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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

Trial 1 Report

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

For
U.S. Department of Energy
Office of Fossil Energy
Morgantown Energy Technology Center
P.O. Box 880
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Bethlehem, Pennsylvania 18016

November 1997

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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:

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

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 seperately. 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.

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, lbs/NTHM	0	141
Injected Coal Rate, lbs/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 lbs/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
Al2O3	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, lbs/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

C FURNACE PRODUCT COAL SIZING OCTOBER 1996

		MEAN %	S. D. %
+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		0.70	0.4
TOTAL		100.0	

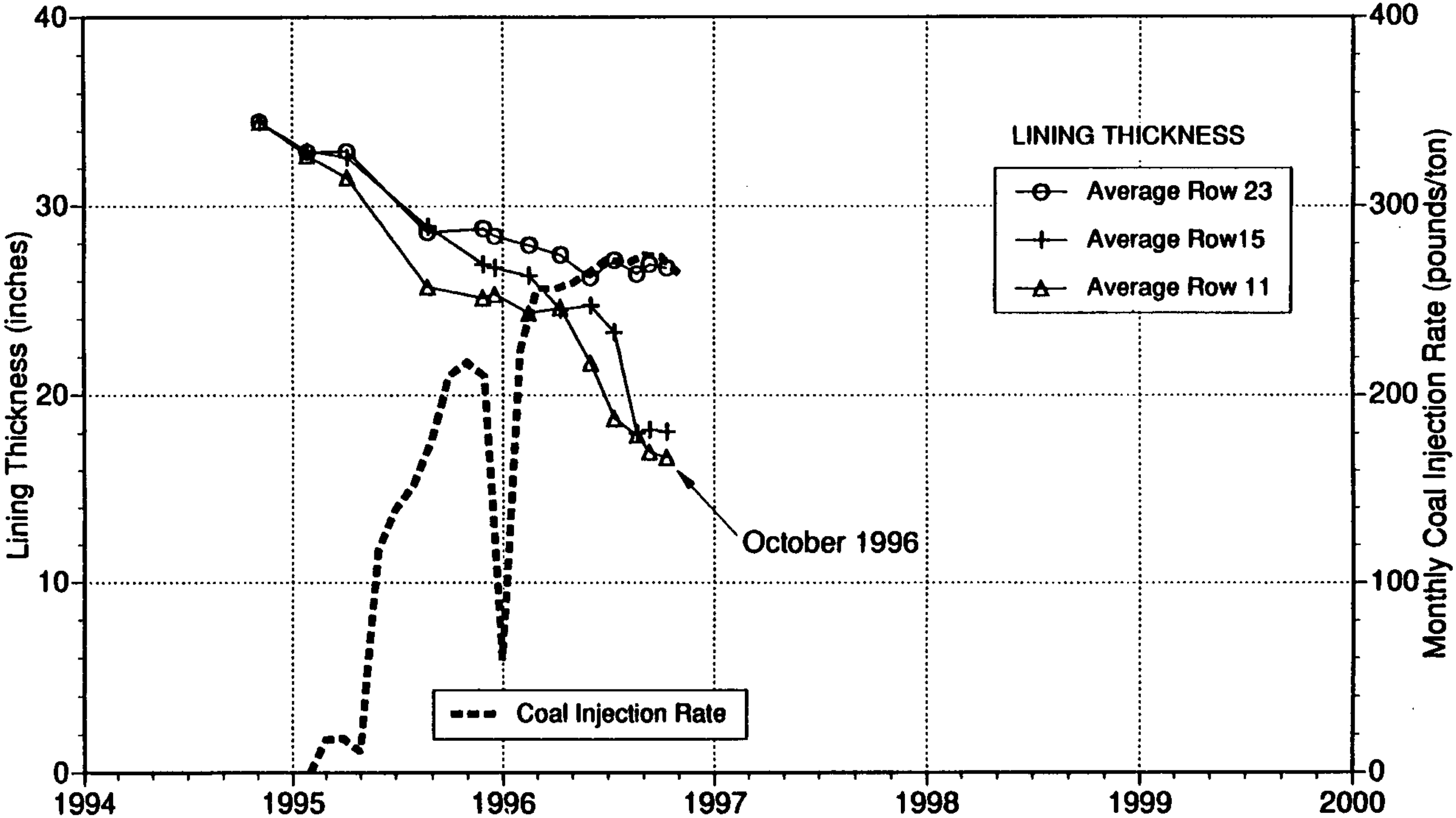
TABLE 3

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

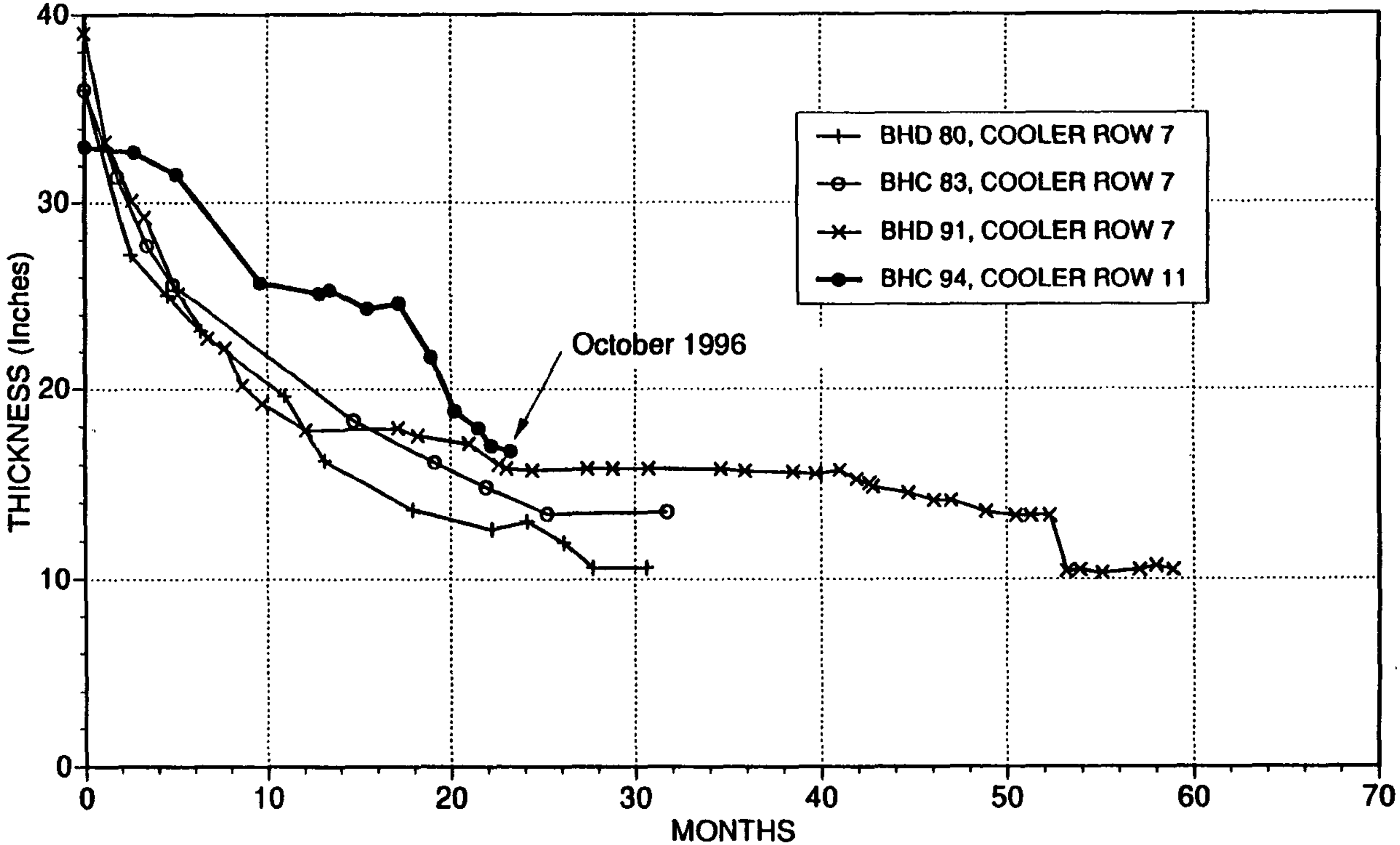
LINING WEAR vs. COAL INJECTION
Burns Harbor "C" Furnace — 5th Campaign



Date Blown In: 11/4/94
Date of Last Measurement: 10/10/96
RAS/JCM

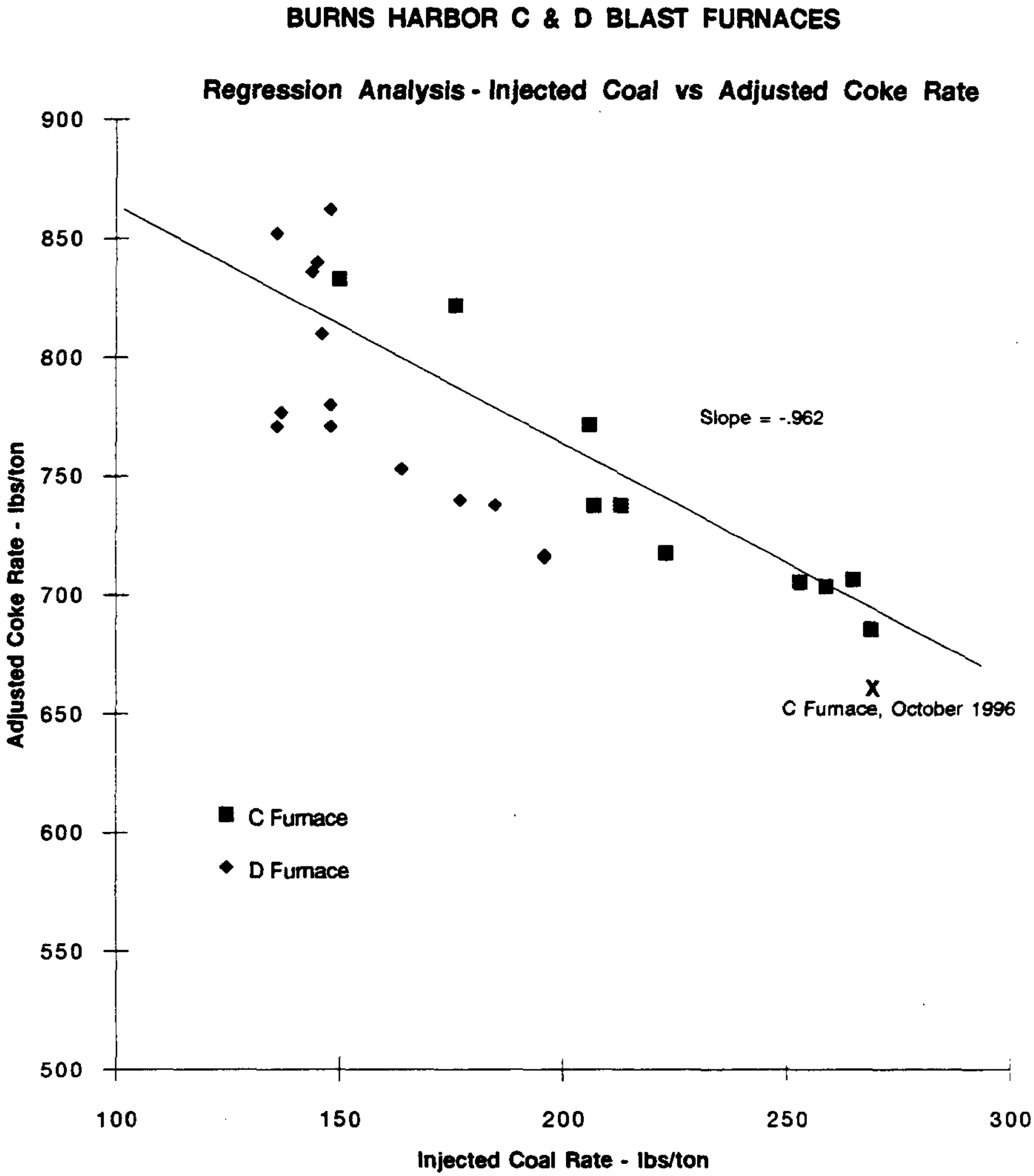
FIGURE 6

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



RAS n066

FIGURE 7


BURNS HARBOR C & D BLAST FURNACES
Regression Analysis - Injected Coal vs Adjusted Coke Rate
900
850
800
750
700
650
600
550
500
Adjusted Coke Rate - lbs/ton
Slope = -.962
X
C Furnace, October 1996
C Furnace
D Furnace
100
150
200
250
300
Injected Coal Rate - lbs/ton

Blast Furnace Granulated Coal Injection
Environmental Monitoring Report

Appendix I - Gaseous Stream Testing Results

A Full-Service
Environmental Consulting
Company

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

Mostardi Platt

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

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

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

Date Sampled	Time Sampled	Hydrogen (mol %)	CO_2 (mol %)	O_2 (mol %)	Carbon Monoxide (mol %)	Total Sulfur Content (ppmv)	Total Sulfur Content (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.

IGT Institute of Gas Technology

Analytical Report

10/15/96
IGT Log # - 9614961.XLS

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi Platt
IGT Sample Number: 9614961
Sample Description: Sample 64017-001 10/3/96 0830
Date Analyzed: 7-Oct-96 Analyst: cla

Component	Mol %	Det. Limit	Weight %
Helium	ND	0.001%	ND
Hydrogen	2.73%	0.04%	0.10%
Carbon Dioxide	14.7%	0.03%	21.5%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	9.30%	0.03%	10.0%
Nitrogen	59.2%	0.03%	55.1%
Methane		0.03%	
Carbon Monoxide	14.1%	0.03%	13.2%
Ethyne		0.002%	
Propane		0.002%	
Propene		0.002%	
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%	
neo-Pentane		0.001%	
i-Pentane		0.002%	
n-Pentane		0.002%	
Pentenes		0.002%	
Hexane Plus		0.002%	
Hydrogen Sulfide	0.0012%	0.0001%	0.0014%
Carbonyl Sulfide	0.0021%	0.0001%	0.0041%
Unidentified		0.001%	
Water	ND	0.001%	ND
Total	100.0%		100.0%

Calculated Real Gas Properties per ASTM D3588-91

Temp. (°F)=	60.0	60.0
Press. (psia)=	14.696	14.73
Compressibility Factor (z) =	0.99929	0.99929
Relative Density =	1.0385	1.0385
Gross HV (DRY) =	55.4	55.5
Gross HV (SAT.) =	54.4	54.5
Wobbe Index =	54.3	54.5
Net HV (Dry) =	53.4	53.6
Net HV (Sat.) =	52.5	52.6

Notes: All blank values are below detection limit
ND - Not Determined
Total Hydrocarbons are below 0.03%

Analytical Report

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi Platt
IGT Sample Number: 9614962
Sample Description: Sample 64017-002 10/3/96 11:00
Date Analyzed: 7-Oct-96 Analyst: ela

Component	Mol %	Det. Limit	Weight %
Helium	ND	0.001%	ND
Hydrogen	4.58%	0.04%	0.30%
Carbon Dioxide	25.9%	0.03%	35.7%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	0.53%	0.03%	0.67%
Nitrogen	46.1%	0.03%	41.9%
Methane		0.03%	
Carbon Monoxide	23.7%	0.03%	21.5%
Ethyne		0.002%	
Propane		0.002%	
Propene		0.002%	
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%	
neo-Pentane		0.001%	
i-Pentane		0.002%	
n-Pentane		0.002%	
Pentenes		0.002%	
Hexane Plus		0.002%	
Hydrogen Sulfide		0.0001%	
Carbonyl Sulfide	0.0036%	0.0001%	0.0071%
Unidentified		0.001%	
Water	ND	0.001%	ND
Total	100.0%		100.0%

Calculated Real Gas Properties per ASTM D3588-91

Temp. (°F) =	60.0	60.0
Press. (psia) =	14.696	14.73
Compressibility Factor [z] =	0.99900	0.99900
Relative Density =	1.0657	1.0657
Gross HV (DRY) =	91.6	91.8
Gross HV (SAT.) =	90.0	90.2
Wobbe Index =	88.8	89.0
Net HV (Dry) =	88.5	88.7
Net HV (Sat.) =	87.0	87.2

Notes: All blank values are below detection limit
ND - Not Determined
Total Hydrocarbons are below 0.03%

IGT Institute of Gas Technology

Analytical Report

10/15/96
IGT Log # - 9614963.XLS

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi Platt
IGT Sample Number: 9614963
Sample Description: Sample 64017-003   10/3/96   13:00
Date Analyzed: 7-Oct-96   Analyst: cla

Component	Mol %	Det. Limit	Weight %
Helium	ND	0.001%	ND
Hydrogen	0.63%	0.04%	0.04%
Carbon Dioxide	3.98%	0.03%	5.98%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	18.6%	0.03%	20.5%
Nitrogen	73.0%	0.03%	69.8%
Methane		0.03%	
Carbon Monoxide	3.84%	0.03%	3.67%
Ethyne		0.002%	
Propane		0.002%	
Propene		0.002%	
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%	
neo-Pentane		0.001%	
i-Pentane		0.002%	
n-Pentane		0.002%	
Pentenes		0.002%	
Hexane Plus		0.002%	
Hydrogen Sulfide	0.0001%	0.0001%	0.0002%
Carbonyl Sulfide	0.0004%	0.0001%	0.0009%
Unidentified		0.001%	
Water	ND	0.001%	ND
Total	100.0%		100.0%

Calculated Real Gas Properties per ASTM D3588-91

Temp. (°F)=	60.0	60.0
Press. (psia)=	14.696	14.73
Compressibility Factor (z) =	0.99955	0.99955
Relative Density =	1.0093	1.0093
Gross HV (DRY) =	14.6	14.6
Gross HV (SAT.) =	14.3	14.3
Wobbe Index =	14.5	14.5
Net HV (Dry) =	14.1	14.2
Net HV (Sat.) =	13.9	13.9

Notes: All blank values are below detection limit
ND - Not Determined
Total Hydrocarbons are below 0.03%

IGT Institute of Gas Technology

Analytical Report

10/24/96
IGT Log # 9615121.XLS

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi Platt
IGT Sample Number: 9615121
Sample Description: Sample 64113-001 10/9/96 0800
Date Analyzed: 23-Oct-96 Analyst: cla

Component	Mol %	Det. Limit	Weight %
Helium	ND	0.001%	ND
Hydrogen	2.26%	0.04%	0.15%
Carbon Dioxide	21.8%	0.03%	30.8%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	3.99%	0.03%	4.15%
Nitrogen	50.7%	0.03%	45.7%
Methane		0.03%	
Carbon Monoxide	21.3%	0.03%	19.2%
Ethyne		0.002%	
Propane		0.002%	
Propene		0.002%	
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%	
neo-Pentane		0.001%	
i-Pentane		0.002%	
n-Pentane		0.002%	
Pentenes		0.002%	
Hexane Plus		0.002%	
Hydrogen Sulfide		0.0001%	
Carbonyl Sulfide	0.0034%	0.0001%	0.0065%
Unidentified		0.001%	
Water	ND	0.001%	ND
Total	100.0%		100.0%

Calculated Real Gas Properties per ASTM D3588-91		
Temp. (°F)=	60.0	60.0
Press. (psia)=	14.696	14.73
Compressibility Factor (z) =	0.99907	0.99907
Relative Density =	1.0731	1.0731
Gross HV (DRY) =	75.9	76.1
Gross HV (SAT.) =	74.6	74.8
Wobbe Index =	73.3	73.5
Net HV (Dry) =	74.4	74.6
Net HV (Sat.) =	73.1	73.3

Notes: All blank values are below detection limit
ND - Not Determined
Total hydrocarbons are less than 0.03%.

IGT Institute of Gas Technology

Analytical Report

10/24/96
IGT Log # 9615122.XLS

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi Platt
IGT Sample Number: 9615122
Sample Description: Sample 64113-002 10/4/96 11:00
Date Analyzed: 23-Oct-96 Analyst: cla

Component	Mol %	Det. Limit	Weight %
Helium	ND	0.001%	ND
Hydrogen	0.73%	0.04%	0.05%
Carbon Dioxide	3.75%	0.03%	5.64%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	18.6%	0.03%	20.5%
Nitrogen	73.1%	0.03%	70.0%
Methane		0.03%	
Carbon Monoxide	3.90%	0.03%	3.74%
Ethyne		0.002%	
Propane		0.002%	
Propene		0.002%	
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%	
neo-Pentane		0.001%	
i-Pentane		0.002%	
n-Pentane		0.002%	
Pentenes		0.002%	
Hexane Plus		0.002%	
Hydrogen Sulfide	0.0001%	0.0001%	0.0001%
Carbonyl Sulfide	0.0004%	0.0001%	0.0009%
Unidentified		0.001%	
Water	ND	0.001%	ND
Total	100.0%		100.0%

Calculated Real Gas Properties per ASTM D3588-91

Temp. (°F)=	60.0	60.0
Press. (psia)=	14.696	14.73
Compressibility Factor [z] =	0.99955	0.99955
Relative Density =	1.0071	1.0071
Gross HV (DRY) =	15.1	15.1
Gross HV (SAT.) =	14.8	14.8
Wobbe Index =	15.0	15.0
Net HV (Dry) =	14.6	14.6
Net HV (Sat.) =	14.3	14.3

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

Analytical Report

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi Platt
IGT Sample Number: 9615123
Sample Description: Sample 64113-003 10/9/96 13:00
Date Analyzed: 23-Oct-96 Analyst: cla

Component	Mol %	Det. Limit	Weight %
Helium	ND	0.001%	ND
Hydrogen	4.04%	0.04%	0.26%
Carbon Dioxide	23.6%	0.03%	33.7%
Ethane		0.03%	
Ethene		0.03%	
Oxygen/Argon	1.26%	0.03%	1.32%
Nitrogen	46.9%	0.03%	42.7%
Methane		0.03%	
Carbon Monoxide	24.2%	0.03%	22.0%
Ethyne		0.002%	
Propane		0.002%	
Propene		0.002%	
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%	
neo-Pentane		0.001%	
i-Pentane		0.002%	
n-Pentane		0.002%	
Pentenes		0.002%	
Hexane Plus		0.002%	
Hydrogen Sulfide	0.0019%	0.0001%	0.0021%
Carbonyl Sulfide	0.0041%	0.0001%	0.0080%
Unidentified		0.001%	
Water	ND	0.001%	ND
Total	100.0%		100.0%

Calculated Real Gas Properties per ASTM D3588-91

Temp. (°F)=	60.0	60.0
Press. (psia)=	14.696	14.73
Compressibility Factor [z] =	0.99903	0.99903
Relative Density =	1.0656	1.0656
Gross HV (DRY) =	92.7	92.9
Gross HV (SAT.) =	91.1	91.3
Wobbe Index =	89.8	90.0
Net HV (Dry) =	89.8	90.0
Net HV (Sat.) =	88.3	88.5

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

Analytical Report

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi Platt
IGT Sample Number: 9615301
Sample Description: Sample 64202-001 10/17/96 08:00
Date Analyzed: 24-Oct-96 **Analyst:** cla

Component	Mol %	Det. Limit	Weight %
Helium	ND	0.001%	ND
Hydrogen	0.83%	0.04%	0.06%
Carbon Dioxide	4.24%	0.03%	6.39%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	17.2%	0.03%	19.0%
Nitrogen	73.5%	0.03%	70.5%
Methane		0.03%	
Carbon Monoxide	4.24%	0.03%	4.06%
Ethyne		0.002%	
Propane		0.002%	
Propene		0.002%	
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%	
neo-Pentane		0.001%	
i-Pentane		0.002%	
n-Pentane		0.002%	
Pentenes		0.002%	
Hexane Plus		0.002%	
Hydrogen Sulfide	0.0003%	0.0001%	0.0004%
Carbonyl Sulfide	0.0006%	0.0001%	0.0013%
Unidentified		0.001%	
Water	ND	0.001%	ND
Total	100.0%		100.0%

Calculated Real Gas Properties per ASTM D3588-91

Temp. (°F)=	60.0	60.0
Press. (psia)=	14.696	14.73
Compressibility Factor [z] =	0.99955	0.99955
Relative Density =	1.0073	1.0073
Gross HV (DRY) =	16.6	16.7
Gross HV (SAT.) =	16.3	16.4
Wobbe Index =	16.6	16.6
Net HV (Dry) =	16.0	16.1
Net HV (Sat.) =	15.8	15.8

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

Analytical Report

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi Platt
IGT Sample Number: 9615302
Sample Description: Sample 64202-002 10/17/96 11 00
Date Analyzed: 24-Oct-96 Analyst: cla

Component	Mol %	Det. Limit	Weight %
Helium	ND	0.001%	ND
Hydrogen	0.52%	0.04%	0.04%
Carbon Dioxide	2.77%	0.03%	4.19%
Ethane		0.03%	
Ethene		0.03%	
Oxygen/Argon	18.4%	0.03%	20.4%
Nitrogen	75.4%	0.03%	72.8%
Methane		0.03%	
Carbon Monoxide	2.69%	0.03%	2.59%
Ethyne		0.002%	
Propane		0.002%	
Propene		0.002%	
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%	
neo-Pentane		0.001%	
i-Pentane		0.002%	
n-Pentane		0.002%	
Pentenes		0.002%	
Hexane Plus		0.002%	
Hydrogen Sulfide	0.0001%	0.0001%	0.0001%
Carbonyl Sulfide	0.0003%	0.0001%	0.0007%
Unidentified		0.001%	
Water	ND	0.001%	ND
Total	100.0%		100.0%

Calculated Real Gas Properties per ASTM D3588-91

Temp. (°F)=	60.0	60.0
Press. (psia)=	14.696	14.73
Compressibility Factor (z) =	0.99958	0.99958
Relative Density =	1.0033	1.0033
Gross HV (DRY) =	10.5	10.5
Gross HV (SAT.) =	10.3	10.3
Wobbe Index =	10.5	10.5
Net HV (Dry) =	10.1	10.1
Net HV (Sat.) =	9.9	10.0

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

IGT Institute of Gas Technology

Analytical Report

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

Major Component Gas Analysis By Gas Chromatography

Client Name: Mosturdi Platt
IGT Sample Number: 9615303
Sample Description: Sample 64202-003 10/17/96 13 00
Date Analyzed: 24-Oct-96 **Analyst:** cla

Component	Mol %	Det. Limit	Weight %
Helium	ND	0.001%	ND
Hydrogen	4.73%	0.04%	0.31%
Carbon Dioxide	24.9%	0.03%	35.7%
Ethane		0.03%	
Ethene		0.03%	
Oxygen/Argon	0.62%	0.03%	0.65%
Nitrogen	44.3%	0.03%	40.2%
Methane		0.03%	
Carbon Monoxide	25.5%	0.03%	23.3%
Ethyne		0.002%	
Propane		0.002%	
Propene		0.002%	
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%	
neo-Pentane		0.001%	
i-Pentane		0.002%	
n-Pentane		0.002%	
Pentenes		0.002%	
Hexane Plus		0.002%	
Hydrogen Sulfide	0.0014%	0.0001%	0.0016%
Carbonyl Sulfide	0.0035%	0.0001%	0.0069%
Unidentified		0.001%	
Water	ND	0.001%	ND
Total	100.0%		100.0%

Calculated Real Gas Properties per ASTM D3588-91

Temp. (°F)=	60.0	60.0
Press. (psia)=	14.696	14.73
Compressibility Factor (z) =	0.99899	0.99899
Relative Density =	1.0656	1.0656
Gross HV (DRY) =	99.1	99.3
Gross HV (SAT.) =	97.3	97.6
Wobbe Index =	96.0	96.2
Net HV (Dry) =	95.8	96.0
Net HV (Sat.) =	94.1	94.3

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

IGT Institute of Gas Technology

Analytical Report

11/1/96
IGT Log #: 9615381.XLS

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi Platt
IGT Sample Number: 9615381
Sample Description: Sample 64312-001   10/25/96 08:00
Date Analyzed: 30-Oct-96   Analyst: [illegible]

Component	Mol %	Det. Limit	Weight %
Helium	ND	0.001%	ND
Hydrogen	4.51%	0.04%	0.30%
Carbon Dioxide	34.1%	0.03%	[illegible]
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	0.34%	0.03%	[illegible]
Nitrogen	[illegible]	0.03%	41.7%
Methane		0.03%	
Carbon Monoxide	24.8%	0.03%	22.6%
Ethyne		0.002%	
Propane		0.002%	
Propene		0.002%	
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%	
neo-Pentane		0.001%	
i-Pentane		0.002%	
n-Pentane		0.002%	
Pentenes		0.002%	
Hexanes Plus		0.002%	
Hydrogen Sulfide	0.0026%	0.0001%	0.0029%
Carbonyl Sulfide	0.0033%	0.0001%	0.0064%
Unidentified		0.001%	
Water	ND	0.001%	ND
Total	100.0%		100.0%

Calculated Real Gas Properties per ASTM D3588-91

Temp. (°F)=	60.0	60.0
Pres. (psia)=	14.696	14.73
Compressibility Factor (z) =	0.99801	0.99801
Relative Density =	1.0644	1.0644
Gross HV (DRY) =	96.7	96.9
Gross HV (SAT.) =	95.0	95.2
Wobbe Index =	93.7	93.9
Net HV (Dry) =	93.5	93.7
Net HV (Sat.) =	91.9	92.1

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

IGT Institute of Gas Technology

Analytical Report

11/1/96
IGT Log # · 9615382.XLS

Major Component Gas Analysis By Gas Chromatography

Client Name: Montarill Hall
IGT Sample Number: 9615382
Sample Description: Sample 64312-002 10/25/96 10:00
Date Analyzed: 30-Oct-96 Analyst: ele

Component	Mol %	Det. Limit	Weight %
Helium	ND	0.001%	ND
Hydrogen	4.60%	0.04%	0.31%
Carbon Dioxide	34.8%	0.03%	36.0%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	0.41%	0.03%	0.44%
Nitrogen	44.4%	0.03%	40.5%
Methane		0.03%	
Carbon Monoxide	15.8%	0.03%	23.0%
Ethyne		0.003%	
Propane		0.003%	
Propene		0.003%	
Propadiene		0.003%	
Propyne		0.003%	
i-Butane		0.003%	
n-Butane		0.003%	
1-Butene		0.003%	
i-Butene		0.003%	
Trans-2-Butene		0.003%	
Cis-2-Butene		0.003%	
1,3-Butadiene		0.003%	
neo-Pentane		0.001%	
i-Pentane		0.003%	
n-Pentane		0.003%	
Pentenes		0.003%	
Hexane Plus		0.003%	
Hydrogen Sulfide	0.0021%	0.0001%	0.0023%
Carbonyl Sulfide	0.0020%	0.0001%	0.0042%
Unidentified		0.001%	
Water	ND	0.001%	ND
Total	100.0%		100.0%

Calculated Real Gas Properties per ASTM D3588-91

Temp (°F)=	60.0	60.0
Press. (psia)=	14.696	14.73
Compressibility Factor (z) =	0.99980	0.99980
Relative Density =	1.0644	1.0644
Gross HV (DRY) =	100.1	100.4
Gross HV (SAT.) =	98.4	98.6
Wobbe Index =	97.1	97.3
Net HV (Dry) =	96.8	97.1
Net HV (Sat.) =	95.2	95.4

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

IGT Institute of Gas Technology

Analytical Report

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

Major Component Gas Analysis By Gas Chromatography

Client Name: Montardi Platt
IGT Sample Number: 9615383
Sample Description: Sample 64312-003   10/25/96 12:00
Date Analyzed: 31-Oct-96   Analyst: cla

Component	Mol %	Det. Limit	Weight %
Helium	ND	0.001%	ND
Hydrogen	4.40%	0.04%	0.29%
Carbon Dioxide	24.3%	0.03%	34.8%
Ethane		0.03%	
Ethene		0.03%	
Oxygen/Argon	0.94%	0.03%	0.99%
Nitrogen	45.7%	0.03%	41.4%
Methane		0.03%	
Carbon Monoxide	24.5%	0.03%	22.3%
Ethyne		0.002%	
Propane		0.002%	
Propene		0.002%	
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%	
neo-Pentane		0.001%	
i-Pentane		0.002%	
n-Pentane		0.002%	
Pentenes		0.002%	
Hexanes Plus		0.002%	
Hydrogen Sulfide	0.0025%	0.0001%	0.0028%
Carbonyl Sulfide	0.0037%	0.0001%	0.0063%
Unidentified		0.001%	
Water	ND	0.001%	ND
Total	100.0%		100.0%

Calculated Real Gas Properties per ASTM D3588-91

Temp. (°F)=	60.0	60.0
Press. (psia)=	14.696	14.73
Compressibility Factor (z) =	0.99900	0.99900
Relative Density =	1.0060	1.0060
Gross HV (DRY) =	95.7	96.0
Gross HV (SAT.) =	94.1	94.3
Wobbe Index =	92.7	92.9
Net HV (Dry) =	92.5	92.8
Net HV (Sat.) =	90.9	91.1

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

IGT Institute of Gas Technology

Analytical Report

10/15/96
IGT Log # : 9614961.XLS

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi Platt
IGT Sample Number: 9614961
Sample Description: Sample 64017-001 10/3/96 08:30
Date Analyzed: 7-Oct-96
Analyst: cla

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

IGT Institute of Gas Technology

Analytical Report

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

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi Platt
IGT Sample Number: 9614962
Sample Description: Sample 64017-002 10/3/96 11:00
Date Analyzed: 7-Oct-96
Analyst: cls

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

IGT Institute of Gas Technology

Analytical Report

10/15/96
IGT Log # : 9614963.XLS

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi Platt
IGT Sample Number: 9614963
Sample Description: Sample 64017-003 10/3/96 13:00
Date Analyzed: 7-Oct-96
Analyst: cla

Component Name	PPMV	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-Butyl 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: Component Detection Limit
1 ppmv for Hydrogen Sulfide
0.2 ppmv for all other compounds

IGT Institute of Gas Technology

Analytical Report

10/24/96
IGT Log # : 9615121.XLS

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi Platt
IGT Sample Number: 9615121
Sample Description: Sample 64113-001   10/9/96 08:00
Date Analyzed: 15-Oct-96
Analyst: cla

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	
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:	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-Butyl Disulfide		As Grains/100 SCF	2.1
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

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

IGT Institute of Gas Technology

Analytical Report

10/24/96
IGT Log # : 9615122.XLS

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

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

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	1.1	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:	5.4
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: Component Detection Limit
1 ppmv for Hydrogen Sulfide
0.2 ppmv for all other compounds

IGT Institute of Gas Technology

Analytical Report

10/24/96
IGT Log # : 9615123.XLS

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi Platt
IGT Sample Number: 9615123
Sample Description: Sample 64113-003 10/9/96 13:00
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	
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:	60.0
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			

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

IGT Institute of Gas Technology

Analytical Report

10/25/96
IGT Log # : 9615301.XLS

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi Platt
IGT Sample Number: 9615301
Sample Description: Sample 64202-001 10/17/96 08:00
Date Analyzed: 23-Oct-96
Analyst: cla

Component Name	PPMV	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-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:	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: Component Detection Limit
1 ppmv for Hydrogen Sulfide
0.2 ppmv for all other compounds

IGT Institute of Gas Technology

Analytical Report

10/25/96
IGT Log # : 9615302.XLS

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi Platt
IGT Sample Number: 9615302
Sample Description: Sample 64202-002 10/17/96 11:00
Date Analyzed: 23-Oct-96
Analyst: cls

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	1	Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	3.3	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:	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: Component Detection Limit
1 ppmv for Hydrogen Sulfide
0.2 ppmv for all other compounds

IGT Institute of Gas Technology

Analytical Report

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

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi Platt
IGT Sample Number: 9615303
Sample Description: Sample 64202-003 10/17/96 13:00
Date Analyzed: 23-Oct-96
Analyst: cla

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	14	Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl 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 t-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-Butyl Disulfide		As Grains/100 SCF	3.1
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

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

IGT Institute of Gas Technology

Analytical Report

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

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi Platt
IGT Sample Number: 9615381
Sample Description: Sample 64312-001 10/25/96 08:00
Date Analyzed: 29-Oct-96
Analyst: cls

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	26	Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	33	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 Sulfur Compounds (all as monosulfides)	
Methyl Ethyl Sulfide			
Diethyl Sulfide			
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:	59.0
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As PPMV	59.0
Di-t-Butyl Disulfide		As Grains/100 SCF	3.7
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

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

IGT Institute of Gas Technology

Analytical Report

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

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi Platt
IGT Sample Number: 9615382
Sample Description: Sample 64312-002 10/25/96 10:00
Date Analyzed: 30-Oct-96
Analyst: cls

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	21	Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	32	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:	53.0
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As PPMV	53.0
Di-t-Butyl Disulfide		As Grains/100 SCF	3.3
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

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

IGT Institute of Gas Technology

Analytical Report

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

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi Platt
IGT Sample Number: 9615383
Sample Description: Sample 64312-003 10/25/96 12:00
Date Analyzed: 30-Oct-96
Analyst: ola

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	25	Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	32	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:	57.0
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As PPMV	57.0
Di-t-Butyl Disulfide		As Grains/100 SCF	3.6
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

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

MOSTARDI-PLATT ASSOCIATES, INC.
Environmental Consultants

Read Instructions on Reverse Side Before Completing Form!

CHAIN-OF-CUSTODY RECORD

Project Number: 54017	Date Results Required:
Client:	TAT(Assessment Only)
Plant/Location:	LAB Use Only — PO Number:
Project Supervisor: CT	LIMS Entry:

Sample Number	Date Sampled	Sample Point Identification	# of Conts	Grab/ Comp	Analysis Requested	Sub Lab
001	10/3	BF-C Blast 830			Major components,	
002	↓	Furnace Gas 1100			Trace Sulfur,	
003		" 1300			Total Hydrocarbon	
					scan	

Delivered by:	Date/Time	Processed by:	Date/Time	Received by Laboratory:
EP	10/4	E.V. 10.4.96		Chris Arnold 10/4/96 12:00pm

Special Instructions:

MOSTARDI-PLATT ASSOCIATES, INC.
Environmental Consultants

L96-1512

Read Instructions on Reverse Side Before Completing Form!

CHAIN-OF-CUSTODY RECORD

Project Number: ~~[illegible]~~ 64113	Date Results Required:		
Client: Bethlehem Steel	TAT(Assessment Only)		
Plant/Location: Burns Harbor / BF	LAB Use Only	PO Number:	
Project Supervisor: CT		LIMS Entry:	

Sample Number	Date Sampled	Sample Point Identification	# of Conts	Grab/ Comp	Analysis Requested	Sub Lab
001	10/9/96	Test 1 0800	1		Trace Sulfur and	
002	↓	2 1100	1		Major Components	
003	↓	3 1300	1		Please Report	
004					TOTAL	
005					Hydrocarbons	
006						
007						
008						
009						
010						
011						
012						
013						
014						
015						
016						

Delivered by:	Date/Time	Processed by:	Date/Time	Received by Laboratory:
KJA	10/14/96	Checked D Santelli	10.14.96	Chris Arnold 10/14/96 2:00pm

Special Instructions:

MOSTARDI-PLATT ASSOCIATES, INC.
Environmental Consultants

L96-1530

Read Instructions on Reverse Side Before Completing Form!

CHAIN-OF-CUSTODY RECORD

Project Number:	64202	Date Results Required:	
Client:		TAT(Assessment Only)	
Plant/Location:		LAB Use Only	PO Number: 17711
Project Supervisor:	CT		LIMS Entry:

Sample Number	Date Sampled	Sample Point Identification	# of Conts	Grab/ Comp	Analysis Requested	Sub Lab
001	10-17-96	Test 1 08:00			Trace Sulfur &	
002	↓	Test 2 11:00			Major Components	
003	↓	Test 3 13:00			Please report total	
					hydrocarbons	

Delivered by:	Date/Time	Processed by:	Date/Time	Received by Laboratory:
	10.18.96	E. V. 10.21.96		Chris Arnold 10/21/96 1:00pm

Special Instructions:

MOSTARDI-PLATT ASSOCIATES, INC.
Environmental Consultants

4

Read Instructions on Reverse Side Before Completing Form!

CHAIN-OF-CUSTODY RECORD

Project Number: 64312	Date Results Required:
Client: BETHLEHEM STEEL	TAT(Assessment Only)
Plant/Location: BURNS HARBOR IN	LAB Use Only — PO Number: 17756
Project Supervisor: CHRIS TREZAK	LAB Use Only — LIMS Entry: E. V. 10.31.96

Sample Number	Date Sampled	Sample Point Identification	# of Conts	Grab/ Comp	Analysis Requested	Sub Lab
001	10-25	BLAST FURNACE	1		Trace sulfur	IGT
002	10-25	BLAST FURNACE	1		Major Compon.	↓
003	10-25	BLAST FURNACE	1			
					Please, also	
					report	
					Total Hydrocarbons	

Delivered by:	Date/Time	Processed by:	Date/Time	Received by Laboratory:
[signature]	10-28 0900	E. V. 10.28.96		

Special Instructions:

Institute of Gas Technology
LOGIN CHAIN OF CUSTODY REPORT (ln01)
Oct 07 1996, 04:16 pm

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

Laboratory Sample Number			Client Sample Number	Collect Date	Receive Date	PR	Due Date
L96-1496-1			SAMPLE 64017-001	03-OCT-96	04-OCT-96		25-OCT-96
report total hydrocarbons							
Gas	P	LANDGAS2					1 Bottles
Gas	C	LANDGAS					
Gas	C	SLFRTG	Hold:04-OCT-96				
L96-1496-2			SAMPLE 64017-002	03-OCT-96	04-OCT-96		25-OCT-96
report total hydrocarbons							
Gas	P	LANDGAS2					1 Bottles
Gas	C	LANDGAS					
Gas	C	SLFRTG	Hold:04-OCT-96				
L96-1496-3			SAMPLE 64017-003	03-OCT-96	04-OCT-96		25-OCT-96
report total hydrocarbons							
Gas	P	LANDGAS2					1 Bottles
Gas	C	LANDGAS					
Gas	C	SLFRTG	Hold:04-OCT-96				
Miscell.	S	ZZ S&H					

Signature: Chris Arnold

Date: 10/4/96

Institute of Gas Technology
LOGIN CHAIN OF CUSTODY REPORT (ln01)
Oct 15 1996, 10:20 am

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

Laboratory Sample Number		Client Sample Number		Collect Date	Receive Date	PR	Due Date
L96-1512-1		SAMPLE 64113-001		09-OCT-96	14-OCT-96		04-NOV-96
Gas	P LANDGAS2						1 Bottles
Gas	C LANDGAS						
Gas	C SLFRTG		Hold:10-OCT-96				
L96-1512-2		SAMPLE 64113-002		09-OCT-96	14-OCT-96		04-NOV-96
Gas	P LANDGAS2						1 Bottles
Gas	C LANDGAS						
Gas	C SLFRTG		Hold:10-OCT-96				
L96-1512-3		SAMPLE 64113-003		09-OCT-96	14-OCT-96		04-NOV-96
Gas	P LANDGAS2						1 Bottles
Gas	C LANDGAS						
Gas	C SLFRTG		Hold:10-OCT-96				
Miscell.	S ZZ S&H						

Report Total Hydrocarbons

Signature: Chris Arnold

Date: 10/14/96

Institute of Gas Technology
LOGIN CHAIN OF CUSTODY REPORT (ln01)
Oct 22 1996, 04:34 pm

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

Laboratory Sample Number			Client Sample Number		Collect Date	Receive Date	PR	Due Date
L96-1530-1			SAMPLE 64202-001		17-OCT-96	21-OCT-96		11-NOV-96
report total hydrocarbons								
Gas	P	LANDGAS2						1 Bottles
Gas	C	LANDGAS						
Gas	C	SLFRTG		Hold:18-OCT-96				
L96-1530-2			SAMPLE 64202-002		17-OCT-96	21-OCT-96		11-NOV-96
report total hydrocarbons								
Gas	P	LANDGAS2						1 Bottles
Gas	C	LANDGAS						
Gas	C	SLFRTG		Hold:18-OCT-96				
L96-1530-3			SAMPLE 64202-003		17-OCT-96	21-OCT-96		11-NOV-96
report total hydrocarbons								
Gas	P	LANDGAS2						1 Bottles
Gas	C	LANDGAS						
Gas	C	SLFRTG		Hold:18-OCT-96				
Miscell.	S	ZZ S&H						

Signature: Chris Arnold

Date: 10/21/96

Institute of Gas Technology
LOGIN CHAIN OF CUSTODY REPORT (ln01)
Oct 28 1996, 02:22 pm

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

Laboratory Sample Number			Client Sample Number	Collect Date	Receive Date	Due PR Date
L96-1538-1			SAMPLE 64312-001	25-OCT-96	28-OCT-96	18-NOV-96
report total hydrocarbons						
Gas	P	LANDGAS2				1 Bottles
Gas	C	LANDGAS				
Gas	C	SLFRTG	Hold:26-OCT-96			
L96-1538-2			SAMPLE 64312-002	25-OCT-96	28-OCT-96	18-NOV-96
report total hydrocarbons						
Gas	P	LANDGAS2				1 Bottles
Gas	C	LANDGAS				
Gas	C	SLFRTG	Hold:26-OCT-96			
L96-1538-3			SAMPLE 64312-003	25-OCT-96	28-OCT-96	18-NOV-96
report total hydrocarbons						
Gas	P	LANDGAS2				1 Bottles
Gas	C	LANDGAS				
Gas	C	SLFRTG	Hold:26-OCT-96			
Miscell.	S	ZZ S&H				

Signature: Chris Arnold

Date: 10/28/96

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-Oct-96		
12-Oct-96		
13-Oct-96		
14-Oct-96		
15-Oct-96		
16-Oct-96	17.0	<0.005
17-Oct-96		
18-Oct-96		
19-Oct-96		
20-Oct-96		
21-Oct-96		
22-Oct-96		
23-Oct-96	47.9	<0.005
24-Oct-96		
25-Oct-96		
26-Oct-96		
27-Oct-96		
28-Oct-96		
29-Oct-96		
30-Oct-96		
31-Oct-96		
Average	23.8	0.009
Maximum	47.9	0.022
Minimum	15.0	<0.005

Bethlehem Steel Corporation
Burns Harbor Division
Monitoring Station 011 Monitoring Summary

Sample Date	Flow (MGD)	Ammonia (as N) (mg/l)	Ammonia (as N) (lb/day)	Cyanide (mg/l)	Cyanide (lb/day)
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-Oct-96	87.4	0.53	386.6	<0.005	0.0
11-Oct-96	86.4				
12-Oct-96	84.2				
13-Oct-96	90.3	0.38	286.4	<0.005	0.0
14-Oct-96	73.1				
15-Oct-96	88.5	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-Oct-96	86.2	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

Bethlehem Steel Corporation
Burns Harbor Division
Outfall 001 Monitoring Summary

Sample Date	Flow (MGD)	Ammonia (as N) (mg/l)	Ammonia (as N) (lb/day)	Cyanide (mg/l)	Cyanide (lb/day)
01-Oct-96	138.8	0.29	335.9		
02-Oct-96	136.5				
03-Oct-96	134.6	0.24	269.6		
04-Oct-96	130.1				
05-Oct-96	125.8				
06-Oct-96	133.7	0.30	334.7	<0.005	0.0
07-Oct-96	125.7				
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-Oct-96	141.7	0.48	567.6		
18-Oct-96	138.7				
19-Oct-96	132.1				
20-Oct-96	125.0	0.40	417.3	<0.005	0.0
21-Oct-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				
26-Oct-96	82.9				
27-Oct-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