

Clean Coal III Project: Blast Furnace Granular Coal Injection Project

Topical Report November 1997

Trial 1 Report - Blast Furnace Granular Coal Injection -Results with Low Volatile Coal

Work Performed Under Cooperative Agreement No.: DE-FC21-91MC27362

For U.S. Department of Energy Office of Fossil Energy Federal Energy Technology Center Pittsburgh Site Pittsburgh, Pennsylvania

By Bethlehem Steel Corporation Bethlehem Pennsylvania

BLAST FURNACE GRANULAR COAL INJECTION -RESULTS WITH LOW VOLATILE COAL

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For U.S. Department of Energy Office of Fossil Energy Morgantown Energy Technology Center P.O. Box 880 Morgantown, West Virginia 26507-0880

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BLAST FURNACE GRANULAR COAL INJECTION -RESULTS WITH LOW VOLATILE COAL

INTRODUCTION

This report describes the first coal trial test conducted with the Blast Furnace Granular Coal Injection System at Bethlehem Steel Corporation's Burns Harbor Plant. This demonstration project is divided into three phases:

Phase I - Design Phase II - Construction Phase III - Operation

The design phase was conducted in 1991-1993. Construction of the facility began in August 1993 and was completed in late 1994. The coal injection facility began operating in January 1995 and Phase III began in November 1995.

The Trial 1 base test on C furnace was carried out in October 1996 as a comparison period for the analysis of the operation during subsequent coal trials.

BACKGROUND

The granulated coal injection facility at the Burns Harbor Plant began operation in January 1995. Coal injection began on D furnace in mid-December 1994, primarily to test the coal grinding and preparation circuits. Significant operations began January 19, 1995 when coal was injected through four tuyeres at a total rate of 20 pounds/NTHM. Coal injection was initiated on C furnace on February 9, 1995 using four tuyeres at an overall rate of 25 pounds/NTHM. The remaining 24 tuyeres used natural gas injection at the same time. These conditions were maintained throughout February and March. Operating difficulties with the coal grinding and preparation system, typical of new facility start up problems, required equipment changes and modifications. The first complete month of operation with coal as the sole injectant on C furnace was June 1995. On D furnace, complete coal injection began in April 1995. Since that time an operational learning curve and the development of efficient operating practices with the granulated coal facility were completed.

Sydney coal, a high volatile coal, was used on both furnaces for eight months. Six different low volatile coal types were subsequently used on both furnaces for seven months. The good operational experience with the low volatile coal resulted in a decision to use low volatile Virginia Pocahontas coal as the standard for granulated coal injection at Burns Harbor. The objective of the overall test program is to determine the effect of coal grind and coal type on blast furnace performance. Meaningful analysis of blast furnace process changes that occur with a change of injected coal type or sizing requires a base test period from which comparisons can be made for future tests. The requirements for an acceptable trial are:

- 1. The base period used for comparison should be chronologically close to the ensuing trial period.
- 2. A steady state operation with minimum day-to-day variability. The length of the test period is flexible, however, the longer the trial duration, the more definitive the results.
- 3. A minimum of major furnace process changes during the trial, particularly with the process variable that is being evaluated.

BLAST FURNACE OPERATIONS

The Burns Harbor C furnace operation during October 1996 meets the requirements for an acceptable comparative base period. The operating results for this period may be used as the basis for the evaluation of future trials.

The October operation on C furnace was adequate in terms of furnace performance parameters using coal injection. The injection facility supplied coal without interruption for the entire month. The average rate of 264 pounds/NTHM varied from 246-278 pounds/NTHM on a daily basis. The furnace coke rate during the period averaged 661 pounds/NTHM.

The important furnace operating conditions that indicate the full range of furnace performance results are discussed and documented in the following. In addition, extensive environmental stream testing of the closed water and gas cleaning systems, furnace refractory temperatures, thermal loads and refractory wear are presented for the Trial Base period.

FURNACE OPERATING CONDITIONS

The C furnace is designated as the granulated coal test facility due, in large part, to the physical improvements made to the furnace during the 1994 reline. The C furnace was enlarged slightly and the refractory cooling system was upgraded to a high density plate cooling configuration. The furnace stack region on C has closely spaced cooling plates that are not on the D furnace. This high density cooling was specifically designed for the rigors of high coal injection rates and to provide for increased production capability.

The essential operating characteristics for the base test are shown in Table 1. These values comprise the operating comparative base results necessary for future trial evaluation.

The type of coal used and the grind size distribution for the trial is of primary consideration for this period. The monthly average chemistry for the Virginia Pocahontas injected coal is shown on Table 2. This coal is a low volatile type with high carbon and relatively low ash content. These two characteristics should provide the highest coke replacement value for the furnace process. The gross heating value, GHV, is also an indication of the heat value provided in the tuyere region of the furnace to offset the reduction in the furnace coke rate. The sulfur content of this coal is .78% and is considered to be mid-range. Candidate coals that were evaluated for use ranged in sulfur content from .32% to 1.75%. The sulfur content and the impact on the furnace process are discussed in more detail later. The sizing of the final granulated coal product is also important to the blast furnace operators. Daily samples are taken on each furnace to determine the size distribution of the coal sent to the furnace. Table 2 shows the average size distribution of the coal injected on C furnace for October. Granular coal size for injection purposes is defined as 100% of the product coal passing a 4 Mesh (5mm) screen, 98% -7 Mesh (3mm) and 10-30% as -200 Mesh. In contrast, pulverized coal is defined as 70% - 80% of the product coal -200 Mesh. The definition of granular coal on C furnace for October is met with the average values shown on Table 2.

The injected coal rate of 264 pounds/NTHM on C furnace during October is one of the highest achieved since the start-up of the coal facility. The reliability of the coal system enabled the operators to reduce furnace coke to a low rate of 661 pounds/NTHM. The low coke rate is not only good economically, it is an indicator of the efficiency of the furnace operation with regard to displacing coke with injected coal.

Hot metal chemistry, particularly silicon and sulfur content, is another important ironmaking parameter. The end user of the molten iron, the Steelmaking Department, specifies the silicon and sulfur levels that are acceptable for their process. Low variability around the average value is necessary to achieve these specifications. The standard deviations of the silicon and sulfur content of the hot metal for October are shown on Table 1.

Table 1 also shows a typical period of natural gas injection on the C furnace during January 1995. Comparatively, we can see the significant operating changes that occur with the use of injected coal versus natural gas. The wind volume on the furnace has decreased significantly with the use of coal. Oxygen enrichment also increased from 24.4% to 27.3% with coal. The amount of moisture added to the furnace in the form of steam increased most significantly from 3.7 grains/SCF of wind to 19.8 grains/SCF. All of these operating variables were increased by the furnace operating personnel to maintain adequate burden material movement. These actions also increased the permeability of the furnace burden column. Permeability is discussed in more detail later.

Also of significance in Table 1 is the adjustment made to the furnace slag chemistry to accommodate the increased sulfur load from the injected coal. The sulfur content of the slag increased from 0.85% with gas to 1.39% with coal. The slag volume also increased in order to help with the additional sulfur input.

Blast furnace slag chemistry and volume is a determining factor in the final sulfur content in the hot metal. The blast furnace slag must be of such a chemistry that it can carry the sulfur supplied by the burden material, including the sulfur contributed by the injected coal. Table 3 shows the sulfur balance on C furnace during the month of October. Injected coal is the second largest contributor of sulfur to the blast furnace process. The blast furnace slag is the largest output variable for the sulfur.

The blast furnace also produces large quantities of gas. The gas exits the top of the furnace, is cleaned and used as a fuel in the hot blast stoves. The excess gas produced is consumed at the plant's boiler house. Special testing during October by the Burns Harbor Plant Environmental Department for the presence of sulfur in the gas shows an average of 3.1 grains per 100 scf during the month. The amount of sulfur present in the gas and the total gas production is shown on Table 3. The total furnace sulfur balance shows reconciliation of the furnace sulfur input to output at 99.2%.

A method of representing furnace stack conditions as well as the overall furnace operation is by calculating a permeability value. Permeability is a function of the blast rate and the pressure drop through the furnace. The equation used for this purpose is:

Permeability = $(Furnace Wind Rate)^2 / [(Furnace Blast Pressure)^2 - (Furnace Top Pressure)^2]$

The larger the permeability number the better the furnace burden movement and the better the reducing gas flows through the furnace column. Figure 1 is a plot of the permeability value and the injected coal rate for each month in 1996. The permeability decreased from January to February as the injected coal rate was increased. Since then, this value has increased monthly, declining only slightly to a level of 1.19 for October. This indicates an acceptable overall operation on the C furnace during the base test period.

ENVIRONMENTAL TEST RESULTS

Gaseous Streams:

During the month weekly gas samples were obtained from the C furnace and analyzed by Mostardi Platt Associates, Inc. Results of the gas samples are presented in Appendix 1.

Wastewater Monitoring

During October, monitoring of the Division's treated process water effluent (Monitoring Station 011) and the Division's combined effluent was conducted in accordance with the NPDES permit. In addition, internal monitoring of the Blast Furnace Recirculating Water System was performed weekly. Figure 2 is a flow diagram of the water system and shows the location of the outfall monitoring stations. All monitoring results at Station 011 and Outfall 001 were within the applicable limitations and/or expected ranges. Monitoring results for the recirculating water system on October 23 indicate a slightly elevated ammonia-nitrogen concentration. The cause of elevated level is unknown. There were no adverse affects on the Division's wastewater system that could be attributed to the BFGCI system during the month. Appendix 2 shows the monitoring results for the month.

FURNACE THERMAL CONDITIONS AND LINING WEAR

The C furnace is equipped with a Thermal Monitor System consisting of two components: eight thermocouples embedded in the furnace refractory at each of four furnace elevations and an extensive system of thermocouples in the discharge water cooling system at five furnace elevations. The heat loss in the furnace is calculated for various elevations in the furnace from the water system thermocouples.

In addition to the array of thermocouples, wear monitors have been placed in the refractories of the furnace at various elevations and quadrants. These monitors give an indication of the amount of brick that is left in the furnace at the various elevations.

The inwall refractory temperatures for C furnace are shown in Figure 3 for 1996. The increased amount of injected coal does not appear to have caused an increase in the temperatures over the ten month time frame. The refractory temperatures for October have decreased at several elevations from some high values during January and February.

By contrast, the thermal load values in $BTU/HR/FT^2$, especially at cooler plate row 11-20, did increase significantly during May, June and July compared to January 1996. However, the heat loads have subsided during the following three months. This trend is shown in Figure 4. Although there has been a increase in thermal loads at row 11-20, the mid-stack elevation on the furnace, none of the other measured elevations have increased significantly. Changes in thermal load values indicate a change in the operating characteristics of the furnace. The C furnace, as mentioned previously, was designed to accept these anticipated increases.

Figure 5 shows the refractory wear monitor readings from the beginning of the C furnace campaign. The amount of coal injected is also shown. This figure seems to indicate that brick wear has increased as coal injection rates have been increased. This may or may not be the proper conclusion on furnace refractory wear. Figure 6 is included in this analysis to

show that refractory wear in a blast furnace may also be attributed to normal wear over the life of the campaign. Figure 6 shows the refractory wear patterns of previous furnace campaigns at the Burns Harbor Plant against service time in months. We note that after twenty months of service, the highest wear area on C furnace with coal injection is slightly better than three previous furnace campaigns without coal injection. We must also note, however, that the previous campaigns shown did not utilize the high density cooling configuration that was installed on the C furnace for the current campaign. More operating data is necessary to determine the relationship between coal injection and furnace refractory wear.

DISCUSSION

A major conclusion of the use of granular coal injection for the October base test as well as the general furnace operational characteristics shown throughout 1996 is that granular coal performs very well in large blast furnaces.

The quantity of furnace coke that is replaced by an injected fuel is an important aspect of the overall value of the injectant on the blast furnace process. The replacement ratio is also a very strong indication of the quality of the overall operation with coal as the injectant. A detailed analysis of the furnace coke/granulated coal replacement value for the C and D furnaces at the Burns Harbor Plant has been completed.

The replacement ratio for a blast furnace injected fuel is defined as the amount of furnace coke/NTHM that is replaced by one pound/NTHM of the injectant. However, there are many furnace operating factors, in addition to the injectant, that affect the reported coke rate. In order to calculate an accurate value for the injected coal's role in the process, all other blast furnace operating variables that result in coke rate changes, positively or negatively, must be accounted for. After technically accounting for coke changes caused by variables other than the coal, we attribute the remaining coke difference to the injected coal.

This evaluation uses monthly average furnace operating results compared to an appropriate base period for each furnace to develop the replacement ratio. We have used twenty five months of data on both furnaces which includes operating results through the second quarter of 1996. The more monthly operating data available the more accurate and appropriate the replacement value determination will be.

The adjusted furnace coke rate and the injected coal are plotted in Figure 7 along with the best fit regression line. The slope of the best fit line shows that the coal/coke replacement is 0.96. The C furnace value for October 1996 is shown separately. This value correlates well with the overall regression. This is an excellent replacement ratio and is significantly better than the 0.8-0.9 replacements reported by other injection operations.

A second conclusion from this work is the ability of the process to adequately handle the increased sulfur loading from the injected coal. As shown in the sulfur balances, the blast furnace slag can be adjusted, without harm to the overall operation, to accommodate the increased sulfur input.

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Thirdly, the unexpectedly large decrease in furnace permeability as a result of the use of injected coal has been overcome by increasing the oxygen enrichment and raising the moisture additions to the furnace.

TABLE 1

BASE PERIOD EVALUATION Burns Harbor C Furnace Summary of Operations

	OCTOBER 1996	JANUARY 1995
Production, NTHM/day	6943	7436
Delays, Min/day	71	25
Coke Rate, lb/NTHM Rep.	661	740
Natural Gas Rate, Ibs/NTHM	0	141
Injected Coal Rate, Ibs/NTHM	264	0
Total Fuel Rate, lbs/NTHM	925	881
Burden %:		
Sinter	35.9	32.3
Pellets	63.8	67.0
Misc.	.3	.7
BOF Slag Ibs/NTHM	5	0
Blast Conditions:		
Dry Air SCFM	137,005	167,381
Blast Pressure, psig	38.8	38.9
Permeability	1.19	1.57
Oxygen in Wind %	27.3	24.4
Temp, F	2067	2067
Moist. Grs/SCF	19.8	3.7
Flame Temp, F	3841	3620
Top Temp, F	226	263
Top Press, psig	16.9	16.1
Coke:		
H2O, %	5.0	4.8
Hot Metal %:		
Silicon	.50	.44
Standard Dev.	.128	.091
Sulfur	.040	.043
Standard Dev.	.014	.012
Phos.	.072	.070
Mn.	.43	.40
Temp., F	2734	2745
Slag %:		
SiO2	36.54	38.02
AI2O3	9.63	8.82
CaO	39.03	37.28
MgO	11.62	12.02
Mn	.46	.45
Sulfur	1.39	0.85
B/A	1.10	1.05
B/S	1.39	1.30
Volume, Ibs/NTHM	424	394

TABLE 2

BURNS HARBOR C FURNACE INJECTED COAL ANALYSIS AND SIZING OCTOBER 1996 - COAL TEST BASE

Coal	Va. Pocahantas
	Six Train Avg., June1996
Vol. Matter, %	18.00
Sulfur, %	.78
Ash, %	5.3
Ultimate Analysis, %	
Carbon	87.1
Oxygen	1.23
Hydrogen	4.2
Nitrogen	1.21
Chlorine	.170
Total Mois.,%	6.6
GHV, BTU/lb (dry)	14974

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C FURNACE PRODUCT COAL SIZING OCTOBER 1996

		MEAN %	<u>S. D. %</u>
+4 Mesh		0	-
-4 Mesh	+ 8 Mesh	0.6	0.2
-8 Mesh	+16 Mesh	3.7	0.5
-16 Mesh	+30 Mesh	10.6	1.1
-30 Mesh	+50 Mesh	16.0	0.6
-50 Mesh	+100 Mesh	26.8	4.6
-100 Mesh	+200 Mesh	27.7	4.2
-200 Mesh	+325 Mesh	13.9	3.3
-325 Mesh TOTAL		0.70	0.4

TABLE 3

BURNS HARBOR C FURNACE SULFUR BALANCE OCTOBER 1996 - COAL TEST BASE

SULFUR INPUT:	October 1996	SULFUR OUTPUT:	October 1996
Material;		Material;	
Furnace Coke, Sulfur Analysis	.69%	Blast Furnace Slag, Sulfur Analysis	1.39%
Tons Coke Used	71,085.0	Total Tons Produced	45,626.6
Tons Sulfur In	490.5	Tons Sulfur Out	634.2
Injected Coal,Sulfur Analysis	.78%	Blast Furnace Iron, Sulfur Analysis	.040%
Tons Coal Used	28,409.0	Total Tons Produced	215,220.0
Tons Sulfur In	221.6	Tons Sulfur Out	86.1
Sinter, Sulfur Analysis	.02%	Flue Dust,Sulfur Analysis	.450%
Tons Sinter Used	121,282.6	Total Tons Produced	1,076.1
Tons Sulfur In	24.3	Tons Sulfur Out	4.8
Pellets, Sulfur Analysis	.01%	Filter Cake, Sulfur Analysis	.482%
Tons Pellets Used	215,306.5	Total Tons Produced	2,570.60
Tons Sulfur In	21.5	Tons Sulfur Out	12.4
Scrap, Sulfur Analysis	.23%	Top Gas, Sulfur Content	3.1 Grs./100 scf
Tons Scrap Used	3,981.7	Total Gas Produced, MMCF	108,246
Tons Sulfur In	9.2	Tons Sulfur Out	23.9
BOF Slag, Sulfur Analysis	.07%		
Tons BOF Used	530.2		
Tons Sulfur In	.4		
TOTAL TONS of SULFUR IN:	767.5	TOTAL TONS of SULFUR OUT:	761.4
		SULFUR OUT/SULFUR IN	.992

FIGURE 5

LINING WEAR vs. COAL INJECTION Burns Harbor "C" Furnace — 5th Campaign



Date of Last Measurement: 10/10/96 RAS/JCM FIGURE 6

COMPARISONS OF LINING WEAR Burns Harbor "C" and "D" Furnaces



RAS n066

FIGURE 7

BURNS HARBOR C & D BLAST FURNACES

injected Coal Rate - Ibs/ton

Blast Furnace Granulated Coal Injection Environmental Monitoring Report -

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Appendix I - Gaseous Stream Testing Results

A Full-Service Environmental Consulting Company

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945 Oaklawn Avenue Elmhurst, Illinois 60126-1012 Phone 708-993-9000 Facsimile 708-993-9017

GAS ANALYSIS STUDY Performed For BETHLEHEM STEEL CORPORATION At The Burns Harbor Works Burns Harbor, Indiana Blast Furnace C October 3, 9, 17 and 25, 1996

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MOSTARDI PLATT PROJECT: 64017, 64113, 64202, 64312 DATE SUBMITTED: NOVEMBER 6, 1996

Bethlehem Steel C-Blast Furnace Gas Test Results Burns Harbor, Indiana

					Carbon	Total S	Sulfur Content
Date Sampled	Time Sampled	Hydrogen (mol %)	CO ₂ (mol %)	0, (mol %)	Monoxide (mol %)	(ppmv)	(as gr/100 scf)
10/03/96	0830	*		*	•	•	•
10/03/96	1100	4.58	25.0	0.63	23.7	36.0	2.3
10/03/96	1300	*		•	*	•	
10/09/96	0800	2.26	21.8	3.99	21.3	34.0	2.1
10/09/96	1100	•		•	•	*	
10/09/96	1300	4.04	23.6	1.26	24.2	60.0	3.8
10/17/96	0800	•	•	•	*	*	*
10/17/96	1100	•	*	*	*	*	*
10/17/96	1300	4.73	24.9	0.62	25.5	49.0	3.1
10/25/96	0800	4.51	24.1	0.84	24.8	59.0	3.7
10/25/96	1000	4.66	24.5	0.61	25.8	53.0	3.3
10/25/96	1200	4.49	24.3	0.94	24.5	57.0	3.6

* Data included in report but shows high % of oxygen and may not be representative of actual conditions.

10/15/96 LOT Log # 19614961 XL3

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Client Name: Mosta	rdi Platt		
IGT Sample Number: 96149	61		
Sample Description: Sample	e 64017-001	10/3/96	0830
Date Analyzed: 7-Oct-	96	Analyst cia	
Component	Mat %	Det. Limit	Weight %
Fishnan	ND	0.001%	ND
21ydrogan	2,73%	0.04%	0.18%
Carbon Despide	14.7%	0.03%	21.5%
Educat		0.03%	
Ethane		0.03%	
Citygen/Argen	5.36%	0.03%	10.0%
Nitrugen	59.2%	0.03%	55.1%
Methane		0.03%	
Cartron Monande	14.1%	0.03%	13.2%
Ednyme		0.002%	
Propenc		0.002%	
Propenc		0.002%	
Propulsan		0.002%	
Рторунс		0.002%	
i-Butanc		0.002%	
- Batane		0.002%	
1-Balanc		0.002%	
Banne		0.002%	
Trans-2-Bulanc		0.002%	
Ca-2-Butene		0.002%	
1.3-Bundane		0.002%	
ano-Pattane		0.001%	
-Pastanc		0.002%	
a-Parane		0.002%	
Pertona		0.002%	
Hazara Pha		0.002%	
Hydragen Sulfide	0.0012%	0.0001%	0.0014%
Cerbanyt Sulfide	0.0021%	0.0001%	0.0041%
Unidentified		0.001%	
Water	ND	0.001%	ND
Tetal	100.8%		100.0%
Calculated Real Gas	Properties per AS	TM D3548-91	•
a waape of a pro-	14.694	14.73	
Compressibility Petter [z] =	0.99929	0.99929	
Relative Density =	1.03#5	1.0385	
Gran HV (DRY) =	55.4	55.5	
Gree HV (SAT.) -	54.4	54.5	
Wohler Index =	543	د الأ	
Net HV (Drv) =	53.4	53 6	
	5 5	52.6	

Total Hydrocarbons are below 0.03%

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10/15/96 FOT Lay # : 9614962.3(1.5

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Chent Nume: Mos			
IGT Sample Number: 9614	962		
Sample Description: Sam	ple 64017-002	10/3/96	11.00
Date Analyzad: 7-00	1-96	Analyst: cia	
Component	Mel %	Dut. Limit	Weight %
	Ŕ	0.001%	ND
iver and	4.58%	0.04%	1.38%
Carbon Dusside	25.9%	0.03%	25.7%
Ethine		0.03%	
Ethene		0.03%	
Orygen/Argen	0.63%	0.03%	0.67%
Nitragen	46.1%	0.03%	41.9%
Methyne		0.03%	
Carbon Monoride	23.7%	0.03%	21.5%
Ethnytec		0.002%	
Property		0.002%	
Propeze		0.002%	
Propadaeae		0.002%	
Propyse		0.002%	
i-Butane		0.002%	
- Butane		0.002%	
1-Butene		0.002%	
-Bulanc		0.002%	
		0.002%	
		0.002%	
and Baseline		0.001%	
		0.007%	
n. Parente		0.002%	
Persiance		0.002%	
Herme Pas		0.002%	
Hydronen Sullide		0.0001%	
Carbonyl Sulfide	9.0036%	0.0001%	0.00719
Unidentified		0 001%	
W ster	ND	0.001%	N
Telaj	100.0%		100.0%
Calculated Real G	n Properties per AS	TM DJS88-91	
	14 44	1,000 100	
مراجع بروری می از این می از این می این این این این این این این این این ای		0	
	1.0557	1.0557	
Gran HV (DRY) =	A16	91.8	
Grow HV (SAT.) *	90.0	90.2	
Wohne Index #	21.1	89.0	
Net HV (Dry) =	11.5	11.7	
Mar HV (Sar) a	87.0	\$7.2	

Total Hydrocarbons are below 0.03%

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IGT Institute of Gas Technology

Instruct of Gas Tachnology 1700 South Mr. Prospect Rd. Des Planes, D. 60012

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IGT Institute of Gas Technology

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Major Componer	nt Gas Analysis	By Gas Chrome	tography
Client Name: Mor	tardi Platt		
IGT Sample Number: 9614	66		
Sample Description: Sam	ple 64017-003	10/3/56	13:00
Date Analyzed: 7-Oc	a-96	Analyst: ck	
-		-	
mponent	Mel %	Det. Limit	Weight %
	ND	0.001%	ND
	1.0%	0.04%	8.84%
ns Dioxide	3.98%	0 03%	5.98%
£		0.03%	
		0.03%	
jim/Argan	18.6%	0.03%	20.5%
	73.8%	0 03%	69.2%
		0.03%	
en Monorode	3.84%	0.03%	3.67%
*		0 002%	
		0.002%	
		0.002%	
abaz		0 002%	
/122		0.002%	
		0.002%	
Later		0.002%	
		0.002%	
		0 002%	
-2-Butene		0.002%	
Butene		0 002%	
and and a second se		0.002%	
Pastape		0.001%	
late		0 002%	
at abs		0.002%	
		0 002%	
ne Pita		0.002%	
ogen Sulfide	9.0001%	0.0001%	8.8802%
anyi Sulfide	8,8004%	0.0001%	8.0009%
lentified		0.001%	
a	ND	0.001%	ND
1	100.0%		100.0%
Calculated Real G	as Properties per Al	STM DJ588-91	
	1.99	67.7	
2700. (Jan	14.070	1	
Compressionry Patter (2) =		0.37733	
	144	1.4673	
	14.0	14.0	
Gras HV (SA1.)*	14.3	14.5	
Wobbe ladest =	14.5	14.5	
Net HV (Dry) *	Į4.}	14.2	
Net VIV / Set 1 a	119	119	

ND - Not Determined

Total Hydronybors are below 0.03%

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IGT institute of Gas Technology

10/24/96 KT Log # 9615121,31.5

-

Major Componen	t Gas Analysis I	y Gas Chrona	tography
Client Name: Most	tardi <u>Platt</u>		
IGT Sample Number: 9615	121		
Sample Description: Samp	ple 64113-001	10/9/96	0800
Date Analyzed: 23-0	et-96	Analyse: cir	L Contraction of the second
Component	36al 96	Det. Limit	Weight %
ielam	ND	0.001%	ND
iyaragan.	2.36%	0.04%	4.15%
Cartons Districts	21.8%	0.03%	34.2%
Edware .		0.03%	
Ethane		0.03%	
Daygen/Argen	3.99%	0.03%	£1 5%
- Stragen	59.7%	0.03%	45.7%
Anthone .		0.03%	
Carbos Monorade	21.3%	0.03%	19.2%
Ethyne		0.002%	
торых		0.002%	
Topes		0.002%	
Propadame		0.002%	
habitet		0.002%	
-Datase		0.002%	
Butanc		0.002%	
-Butent		0.002%	
-Butane		0.002%	
rate-2-Ballage		0.002%	
Car, 2 Batter		0.002%	
3-Batadiene		0.002%	
ne-Pantanc		0.001%	
Period		0.002%	
		0.002%	
		0.002%	
Science Film Antonio Film		0.002%	
		0.000176	
and control and the set	9.04694 78	0.000176	4.944D 74
	ND	0.001%	· ND
[etal	108.5%		100.0%
Calandaria Part C.	. Proceeding and A C		
Tens ("F>	L	6.6	
Press. (pain)=	14.6%	14.73	
Comprembility Factor [2]	0.99907	0.99907	
Relative Duranty -	1.073)	1.0731	
Gross HV (DRY) =	75.9	76.1	
Gross HV (SAT.) =	74.6	74.8	
Wobbe index =	נמ	73.5	
Net HV (Dry) =	74,4	74.6	
Net HV (Set.) +	73.1	73.3	

Notes: All black values are below detection lingu

ND - Not Determined

Total hydrocarbons are less than 0.03%.

10/24/96 IGT Log # 9615122.32.5

.

Major Componen	t Gas Analysis I	By Gas Chromi	tography
Cient Name: Mon	tardi Platt		
IGT Sample Number: 9615	122		
Sample Description: Sam	ble 64113-002	10/4/46	11:00
Date Analyzed: 23-0	c 1-96	Analyst: clu	
		////////	
Component	Mai %	Det. Limit	Weight %
Heliosp	ND	0.001%	ND
Rydrogen	0.73%	0.04%	4.05%
Carbon Dissols	3.75%	0.03%	5.64%
Etheme		0.03%	
Ethene		0.03%	
Cirygen/Arijan	18.6%	0.03%	28.5%
Narogan	73.1%	0.03%	78.8%
Matheme		0.03%	
Carbon Monomée	3.99%	0.03%	3.74%
Ednyan		0.002%	
Propage		0.007%	
Propuse		0.002%	
Propadogat		0.002%	
Рторуде		0.002%	
-Dutan:		0.002%	
-Butanc		0.002%	
l-Buzene		0.002%	
Butanz		0.002%	
Trans-2-Bullance		0.002%	
Cis-2-Busene		0.002%	
1.3-Bundiene		0.002%	
ant>-Pentanet		0.001%	
Person		0.002%	
-Petiane		0.002%	
Personal		0.002%	
Herme Plan		9.002%	
ilydrogen Sulfide	0.0001%6	0.0001%	0.0001%
Carbonyi Sulfide	1.1004%	£0001%	4.8807%
Understand		0.001%	
Willer	ND	0.001%	<u> </u>
Totai	100.0%		100.0%
Calculated Real Ga	Properties per AS	TM DISSE-91	
Temp. (**)*	6.93	48.8	
Pres. (pas)=	14.696	14,73	
Compressibility Faster (2) *	0.99955	0.99955	
Relative Departy +	1.0071	1.0071	
Gross HV (DRY) =	15.1	15.1	
Gross (IV (SAT.) =	14.8	14.8	
Wabbe Index =	15.0	15.0	
Net HV (Dry) =	14.6	14.6	
Net HV (SøL) =	H3	143	

Notes: All blank values are below detection light ND - Not Determined Total hydrocarbans are less than 0.03%

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Analytical Report

Major Composi			after after 1
Client Name: M	ostardi Platt		
IGT Sample Number: 96	15123		
Sample Description: Sa	mple 64113-003	10/9/96	13.00
Date Analyzed: 23	-Oct-96	Analyst: cla	
Component	Mal %	Det. Limit	Weight %
Leine		0.001%	N
ivinan	444	0.04%	0.26%
Certon Dioxide	23,6%	0 03%	33.7%
Ethane .		0.03%	
ihere .		0.03%	
xygan/Argon	1.26%	0.03%	1.32%
larajan.	46.9%	0.03%	41.7%
(chan:		0.03%	
larbos Moscoode	34.2%	0.03%	22.0%
thytes		0.002%	
- Contraction -		0 002%	
cpate		0.002%	
spatiene		0.002%	
		0.002%	
lane		0.002%	
Butane		0.002%	
Julene		0.002%	
		0.002%	
En-2-Black		0.002%	
		0.002%	
		0.002%	
		0.001%	
		0.002%	
		0.00276	
nume Pas		0.00774	
draman Sulfsde	0.001954	6.0001%	
rbarvi Sulfide	0.004196	0.0001%	
sidentified		0.001%	
	ND	0.001%	ND
lai	100.0%		100.0%
Calculated Real	Ges Preserties our AS	TM D3588-91	
Tem. (7)-	6.1	64.5	
Press. (print)**	14.6%	14.73	
Compressibility Factor [z] -	0,99903	0.99903	
Relative Density =	1.0656	1.0656	
Getass HV (DRY) +	92.7	92.9	
Gross HV (SAT.) =	91.1	513	
Wobbe Index •	89.8	90.0	
		60 A	
Net HV (Dry) =	87.8	90.0	

ND - Not Determent

Total hydrocerboss are less than 0.03%

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Analytical Report

10/25/96 ICT Log # : 961530; JCLS

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Major Compone	nt Gas Analysis l	By Gas Chrome	tography
Client Name: Mo	stardi Platt		
IGT Sample Number: 961	5301		
Sample Description: Sam	nple 64202-001	10/17/56	05.00
Date Analyzed: 24-4	0	Anabat: cla	
Component	Mal %	Det. Link	Weight %
Relian.	ND	0.001%	NC
ilydragen -	4.53%	0.04%	1.06%
arten Destide	4,24%	0.03%	639%
item:		0.03%	
ifanne.		0.03%	
Carygen/Argen	17.2%	0.03%	19.8%
larajan	73.5%	0.03%	70.5%
fetbala:		0.03%	
Larbon Monanciale	4.34%	0.03%	4.06%
illiyas		0.002%	
		0.002%	
TOPER		0.002%	
Topo Sant		0.002%	
		0.002%	
Baas		0.002%	
Batas		0.002%	
Buter		0.002%	
Butanc		0.002%	
na-2-Bulanc		0.002%	
-2 Parme		0.002%	
3-Bassiene		0.002%	
-Pentant		0.001%	
Perstance		0.002%	
Particle		0.002%	
		0.007%	
estane Plan		0.002%	
Netronen Selfinic	0,0003%	0.0001%	0,004494
internet Sulfide	8.8006%	0.0001%	0.001344
Indentified		0.001%	
	ND	0.001%	120
etal	100.0%		100.0%
Calculated Rant G	ia Properties ser AS	TM 03588-91	
Ten- (T)	4.1	60.A	
Press. (seas)*	14.9%	14.73	
Compressibility Factor [z] =	0.99955	0.99955	
Reserve Denser -	1,0073	1.0773	
Gran HV (DRY) =	16.6	16.7	
Gras HV (SAT.) -	16.1	16.4	
Wobbe lader -	16.6	16.6	
		16.1	
Net HV (Dev) =	16.0	30.1	

Notae: All blank values are below detection intait ND - Not Detectorized

Total hydrocerbone arc last then 0.03%

-

Chient Name: Mor	tardi Platt		
IGT Sample Number: 9615	302	, ,	
Sample Description: Sam	pie 64202-002	10/17/96	11 01
Date Analyzed: 24-0	ka-96	Analyst: cla	ŀ
Component	Mal %	Det. Limit	Weight 9
Helana	ND	0.001%	DK
Hydrogen	1.52%	0.04%	LNY
Carbon Domine	2,77%	0.03%	4199
Ethane .		0.03%	
Ethage:		0.03%	
Citygue/Argos	18.4%	0.03%	24.4%
Naragen	75.4%	0.03%	72.81
) fathar		0.03%	
Carbon Monosóde	2.69%	0.03%	2.57%
Ethylac		0.002%	
Propense		0.002%	
Proper		0.002%	
Propadient		0.002%	
Propyat		0.002%	
i. Batage		0.002%	
		0.002%	
]-Billent		0.002%	
		0.002%	
		0.002%	
		0.002%	
		0.00276	
		0.00176	
- Press and		0.00274	
		0.00274	
Herane Plan		0.00744	
Hydronan Sulfide	8.800 M.	0 0001%	0.0007%
Carbonyi Saliate	1.000114	0.0001%	0.0007
Lindersford		0.001%	
West Contraction of the second	ND	0.001%	N
Tetal	100.0%		100.05
Colculated Hant Ge	e Properties per AS	TM D3588-91	
Temp. ("F)"	6.13	60.8	
Prum. (pain)=	14.6%	1473	
Compressibility Feder (z) =	0.59958	0.99958	
Relative Datasty -	1.0053	1.0033	
Gross HV (DRY) =	10.5	10.5	
Gran HV (SAT.) =	10.3	10.3	
Wobbe index *	10.5	10.5	
Net HV (Dry)=	10.1	10.1	
Net HV (Set.) =	9.9	10.0	

ND - Not Determined Total hydrocarbons are less then 0.03%

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Analytical Report

10/25/96 1071 Lag # : 961 5303 ____

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Major Componen	t Gas Analysis I	y Gas Chronn	tography
Client Name: Mos	tardi Platt		
IGT Sample Number: 9615	303		
Sample Description: Sam	ole 64202-003	10/17/5	6 12
Date Analyzed: 24-0	et-96	Anober de	
			•
imponent	Mol %	Det. Limit	Weight %
	ND	0.001%	
áragas	4.73%	0.04%	0.31%
ren Demode	34.9%	0.03%	35.7%
		0.03%	
e .		0.03%	
ngen/Argen	442%	0.03%	8.45%
Tajata	44.2%	0.03%	41.2%
here		0.03%	
on Monoxide	25.5%	0.03%	23.2%
×		0 002%	
		0.002%	
		0.002%	
wher:		0.002%	
ye:		0.002%	
		0.002%	
late .		0.002%	
		0.002%	
		0.002%	
- 2- 94,434		0.007%	
		0 002%	
		0.002%	
		0.0D1%	
		0.002%	
		0.002%	
		0.002%	
per contra		0.002%	
region of the second		0.000196	4.4716%
antified		0.000176	1.0007%
	N	0.00114	1 270
1	100.0%		100.0%
Calculated Real Ga	Properties per AS	TM D3585-91	
-(۳) هه (64.6	6.0	
Press. (pasis)-	14.696	14.73	
Comprendicity Factor (2) -	0.99899	0,99899	
Raissive Dunnity -	1.0656	1.0656	
Gross HV (DRY) +	99.1	99 3	
Grow HV (SAT.) =	97.3	97.6	
Wabbe index =	96.0	96.2	
Net EY (Dry) =	95.L	96.0	
Het HV (Set.) =	94.1	943	
Meden ARhi		محمد المحمد	
ND.	an Determined		

ND - Not Determined Total hydrocerbons are less then 0.03%

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Analytical Report

L1/1/96 20T Lag # : 9615381.3C.5

Majer Component	t Ges Analysis B	7 Ges Chromatin	raphy
Climit Name: Ment	and Flatt		
IGT Sample Number: \$615	301	1 1 101	
Sample Description: Samp	de 64312-001	10/25/96	09.00
Date Analyzed: 30-0	ci-96	Analyst: die	
	1444 PA	Det. Limit	Waght %
	ND	0.001%	ND
	451%	0.04%	6.34%
m Diatida	341%	0.03%	34,2%
		0.03%	
		0.03%	
	0.34%	0 83%	6.07%
	46.3%	0.03%	41.7%
■		0.03%	
i Mananida	24.8%	0.03%	22.6%
		8 002%	
		6 (127%)	
		0.007%	
		- 002m	
-		0.007H	
-		0.022%	
- Base		0 00274	
		8.002%	
-		9.002%	
		0.001%	
•		0 002%	
		0 002%	
-		0 002%	
Phen		0.002%	
an Indian	6.0126%	0.9201%	0.0029%6
yt Sulfide	6.0023%	0.0001%	0.0064%
mõet		6.001%	
	ND	0.001%	
	147149		100.5%
Calculated Real Co	a Properties per Al	CTP4 (00400-91	
Press. (anis)-	14.006	14.73	
Conversibility Farm Int -	0.99901	0 1990)	
Relate Dame -	1.0044	1,0044	
Gran HY (GRY) -	96.7	31.5	
Que MY (LAT.) -	95.0	95.2	
Walte July -	\$3.7	93.9	
Her KV (Dry) -	93.5	93.7	
Hat HY (Hat.) +	91.9	92.1	
Plates: All bi	ومراجع وبير ويعرفوه باعما	deterton limit	
ND-	Het Determinent		

Total Systems in the time 0.02%.

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Analytical Report

1774 NT Lag # - 9615382.30.8

Maji	er Camponent C	ins Analysis B	Ges Chromes	ut state
Climit	Name: Mantag	d llaŭ		
ICT Secols N	amber: 961536	2		
Samuela Dave	dution: Records	64112-842	10/25/41	10.00
Deep As	shands 10-Out	K		
		~		
Campenant		Mel %	Bot. Lámh	Weight %
		ND.	6.001%	Ю
		4.66%	0.04%	633%
atan Dissist		34.2%	1.03%	36.8%
there are a second s			8.07%	
lane -			0.07%	
nyijiti/Anyati		6.E.W	0.03%	6.64%
		46.4%	0.00%s	41.5%
infano.			÷ 07%	
etes Manade		7776	8.03%	23.5%
ها بر ش			0.000%	
			0.0021%	
			0.007%	
apada aga			0.002%	
			1 CC 24.	
Denne.			0.037%	
julain -			0.000%6	
-bann				
			0.000%	
3-7- 7-8 -8			0.00246	
Laura Maria			6.000m	
hadanan dalifata		A 44731 %.	0.000166	
ayan ugun angen Saturnat Satilan		8.885394	0.000194	
المراز المراز المراز			0.001%	
i der		ND	0.001%	167
latel		100.0%		HALPA
	أحمل إستار أستخلصا	Taurila in Al	The Databal at	
		444	44.4	
	. fame in	14.006	14.93	

Temp (**)-	6.6	44.0
Press. (pain)*	34.006	14.73
Compressibility Patter [1] -	0.599900	8.99900
Relative Dentity -	6.00666	1 Q646
Green HV (DRT) =	190.1	100.4
Green HTV (BAT.) =	14.4	98.6
Walte Inter -	97. 1	773
Max #14 (Day) -	96.8	\$7. 1
Nat HV (Bat.) =	95.2	154

ina: All blatt volues av belov detectors have JAD - Hei Detersejand Total hydrosytops av lass then 0.02% 26

IGT Lestine of Our Technology

Analytical Report

۱۱/۱/۱۸ ۵.۵۵ دهدا ۱۹۹۱ ۹ ویل ۲۵۲

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Majer Campanan	Ges Analysis I	y Ges Chrones	
Chest Name: Mast	rdi Platt		
IGT Sample Number: 9615	163		
Sampir Dunriptim: Samp	ie 64312-063	- 10/25/56	17 44
Date Analyted: 31-O	x-96	Analyst: ein	
	Ned %	Test. Limit	Weight %
	ND:	8.001%	ж
	4.0%	****	4.39%
45 Distante	34,3%	8.00%	34.8%
-		0 00%	
-		0.00%	
an / Argan	8.94%	0.87%	4.99%
	46.7%	0.03%	41.4%
		6.09%	
m Léonaite	34,5%	8.02%	22.3%
		0.002%	
		0.002%	
		6.002%	
		4.003%	
-		0.002%	
		0.007%	
		0.002%	
		0.002%	
		0.002%	
-3-Butter		0.002%	
ð dense		0 802%	
		0 002%	
		8.001%	
		0.027N	
Ret a		0 CE2%	
		0.005%	
na Tag		0.002%	
ngen Bullde	0.0125%	9.0001%	8.0030%
tayi Salisin	0.010274	8.0001%	1.0063%
		8.001%	
·	ND	E.OD1%	NO
i 	100.2%		104,2%
Calculated Bant Ga	- Properties per Al	The Dome-Pt	
Tang, (**)*			
		14.73	
Compression and Party Party at a			

1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 		
Prom (prom)	14.006	14.73
Compressibility Poster (a) -	0.99900	0.57750
Relative Density -	3.0000	1.8640
Gran HV (DRT) =	95.7	16.0
One HY (BAT.) -	M .1	963
Webbe Index -	\$2. 7	92.9
Nat HV (Cry) +	72.5	92.8
Nat HV (Bal.) +	90.9	91.1

Notage AD blank velves ger balser detentors jank MD - Net Deservined Total bydrowylene are best dan (276

IGT Institute of Gas Technology

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi Platt IGT Sample Number: 9614961 Sample Description: Sample 64017-001 Date Analyzed: 7-Oct-96 Analyst: cla

10/3/56 08:30

Component Name	PP	MV	Component Name	PPMV
Hydrogen Sulfide		12	Thiophene	
Sulfur Dioxide			C1-Thiophenes	
Carbonyl Sulfide		21	C2-Thiophenes	
Carbon Disulfide			C3-Thiophenes	
Methyl Mercaptan			Benzothiophene	
Ethyl Mercaptan			C1-Benzothiophenes	
i-Propyl Mercaptan			C2-Benzothiophenes	
p-Propyl Mercaptan				
t-Butyl Mercaptan			Thiophane	
Dimethyl Sulfide			Individual Unidentified	
Methyl Ethyl Sulfide			Sulfur Compounds	
Diethyl Sulfide			(all as monosulfides)	
Di-t-Butyl Sulfide				
Dimethyl Disulfide				
Methyl Ethyl Disulfide				
Methyl i-Propyl Disulfide				
Diethyl Disulfide				
Methyl n-Propyl Disulfide				
Methyl t-Butyl Disulfide				
Ethyl i-Propyl Disulfide				
Ethyi a-Propyi Disulfide				
Ethyl t-Butyl Disulfide				
Di-i-Propyl Disulfide			Total Unidentified:	0
i-Propyl n-Propyl Disulfide			Total Identified:	33.0
Di-n-Propyl Disulfide				
i-Propyl t-Butyl Disulfide			Total Sulfur Content	
n-Propyl t-Butyl Disulfide			As PPMV	33.0
Di-t-Butyl Disulfide			As Grains/100 SCF	2.1
Dimethyl Trisulfide				
Diethyl Trisulfide				
Di-t-Butyl Trisulfide				
- •	Notes:	Co	mponent Detection Limit	

Component Detection Limit 1 ppmv for Hydrogen Sulfide 0.2 ppmv for all other compounds

10/15/96 IGT Log # : 9614962.XLS

IGT Institute of Gas Technology

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi Platt IGT Sample Number: 9614962 Sample Description: Sample 64017-002 /0/3/56 //00 Date Analyzed: 7-Oct-96 Analyst: cla

Component Name	PP	MV	Component Name	PPMV
Hydrogen Sulfide		· · · · · · · · · · · · · · · · · · ·	Thiophene	
Sulfur Dioxide			C1-Thiophenes	
Carbonyl Sulfide		36	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	
Dimethyl Sulfide			Individual Unidentified	
Methyl Ethyl Sulfide			Sulfur Compounds	
Diethyl Sulfide			(all as monosulfides)	
Di-t-Butyl Sulfide				
Dimethyl Disulfide				
Methyl Ethyl Disulfide				
Methyl i-Propyl Disulfide				
Diethyl Disulfide				
Methyl n-Propyl Disulfide				
Methyl 1-Butyl Disulfide				
Ethyl i-Propyl Disulfide				
Ethyl n-Propyl Disulfide				
Ethyl t-Buryl Disulfide				
Di-i-Propyl Disulfide			Total Unidentified:	0
i-Propyl n-Propyl Disulfide			Total Identified:	36 0
Di-n-Propyl Disulfide				
i-Propyl t-Butyl Disulfide			Total Sulfur Content	
n-Propyl t-Butyl Disulfide			As PPMV	36.0
Di-t-Butyl Disulfide			As Grains/100 SCF	2.3
Dimethyl Trisulfide				
Diethyl Trisulfide				
Di-t-Butyl Trisulfide				
	Notes:	Co	mponent Detection Limit	

Institute of Gas Technology 1700 South ML Prospect Rd. Des Plaines, IL 60018

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10/15/96 IGT Log # : 9614963_XLS

IGT Institute of Gas Technology

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TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: <u>Mostardi Platt</u> IGT Sample Number: 9614963 Sample Description: Sample 64017-003 /*/3/56 /3*** Date Analyzed: 7-Oct-96 Analyst: cla

Component Name	PF	MV	Component Name	PPMV
Hydrogen Sulfide	······	1.4	Thiophene	
Sulfur Dioxide			C1-Thiophenes	
Carbonyl Sulfide		4.3	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	
Dimethyl Sulfide			Individual Unidentified	
Methyl Ethyl Sulfide			Sulfur Compounds	
Diethyl Sulfide			(all as monosulfides)	
Di-t-Butyl Sulfide				
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
i-Propyl n-Propyl Disulfide			Total Identified:	5.7
Di-n-Propyl Disulfide				
i-Propyl t-Buryl Disulfide			Total Sulfur Content	
n-Propyl t-Butyl Disulfide			AS PPMV	5.7
Di-t-Butyl Disulfide			As Grains/100 SCF	0.4
Dimethyl Trisulfide				
Diethyl Trisulfide				
Di-t-Butyl Trisulfide				
	Notes:	Cor	mponent Detection Limit	

Analytical Report

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: <u>Mostardi Platt</u> IGT Sample Number: 9615121 Sample Description: Sample 64113-001 Date Analyzed: 15-Oct-96 Analyst: cla

10/9/96 03:00

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide		Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	34	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan		Benzothiophene	
Ethyi Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
Dimethyl Sulfide		Individual Unidentified	
Methyl Ethyl Sulfide		Sulfur Compounds	
Diethyi Sulfide		(all as monosulfides)	
Di-t-Butyl Sulfide			
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Buryl Disulfide			
Etbyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0
i-Propyl n-Propyl Disulfide		Total Identified:	34.0
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		Total Sulfur Content	
n-Propyl t-Butyl Disulfide		As PPMV	34.0
Di-t-Buryl Disulfide		As Grains/100 SCF	2.1
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Buryl Trisulfide			
	Natan Car	mention Limit	

Notes:

Component Detection Limit 1 ppmv for Hydrogen Sulfide 0.2 ppmv for all other compounds

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Analytical Report

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: <u>Mostardi Plan</u> IGT Sample Number: 9615122 Sample Description: Sample 64113-002 10/9/66 11:00 Date Analyzed: 15-Oct-96 Analyst: cla

Component Name	PP	MV	Component Name	PPMV
Hydrogen Sulfide		1.1	Thiophene	······································
Sulfur Dioxide			C1-Thiophenes	
Carbonyl Sulfide		4.3	C2-Thiophenes	
Carbon Disulfide			C3-Thiophenes	
Methyl Mercapian			Benzothiophene	
Ethyl Mercaptan			C1-Benzothiophenes	
i-Propyl Mercaptan			C2-Benzothiophenes	
n-Propyl Mercaptan				
t-Butyl Mercaptan			Thiophane	
Dimethyl Sulfide			Individual Unidentified	
Methyl Ethyl Sulfide			Sulfur Compounds	
Diethyl Sulfide			(all as monosulfides)	
Di-t-Butyl Sulfide				
Dimethyl Disulfide				
Methyl Ethyl Disulfide				
Methyl i-Propyl Disulfide				
Diethyl Disulfide				
Methyl n-Propyl Disulfide				
Methyl t-Butyl Disulfide				
Ethyl i-Propyl Disulfide				
Ethyi n-Propyl Disulfide				
Ethyl t-Butyl Disul5de				
Di-i-Propyl Disulfide			Total Unidentified:	0
i-Propyl n-Propyl Disulfide			Total Identified:	5.4
Di-n-Propyl Disulfide				
i-Propyl t-Butyl Disulfide			Total Sulfur Content	
n-Propyl t-Butyl Disulfide			As PPMV	5.4
Di-t-Butyl Disulfide			As Grains/100 SCF	0.3
Dimethyl Trisulfide				
Diethyl Trisulfide				
Di-t-Butyl Trisulfide				
	Notes:	Co	mponent Detection Limit	
		lp	pmv for Hydrogen Sulfide	

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

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TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: <u>Mostardi Platt</u> IGT Sample Number: 9615123 Sample Description: Sample 64113-003 / 0/4/46 /3:00 Date Analyzed: 15-Oct-96 Analyst: cla

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	19	Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	41	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	
Dimethyl Sulfide		Individual Unidentified	
Methyi Ethyl Sulfide		Sulfur Compounds	
Diethyl Sulfide		(all as monosulfides)	
Di-t-Butyl Sulfide			
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Buryl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0
i-Propyl n-Propyl Disulfide		Total Identified:	6 0.0
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		Total Sulfur Content	
n-Propyl t-Butyl Disulfide		As PPMV	60.0
Di-t-Butyl Disulfide		As Grains/100 SCF	3.8
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			
	N		

Notes:

Component Detection Limit 1 ppmv for Hydrogen Sulfide 0.2 ppmv for all other compounds

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TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

10/17/96 05:00

Client Name: Mostardi Plan IGT Sample Number: 9615301 Sample Description: Sample 64202-001 Date Analyzed: 23-Oct-96 Analyst: cla

Component Name	PPM	IV	Component Name	PPMV
Hydrogen Sulfide	······································	3.2	Thiophene	
Sulfur Dioxide			C1-Thiophenes	
Carbonyl Sulfide	(6.4	C2-Thiophenes	
Carbon Disulfide			C3-Thiophenes	
Methyl Mercaptan			Benzothiophene	
Ethyl Mercaptan			C1-Benzothiophenes	
i-Propyi Mercaptan			C2-Benzothiophenes	
n-Propyl Mercaptan				
t-Butyl Mercaptan			Thiophane	
Dimethyl Sulfide			Individual Unidentified	
Methyl Ethyl Sulfide			Sulfur Compounds	
Diethyl Sulfde			(all as monosulfides)	
Di-t-Butyl Sulfide				
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
i-Propyl n-Propyl Disulfide			Total Identified:	9.6
Di-n-Propyl Disulfide				
i-Propyl t-Butyl Disulfide			Total Sulfur Content	
n-Propyl t-Butyl Disulfide			As PPMV	9.6
Di-t-Butyl Disulfide			As Grains/100 SCF	0.6
Dimethyl Trisulfide				
Diethyl Trisulfide				
Di-t-Butyl Trisulfide				
	Notes:	Cor	mponent Detection Limit	

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TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi Platt IGT Sample Number: 9615302 Sample Description: Sample 64202-002 1 •/17/56 11:00 Date Analyzed: 23-Oct-96 Analyst: cla

Component Name	PP	MV	Component Name	PPMV
Hydrogen Sulfide		1	Thiophene	
Sulfur Dioxide			C1-Thiophenes	
Carbonyl Sulfide		3.3	C2-Thiophenes	
Carbon Disulfide			C3-Thiophenes	
Methyl Mercapian			Benzothiophene	
Ethyl Mercaptan			C1-Benzothiophenes	
i-Propyl Mercaptan			C2-Benzothiophenes	
n-Propyl Mercaptan				
1-Butyl Mercaptan			Thiophane	
Dimethyl Sulfide			Individual Unidentified	
Methyl Ethyl Sulfide			Sulfur Compounds	
Diethyl Sulfide			(all as monosulfides)	
Di-t-Butyl Sulfide				
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-Buryl Disulfide				
Di-i-Propyl Disulfide			Total Unidentified:	0
i-Propyl n-Propyl Disulfide			Total Identified:	4.3
Di-n-Propyl Disulfide				
i-Propyl t-Butyl Disulfide			Total Sulfur Content	
n-Propyl t-Butyl Disulfide			As PPMV	4.3
Di-t-Butyl Disulfide			As Grains/100 SCF	0.3
Dimethyl Trisulfide				
Diethyl Trisulfide				
Di-t-Butyl Trisulfide				
	Notes:	Co	apponent Detection Limit	

10/25/96 IGT Log # : 9615303.XLS

IGT Institute of Gas Technology

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: <u>Mostardi Plat</u> IGT Sample Number: 9615303 Sample Description: Sample 64202-003 / *//7/56 / 3:00 Date Analyzed: 23-Oct-96 Analyst: cla

Component Name	PPMV		Component Name	PPMV	
Hydrogen Sulfide		14	Thiophene		
Sulfur Dioxide			C1-Thiophenes		
Carbonyi Sulfide		35	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		
Dimethyl Sulfide			Individual Unidentified		
Methyl Ethyl Sulfide			Sulfur Compounds		
Diethyl Sulfide			(all as monosulfides)		
Di-t-Butyl Sulfide					
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 i-Butyl Disulfide					
Di-i-Propyl Disulfide			Total Unidentified:	0	
i-Propyl n-Propyl Disulfide			Total Identified:	49.0	
Di-n-Propyl Disulfide					
i-Propyl t-Butyl Disulfide			Total Sulfur Content		
n-Propyl t-Butyl Disulfide			As PPMV	49.0	
Di-t-Buryl Disulfide			As Grains/100 SCF	3.1	
Dimethyl Trisulfide					
Diethyl Trisulfide					
Di-t-Butyl Trisulfide					
	Notes:	Cor	nponent Detection Limit		

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IGT Institute of Ges Technology Analytical Report

10/31/96 IGT Log # : 9615381.XLS

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: <u>Mostardi Platt</u> IGT Sample Number: 9615381 Sample Description: Sample 64312-001 Date Analyzed: 29-Oct-96 Analyzet: els

10/25/56 08:00

Composent Name	PP!	MV	Component Name	PPMV
Hydrogen Sulfide		26	Thiophene	
Sulfer Dioxide			C1-Thiophenes	
Carbonyl Salfide		33	C2-Thiophones	
Carbon Disulfide			C3-Thiophenes	
Methyl Mercaptan			Bezothiophene	
Ethyl Merceptan			C i -Benzothiophenes	
i-Propyl Merceptan			C2-Benzothiophenes	
a-Propyl Merceptan				
t-Butyl Marcapian			Thiophane	
Dimethyl Sulfide			Individual Unidentified	
Mothyl Ethyl Sulfide			Salfar Compounds	
Diethyl Sulfde			(all as monosulfides)	
Di-t-Buryl Sulfide				
Dimethyl Disulfide				
Methyl Ethyl Disulfide Methyl i-Propyl Disulfide				
Diethyl Disulfide				
Methyl a Propyl Disulfide				
Methyl t-Butyl Disulfide				
Ethyl i-Propyl Disulfide				
Ethyl n-Propyl Disulfide				
Ethyl t-Buryl Disulfide				
Di-i-Propy! Disulfide			Total Unidentified:	0
i-Propyl p-Propyl Disulfide			Total Identified:	59 .0
Di-n-Propyl Disulfide				
i-Propyl t-Butyl Disulfide			Total Sulfur Content	
n-Propyl t-Butyl Disul5de			AJ PPMV	\$9.0
Di-t-Butyl Disulfide			As Omins/100 SCF	3.7
Dimethyl Trisulfide				
Diethyl Trisulfide				
Di-t-Buryl Tripulfide				
-	Notes:	Co	mponent Detection Limit	
		1 8	zanv for Hydrogen Sulfide	

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Analytical Report

11/1/96 IGT Log #: 9615382.XLS

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Montardi Platt IGT Sample Number: 9615342 Sample Description: Sample 64312-002 Date Analyzed: 30-Oct-96 Analyst: da

10/25/56 10.00

Component Name	PPN	IV	Component Name	PPMV
Hydrogen Sulfide		21	Thiophene	
Sulfar Dioxide			C1-Thiophenes	
Carbonyl Sulfide		32	C2-Thiophenes	
Carbon Disulfide			C3-Thiophones	
Methyl Merceptan			Benzothiophene	
Ethyl Mercaptan			C1-Benzothiophenes	
i-Propyl Mercepten			C2-Benzothiophenes	
n-Propyl Merenpian				
t-Butyl Merceptan			Thiophane	
Dimethyl Sulfide			Individual Unidentified	
Methyl Ethyl Sulfide			Sulfar Compounds	
Disthyl Sulfde			(all as monoralfides)	
Di-t-Butyl Sulfde				
Dimethyl Disulfide				
Methyl Ethyl Disulfide Methyl i-Propyl Disulfide				
Diethyl Disulfide				
Methyl a Propyl Disulfide				
Methyl t-Butyl Disulfide				
Ethyl i-Propyi Disulfide				
Ethyi a-Propyi Disulfide				
Ethyl t-Buryl Disulfide				
Di-i-Propyl Disulfide			Total Unidentified:	0
i-Propyl a-Propyl Disulfide			Total Identified:	\$3.0
Di-p-Propyl Disulfide				
i-Propyl 1-Butyl Disulfide			Total Suifur Centent	
p-Provel 1-Buryl Disulfide			As PPMV	53.0
Di-t-Buryl Disulfide			As Orains/100 SCF	3.3
Dimetry Trisulfide				
Diethyl Trisulfide				
Di-t-Butyl Trisulfide				
- •	Notes:	С	omponent Detection Limit	
		1	ppmv for Hydrogen Sulfide	

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Analytical Report

11/1/96 IGT Log # : 9615383.XLS

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: <u>Monterti Plati</u> IGT Sample Number: 9615383 Sample Description: Sample 64312-003 Date Analyzed: 30-Oxt-96 Analyst: ola

10/25/96 12:00

Component Name	PPM	IV	Component Name	PPMV
Hydrogen Sulfide		25	Thiophene	
Sulfur Dioxide			C1-Thiophenes	
Carbonyl Sulfide		32	C2-Thiophenes	
Carbon Disulfde			C3-Thiophenes	
Mathyl Merceptan			Benzothiophene	
Ethyl Morcepten			C1-Benzothiophenes	
i-Propyl Mercepten			C2-Bezzothiophenes	
n-Propyl Mercapten				
1-Butyl Merceptan			Thiophane	
Dimethyl Sulfide			Individual Unidentified	
Methyl Ethyl Sulfde			Sulfar Compounds	
Diethyl Sulfide			(all as monosulfides)	
Di-t-Butyl Sulfide				
Dimethyl Disulfide				
Methyl Ethyl Disulfide				
Methyl i-Propyl Disulfide				
Diethyl Disulfide				
Methyl n-Propyl Disulfide				
Methyl t-Buryl Disulfide				
Ethyl i-Propyl Disulfide				
Ethyl a-Propyl Disulfide				
Ethyl t-Butyl Disulfide				
Di-i-Propyl Disulfide			Total Unidentified:	0
i-Propyl a-Propyl Disulfide			Total Identified:	57.0
Di-n-Propyl Disulfide				
i-Propyl t-Butyl Disulfide			Total Sulfur Content	
n-Propy) t-Butyl Disulfide			As PPMV	57.0
Di-t-Buryl Disulfide			As Grains/100 SCF	3.6
Dimethyi Triaulfide				
Disthyl Trisulfide				
Di-t-Butyl Trisulfide				
	Notes:	C	emponent Detection Limit	

1 ppinv for Hydrogen Sulfide

Environmental Consultants

			CHAIN	-OF-CU	STODY	RECO	RD		
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Client:		, , , , , , , , , , , , , , , , , , ,			TAT	(Assess	neat Only)		
Plant/Loca	tion:				LAB	PO	Number:		
Project Suj	pervisor:	4			Offe Only	LD	AS Entry:		J
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Read Instructions on Reverse Side Before Completing Form!

Special Instructions:

Environmental Consultants

1_96-1512

Read Instructions on Reverse Side Before Completing Form! CHAIN-OF-CUSTODY RECORD Date Results Required: Project Number: Client: TAT(Assessment Only) LAB PO Number: Plant/Location: Use LIMS Entry: Project Supervisor: Only ጦ Sample Point Identification # of Grab/ Analysis Requested Date Sub Sample Lab Conts Comp Number Sampled 0800 TwTI 001 13/9/7 Trace LIFSA 2 1 Confort 002 1100) 3 1300 003 1 LASE Keps 004 Inocations 005 006 007 800 009 010 011 012 013 . 014 015 016 Processed Date The Sanfelli 10.14.96 Date/Time 10/10/176 Received by Laboratory: Date/Time Delivered by: Chris.

Special Instructions:

Environmental Consultants

L96-1530

		CH	AIN-OF-CU	STODY	RECO	RD	roim:	
Project N	umber:	64200	r L	Date	Results I	Required:		
Client:			· · · · · · · · · · · · · · · · · · ·	TAT	(Assessii	nent Only)		
Plant/Loca	ation:	· · ·	/	LAB	PO	Number: 17	7//	<u> </u>
Project Su	pervisor:	<u></u> CT		Only	LIN	IS Entry:		
Sample Number	Date Sampled	Sample Point Ide	ntification	# of Conts	Grab/ Comp	Analysis Re	quested	Sub Lab
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Read Instructions on Reverse Side Before Completing Form

Special Instructions:

Environmental Consultants

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Read Instructions on Reverse Side Before Completing Form!									
CHAIN-OF-CUSTODY RECORD									
Project Nu	Project Number: 64312 Date Results Required:								
Client:	BETHL	EHEM STEEL	TAT	(Assessu	ment Only)				
Plant/Local	tion: Bur	VS HARBOR IN		B PO	Number: 177	56			
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Sample Number	Date Sampled	Sample Point Identification	# of Conts	Grab/ Comp	Analysis Re	quested	Sub Lab		
001	10-25	BLAST FURNACE	1		Frace.	sulfue	I 67		
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Special Instructions:

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Institute of Gas Technology LOGIN CHAIN OF CUSTODY REPORT (1n01) Oct 07 1996, 04:16 pm

Login Number: L96-1496 Account: MOSTARDI PLATT Mostardi Platt Associates, Inc Project: MOST 96-1496

Laboratory Client Collect Receive Due Sample Number Date PR Date

L96-1496-1 report tota Gas Gas Gas	P P C C	SAMPLE hydrocarbons LANDGAS2 LANDGAS SLFRTG	64017-	-001 Hold:04-	03-0CT-96	04-OCT-96	25-OCT-96 1 Bottles
L96-1496-2 report tota Gas Gas Gas	P C C	SAMPLE hydrocarbons LANDGAS2 LANDGAS SLFRTG	64017-	-002 Hold:04-	03-0CT-96	04-OCT-96	25-OCT-96 1 Bottles
L96-1496-3 report tota Gas Gas Gas Miscell.	PCCS	SAMPLE hydrocarbons LANDGAS2 LANDGAS SLFRTG ZZ S&H	64017-	-003 Hold:04-	03-0CT-96	04-OCT-96	25-OCT-96 1 Bottles

Page 1

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Chrie and Signature: Date:

Institute of Gas Technology LOGIN CHAIN OF CUSTODY REPORT (1n01) Oct 15 1996, 10:20 am

Login Number: L96-1512 Account: MOSTARDI PLATT Mostardi Platt Associates, Inc Project: MOST 96-1512

Laboratory Client Collect Receive Due Sample Number Date Date PR Date

L96-1512-1 Gas Gas Gas	₽ C C	LANDGAS2 LANDGAS SLFRTG	SAMPLE	64113-	001 Hold:10-	09-0 CT-96 0CT-96	14-0CT-96	04-NOV-96 1 Bottles
L96-1512-2 Gas Gas Gas	P C C	LANDGAS2 LANDGAS SLFRTG	SAMPLE	64113-	002 Hold:10-	09-0 CT-96 0CT-96	14-0CT-96	04-NOV-96 1 Bottles
L96-1512-3 Gas Gas Gas Miscell.	P C C S	LANDGAS2 LANDGAS SLFRTG ZZ S&H	SAMPLE	64113-	003 Hold:10-	09-007-96 007-96 Tota	14-0CT-96	04-NOV-96 1 Bottles

Report Hydrocarbons

Page 1 Signature: <u>Chris Cured</u> Date: <u>10/14/96</u>

Institute of Gas Technology LOGIN CHAIN OF CUSTODY REPORT (1n01) Oct 22 1996, 04:34 pm

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Login Number: L96-1530 Account: MOSTARDI PLATT Mostardi Platt Associates, Inc Project: MOST 96-1530

Laboratory Client Collect Receive Due Sample Number Sample Number Date PR Date

L96-1530-1 report tota Gas Gas Gas	P C C	SAMPLE hydrocarbons LANDGAS2 LANDGAS SLFRTG	64202-	001 Hold:18-	17-0CT-96	21-OCT-96	11-NOV-96 1 Bottles
L96-1530-2 report tota Gas Gas Gas	I P C C	SAMPLE hydrocarbons LANDGAS2 LANDGAS SLFRTG	64202-	-002 Hold:18-	17-0CT-96	21-OCT-96	11-NOV-96 1 Bottles
L96-1530-3 report tota Gas Gas Gas Miscell.	P C C S	SAMPLE hydrocarbons LANDGAS2 LANDGAS SLFRTG ZZ S&H	64202-	003 Hold:18-	17-0CT-96	21-OCT-96	ll-NOV-96 l Bottles

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Si	gnature: _	(line)	Inel
	Date: _	10/21/9	6

847 768-0970

Institute of Gas Technology LOGIN CHAIN OF CUSTODY REPORT (1n01) Oct 28 1996, 02:22 pm

Login Number: L96-1538 Account: MOSTARDI PLATT Mostardi Platt Associates, Inc Project: MOST 96-1538

Laboratory Chiens Chiense Chiense

L96-1538-1 report tota Gas Gas Gas	I P C C	SAMPLE hydrocarbons LANDGAS2 LANDGAS SLFRTG	64312-	001 Hold:26-	25-0CT-96	28-0CT-96	18-NOV-96 1 Bottles
L96-1538-2 report tota	1	SAMPLE hydrocarbons	64312-	002	25-0CT-96	28-OCT-96	18-NOV-96
Gas Gas	P C C	LANDGAS2 LANDGAS SLEPTG		Hold.26.	-007-96		1 Bottles
Jab	-	SDIK:0		11020.40	-001-30		
L96-1538-3	1	SAMPLE	64312-	003	25-OCT-96	28-0CT-96	18-NOV-96
Gas	PC	LANDGAS2					1 Bottles
Gas Miscell.	čs	SLFRTG ZZ S&H		Hold:26-	-OCT-96		

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Signature: Chris. Cimelal Date: $\frac{10/28/96}{28}$

Blast Furnace Granulated Coal Injection Environmental Monitoring Report

Appendix II - Wastewater Monitoring Summaries

Bethlehem Steel Corporation Burns Harbor Division Blast Furnace Closed Water Pump Station Cold Well Monitoring Summary

Sample Date	Ammonia (as N) (mg/l)	Cyanide (mg/l)
01-Oct-96		
02-Oct-96	15.0	0.022
03-Oct-96		
04-Oct-96		
05-Oct-96		
06-Oct-96		
07-Oct-96		
08-Oct-96		
09-Oct-96	15.4	0.012
10-Oct-96		
11-0ct-96		
12-Oct-96		
13-Oct-96		
14-Oct-96		
15-Oct-96		
16-Oct-96	17.0	<0.005
17-Oct-96		
18-0ct-96		
19-00-96		
20-001-95		
27- UCI-96		
22-UG-90	47.0	-0.005
23-Ua-96	47.9	<0.005
24-UCI-96		
25-00-90		
20-UCI-50		
27-00-50		
26-00-90		
29-00-90		
30-001-30 21 Oct 95		
31-001-30		
Average	23.8	0.009
Maximum	47.9	0.022
Minimum	15.0	<0.005

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Bethlehem Steel Corporation Burns Harbor Division Monitoring Station 011 Monitoring Summary

Sample	Flow	Ammonia (as N)	Ammonia (as N)	Cyanide	Cyanide
Date	(MGD)	(mg/I)	(ID/day)	(mg/i)	(ID/Gay)
01-Oct-96	91.9	0.35	268.4	<0.005	0.0
02-Oct-96	85.7				
03-Oct-96	89.8	0.29	217.3	<0.005	0.0
04-Oct-96	80.8				
05-Oct-96	76.8				
06-Oct-96	72.3	0.37	223.2	<0.005	0.0
07-Oct-96	73.4				
08-Oct-96	90.6	0.42	317.5	<0.005	0.0
09-Oct-96	85.9				
10-0ct-96	87.4	0.53	38 6.6	<0.005	0.0
11-Oct-96	86.4				
12-Oct-96	84.2				
13-0ct-96	90 .3	0.38	286.4	<0.005	0.0
14-Oct-96	73.1				
15-Oct-96	8 8.5	0.63	465.3	<0.005	0.0
16-Oct-96	93 .2				
17-Oct-96	97.6	0.70	570.1	<0.005	0.0
18-Oct-96	89.8				
19-Oct-96	72. 9				
20-Oct-96	81.6	0.71	483.5	<0.005	0.0
21-Oct-96	76.7				
22-Oct-96	89.9	0.52	390.1	<0.005	0.0
23-Oct-96	90.4				
24-Oct-96	90.1	0.47	353.4	<0.005	0.0
25-Oct-96	33.3				
26-Oct-96	30 .9				
27-Oct-96	30.5	1.02	259.6	<0.005	0.0
28-Oct-96	31.6				
29-0ct-96	8 6.2	0.58	417.2	<0.005	0.0
30-Oct-96	86.1				
31-Oct-96	85.2	0.38	270.2	<0.005	0.0
Average	78.2	0.53	350.6	<0.005	0.0
Maximum	97.6	1.02	570.1	<0.005	0.0
Minimum	30.5	0.29	217.3	<0.005	0.0

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Bethlehem Steel Corporation Burns Harbor Division Outfall 001 Monitoring Summary

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Sample Date	Flow (MGD)	Ammonia (as N) (mo/l)	Ammonia (as N) (lb/day)	Cyanide (mg/l)	Cyanide (Ib/day)
01-Oct-96	138.8	0.29	335.9	((12/449)
02-Oct-96	136.5	0.20			
03-Oct-96	134.6	0.24	269 6		
04-Oct-96	130.1		200.0		
05-Oct-96	125.8				
06-Oct-96	133.7	0.30	334.7	<0.005	0.0
07-Oct-96	125.7				0.0
08-Oct-96	138.4	0.36	415.8		
09-Oct-96	135.8				
10-Oct-96	140.0	0.41	479.0		
11-Oct-96	132.0				
12-Oct-96	129.9				
13-Oct-96	132.8	0.37	410.0	<0.005	0.0
14-Oct-96	128.3				
15-Oct-96	138.1	0.45	518.6		
16-Oct-96	144.4				
17-0ct-96	141.7	0.48	5 67.6		
18-Oct-96	138.7				
19-Oct-96	132.1				
20-Oct-96	125.0	0.40	417.3	<0.005	0.0
21-0ct-96	129.5				
22-Oct-96	140.2	0.44	514.8		
23-Oct-96	135.2				
24-Oct-96	134.0	0.38	424.9		
25-Oct-96	85.0				
25-Oct-96	82.9				
27-0ct-96	76.5	0.51	325.6	<0.005	0.0
28-Oct-96	102.8				
29-Oct-96	152.7	0.58	739.1		
30-Oct-96	125.3				
31-Oct-96	125.6	0.38	398.3		
Average	128.1	0.40	439.4	<0.005	0.0
Maximum	152.7	0.58	739.1	<0.005	0.0
Minimum	76.5	0.24	269.6	<0.005	0.0

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