenecarbonitriles	11.0
Acenaphthene	11.5
Dibenzofuran	22.4
Phenalene	11.7
Fluorene	66.0
Methyldibenzofuran	4.14
Methylfluorenes	13.2
Fluorenone	9.45
Phenanthrene	187
Anthracene	50.4
Carbazole	2.06
Benzoquinoline	2.55
Phenylnaphthalenes	12.6
Benzo[c]cinnoline	2.20
Methylphenanthrene or Methylanthracene	4.29
Methylphenanthrene or Methylanthracene	4.50
4H-Cyclopenta[d,e,f]phenanthrene	14.5
Fluoranthene	16.6
Pyrene	17.3
Methylpyrenes	9.57
Additional Unidentified Components	**139**
Total :	**1321**

Notes: Detection Limit = 0.238 mg

All components were tentatively identified by comparing the mass spectra of each component to a mass spectral reference library.

Estimated concentrations of all components were calculated as naphthalene by GC-FID.

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Sample Login No: 031326-008 Date: July 15, 2003
Sample Description: Carbon ash fines, 6/26/03

Proximate Analysis	(As received)	(As received) w/SO3 correction	(Dry basis)
Moisture, %	5.92	5.92	
Volatile Matter, %	15.02	15.02	15.96
Ash, %	25.64	25.57	
Fixed Carbon, % (by difference)	53.43	53.49	

Ultimate Analysis	(Dry basis)
Ash, %	27.18
Carbon, %	65.09
Hydrogen, %	0.52
Nitrogen, %	0.23
Sulfur, %	0.02
Oxygen, % (by difference)	6.96

Analyst: NJP

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Analytical Report

Batch # : 031327
August 06, 2003

Prepared for:

Andrew Kramer, Process Engineering
Phone: (847) 768-0612

Project #: 61129-08

Received Date: 7/2/2003

Submitted by: Karen Crippen, (847) 768-0604
Chemical Research Services

Technical contact for this report: _____
Russell Bora (847) 768-0693

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Major Component Gas Analysis By Gas Chromatography

Report Date: 17-Jul-03
Client Name: 61129-08
GTI Sample Number: 031327-001
Sample Description: Gas sample #1 6/30/2003 16:00
Date Analyzed: 15-Jul-03 **Analyst:** MAD

Component	Mol %	Det. Limit	Weight %
Helium		0.1%	
Hydrogen	**11.4%**	0.1%	**0.83%**
Carbon Dioxide	**18.9%**	0.03%	**30.0%**
Oxygen/Argon	**1.23%**	0.03%	**1.43%**
Nitrogen	**51.2%**	0.03%	**51.8%**
Carbon Monoxide	**10.8%**	0.03%	**10.9%**
Methane	**4.64%**	0.002%	**2.69%**
Ethane	**0.24%**	0.002%	**0.26%**
Ethene	**1.14%**	0.002%	**1.16%**
Ethyne	**0.010%**	0.002%	**0.009%**
Propane	**0.010%**	0.002%	**0.016%**
Propene	**0.123%**	0.002%	**0.187%**
Propadiene		0.002%	
Propyne	**0.006%**	0.002%	**0.008%**
i-Butane		0.002%	
n-Butane		0.002%	
1-Butene	**0.003%**	0.002%	**0.006%**
i-Butene	**0.006%**	0.002%	**0.012%**
trans-2-Butene	**0.005%**	0.002%	**0.010%**
cis-2-Butene	**0.003%**	0.002%	**0.007%**
1,3-Butadiene	**0.030%**	0.002%	**0.058%**
i-Pentane		0.002%	
n-Pentane		0.002%	
neo-Pentane		0.002%	
Pentenes	**0.003%**	0.002%	**0.009%**
Hexane Plus	**0.199%**	0.002%	**0.617%**
Hydrogen Sulfide	**0.00232%**	0.00005%	**0.00285%**
Carbonyl Sulfide		0.00005%	
Total	**100.0%**		**100.0%**

Calculated Real Gas Properties per ASTM D3588-98

Temp. (°F) =	**60.0**	**60.0**
Press. (psia) =	**14.696**	**14.73**
Compressibility Factor [z] (Dry) =	0.99913	0.99913
Compressibility Factor [z] (Sat.) =	0.99890	0.99890
Relative Density (Dry) =	0.9580	0.9580
Gross HV (Dry) (Btu/ft³) =	155.4	155.8
Gross HV (Sat.) (Btu/ft³) =	152.8	153.1
Wobbe Index =	158.8	159.2
Net HV (Dry) (Btu/ft³) =	142.5	142.8
Net HV (Sat.) (Btu/ft³) =	140.1	140.4

Notes: All blank values are below detection limit
N.A. - Not Analyzed

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TRACE SULFUR DETERMINATION BY ASTM D6228-98

Report Date: 17-Jul-03
Client Name: 61129-08
GTI Sample Number: 031327-001
Sample Description: Gas sample #1 6/30/2003 16:00
Date Analyzed: 2-Jul-03
Analyst: MAD

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	23.2	Thiophene	1.17
Sulfur Dioxide		C1-Thiophenes	0.13
Carbonyl Sulfide		C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan		Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	24.5
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As molar PPM	24.5
Di-t-Butyl Disulfide		As Grains/100 SCF @ STP	1.53
Dimethyl Trisulfide		As Grains/100 SCF @ 14.73 psia, 60°F	1.45
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes:

Component Detection Limit:
0.5 ppmv for H2S, COS, and SO2
0.05 ppmv for all other compounds per sulfur
All blank values are below detection limit.
STP= 14.696psia, 0°C

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CORE LABORATORIES

KAREN CRIPPEN
GAS TECHNOLOGY INSTITUTE
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DES PLAINES, IL 60018

Sample Number: 132956-003
Sample Date: 6/30/03 4:00:00 PM
Date Reported: 7/24/03
Date Received: 7/18/03
Sample ID: Sample # 1 (06-30-03)
Description:

Analytical Report

Test	Result	Units	Method	Date	Analyst
Nitrogen Compounds,Comprehensive					
Ammonia	1	ppm v / v	GC-Chemiluminesci	7/24/03	JB
Nitric Oxide	< 1	ppm v / v			
Nitrous Oxide	< 1	ppm v / v			
Hydrogen Cyanide	< 1	ppm v / v			
Methyl amine	< 1	ppm v / v			
Dimethyl amine	< 1	ppm v / v			
Acetonitrile	1	ppm v / v			
Acrylonitrile	< 1	ppm v / v			
Ethyl amine	< 1	ppm v / v			
Diethyl amine	< 1	ppm v / v			
Isopropyl Amine	< 1	ppm v / v			
Propionitrile	2	ppm v / v			
Tert-Butyl Amine	< 1	ppm v / v			
Isobutyl nitrile	< 1	ppm v / v			
Butyl nitrile	< 1	ppm v / v			
Pyridine	< 1	ppm v / v			
Pyrrole	< 1	ppm v / v			
Pentane nitrile	< 1	ppm v / v			
2-Methyl pyridine	< 1	ppm v / v			
2-Methyl pyrrole	< 1	ppm v / v			
3-Methyl pyrrole	< 1	ppm v / v			
3 & 4-Methyl pyridine	< 1	ppm v / v			
2,6-Dimethyl pyridine	< 1	ppm v / v			
2-Ethyl pyridine	< 1	ppm v / v			
2-Ethyl pyrrole	< 1	ppm v / v			
2,4-Dimethyl pyridine	< 1	ppm v / v			
2,4 Dimethyl pyrrole	< 1	ppm v / v			

Core Lab
PETROLEUM SERVICES

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CORE LABORATORIES

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GAS TECHNOLOGY INSTITUTE
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DES PLAINES, IL 60018

Sample Number: 132956-003
Sample Date: 6/30/03 4:00:00 PM
Date Reported: 7/24/03
Date Received: 7/18/03
Sample ID: Sample # 1 (06-30-03)
Description:

Analytical Report

Test	Result	Units	Method	Date	Analyst
2,3-Dimethyl pyridine	< 1	ppm v / v			
4-Ethyl pyridine	< 1	ppm v / v			
3,5-Dimethyl pyridine	< 1	ppm v / v			
Aniline	< 1	ppm v / v			
Unidentified Nitrogen	< 1	ppm v / v			

Approved By: Jean Waits
Supervising Chemist

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Major Component Gas Analysis By Gas Chromatography

Report Date: 17-Jul-03
Client Name: 61129-08
GTI Sample Number: 031327-002
Sample Description: Gas sample #2 6/30/2003 16:45
Date Analyzed: 15-Jul-03 **Analyst:** MAD

Component	Mol %	Det. Limit	Weight %
Helium		0.1%	
Hydrogen	**10.9%**	0.1%	**0.79%**
Carbon Dioxide	**18.8%**	0.03%	**29.7%**
Oxygen/Argon	**1.13%**	0.03%	**1.31%**
Nitrogen	**52.6%**	0.03%	**52.8%**
Carbon Monoxide	**10.4%**	0.03%	**10.4%**
Methane	**4.44%**	0.002%	**2.55%**
Ethane	**0.22%**	0.002%	**0.24%**
Ethene	**1.10%**	0.002%	**1.11%**
Ethyne	**0.018%**	0.002%	**0.017%**
Propane	**0.009%**	0.002%	**0.014%**
Propene	**0.116%**	0.002%	**0.176%**
Propadiene	**0.002%**	0.002%	**0.003%**
Propyne	**0.007%**	0.002%	**0.011%**
i-Butane		0.002%	
n-Butane		0.002%	
1-Butene	**0.002%**	0.002%	**0.004%**
i-Butene	**0.006%**	0.002%	**0.011%**
trans-2-Butene	**0.004%**	0.002%	**0.007%**
cis-2-Butene	**0.003%**	0.002%	**0.005%**
1,3-Butadiene	**0.033%**	0.002%	**0.064%**
i-Pentane		0.002%	
n-Pentane		0.002%	
neo-Pentane		0.002%	
Pentenes	**0.004%**	0.002%	**0.010%**
Hexane Plus	**0.204%**	0.002%	**0.630%**
Hydrogen Sulfide	**0.00242%**	0.00005%	**0.00296%**
Carbonyl Sulfide		0.00005%	
Total	**100.0%**		**100.0%**

Calculated Real Gas Properties per ASTM D3588-98

Temp. (°F) =	**60.0**	**60.0**
Press. (psia) =	**14.696**	**14.73**
Compressibility Factor [z] (Dry) =	0.99913	0.99913
Compressibility Factor [z] (Sat.) =	0.99891	0.99890
Relative Density (Dry) =	0.9626	0.9626
Gross HV (Dry) (Btu/ft³) =	149.8	150.2
Gross HV (Sat.) (Btu/ft³) =	147.3	147.6
Wobbe Index =	152.7	153.1
Net HV (Dry) (Btu/ft³) =	137.4	137.7
Net HV (Sat.) (Btu/ft³) =	135.0	135.4

Notes: All blank values are below detection limit
N.A. - Not Analyzed

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TRACE SULFUR DETERMINATION BY ASTM D6228-98

Report Date: 17-Jul-03
Client Name: 61129-08
GTI Sample Number: 031327-002
Sample Description: Gas sample #2 6/30/2003 16:45
Date Analyzed: 2-Jul-03
Analyst: MAD

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	24.2	Thiophene	1.03
Sulfur Dioxide		C1-Thiophenes	0.10
Carbonyl Sulfide		C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan	0.05	Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	25.4
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As molar PPM	25.4
Di-t-Butyl Disulfide		As Grains/100 SCF @ STP	1.59
Dimethyl Trisulfide		As Grains/100 SCF @ 14.73	1.50
Diethyl Trisulfide		psia, 60°F	
Di-t-Butyl Trisulfide			

Notes:
Component Detection Limit:
0.5 ppmv for H2S, COS, and SO2
0.05 ppmv for all other compounds per sulfur
All blank values are below detection limit.
STP= 14.696psia, 0°C

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CORE LABORATORIES

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Sample Number: 132956-004
Sample Date: 6/30/03 4:45:00 PM
Date Reported: 7/24/03
Date Received: 7/18/03
Sample ID: Sample # 2 (06-30-03)
Description:

Analytical Report

Test	Result	Units	Method	Date	Analyst
Nitrogen Compounds,Comprehensive					
Ammonia	1	ppm v / v	GC-Chemiluminesci	7/24/03	JB
Nitric Oxide	< 1	ppm v / v			
Nitrous Oxide	< 1	ppm v / v			
Hydrogen Cyanide	< 1	ppm v / v			
Methyl amine	< 1	ppm v / v			
Dimethyl amine	< 1	ppm v / v			
Acetonitrile	< 1	ppm v / v			
Acrylonitrile	< 1	ppm v / v			
Ethyl amine	< 1	ppm v / v			
Diethyl amine	< 1	ppm v / v			
Isopropyl Amine	< 1	ppm v / v			
Propionitrile	2	ppm v / v			
Tert-Butyl Amine	< 1	ppm v / v			
Isobutyl nitrile	< 1	ppm v / v			
Butyl nitrile	< 1	ppm v / v			
Pyridine	< 1	ppm v / v			
Pyrrole	< 1	ppm v / v			
Pentane nitrile	< 1	ppm v / v			
2-Methyl pyridine	< 1	ppm v / v			
2-Methyl pyrrole	< 1	ppm v / v			
3-Methyl pyrrole	< 1	ppm v / v			
3 & 4-Methyl pyridine	< 1	ppm v / v			
2,6-Dimethyl pyridine	< 1	ppm v / v			
2-Ethyl pyridine	< 1	ppm v / v			
2-Ethyl pyrrole	< 1	ppm v / v			
2,4-Dimethyl pyridine	< 1	ppm v / v			
2,4 Dimethyl pyrrole	< 1	ppm v / v			

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CORE LABORATORIES

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Sample Number: 132956-004
Sample Date: 6/30/03 4:45:00 PM
Date Reported: 7/24/03
Date Received: 7/18/03
Sample ID: Sample # 2 (06-30-03)
Description:

Analytical Report

Test	Result	Units	Method	Date	Analyst
2,3-Dimethyl pyridine	< 1	ppm v / v			
4-Ethyl pyridine	< 1	ppm v / v			
3,5-Dimethyl pyridine	< 1	ppm v / v			
Aniline	< 1	ppm v / v			
Unidentified Nitrogen	< 1	ppm v / v			

Approved By: Jean Waits
Supervising Chemist

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Hydrocarbon Analysis in Xylene Wash

GTI Sample Number: 031327-003

Sample Description: Xylene Wash 6/30/2003

Tentative Component ID	Estimated mg recovered
Hydroxymethylpentanone	7.07
i-Propylbenzene	5,380
Phenol/n-Propylbenzene	2,740
Benzeneamine	<1.84
Benzonitrile/1-Ethyl-3-methylbenzene	4,290
1-Ethyl-4-methylbenzene	206
1-Ethyl-2-methylbenzene	284
Trimethylbenzenes	632
Methyl phenols/Indene	202
Methylbenzonitriles	<1.84
Tetramethylpiperidinone	<1.84
Methylbenzofuran	12.6
Dimethylphenols	15.7
Methylindenes	35.1
Methylbenzaldehydes	23.0
Naphthalene	739
Quinoline	8.54
Isoquinoline	7.25
Indole	11.2
2-Methylnaphthalene	175
1-Methylnaphthalene	120
Methylquinolines	<1.84
Methylindoles	<1.84
1,1'-Biphenyl	101
Ethylnaphthalenes	20.3
Dihydroacenaphthylene	9.02

Tentative Component ID	Estimated mg recovered
Indazole	<1.84
Methoxypropenylphenol/Dimethylnaphthalenes	41.5
Ethenylnaphthalene	57.7
Acenaphthylene	356
Methyl-1,1'-biphenyl	19.4
Naphthalenecarbonitriles	16.6
Acenaphthene	44.4
Dibenzofuran	55.5
Phenalene	30.5
Fluorene	140
Methyldibenzofuran	11.7
Methylfluorenes	34.1
Fluorenone	20.7
Phenanthrene	368
Anthracene	85.9
Carbazole	6.33
Benzoquinoline	7.99
Phenylnaphthalenes	48.0
Benzo[c]cinnoline	8.85
Methylphenanthrene or Methylanthracene	15.7
Methylphenanthrene or Methylanthracene	16.4
4H-Cyclopenta[d,e,f]phenanthrene	52.8
Fluoranthene	97.6
Pyrene	111
Methylpyrenes	48.0
Additional Unidentified Components	**1,566**
Total :	**18,279**

Total Filtered Solids (Dry Weight): 0.2 g (0.013% wt.)

Notes: Detection Limit = 1.84 mg

All components were tentatively identified by comparing the mass spectra of each component to a mass spectral reference library.

Toluene and Ethylbenzene were found in large quantities but not calculated, based on the assumption that the source of these components were from the Xylene solvent.

Due to the lack of a solvent blank to identify additional solvent impurites, all additional components found have been reported.

Estimated concentrations of all components were calculated as naphthalene by GC-FID.

Results are based on a total volume of 1840 mLs.

GAS TECHNOLOGY INSTITUTE

Chemical Research Services

Analytical Report

Batch #: 031328.doc
Date: July 18, 2003

Prepared for:

Andrew Kramer
X5612

Gas Technology Institute
1700 S. Mt Prospect Rd.
Des Plaines, IL 60018

Project # 61129-08

Received Date: 7/2/2003

Disclaimer:

Neither GTI nor any person acting on behalf of GTI assumes any liability with respect to the use of, or for damages resulting from the use of, any information presented in this report.

In April 2000, the Institute of Gas Technology (IGT) and the Gas Research Institute (GRI) combined to form the Gas Technology Institute (GTI).

Submitted by: Karen Crippen, (847) 768-0604
Chemical Research Services

Technical Contact: Alan G. Janos, (847) 768-0603

GAS TECHNOLOGY INSTITUTE

Chemical Research Services

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Analytical Report

Batch #: 031328.doc
Date: July 18, 2003

Liquid Sample #1, 6/30/03 (031328-001)

Phase separation:

Organic phase (oil) recovered:	7.6 g	1.26 wt%
Aqueous phase recovered:	581.6 g	96.78 wt%
Solid phase recovered:	0.5 g	0.08 wt%
Loss (by difference):	11.3 g	1.88 wt%
Total sample received:	601.0 g	

Analyst: AGJ

Oil phase analyses (031328-003): (GC work only per A.K.)

Water phase analyses (031328-002):

Total Carbon:	0.61 wt%
Kjeldahl Nitrogen:	0.23 wt%
Ammonia:	0.25 wt%

Analyst: NJP, JS, AGJ

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Hydrocarbon Analysis in Oil Phase

GTI Sample Number: 031328-003

Sample Description: Liquid 6/30/03 Oil Phase

Tentative Component ID	Estimated mg recovered
Hydroxymethylpentanone	<0.670
Ethylbenzene	<0.670
m,p-Xylene	<0.670
o-Xylene	<0.670
Phenol	18.9
Benzeneamine	<0.670
Benzonitrile	<0.670
Methylphenols/Indene	46.1
Methylbenzonitriles	1.29
Tetramethylpiperidinone	<0.670
Methylbenzofuran	2.63
Dimethylphenols	14.6
Methylindenes	14.5
Methylbenzaldehydes	19.9
Naphthalene	403
Quinoline	12.9
Isoquinoline	11.4
Indole	13.4
2-Methylnaphthalene	221
1-Methylnaphthalene	161
Methylquinolines	5.61
Methylindoles	1.64
1,1'-Biphenyl	183
Ethylnaphthalenes	35.7
Dihydroacenaphthylene	14.4
Indazole	<0.670

Tentative Component ID	Estimated mg recovered
Methoxypropenylphenol/Dimethylnaphthalenes	74.4
Ethenylnaphthalene	101
Acenaphthylene	571
Methyl-1,1'-biphenyl	36.2
Naphthalenecarbonitriles	26.2
Acenaphthene	77.6
Dibenzofuran	96.8
Phenalene	45.5
Fluorene	242
Methyldibenzofuran	18.8
Methylfluorenes	43.3
Fluorenone	28.3
Phenanthrene	713
Anthracene	154
Carbazole	5.58
Benzoquinoline	6.65
Phenylnaphthalenes	43.4
Benzo[c]cinnoline	5.81
Methylphenanthrene or Methylanthracene	14.6
Methylphenanthrene or Methylanthracene	14.7
4H-Cyclopenta[d,e,f]phenanthrene	46.9
Fluoranthene	66.5
Pyrene	70.4
Methylpyrenes	24.3
Additional Unidentified Components	**477**
Total :	**4185**

Notes: Detection Limit = 0.670 mg

All components were tentatively identified by comparing the mass spectra of each component to a mass spectral reference library.

Estimated concentrations of all components were calculated as naphthalene by GC-FID.

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Sample Login No: 031328-004 Date: July 15, 2003
Sample Description: Carbon ash fines, 6/30/03

Proximate Analysis	(As received)	(As received) w/SO3 correction	(Dry basis)
Moisture, %	4.64	4.64	
Volatile Matter, %	26.47	26.47	27.75
Ash, %	37.46	37.32	
Fixed Carbon, % (by difference)	31.44	31.58	

Ultimate Analysis	(Dry basis)
Ash, %	39.13
Carbon, %	49.67
Hydrogen, %	0.61
Nitrogen, %	0.24
Sulfur, %	0.12
Oxygen, % (by difference)	10.24

Analyst: NJP

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Analytical Report

Batch # : 031303
July 15, 2003

Prepared for:

Andrew Kramer, Process Engineering
Phone: (847) 768-0612

Project #: 61129-08

Received Date: 6/26/2003

Submitted by: Karen Crippen, (847) 768-0604
Chemical Research Services

Technical contact for this report: Alan G. Janos

Alan G. Janos (847) 768-0603

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Sample Login No: 031303-001 Date: July 15, 2003
Sample Description: 6/12/03 Carbon Ash Fines

Proximate Analysis	(As received)	(As received) w/SO3 correction	(Dry basis)
Moisture, %	6.98	6.98	
Volatile Matter, %	16.08	16.08	17.29
Ash, %	41.58	41.46	
Fixed Carbon, % (by difference)	35.36	35.48	

Ultimate Analysis	(Dry basis)
Ash, %	44.57
Carbon, %	47.46
Hydrogen, %	0.51
Nitrogen, %	1.05
Sulfur, %	0.05
Oxygen, % (by difference)	6.36

Analyst: NJP

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Analytical Report

Batch # : 031305
July 15, 2003

Prepared for:

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Phone: (847) 768-0612

Project #: 61129-08

Received Date: 6/26/2003

Submitted by: Karen Crippen, (847) 768-0604
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Technical contact for this report: Alan G. Janos (847) 768-0603

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Sample Login No: 031305-001
Sample Description: Test #14, Solids, 6/18/03

Date: July 15, 2003

Proximate Analysis	(As received)	(As received) w/SO3 correction	(Dry basis)
Moisture, %	5.27	5.27	
Volatile Matter, %	14.25	14.25	15.04
Ash, %	25.64	25.50	
Fixed Carbon, % (by difference)	54.85	54.98	

Ultimate Analysis	(Dry basis)
Ash, %	26.92
Carbon, %	65.44
Hydrogen, %	1.16
Nitrogen, %	0.60
Sulfur, %	0.10
Oxygen, % (by difference)	5.78

Analyst: NJP

Appendix D
Typical Material & Energy Balance

Material & Energy Balance - Test Run 15, April 15, 2003

Input				Lbs/hr	C	H	O	N	S	Ash	Total	Btu	Adj Value	Original values	
Biomass (Menard)					1.37	0.18	1.30	0.00	0.000	0.01	2.87	23,132	3		
Moisture						0.00	0.00				0.00				
Steam						0.10	0.84				0.94	1,371		7.11	g/min
Air							1.41	4.65			6.06	1,907	35	35.5	l/min
Nitrogen (purge)								0.66			0.66		2.9	4	l/min
Total Input					1.37	0.28	3.56	5.31	0.00	0.01	10.54	26,411			
Output					C	H	O	N	S	Ash	Total	Btu			
Solids					0.02					0.01	0.03	379			
Oils/Tars					0.01						0.015	225			
Condensate						0.14	1.10				1.23	2,216	1019	840	
Product Gas Composition												0			
Lbs/hr	0.34261													2.057	cfm
H2	11.95%	10.200%	13.700%			0.08					0.08				
CO	10.11%	8.620%	11.600%		0.42		0.55				0.97				
CO2	17.00%	16.200%	17.800%		0.70		1.86				2.56				
CH4	3.59%	2.610%	4.570%		0.15	0.05					0.20				
C2H4	0.46%	0.420%	0.509%		0.04	0.01					0.04				
C2H6	0.11%	0.076%	0.148%		0.01	0.00					0.01				
C3H8	0.02%	0.015%	0.020%		0.00	0.00					0.00				
C6H6	0.13%	0.135%	0.120%		0.03	0.00					0.03				
N2	55.45%	60.500%	50.400%					5.32			5.32	6,840			
O2	0.45%	0.34%	0.56%				0.05				0.05				
H2S	0.0154%	0.0159%	0.0149%			0.0001			0.0017		0.0018				
COS	0.0009%	0.0008%	0.0009%		0.0000		0.0000		0.0001		0.0002				
Total Gas	Average	Sample 1	Sample 2		1.34	0.14	2.47	5.32	0.00	0.00	9.28	20,358			
Total Output					1.38	0.28	3.57	5.32	0.00	0.01	10.56	30,019			
Balance (Output/Input), %					-0.16%	0.27%	-0.28%	-0.09%	0.00%	0.00%	-0.18%				

Material & Energy Balance - Test Run 27, June 26, 2003

Input	Lbs/hr	C	H	O	N	S	Ash		Total	Btu	Adj Value	Original values	
Biomass (Menard)		1.65	0.21	1.56	0.00	0.0003	0.0151		3.44	27,726	3.3		
Moisture			0.00	0.00					0.00				
Steam			0.09	0.73					0.82	1,202		6.23	g/min
Air				1.55	5.11				6.65	2,096	35	39	l/min
Nitrogen (purge)					0.35				0.35		2.3	2.1	l/min
Total Input		1.65	0.30	3.85	5.46	0.0003	0.02		11.27	31,023			
Output		C	H	O	N	S	Ash	NH3	Total	Btu			
Solids		0.04		0.00			0.0151		0.06	663			
Oils/Tars		0.05	0.00	0.00	0.00				0.055	824	0		
Condensate		0.01	0.16	1.29				0.0041	1.46	2,612	577	770	
Product Gas Composition										0			
Lbs/hr	0.345507											2.075	cfm
H2	7.000%		0.05						0.05				
CO	12.500%	0.52		0.69					1.21				
CO2	16.200%	0.67		1.79					2.46				
CH4	4.520%	0.19	0.06						0.25				
C2H4	1.300%	0.11	0.02						0.13				
C2H6	0.160%	0.01	0.00						0.02				
C3H8	0.033%	0.00	0.00						0.01				
C6H6 plus	0.220%	0.05	0.00						0.06				
N2	56.500%				5.47				5.47	7164			
O2	0.65%			0.07					0.07				
H2S	0.0023%		0.0000			0.0002			0.0003				
COS									0.0000				
Total Gas	Sample 1	1.56	0.14	2.55	5.47	0.0002	0.00		9.71	20,531			
Total Output		1.65	0.30	3.85	5.47	0.0002	0.02		11.28	31,793			
Balance (Output/Input), %		-0.07%	-0.07%	-0.04%	-0.14%		0.00%		-0.05%				

Material & Energy Balance - Test Run 29, June 30, 2003

Input			Lbs/hr	C	H	O	N	S	Ash		Total	Btu	Adj Value	Original values	
Biomass				1.46	0.19	1.39	0.0031	0.000	0.01		3.05	24,583	3.2		
Moisture					0.00	0.00					0.00				
Steam					0.09	0.72					0.81	1,179		6.1143	g/min
Air						1.29	4.26				5.54	1,746	28	32.5	l/min
Nitrogen (purge)							0.12				0.12		2.3	0.75	l/min
Total Input				1.46	0.28	3.40	4.38	0.00	0.01		9.54	27,508			
Output				C	H	O	N	S	Ash	NH3	Total	Btu			
Solids				0.017		0.004		0.0000	0.01		0.034	408			
Oils/Tars				0.055	0.005	0.00					0.062	934	0.01		
Condensate				0.007	0.13	1.01	0.076			0.0029	1.14	2,048	582	690	gms
Product Gas Composition												0			
Lbs/hr	0.301099													1.8083	cfm
H2	11.15%	11.40%	10.90%		0.07						0.07				
CO	10.60%	10.80%	10.40%	0.383		0.51					0.89				
CO2	18.85%	18.90%	18.80%	0.681		1.82					2.50				
CH4	4.54%	4.64%	4.44%	0.164	0.05						0.22				
C2H4	1.120%	1.140%	1.10%	0.081	0.01						0.09				
C2H6	0.230%	0.240%	0.22%	0.017	0.00						0.02				
C3H8	0.120%	0.123%	0.12%	0.013	0.00						0.02				
C6H6 plus	0.20%	0.20%	0.20%	0.044	0.00						0.05				
N2	51.90%	51.20%	52.60%				4.38				4.38	6,106			
O2	0.51%	0.57%	0.46%			0.05					0.05				
H2S	0.0024 %	0.0023 %	0.0024 %		0.0000			0.0002			0.0002				
COS															
Total Gas	Average	Sample 1	Sample 2	1.382	0.15	2.38	4.38	0.0002	0.00		8.28	17,892			
Total Output				1.462	0.28	3.40	4.45	0.0003	0.01		9.52	27,389			
Balance (Output/Input), %				-0.002	-0.20%	0.15%	-1.49%	13.17%	0.00%		0.19%				