BLAST FURNACE GRANULAR COAL INJECTION RESULTS USING PULVERIZED AND GRANULATED HIGH VOLATILE COAL

Report on Trials 3 and 4

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INTRODUCTION

This report presents the results of two trials conducted with the Blast Furnace Granular Coal Injection System at Bethlehem Steel Corporation's Burns Harbor Plant. The trials were conducted using granulated and pulverized high volatile coal from Colorado. The first trial was conducted to quantify the effect that a high volatile western coal, Colorado Oxbow, has on the blast furnace operation and the process economics compared to the eastern low volatile coal that is the current standard at Burns Harbor. The high volatile western coal was pulverized for the second trial. The pulverized trial period is compared to the granular period using the high volatile coal and analyzed for blast furnace process differences.

The first trial, the comparison of high to low volatile coal, is an important aspect of the demonstration project. This trial shows the role that coal chemistry, specifically carbon and ash content, has on the blast furnace process. The objective of the second trial was to determine if injected coal size, i.e., pulverized versus granulated, has an impact on blast furnace performance. This comparison of pulverized versus granulated coal was an important part of the demonstration project.

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. The design of this coal injection system, especially the coal grinding mills, make it possible to pulverize as well as granulate coal for furnace injection. 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.

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.

Complete coal injection began on D furnace in April 1995 and on C in June 1995. Since that time the operation has progressed steadily and culminated in the development of efficient operating practices using the granulated coal facility.

During the start of coal injection, Sydney coal, a high volatile eastern coal, was used on both furnaces for eight months. Subsequently, six different low volatile coals were used on both furnaces for seven months. The low volatile coals performed well and led to the use of Buchanan low volatile as the standard coal since 1996.

Meaningful analysis of blast furnace process changes that occur with a change to injected coal type or sizing requires a base test period from which comparisons can be made. The requirements for an acceptable trial are:

1. A steady state operating period. The length of the period is flexible, however, the longer the trial duration, the more definitive the results.

2. Minimal furnace outages or delays during the trial.

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 is designated as the granulated coal test facility due, in large part, to the physical improvements made to the furnace during the 1994 reline. This furnace was used for the low volatile coal trial and the higher ash coal trial. [1,2] However, operational difficulties on C furnace during the Colorado coal trial period required that the D furnace be used for the evaluation of both granular and pulverized high volatile coal.

Table 1 shows the operating time periods used on D furnace for the two trials. Operating data from August 1998 is used as the base period to compare the furnace operation using low volatile granular coal with the trial of granular high volatile coal conducted in October, 1998. The second trial was with pulverized Colorado coal. These trial results were compared to those of the granulated Colorado coal trial. This trial was planned to run the full month of November; however, extreme wear to the grinding mills during the granular trial resulted in the inability of the mill to pulverize the coal. Consequently, the first two weeks of November were used for emergency repairs. The pulverized coal trial began on November 13 and concluded on November 26 when the Colorado coal supply was depleted.

The important operating conditions that indicate the full range of furnace performance results are discussed and documented for the base and trial operating periods in the following. In addition, environmental stream testing of the closed water and gas cleaning

systems, furnace refractory temperatures, thermal loads and refractory wear readings are presented for the operating trial periods.

FURNACE TRIAL OPERATING CONDITIONS

The D Furnace Operation

The high volatile coal injection evaluation was completed during the 4th quarter of 1998. The trial comparing the high volatile, western coal to an eastern, low volatile coal was an important test in the DOE cooperative demonstration project. The second trial, comparing the operation of the blast furnace with granular high volatile coal to the same coal with pulverized sizing, was the heart of the demonstration project. The planning for these trials and the procurement of the high volatile coal from Colorado began during the spring of 1998. Five trainloads, approximately 40,000 tons, of the coal was ordered for delivery beginning in September. The trial period was to begin on C furnace on October 1, 1998. However, operating difficulties, unrelated to coal injection, began to plague C furnace. Several major outages on C furnace during late September and extending throughout the trial period in October resulted in poor operating conditions. It was also necessary to switch C furnace to natural gas from coal injection in order to stabilize the furnace operation. The frequent delays and the use of natural gas caused a lack of meaningful data with coal injection. Since the Colorado coal supply was dwindling and the prospects of C furnace returning to a suitable operating standard was unlikely, the trial was switched to D furnace. The first two comparison periods on D furnace, complete monthly periods during August and October, proceeded as planned. However, the pulverized, high volatile period which was also planned as a full month trial during November had to be shortened. On November 1, when the coal-grinding mill was adjusted to produce pulverized coal, the resulting coal did not meet the sizing requirements. A close examination of the mills revealed that the high volatile coal used during the previous month had severely worn the bull ring on both mills and pulverizing was not possible. Emergency repairs for resurfacing the bullrings of both mills began immediately. Twelve days were required to repair and reset the mills to produce pulverized coal. Fortunately, enough Colorado coal remained to conduct a fourteen-day trial before the supply ran out on November 27.

General Trial Observations:

The use of granular low volatile coal at Burns Harbor began during 1996 and has resulted in excellent operating performance. These operating results and a subsequent DOE trial conducted in October, 1996 established a good benchmark on the use of granular low volatile coal for injection in the blast furnace.[1] The base operating period selected for this trial, August 1998, reflects the advantages of the granular low volatile coal and is shown in Table 1. The coke rate of 683 pounds/NTHM at a coal injection rate of 250 pounds/NTHM resulted in an overall low fuel rate of 935 pounds/NTHM and contributed to the good production level of 7078 NTHM/day. This period provides a good comparison base for the high volatile coal operating periods.

The blast furnace operation using granular, high volatile, western coal during October is shown on Table 1. Compared to the base period, the coke rate is 115 pounds higher at 798 pounds/NTHM. Although the injected coal rate is about 60 pounds/NTHM lower at 190 pounds/NTHM, the increase in coke rate is not proportional to the injected coal decrease. This comparison shows that the low volatile coal supports a lower furnace coke rate than the high volatile coal.

The results of the blast furnace performance with pulverized high volatile coal are shown as Trial 2 in Table 1. The coke rate, coal injection rate and the overall fuel rate are very similar to the operation using granular high volatile coal. The injected coal rate is lower during this period because the two coal grinding mills could only pulverize 183 pounds/NTHM of coal. The comparison of the two trial periods shows similar results and leads to the conclusion that the blast furnace process is unaffected by the injected coal being granulated or pulverized.

The initial plan was to inject the western coal at a rate of 250 pounds/NTHM, the same as in the August 1998 base period. However, this coal was very difficult to grind even to a granular size. At this point in the granular trial, we realized that we would not be able to pulverize this coal at a rate of 250 pounds/NTHM. Therefore, to insure a good coke comparison and furnace operation between the granular and pulverized trials, the granular coal was kept to a rate that we thought could be sustained during the pulverized coal trial. Even at the lower rate of 190 pounds/NTHM, the grinding mills could not maintain this level during the pulverized trial period. Although trial data is more compelling than speculation, we believe that the comparison of granular versus pulverized coal would remain the same at even higher injection levels.

One furnace variable that was of concern during the planning phase of the trial for using pulverized coal was permeability. Table 1 shows that during the base period and the granular trial there was no change in permeability. The values were 1.43 and 1.42, respectively. During the pulverized coal trial, the furnace permeability did decrease to 1.33. However, this was likely because Chinese coke was not on the furnace during the pulverized trial period but was in the burden during the two previous operating periods. We have previously documented the increase in furnace permeability that accompanies the use of larger sized Chinese coke.[3] We believe that the reduction in permeability during this period is attributable to the lack of Chinese coke rather than the use of pulverized coal. This is supported by the fact that the permeability on the D furnace remained low, at 1.36, during December 1998 after the pulverized coal trial had ended and Chinese coke was no longer available.

Coal Chemistry and Sizing:

The comparison of injected coal chemistry between the Buchanan and the high volatile, Oxbow coal is shown on Table 2. The large difference in coke rate seen between the aforementioned periods is attributable to the difference in carbon content of the two coals. The Oxbow coal averages 73.2% carbon versus 86.3% for the Buchanan low volatile coal. The increase in coke rate is also due to the higher ash content of the Oxbow coal. Buchanan ash content is 5.23% compared to 11.20% for the Oxbow. The furnace

slag volume during the operating period with Buchanan is 430 pounds/NTHM. The higher ash content of the Oxbow causes the slag volume to rise to 461 pounds/NTHM during the first trial. A slag volume increase in the blast furnace results in an increase in the coke rate.

Coal sizing was a concern and was closely monitored during each trial period. Table 3 shows the injected coal sizing for each period as well as the raw coal sizing. The raw coal sizing shown is the size fraction of the coal as measured by the vendor at the shipping site. The product coal sizing shown in the table is the size fraction of the injection coal after grinding in the preparation mills. The granular sizing shown for the low volatile, Buchanan and the high volatile, Oxbow coal is the monthly average of daily samples taken on D furnace during August and October. The values for the pulverized sizing are the average of ten daily samples taken during the pulverized trial. The pulverized coal only shows the minus 200 mesh fraction because, unlike the granular size, the pulverized coal particles stick together and the measurement is made using a device with only one screen. This equipment puts the entire sample under vacuum and draws the portion of coal that is -200 mesh through the screen. This method of analysis was done on a daily basis to insure that the grinding mills were set properly. A more accurate method of screen analysis, the wet screen method, is often used. The Burns Harbor Plant laboratory is not equipped for this method, however, two samples were sent to an independent laboratory for wet analysis. The average of the two samples is also shown on Table 3. This method shows that the minus 200-mesh fraction of the injected coal is 74%.

The raw coal sizing shown on Table 3 demonstrates a fundamental difference between high volatile and low volatile coal. The low volatile coal arrives at the coal grinding facility with 83% of the coal already sized at minus one-quarter inch. The grinding mills require less energy to achieve the proper sizing for injection than for the high volatile coal that is only 36% minus one-quarter inch. In addition, grinding the low volatile coal with an HGI of 100 is much easier than grinding the Oxbow coal that has an HGI of 46 – 48. This is demonstrated later.

Furnace Coke Rate Results:

One of the reasons for the October trial was to determine the coke rate difference between the use of low volatile and high volatile injected coals. In order to assess the furnace coke rate during a trial, all of the variables that affect the furnace coke rate and are different from the base must be adjusted for by using coke correction factors. The variables that are not corrected or adjusted are those affected by the operating variable that is being assessed. After all of the operational coke differences between the base period and the trial period are accounted for, the remaining coke is attributed to the variable being studied. Since the Colorado coal is higher in ash than the Buchanan coal and is a consequence of the difference between the two coals, we have not adjusted the coke rate for changes in the furnace slag volume. The blast furnace slag volume is directly affected by the injected coal ash.

The result of the first comparison of the base period to the granulated high volatile period is shown in Table 4. The primary correction for the October period is the rather large difference in the injected coal rate. A correction of one pound/NTHM injected coal replacing one pound/NTHM of coke is used for the difference in injection rate. Hot metal silicon content did increase substantially during the granular trial period and a correction of 11 pounds/NTHM is used for this factor. After each factor in the analysis is accounted for, we are left with a 46 pound/NTHM higher coke rate in the high volatile trial period than during the low volatile base period. The higher coke rate is attributed to the use of the high volatile coal. This result is plausible because the Buchanan coal is 13% higher in carbon content than the Oxbow coal. Since carbon is the primary fuel and reductant for the furnace, the difference in fuel rates is understandable. In addition, the almost 6% higher ash content of the western coal is a distinct coke disadvantage. The previously mentioned higher ash coal trial documents a coke disadvantage of three pounds per NTHM for each one percent increase in the ash content of the injected coal. Regardless of where and how each furnace factor is applied, the overwhelming conclusion from this comparison is that the low volatile coal provides a very substantial coke rate advantage to the blast furnace.

The coke comparison of the high volatile granular trial to the pulverized trial is shown in Table 5. The operating periods are very similar and there were only small corrections necessary. We included blast furnace slag volume in these corrections because the injection coal type was the same for both periods. The largest corrections were for the decrease in wind volume during the pulverized period and the increase in slag volume. The wind decreased because the furnace permeability was lower due to the lack of Chinese coke in the burden as previously discussed. The three pound coke difference for the pulverized trial period is within the plus or minus five-pound error limit and strongly indicates that there is no difference in the blast furnace operation with the use of pulverized coal.

Table 6 shows the blast furnace sulfur balance results for both of the trials. The sulfur content of all of the raw material inputs as well as the material outputs use the monthly average sulfur analysis. The sulfur content of the blast furnace gas is the average of three samples that were taken for each period by Mostardi Platt. The balances are very good for both trial periods.

Coal Grinding Energy Consumption:

The primary reason for adopting the British Steel granular coal injection technology was to inject coal into the blast furnace by the most efficient and cost effective method. One reason for choosing granular over the pulverizing process is presented in Figure 1. The figure shows the combined energy consumption of both coal grinding mills per ton of coal processed. Four points of interest are shown on the figure.

The first point, May 1998, is a period during which we attempted to pulverize low volatile coal. During this month pulverized coal was produced in the mill but severe line plugging did not allow for an appropriate furnace process trial. This experience was

detailed in the quarterly status report for the period April-June 1998.[4] The energy consumption in April increased from about 10 KWH/ton with granular coal to 14 KWH/ton with pulverized coal.

The granular coal base period is labeled on Figure 1 as "granular low vol." The third point is from the high volatile granular period. The increase from 7.5 KWH/ton for granular, low volatile coal to 19.6 KWH/ton for granular, high volatile is very significant. These two points are an added incentive for the use of low volatile coal at Burns Harbor. The last point on Figure 1 shows the rise in energy consumption from the granular period in October to the pulverized period during the last two weeks in November. The KWH/ton increase from 19.6 to 31.4 is very significant in the overall cost of preparing the coal for injection.

FURNACE THERMAL CONDITIONS AND REFRACTORY LINING WEAR

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

In addition to the array of thermocouples, wear monitors are located in the refractories of the furnace at various elevations and quadrants. These monitors give an indication of the amount of brick that is remaining in the furnace at various elevations.

The furnace operation can be evaluated implicitly by studying differences in these measurements over time. For example, if there are higher heat loads observed in the furnace during a change in the furnace practice, we may imply that the practice change was responsible for the increased heat loads. We have observed, with the use of the refractory wear monitors that coal injection causes increased wear of the brick lining.

Figure 2 shows the inwall refractory temperatures at three elevations. These values have changed very little during the entire year. This figure indicates that during the trial periods as well as the base period there was no change in the refractory temperatures.

Figure 3 shows the calculated thermal loads in the bosh, mantle and cooling Row 2. These are the lower elevations in the furnace. As in Figure 2, there is no significant change in the values during the trial periods.

In October, during the granular, high volatile coal trial there was a significant increase in the thermal load values at Row 4 and Row 7. This is shown on Figure 4. Figure 5 shows the same increase at Row 16. There is not a good explanation for the increase in values at these three distinct elevations since the thermal loads returned to the previous values in the ensuing high volatile, pulverized trial. The furnace practices did not change significantly between the granular and pulverized trial periods.

Figure 6 shows the refractory wear monitor readings from the beginning of the D furnace campaign. The amount of injected coal is also shown since the start-up of the facility. The refractory wear appears to have accelerated when coal injection began and during the following months. However, as operating practices were fine-tuned and the other furnace variables came into line, the refractory wear lessened and has been steady over the last year. Refractory wear with coal injection now appears to be about the same as before coal injection with the adoption of consistent practices and a steady state operation.

ENVIRONMENTAL TEST RESULTS

Gaseous Streams:

Blast furnace gas samples were obtained from D furnace and analyzed by Mostardi Platt Associates, Inc. during the two trial periods with the high volatile coal. The results of the samples are presented in Appendix 1. When Mostardi Platt was on site to take the gas samples, plant operators were not aware of which furnace would eventually be designated as the trial furnace. Therefore, Mostardi Platt took samples on C and D furnace during the two trial periods. Although we are not discussing the gas samples taken on C furnace, the gas analysis results are show in Appendix I.

Wastewater Monitoring:

During the trial periods from October 1, 1998 through November 30 and including the data from December 1998, monitoring of the Division's treated process water effluent (Monitoring Station 011) and the Division's combined effluent (Outfall 001) was conducted in accordance with the Division's NPDES permit. In addition, internal monitoring of the Blast Furnace Recirculating Water System was performed weekly. All monitoring results for ammonia, nitrogen and total cyanide at Monitoring Station 011, Outfall 001 and the Blast Furnace Recirculating Water System were within the applicable limitations and/or expected ranges. There were no adverse affects on the Division's wastewater system that could be attributed to the BFGCI system during the trial periods with granular and pulverized coal. The results for the three month period that includes the trials is shown in Appendix II.

CONCLUSIONS

The primary goal of the Clean Coal Project and the Cooperative Agreement with the United States Department of Energy was to demonstrate the advantages of using a granular coal injection facility rather than a pulverized coal injection system. Secondary objectives were to determine the effect of coal grind size and coal type on blast furnace performance. This series of trials has clearly shown that granular coal can ce used on a large blast furnace with good results. In addition, the furnace operation using low volatile versus high volatile coal is, without doubt, a superior operation.

The energy consumption for pulverizing compared to granulating the same coal is significantly higher. The high volatile coal required 31.4 KWH/ton to pulverize during

this trial and 19.6KWH/ton to granulate. In addition, the operating data clearly shows that the blast furnace process is unaffected by whether the coal is pulverized or granular at the coal injection rate of 183 pounds/NTHM.

Another conclusion, based on the trial is that the low volatile coal replaces more coke than the lower carbon content, high volatile coal. This result is very important to the Burns Harbor Plant. Prior to coal injection the Plant had to purchase coke to supplement the coke produced. Until the successful use of low volatile coal began and large reductions in coke rate were accomplished, the blast furnace was still dependent on some outside purchased coke. At a production rate of 14,000 NTHM/day for two furnaces, the blast furnace operation is currently self-sufficient with the home coke supply. However, during times of high productivity, there could be a slight need for external coke. The successful injection of low volatile coal closes a large portion of the coke supply/use gap.

We also believe, based on the unsuccessful attempt to inject pulverized, low volatile coal, that it is not possible to inject low volatile coal unless it is in the granular size range. Other blast furnace operators have tried to use low volatile coal in a pulverizing system and have failed due to plugging in the coal delivery lines. This is, for the Burns Harbor facility, a key attribute for the granular system.

ACKNOWLEDGEMENTS

The blast furnace operation with the Oxbow coal was extremely difficult during the trial periods. The management at the Burns Harbor Plant is commended for supporting Bethlehem's commitment to the Department of Energy to demonstrate the Granular Coal Injection System.

In addition, the blast furnace superintendent, D. G. Hill and his supervisors are thanked for their diligence in completing these trials despite the extreme adversity of the operation.

The work accomplished showed that the conclusion of these trials is clear. Granular coal injection using low volatile coal provides Bethlehem with measurable advantages, operationally as well as economically.

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APPENDICES

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REFERENCES

1. Trial 1 Report Clean Coal III Project – BLAST FURNACE GRANULAR COAL INJECTION – RESULTS WITH LOW VOLATILE COAL, November 1997 Cooperative Agreement No.: DE-FC21-91MC27362

2. Trial 2 Report Clean Coal III Project – BLAST FURNACE GRANULAR COAL INJECTION – RESULTS WITH HIGHER ASH COAL, November 1997 Cooperative Agreement No.: DE-FC21-91MC27362

3. QUARTERLY TECHNICAL PROGRESS REPORT – BLAST FURNACE GRANULATED COAL INJECTION – JULY 1 TO SEPTEMBER 30, 1998

4. QUARTERLY TECHNICAL PROGRESS REPORT – BLAST FURNACE GRANULATED COAL INJECTION – APRIL 1 TO JUNE 30, 1998

TABLE 1

D Furnace
DOE Trials with High Volatile Coal

	BASE Buchanan Coal Granular AUGUST 1998	TRIAL 1 Oxbow, Colorado Coal Granular OCTOBER 1998	TRIAL 2 Oxbow, Colorado Coal Pulverized November 13-26,1998
Production, NTHM/day	7078	6689	6710
Delays, Min/day	48	66	73
Coke Rate, lb/NTHM Rep.	**683**	**798**	**800**
Natural Gas Rate, lbs/NTHM	2	2	0
Injected Coal Rate, lbs/NTHM	**250**	**190**	**183**
Total Fuel Rate, lbs/NTHM	935	990	983
Burden %:			
Sinter	30.8	35.3	35.7
Pellets	69.0	64.5	63.6
Misc.	.2	.1	.7
BOF Slag, lbs/NTHM	*10*	*0*	*0*
Blast Conditions:			
Dry Air, SCFM	149,599	150,096	141,539
Blast Pressure, psig	37.6	38.0	37.4
Permeability	1.43	1.42	1.33
Oxygen in Wind, %	25.5	25.3	26.4
Temp, F	2089	2044	2080
Moist., Grs/SCF	21.2	19.3	22.8
Flame Temp, F	3836	3870	3935
Top Temp, F	263	216	197
Top Press, psig	16.7	17.0	16.6
Coke:			
H2O, %	4.7	5.1	5.2
Chinese Coke, %	14.5	12.3	0
Hot Metal %:			
Silicon	.49	.60	.52
Standard Dev.	.104	.115	.110
Sulfur	.041	.036	.035
Standard Dev.	.016	.012	.014
Phos.	.058	.062	.061
Mn.	.37	.40	.39
Temp., F	2652	2640	2686
Slag %:			
SiO2	37.30	36.60	36.20
Al2O3	9.47	10.46	10.50
CaO	40.09	39.29	38.82
MgO	11.21	11.26	11.72
Mn	.36	.37	.37
Sulfur	1.45	1.43	1.33
B/A	1.10	1.07	1.08
B/S	1.38	1.38	1.40
Volume, lbs/NTHM	430	461	504

TABLE 2

Coal Chemistry Comparison of Low Volatile and High Volatile Coal

Coal	Buchanan	Oxbow, Colorado					
TRAIN #		#1	#2	#3	#4	#5	**AVERAGE**
Vol Matter, %	18.00	37.83	37.89	36.62	36.68	36.68	**37.14**
C(%)	86.3	74.44	75.10	72.62	72.39	71.52	**73.214**
O(%)	2.18	8.13	8.03	7.90	8.15	7.74	**7.99**
H2(%)	4.15	5.28	5.26	5.01	5.08	4.91	**5.108**
N2(%)	1.20	1.79	1.76	1.62	1.78	1.66	**1.722**
Cl(%)	.16	.02	.02	.01	.01	.03	**0.018**
Ash, %	5.23	9.51	9.06	12.07	11.90	13.45	**11.198**
Total Mois.,%	6.45	NA	NA	5.79	5.47	6.46	**5.91**
Sulfur, %	.76	.85	.79	.72	.70	.72	**.76**
GHV, BTU/lb	15,000	13,519	13,493	12,962	13,306	12,761	**13,208**
HGI	100	NA	NA	NA	NA	NA	**46 - 48**
Phos. (P2O5),%	.004	.055	.057	.041	.064	.050	**.053**
Alkali, % (Na2O,K2O)	(.030 , .09)	(.262,.087)	(.262,.087)	(.279,.129)	(.361,.148)	(.370,.159)	**(.265,.122)**
SiO2 (%)	1.77	5.16	5.02	5.68	8.09	8.13	**6.42**
Al2O3 (%)	1.14	2.28	2.44	1.99	2.66	2.92	**2.46**
CaO (%)	.63	.36	.37	.31	.42	.39	**.37**
MgO (%)	.10	.18	.17	.20	.24	.28	**.21**

TABLE 3

Raw Coal and Product Coal Sizing Comparison

Buchanan Coal Raw Coal Sizing

Screen Size	% On	% Cum
+2"	0.0	0.0
2x1-1/4"	0.6	0.6
1-1/4x1"	0.7	1.3
1x3/4"	1.7	3.0
3/4x1/2"	4.5	7.5
1/2x3/8"	1.5	9.0
3/8x1/4"	8.0	17.0
1/4x4M	2.0	19.0
4x8M	15.0	34.0
8x16M	17.0	51.0
16x28M	16.0	67.0
28x48M	13.0	80.0
48x100M	11.0	91.0
100x200M	5.3	96.3
-200M	3.7	100.0

Buchanan Coal Product Coal Sizing

Granular Size

August 1998

Screen Size	% On	% Cum
+4M	0.0	0.0
-4x8M	0.2	0.2
-8x16M	2.0	2.2
-16x30M	8.1	10.3
-30x50M	15.3	25.6
-50x100M	28.4	54.0
-100x200M	32.6	86.6
-200x325M	12.2	98.8
-325M	1.2	100.0

Granulated Coal is: 100% -4 Mesh(5mm)
98% -7 Mesh(3mm)
< 30% -200 Mesh

Pulverized Coal is: 65% -200 Mesh

Oxbow Coal Raw Coal Sizing

Screen Size	% On	% Cum
2"	0.0	0.0
1"	17.9	17.9
1/2"	25.1	43.0
1/4"	21.0	64.0
-1/4"	36.0	100.0

Oxbow Coal Product Coal Sizing

Granular Size

October 1998

Screen Size	% On	% Cum
+4M	0.0	0.0
-4x8M	1.1	1.1
-8x16M	6.2	7.3
-16x30M	14.5	21.8
-30x50M	16.6	38.4
-50x100M	18.1	56.5
-100x200M	18.6	75.1
-200x325M	15.1	91.2
-325M	9.8	100.0

Oxbow Coal Product Coal Sizing

Pulverized Size

November 13-26

+ 50 Mesh	- 200 Mesh
0.48%	66.10%

Oxbow Coal Product Coal Sizing

Pulverized Size

2 Sample Average (Wet Analysis)

Screen Size	% Cum
+8M	0.00
-8x16M	0.03
-16x28M	0.18
-28x48M	0.56
-48x100M	7.07
-100x200M	26.24
-200x325M	49.40
-325M	100.00

TABLE 4

BURNS HARBOR D FURNACE ADJUSTED COKE RATE COMPARISON
GRANULAR LOW VOLATILE COAL COMPARED TO GRANULAR HIGH VOLATILE COAL

Coke Correction Variables:	Buchanan Base AUGUST 1998 Granular	Colorado Oxbow OCTOBER 1998 Granular
Natural Gas, lbs/NTHM	2.0	2.0
Coke Correction, lbs coke		**0.0**
Injected Coal, lbs/NTHM	250	190
Coke Correction, lbs coke		**-60.0**
Sinter, %	30.6	35.0
Coke Correction, lbs coke		**+3.5**
Pellets, %	68.5	63.9
Coke Correction, lbs coke		**+3.7**
Wind Volume, SCFM	149,600	149,600
Coke Correction, lbs coke		**0.0**
Blast Temperature, F	2089	2045
Coke Correction, lbs coke		**-7.7**
Added Moisture, Grs./SCFM Wind	21.2	19.5
Coke Correction, lbs coke		**+5.8**
Iron Silicon Content, %	.49	.60
Coke Correction, lbs coke		**-11.0**
Iron Sulfur Content, %	.042	.037
Coke Correction, lbs coke		**-2.5**
Iron Manganese Content, %	.37	.40
Coke Correction, lbs coke		**-0.7**
Coke Ash(Includes Chinese Coke)	7.80	7.80
Coke Correction, lbs coke		**0.0**
TOTAL CORRECTIONS: lbs coke	BASE	-68.9
Reported Furnace Coke Rate, lbs/NTHM	683	798
Corrected Furnace Coke Rate, lbs/NTHM	BASE	729
Coke Rate Difference from Base		**46 Pounds of Coke/NTHM**

TABLE 5

BURNS HARBOR D FURNACE ADJUSTED COKE RATE COMPARISON
GRANULAR HIGH VOLATILE COAL COMPARED TO PULVERIZED HIGH VOLATILE COAL

Coke Correction Variables:	Colorado Oxbow OCTOBER 1998 Granular	Colorado Oxbow 11/13-11/26/98 Pulverized
Natural Gas, lbs/NTHM	2.0	0.0
Coke Correction, lbs coke		**-2.4**
Injected Coal, lbs/NTHM	190	183
Coke Correction, lbs coke		**-7.0**
Sinter, %	35.0	35.7
Coke Correction, lbs coke		**+0.6**
Pellets, %	63.9	63.6
Coke Correction, lbs coke		**+0.2**
Wind Volume, SCFM	149,600	141,539
Coke Correction, lbs coke		**+8.2**
Blast Temperature, F	2045	2080
Coke Correction, lbs coke		**+6.0**
Added Moisture, Grs./SCFM Wind	19.5	22.8
Coke Correction, lbs coke		**-11.0**
Iron Silicon Content, %	.60	.52
Coke Correction, lbs coke		**+8.0**
Iron Sulfur Content, %	.037	.035
Coke Correction, lbs coke		**-1.0**
Iron Manganese Content, %	.40	.39
Coke Correction, lbs coke		**+0.3**
Furnace Slag Volume, lb/NTHM	461	504
Coke Correction, lbs coke		**-8.6**
Coke Ash(Includes Chinese Coke)	7.80	7.70
Coke Correction, lbs coke		**+2.0**
TOTAL CORRECTIONS: lbs coke	BASE	-4.7
Reported Furnace Coke Rate, lbs/NTHM	798	800
Corrected Furnace Coke Rate, lbs/NTHM	BASE	795
Coke Rate Difference from Base		**-3**

TABLE 6

BURNS HARBOR D FURNACE SULFUR BALANCE
GRANULAR HIGH VOLATILE COAL TRIAL

ULFUR INPUT:	October 1998	SULFUR OUTPUT	October 1998
laterial:		Material:	
urnace Coke, Sulfur Analysis	0.72%	Blast Furnace Slag, Sulfur Analysis	1.43%
Tons Coke Used	82830	Tons Produced	47799
Tons Sulfur In	596.4	Tons Sulfur Out	683.5
njected Coal, Sulfur Analysis	0.76%	Blast Furnace Iron, Sulfur Analysis	0.036%
Tons Coal In	19804	Tons Produced	207373
Tons Sulfur In	*150.5*	*Tons Sulfur Out*	*74.7*
Sinter, Sulfur Analysis	0.02%	Flue Dust, Sulfur Analysis	0.46%
Tons Sinter Used	115766	Tons Produced	1144
Tons Sulfur In	23.2	Tons Sulfur Out	5.3
Pellets, Sulfur Analysis	0.01%	Filter Cake, Sulfur Analysis	0.52%
Tons Sinter Used	211703	Tons Produced	2995
Tons Sulfur In	21.2	Tons Sulfur Out	15.6
Scrap, Sulfur Analysis	0.13%	Top Gas, Sulfur Content	1.7 grs./100SCF
Tons Scrap Used	3546	Gas Produced, MMCF	103,400
Tons Sulfur In	4.6	Tons Sulfur Out	12.5
TOTAL TONS OF SULFUR IN:	**795.9**	TOTAL TONS OF SULFUR OUT:	**791.6**
		SULFUR OUT/SULFUR IN:	**0.995**

BURNS HARBOR D FURNACE SULFUR BALANCE
PULVERIZED HIGH VOLATILE COAL TRIAL

SULFUR INPUT:	November 13-26,1998	SULFUR OUTPUT	November 13-26,1998
Material:		Material:	
Furnace Coke, Sulfur Analysis	0.72%	Blast Furnace Slag, Sulfur Analysis	1.33%
Tons Coke Used	37565	Tons Produced	23719
Tons Sulfur In	270.5	Tons Sulfur Out	315.5
Injected Coal, Sulfur Analysis	0.76%	Blast Furnace Iron, Sulfur Analysis	0.035%
Tons Coal In	8595	Tons Produced	93938
Tons Sulfur In	65.3	Tons Sulfur Out	32.8
Sinter, Sulfur Analysis	0.02%	Flue Dust, Sulfur Analysis	0.55%
Tons Sinter Used	52835	Tons Produced	456
Tons Sulfur In	10.6	Tons Sulfur Out	2.5
Pellets, Sulfur Analysis	0.01%	Filter Cake, Sulfur Analysis	0.46%
Tons Sinter Used	94255	Tons Produced	1148
Tons Sulfur In	9.4	Tons Sulfur Out	5.3
Scrap, Sulfur Analysis	0.13%	Top Gas, Sulfur Content	1.1 grs./100SCF
Tons Scrap Used	1070	Gas Produced, MMCF	47,400
Tons Sulfur In	1.4	Tons Sulfur Out	3.7
TOTAL TONS OF SULFUR IN:	**357.2**	TOTAL TONS OF SULFUR OUT:	**359.8**
		SULFUR OUT/SULFUR IN:	**1.007**

FIGURE 1

BURNS HARBOR - COAL GRINDING MILL ENERGY CONSUMPTION

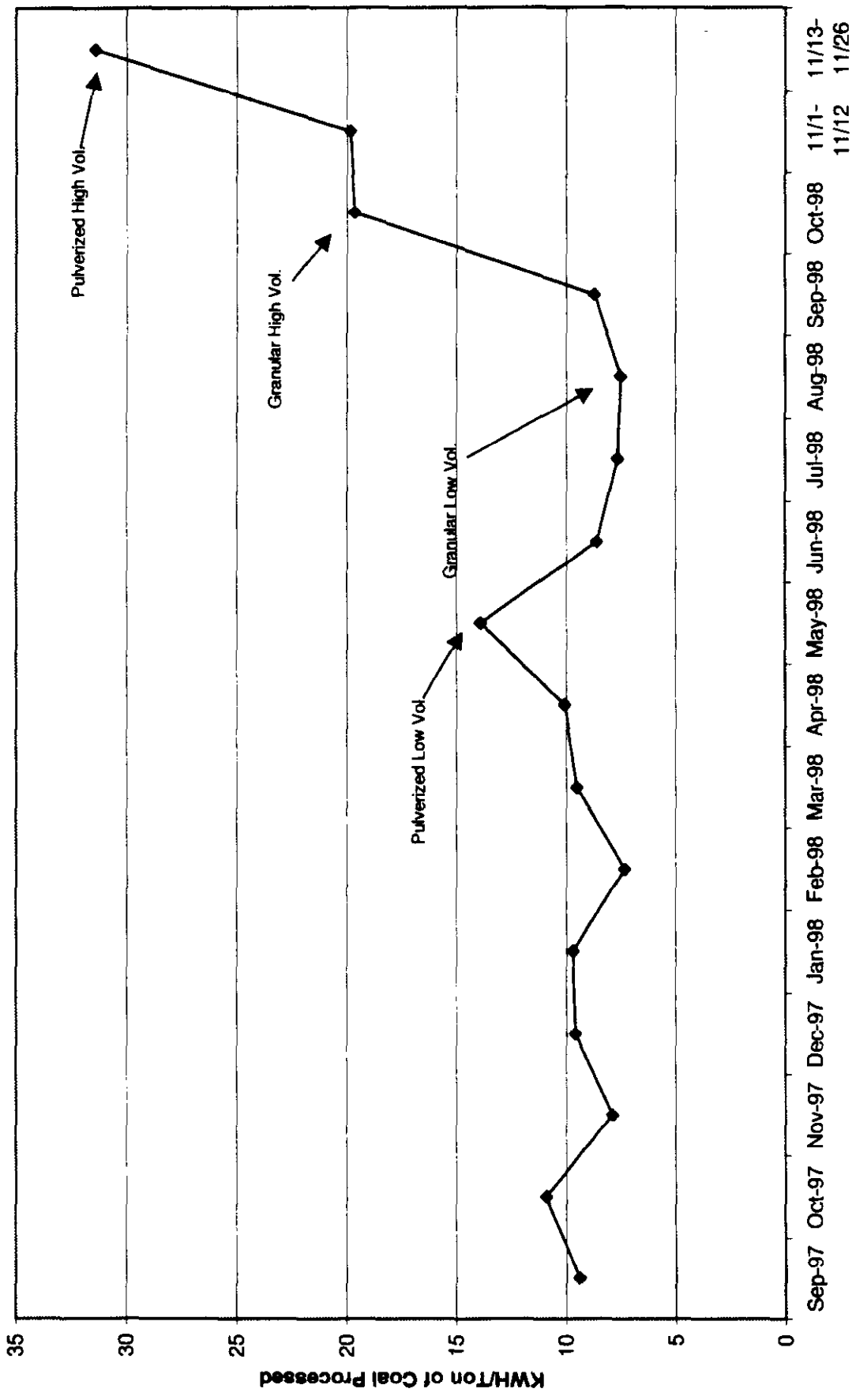


FIGURE 2

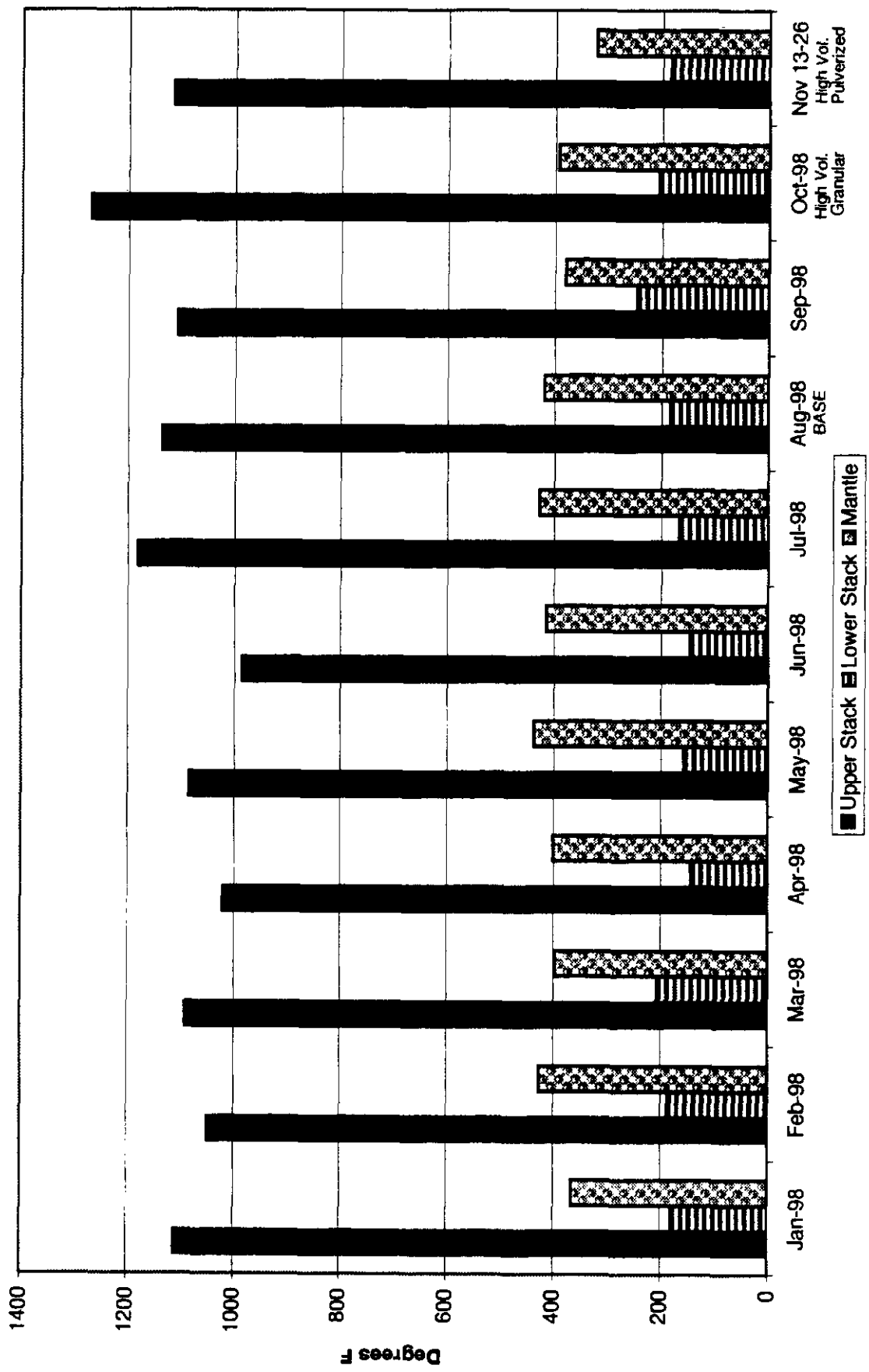

BURNS HARBOR D FURNACE - INWALL REFRACTORY TEMPERATURES
Degrees F
1400
1200
1000
800
600
400
200
0
Jan-98
Feb-98
Mar-98
Apr-98
May-98
Jun-98
Jul-98
Aug-98
BASE
Sep-98
Oct-98
High Vol. Granular
Nov 13-26
High Vol. Pulverized
Upper Stack
Lower Stack
Mantle

FIGURE 3

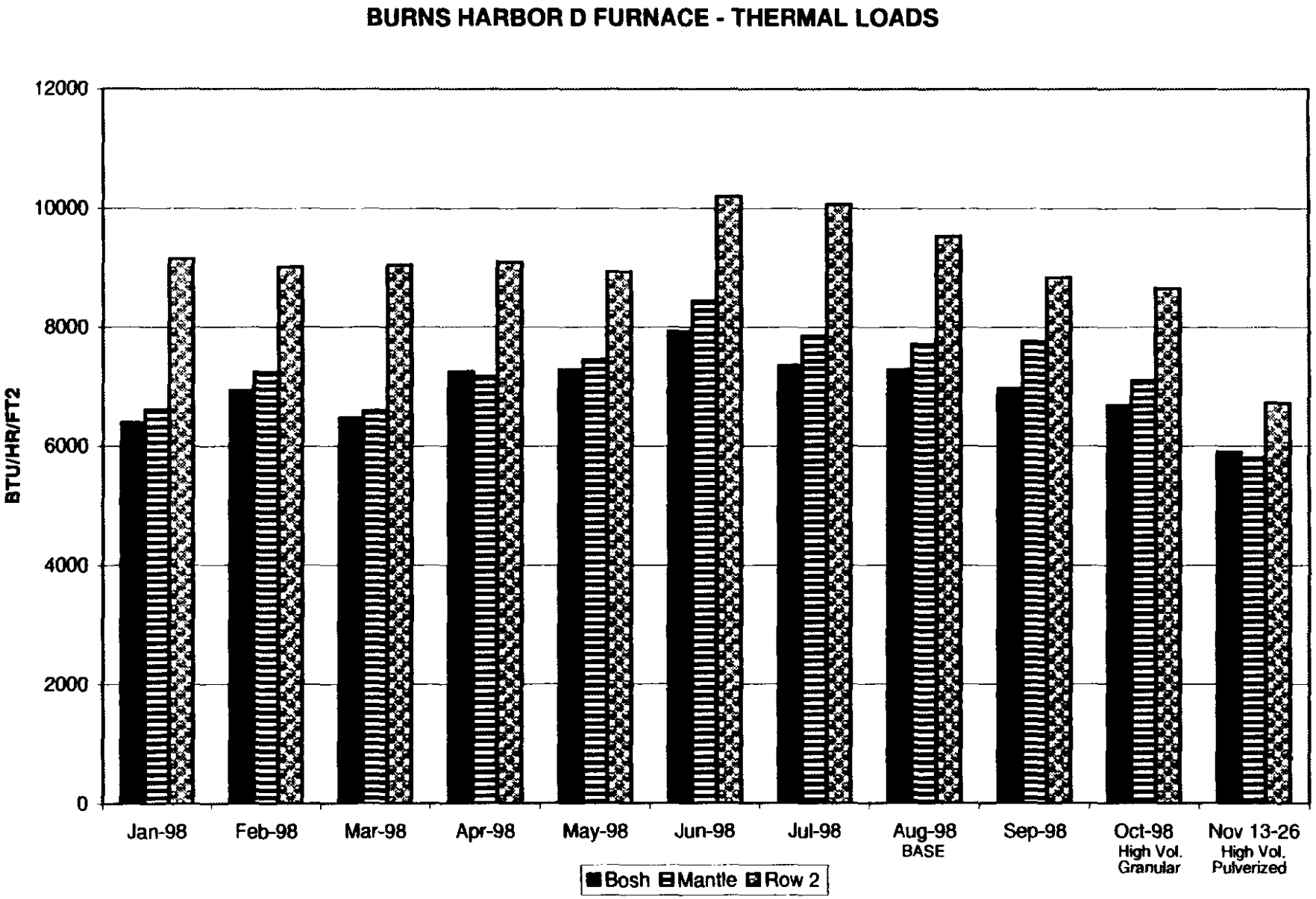

BURNS HARBOR D FURNACE - THERMAL LOADS
BTU/HR/FT2
12000
10000
8000
6000
4000
2000
0
Jan-98
Feb-98
Mar-98
Apr-98
May-98
Jun-98
Jul-98
Aug-98
BASE
Sep-98
Oct-98
High Vol.
Granular
Nov 13-26
High Vol.
Pulverized
Bosh
Mantle
Row 2

FIGURE 4

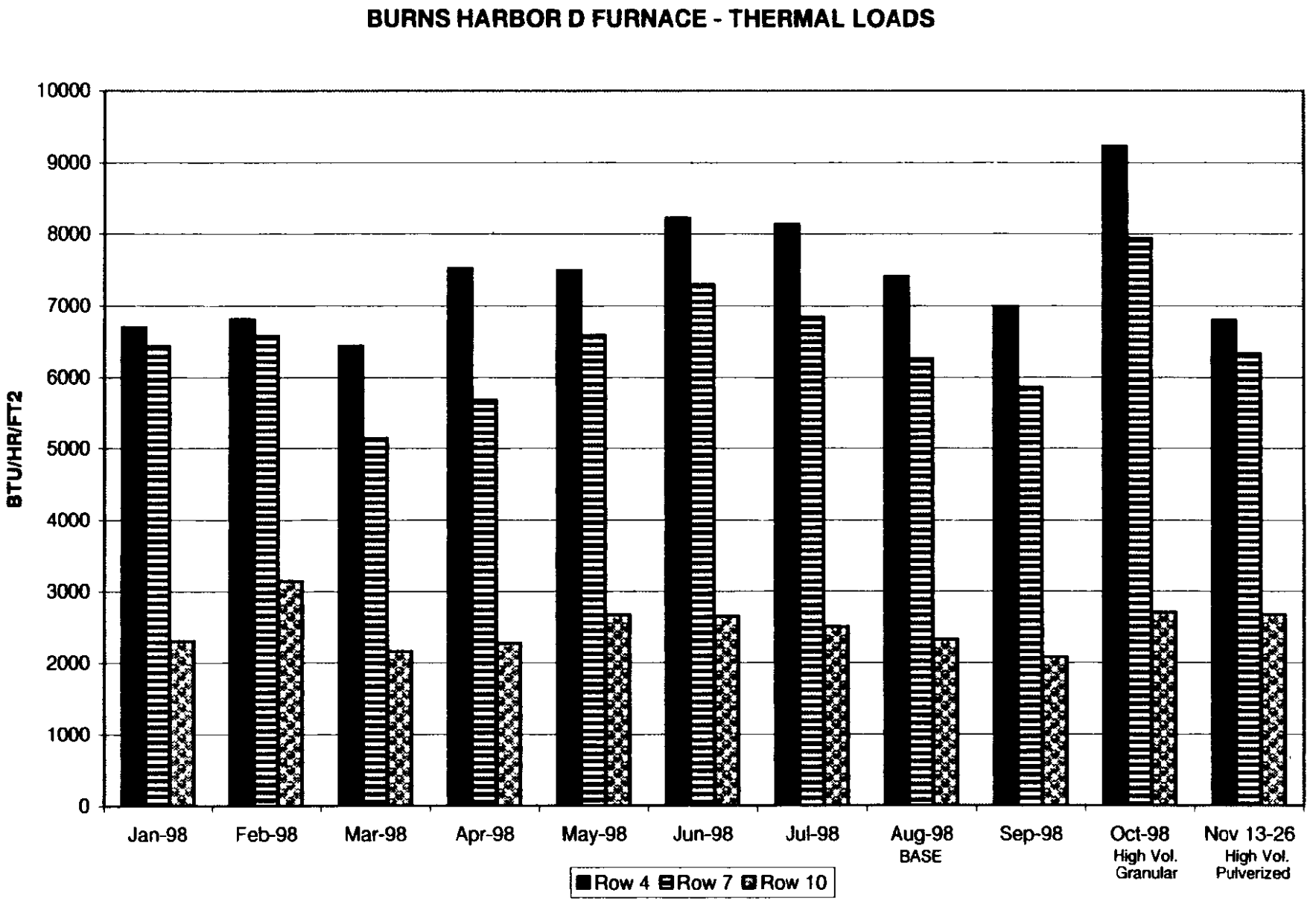

BURNS HARBOR D FURNACE - THERMAL LOADS
BTU/HR/FT2
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Jan-98
Feb-98
Mar-98
Apr-98
May-98
Jun-98
Jul-98
Aug-98
BASE
Sep-98
Oct-98
High Vol.
Granular
Nov 13-26
High Vol.
Pulverized
Row 4
Row 7
Row 10

FIGURE 5

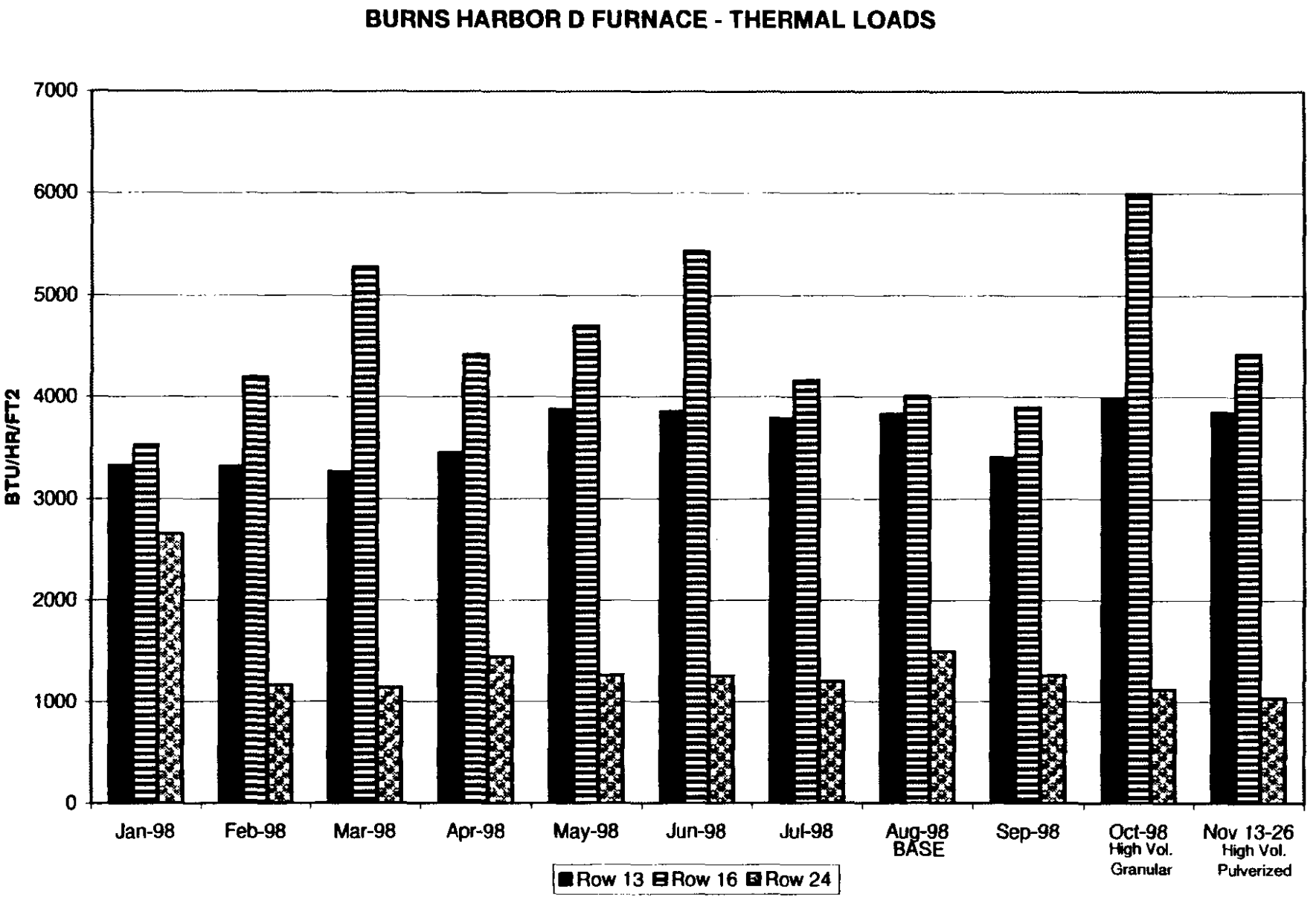
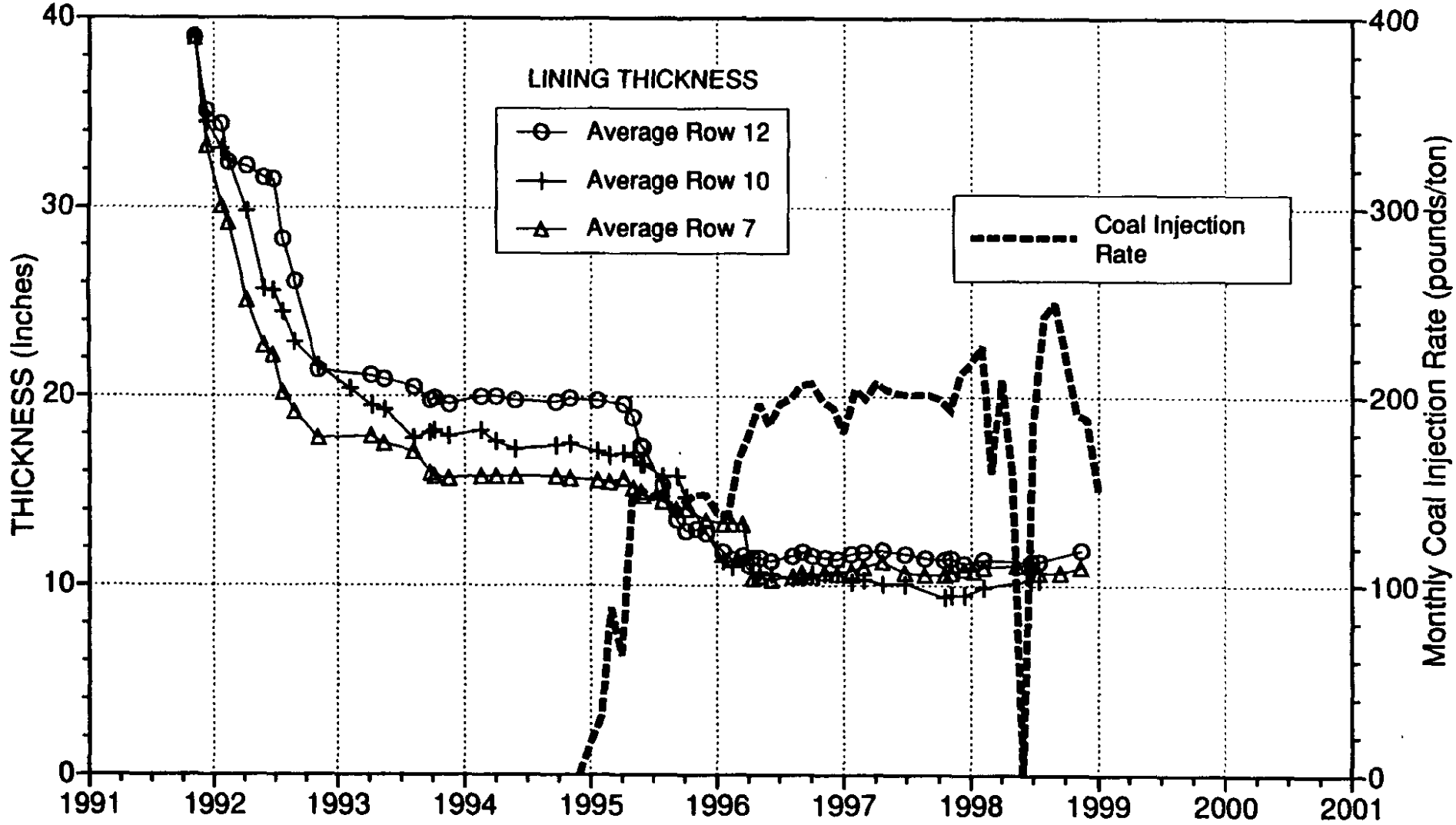

BURNS HARBOR D FURNACE - THERMAL LOADS
BTU/HR/FT2
7000
6000
5000
4000
3000
2000
1000
0
Jan-98
Feb-98
Mar-98
Apr-98
May-98
Jun-98
Jul-98
Aug-98 BASE
Sep-98
Oct-98 High Vol. Granular
Nov 13-26 High Vol. Pulverized
Row 13
Row 16
Row 24

FIGURE 6
LINING WEAR vs. COAL INJECTION
BURNS HARBOR "D" FURNACE



Date Blown In: 11/4/91
Date of Last Measurement: 11/12/98
RAS/JCM

Blast Furnace Granulated Coal Injection
Environmental Monitoring Report

Appendix I – Gaseous Stream Testing Results

Mostardi-Platt Associates, Inc.
A Full-Service
Environmental Consulting
Company

945 Oaklawn Avenue
Elmhurst, Illinois 60126-1012
Phone 630-993-9000
Facsimile 630-993-9017

Mostardi Platt

GAS ANALYSIS STUDY

Performed For

BETHLEHEM STEEL CORPORATION

At The

Burns Harbor Plant
Blast Furnaces C and D
Burns Harbor, Indiana
October 23, 1998

MOSTARDI PLATT PROJECT 84115
DATE SUBMITTED: NOVEMBER 13, 1998

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

						Total Sulfur Content	
Date Sampled	Time Sampled	Hydrogen (mol %)	CO_2 (mol %)	O_2 (mol %)	Carbon Monoxide (mol %)	(ppmv)	(as gr/100 scf)
10/23/98	0800	6.44	23.5	0.67	22.9	20.1	1.26
10/23/98	1015	6.45	23.2	0.70	21.6	29.4	1.84
10/23/98	1145	8.38	22.4	0.73	21.1	48.9	3.06

D-Blast Furnace
Gas Test Results
Burns Harbor, Indiana

						Total Sulfur Content	
Date Sampled	Time Sampled	Hydrogen (mol %)	CO_2 (mol %)	O_2 (mol %)	Carbon Monoxide (mol %)	(ppmv)	(as gr/100 scf)
10/23/98	0800	3.46	23.6	0.67	22.6	32.2	2.01
10/23/98	1015	2.96	21.4	0.70	20.2	25.6	1.60
10/23/98	1145	3.15	21.7	0.59	20.8	23.7	1.48

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi-Platt Associates, Inc.

IGT Sample Number: 98146201

1CA

Sample Description: 84115-001

Date Analyzed: 10/29-11/6/98 Analyst: RJB

Component	Mol %	Det. Limit	Weight %
Helium	N.D.	0.001%	N.D.
Hydrogen	6.44%	0.04%	0.43%
Carbon Dioxide	23.5%	0.03%	34.3%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	0.67%	0.03%	0.72%
Nitrogen	46.5%	0.03%	43.2%
Methane		0.03%	
Carbon Monoxide	22.9%	0.03%	21.3%
Ethyne		0.002%	
Propene		0.002%	
Propane		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	0.001909%	0.000002%	0.002779%
Undetermined		0.03%	
Water	N.D.	0.001%	N.D.
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] =	0.99908	0.99907
Relative Density =	1.0405	1.0405
Gross HV (DRY) =	95.7	95.9
Gross HV (SAT.) =	94.0	94.2
Wobbe Index =	93.8	94.0
Net HV (Dry) =	91.3	91.5
Net HV (Sat.) =	89.7	89.9

Notes: All blank values are below detection limit
N.D. - Not Determined

IGT Institute of Gas Technology

Analytical Report

11/12/98
IGT Log # : 98146201.xls

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98146201
Sample Description: 84115-001 1CA
Date Analyzed: 10/29-11/6/98
Analyst: RJB

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	1.1	Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	19.0	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan		Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	20.1
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		Total Sulfur Content	
n-Propyl t-Butyl Disulfide		As PPMV	20.1
Di-t-Butyl Disulfide		As Grains/100 SCF	1.26
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes:
Component Detection Limit:
1 ppmv for Hydrogen Sulfide
0.1 ppmv for all other compounds per sulfur
Underlined numbers are below standard detectio limits, and are included for information only.
All blank values are below detection limit.

EXTENDED GAS ANALYSIS BY GC/FID

IGT Sample Number: 998146201
Sample Description: 84115-001 1CA
Date Analyzed: 11/11/98
Analyst: RJB

Component Name	Mole %	Wt %
Neopentane	BDL	See
Isopentane	BDL	SynGas
n-Pentane	BDL	Data
Cycloalkanes		
Cyclopentane	BDL	BDL
Methylcyclopentane	BDL	BDL
Cyclohexane	BDL	BDL
Methylcyclohexane	BDL	BDL
Aromatics		
Benzene	BDL	BDL
Toluene	BDL	BDL
Ethylbenzene	BDL	BDL
m-Xylene	BDL	BDL
p-Xylene	BDL	BDL
Styrene	BDL	BDL
o-Xylene	BDL	BDL
C3 Benzenes	BDL	BDL
Naphthalene	BDL	BDL
C1 Naphthalenes	BDL	BDL
C2 Naphthalenes	BDL	BDL

Component Name	Mole %	Wt %
Paraffins		
Hexanes	BDL	BDL
Heptanes	BDL	BDL
2,2,4-Trimethylpentane	BDL	BDL
Octanes	BDL	BDL
Nonanes	BDL	BDL
Decanes	BDL	BDL
Undecanes	BDL	BDL
Dodecanes	BDL	BDL
Tridecanes	BDL	BDL
Tetradecanes	BDL	BDL
Pentadecanes	BDL	BDL
Hexadecanes	BDL	BDL
Heptadecanes	BDL	BDL
Octadecanes	BDL	BDL
Nonadecanes	BDL	BDL
Eicosanes +	BDL	BDL

Total from Cyclopentane to Eicosanes +	BDL	BDL

Notes: BDL = below detection limit (0.0001 mole %).

IGT Institute of Gas Technology

Analytical Report

11/12/98
IGT Log # : 98146202.xls

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98146202
Sample Description: 84115-004
Date Analyzed: 10/29-11/6/98 Analyst: RJB

2CB

Component	Mol %	Det. Limit	Weight %
Helium	N.D.	0.001%	N.D.
Hydrogen	6.45%	0.04%	0.43%
Carbon Dioxide	23.2%	0.03%	33.9%
Ethane		0.03%	
Ethene		0.03%	
Oxygen/Argon	0.78%	0.03%	0.75%
Nitrogen	48.1%	0.03%	44.8%
Methane		0.03%	
Carbon Monoxide	21.6%	0.03%	20.1%
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	0.0009%	0.0001%	0.0010%
Carbonyl Sulfide	0.00206%	0.00002%	0.00411%
Undetermined		0.03%	
Water	N.D.	0.001%	N.D.
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) =	0.99909	0.99909
Relative Density =	1.0389	1.0389
Gross HV (DRY) =	91.4	91.6
Gross HV (SAT.) =	89.8	90.0
Wobbe Index =	89.6	89.8
Net HV (Dry) =	87.0	87.2
Net HV (Sat.) =	85.4	85.6

Notes: All blank values are below detection limit
N.D. - Not Determined

IT Institute of Gas Technology

Analytical Report

11/12/98
IGT Log # : 98146202.xls

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98146202
Sample Description: 84115-004 2CB
Date Analyzed: 10/29-11/6/98
Analyst: RJB

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	8.8	Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	20.6	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan		Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	29.4
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		Total Sulfur Content	
n-Propyl t-Butyl Disulfide		As PPMV	29.4
Di-t-Butyl Disulfide		As Grains/100 SCF	1.84
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes:
Component Detection Limit:
1 ppmv for Hydrogen Sulfide
0.1 ppmv for all other compounds per sulfur
Underlined numbers are below standard detectio limits, and are included for information only.
All blank values are below detection limit.

EXTENDED GAS ANALYSIS BY GC/FID

GT Sample Number: 998146202
Sample Description: 84115-004
Date Analyzed: 11/11/98
Analyst: RJB

2 C B

Component Name	Mole %	Wt %
entane	BDL	See
ntane	BDL	SynGas
ane	BDL	Data
alkanes		
pentane	BDL	BDL
/cyclopentane	BDL	BDL
hexane	BDL	BDL
/cyclohexane	BDL	BDL
atics		
ne	0.0001%	<0.0001%
ne	BDL	BDL
benzene	BDL	BDL
lene	BDL	BDL
ene	BDL	BDL
ne	BDL	BDL
ene	BDL	BDL
nzenes	BDL	BDL
halene	BDL	BDL
phthalenes	BDL	BDL
phthalenes	BDL	BDL

Component Name	Mole %	Wt %
Paraffins		
Hexanes	BDL	BDL
Heptanes	BDL	BDL
2,2,4-Trimethylpentane	BDL	BDL
Octanes	BDL	BDL
Nonanes	BDL	BDL
Decanes	BDL	BDL
Undecanes	BDL	BDL
Dodecanes	BDL	BDL
Tridecanes	BDL	BDL
Tetradecanes	BDL	BDL
Pentadecanes	BDL	BDL
Hexadecanes	BDL	BDL
Heptadecanes	BDL	BDL
Octadecanes	BDL	BDL
Nonadecanes	BDL	BDL
Eicosanes +	BDL	BDL

Total from Cyclopentane to Eicosanes +	0.0001%	<0.0001%

: BDL = below detection limit (0.0001 mole %).

Institute of Gas Technology

Analytical Report

11/12/98
IGT Log # : 98146203.xls

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98146203
Sample Description: 84115-005 3CA
Data Analyzed: 10/29-11/9/98 Analyst: RJB

Component	Mol %	Det. Limit	Weight %
Helium	N.D.	0.001%	N.D.
Hydrogen	8.38%	0.04%	0.57%
Carbon Dioxide	22.4%	0.03%	33.5%
Ethane		0.03%	
Ethane		0.03%	
Oxygen/Argon	0.73%	0.03%	0.88%
Nitrogen	47.4%	0.03%	45.1%
Methane		0.03%	
Carbon Monoxide	21.1%	0.03%	20.0%
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	0.0027%	0.0001%	0.0031%
Carbonyl Sulfide	0.00215%	0.00002%	0.00439%
Unidentified		0.03%	
Water	N.D.	0.001%	N.D.
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] =	0.99913	0.99913
Relative Density =	1.0174	1.0174
Gross HV (DRY) =	96.3	96.5
Gross HV (SAT.) =	94.6	94.8
Wobbe Index =	95.5	95.7
Net HV (Dry) =	90.6	90.8
Net HV (Sat.) =	89.0	89.2

Notes: All blank values are below detection limit
N.D. - Not Determined

Analytical Report

11/12/98

Institute of Gas Technology

IGT Log # : 98146203.xls

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98146203
Sample Description: 84115-005 3CA
Date Analyzed: 10/29-11/9/98
Analyst: RJB

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	27.4	Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	21.5	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan		Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	48.9
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As PPMV	48.9
Di-t-Butyl Disulfide		As Grains/100 SCF	3.06
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes:
Component Detection Limit:
1 ppmv for Hydrogen Sulfide
0.1 ppmv for all other compounds per sulfur
Underlined numbers are below standard detectio limits, and are included for information only.
All blank values are below detection limit.

EXTENDED GAS ANALYSIS BY GC/FID

T Sample Number: 998146203
ample Description: 84115-005
Date Analyzed: 11/11/98
Analyst: RJB

3CA

ponent Name	Mole %	Wt %
ane	BDL	See
ne	BDL	SynGas
ne	BDL	Data
lkanes		
utane	BDL	BDL
cyclopentane	BDL	BDL
xane	BDL	BDL
cyclohexane	BDL	BDL
tics		
	0.0002%	<0.0001%
	0.0001%	<0.0001%
nzene	BDL	BDL
ne	BDL	BDL
e	BDL	BDL
	BDL	BDL
e	BDL	BDL
nes	BDL	BDL
lene	BDL	BDL
thalenes	BDL	BDL
thalenes	BDL	BDL

Component Name	Mole %	Wt %
Paraffins		
Hexanes	BDL	BDL
Heptanes	BDL	BDL
2,2,4-Trimethylpentane	BDL	BDL
Octanes	BDL	BDL
Nonanes	BDL	BDL
Decanes	BDL	BDL
Undecanes	BDL	BDL
Dodecanes	BDL	BDL
Tridecanes	BDL	BDL
Tetradecanes	BDL	BDL
Pentadecanes	BDL	BDL
Hexadecanes	BDL	BDL
Heptadecanes	BDL	BDL
Octadecanes	BDL	BDL
Nonadecanes	BDL	BDL
Eicosanes +	BDL	BDL

Total from Cyclopentane to Eicosanes +	0.0003%	<0.0002%

BDL = below detection limit (0.0001 mole %).

Institute of Gas Technology

Analytical Report

11/12/98
IGT Log # : 98146204.xls

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98146204 1DA
Sample Description: 84115-006
Date Analyzed: 10/29-11/9/98 Analyst: RJB

Component	Mol %	Det. Limit	Weight %
Helium	N.D.	0.001%	N.D.
Hydrogen	3.46%	0.04%	0.23%
Carbon Dioxide	23.6%	0.03%	32.6%
Ethane		0.03%	
Ethene		0.03%	
Oxygen/Argon	0.67%	0.03%	0.79%
Nitrogen	49.6%	0.03%	45.8%
Methane		0.03%	
Carbon Monoxide	22.6%	0.03%	20.5%
Ethyne		0.002%	
Propene		0.002%	
Propane		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	0.0084%	0.0001%	0.0094%
Carbonyl Sulfide	0.00282%	0.00002%	0.00348%
Unidentified		0.03%	
Water	N.D.	0.001%	N.D.
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] =	0.99904	0.99904
Relative Density =	1.0682	1.0682
Gross HV (DRY) =	84.4	84.6
Gross HV (SAT.) =	82.9	83.1
Wobbe Index =	81.6	81.8
Net HV (Dry) =	82.0	82.2
Net HV (Sat.) =	80.6	80.8

Notes: All blank values are below detection limit
N.D. - Not Determined

IGT Institute of Gas Technology

Analytical Report

11/12/98
IGT Log # : 98146204.xls

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98146204
Sample Description: 84115-006 1DA
Date Analyzed: 10/29-11/9/98
Analyst: RJB

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	4.0	Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	28.2	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan		Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	32.2
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As PPMV	32.2
Di-t-Butyl Disulfide		As Grains/100 SCF	2.01
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes:
Component Detection Limit:
1 ppmv for Hydrogen Sulfide
0.1 ppmv for all other compounds per sulfur
Underlined numbers are below standard detectio limits, and are included for information only.
All blank values are below detection limit.

EXTENDED GAS ANALYSIS BY GC/FID

IGT Sample Number: 998146204
Sample Description: 84115-006
Date Analyzed: 11/11/98
Analyst: RJB

1DA

Component Name	Mole %	Wt %
ipentane	BDL	See
entane	0.0001%	SynGas
ntane	BDL	Data
loalkanes		
lopentane	BDL	BDL
hylcyclopentane	BDL	BDL
lohexane	BDL	BDL
hylcyclohexane	BDL	BDL
matics		
zene	BDL	BDL
uene	BDL	BDL
ylbenzene	BDL	BDL
Cylene	BDL	BDL
ylene	BDL	BDL
ene	BDL	BDL
ylene	BDL	BDL
Benzenes	BDL	BDL
hthalene	BDL	BDL
Naphthalenes	BDL	BDL
Naphthalenes	BDL	BDL

Component Name	Mole %	Wt %
Paraffins		
Hexanes	BDL	BDL
Heptanes	BDL	BDL
2,2,4-Trimethylpentane	BDL	BDL
Octanes	BDL	BDL
Nonanes	BDL	BDL
Decanes	BDL	BDL
Undecanes	BDL	BDL
Dodecanes	BDL	BDL
Tridecanes	BDL	BDL
Tetradecanes	BDL	BDL
Pentadecanes	BDL	BDL
Hexadecanes	BDL	BDL
Heptadecanes	BDL	BDL
Octadecanes	BDL	BDL
Nonadecanes	BDL	BDL
Eicosanes +	BDL	BDL
Total from Cyclopentane to Eicosanes +	BDL	BDL

ks: BDL = below detection limit (0.0001 mole %).

IT Institute of Gas Technology

Analytical Report

11/12/98
IGT Log # : 98146205.xls

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98146205
Sample Description: 84115-008
Date Analyzed: 10/30-11/9/98 Analyst: RJB

2DA

Component	Mol %	Det. Limit	Weight %
Helium	N.D.	0.001%	N.D.
Hydrogen	2.96%	0.04%	0.19%
Carbon Dioxide	21.4%	0.03%	38.6%
Ethane		0.03%	
Ethene		0.03%	
Oxygen/Argon	0.78%	0.03%	0.74%
Nitrogen	54.8%	0.03%	58.8%
Methane		0.03%	
Carbon Monoxide	20.2%	0.03%	18.4%
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	0.00256%	0.00002%	0.00501%
Unidentified		0.03%	
Water	N.D.	0.001%	N.D.
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) =	0.99912	0.99912
Relative Density =	1.0602	1.0602
Gross HV (DRY) =	75.0	75.1
Gross HV (SAT.) =	73.7	73.8
Wobbe Index =	72.8	73.0
Net HV (Dry) =	72.9	73.1
Net HV (Sat.) =	71.7	71.8

Notes: All blank values are below detection limit
N.D. - Not Determined

IT Institute of Gas Technology

Analytical Report

11/12/98
IGT Log # : 98146205.xls

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98146205
Sample Description: 84115-008 2DA
Date Analyzed: 10/30-11/9/98
Analyst: RJB

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide		Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	25.6	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan		Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	25.6
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As PPMV	25.6
Di-t-Butyl Disulfide		As Grains/100 SCF	1.60
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes:
Component Detection Limit:
1 ppmv for Hydrogen Sulfide
0.1 ppmv for all other compounds per sulfur
Underlined numbers are below standard detectio limits, and are included for information only.
All blank values are below detection limit.

EXTENDED GAS ANALYSIS BY GC/FID

IGT Sample Number: 98146205
Sample Description: 84115-008
Date Analyzed: 11/12/98
Analyst: RJB

2DA

omponent Name	Mole %	Wt %
sopentane	BDL	See
opentane	BDL	SynGas
Pentane	BDL	Data
ycloalkanes		
yclopentane	BDL	BDL
ethylcyclopentane	BDL	BDL
yclohexane	BDL	BDL
ethylcyclohexane	BDL	BDL
romatics		
enzene	BDL	BDL
oluene	BDL	BDL
thylbenzene	BDL	BDL
-Xylene	BDL	BDL
Xylene	BDL	BDL
yrene	BDL	BDL
Xylene	BDL	BDL
3 Benzenes	BDL	BDL
aphthalene	BDL	BDL
1 Naphthalenes	BDL	BDL
2 Naphthalenes	BDL	BDL

Component Name	Mole %	Wt %
Paraffins		
Hexanes	BDL	BDL
Heptanes	BDL	BDL
2,2,4-Trimethylpentane	BDL	BDL
Octanes	BDL	BDL
Nonanes	BDL	BDL
Decanes	BDL	BDL
Undecanes	BDL	BDL
Dodecanes	BDL	BDL
Tridecanes	BDL	BDL
Tetradecanes	BDL	BDL
Pentadecanes	BDL	BDL
Hexadecanes	BDL	BDL
Heptadecanes	BDL	BDL
Octadecanes	BDL	BDL
Nonadecanes	BDL	BDL
Eicosanes -	BDL	BDL

Total from Cyclopentane to Eicosanes +	BDL	BDL

otes: BDL = below detection limit (0.0001 mole %).

GT Institute of Gas Technology

Analytical Report

11/12/98
IGT Log # : 98146206.xls

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98146206 3DA
Sample Description: 84115-010
Date Analyzed: 10/30-11/9/98 Analyst: RJB

Component	Mol %	Det. Limit	Weight %
Helium	N.D.	0.001%	N.D.
Hydrogen	3.15%	0.00%	0.21%
Carbon Dioxide	21.7%	0.03%	31.1%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	0.59%	0.03%	0.62%
Nitrogen	53.7%	0.03%	49.1%
Methane		0.03%	
Carbon Monoxide	20.8%	0.03%	19.0%
Ethyne		0.002%	
Propene		0.002%	
Propane		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	0.00137%	0.00002%	0.00464%
Unidentified		0.03%	
Water	N.D.	0.001%	N.D.
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) =	0.99911	0.99911
Relative Density =	1.0600	1.0600
Gross HV (DRY) =	77.7	77.8
Gross HV (SAT.) =	76.3	76.5
Wobbe Index =	75.4	75.6
Net HV (Dry) =	75.5	75.7
Net HV (Sat.) =	74.2	74.4

Notes: All blank values are below detection limit
N.D. - Not Determined

GT Institute of Gas Technology

Analytical Report

11/12/98
IGT Log # : 98146206.xls

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98146206
Sample Description: 84115-010 3DA
Date Analyzed: 10/30-11/9/98
Analyst: RJB

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide		Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	23.7	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan		Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	23.7
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		Total Sulfur Content	
n-Propyl t-Butyl Disulfide		As PPMV	23.7
Di-t-Butyl Disulfide		As Grains/100 SCF	1.48
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes:
Component Detection Limit:
1 ppmv for Hydrogen Sulfide
0.1 ppmv for all other compounds per sulfur
Underlined numbers are below standard detectio limits, and are included for information only.
All blank values are below detection limit.

EXTENDED GAS ANALYSIS BY GC/FID

IGT Sample Number: 98146206
Sample Description: 84115-010
Date Analyzed: 11/12/98
Analyst: RJB

3DA

Component Name	Mole %	Wt %
Neopentane	BDL	See
Isopentane	BDL	SynGas
n-Pentane	BDL	Data
Cycloalkanes		
Cyclopentane	BDL	BDL
Methylcyclopentane	BDL	BDL
Cyclohexane	BDL	BDL
Methylcyclohexane	BDL	BDL
Aromatics		
Benzene	0.0001%	<0.0001%
Toluene	BDL	BDL
Ethylbenzene	BDL	BDL
m-Xylene	BDL	BDL
p-Xylene	BDL	BDL
Styrene	BDL	BDL
o-Xylene	BDL	BDL
C3 Benzenes	BDL	BDL
Naphthalene	BDL	BDL
C1 Naphthalenes	BDL	BDL
C2 Naphthalenes	BDL	BDL

Component Name	Mole %	Wt %
Paraffins		
Hexanes	BDL	BDL
Heptanes	BDL	BDL
2,2,4-Trimethylpentane	BDL	BDL
Octanes	BDL	BDL
Nonanes	BDL	BDL
Decanes	BDL	BDL
Undecanes	BDL	BDL
Dodecanes	BDL	BDL
Tridecanes	BDL	BDL
Tetradecanes	BDL	BDL
Pentadecanes	BDL	BDL
Hexadecanes	BDL	BDL
Heptadecanes	BDL	BDL
Octadecanes	BDL	BDL
Nonadecanes	BDL	BDL
Eicosanes +	BDL	BDL

Total from Cyclopentane to Eicosanes +	0.0001%	<0.0001%

Notes: BDL = below detection limit (0.0001 mole %).

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Mostardi Platt

GAS ANALYSIS STUDY
Performed For
BETHLEHEM STEEL CORPORATION
At The
Burns Harbor Plant
Blast Furnaces C and D
Burns Harbor, Indiana
November 13, 1998

MOSTARDI PLATT PROJECT 84634
DATE SUBMITTED: DECEMBER 18, 1998

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

						Total Sulfur Content	
Date Sampled	Time Sampled	Hydrogen (mol %)	CO_2 (mol %)	O_2 (mol %)	Carbon Monoxide (mol %)	(ppmv)	(as gr/100 scf)
11/13/98	1000	13.7	31.9	0.65	9.40	28.0	1.75
11/13/98	1115	8.2	20.6	0.84	21.9	40.0	2.50
11/13/98	1215	14.1	34.4	0.67	4.82	18.6	1.16

D-Blast Furnace
Gas Test Results
Burns Harbor, Indiana

						Total Sulfur Content	
Date Sampled	Time Sampled	Hydrogen (mol %)	CO_2 (mol %)	O_2 (mol %)	Carbon Monoxide (mol %)	(ppmv)	(as gr/100 scf)
11/13/98	1000	2.98	19.8	0.63	21.7	12.9	0.81
11/13/98	1115	2.99	21.9	0.66	22.5	19.9	1.24
11/13/98	1215	3.05	21.1	0.58	21.0	20.4	1.28

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98148701
Sample Description: *84634-001*
Date Analyzed: 11/17-12/1/98 **Analyst:** RJB

Component	Mol %	Det. Limit	Weight %
Helium	N.D.	0.001%	N.D.
Hydrogen	13.7%	0.04%	0.94%
Carbon Dioxide	31.9%	0.03%	47.5%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	0.65%	0.03%	0.72%
Nitrogen	43.9%	0.03%	41.7%
Methane	0.47%	0.03%	0.25%
Carbon Monoxide	9.40%	0.03%	8.92%
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	0.0005%	0.0001%	0.0006%
Carbonyl Sulfide	0.00225%	0.00002%	0.00458%
Unidentified		0.03%	
Water	N.D.	0.001%	N.D.
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] =	0.99886	0.99886
Relative Density =	1.0199	1.0199
Gross HV (DRY) =	81.9	82.1
Gross HV (SAT.) =	80.4	80.6
Wobbe Index =	81.1	81.3
Net HV (Dry) =	*72.0*	*72.2*
Net HV (Sat.) =	70.8	70.9

Notes: All blank values are below detection limit
N.D. - Not Determined
Flowing liquid and black solid material were present in the sample cylinder.

IGT Institute of Gas Technology

Analytical Report

12/3/98
IGT Log # : 98148701.xls

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98148701
Sample Description: 84634-001
Date Analyzed: 11/17-12/1/98
Analyst: RJB

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	5.3	Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	22.5	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan	0.23	Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as *monosulfides*)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	28.0
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As PPMV	28.0
Di-t-Butyl Disulfide		As Grains/100 SCF	1.75
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes:
Component Detection Limit:
1 ppmv for Hydrogen Sulfide
0.1 ppmv for all other compounds per sulfur
All blank values are below detection limit.
Flowing liquid and black solid material were present in the sample cylinder.

EXTENDED GAS ANALYSIS BY GC/FID

IGT Sample Number: 98148701
Sample Description: 84634-001
Date Analyzed: 12/3/98
Analyst: RJB

Component Name	Mole %	Wt %
eopentane	BDL	See
opentane	BDL	SynGas
-Pentane	BDL	Data
ycloalkanes		
yclopentane	BDL	BDL
lethylcyclopentane	BDL	BDL
yclohexane	BDL	BDL
lethylcyclohexane	BDL	BDL
romatics		
enzene	BDL	BDL
oluene	BDL	BDL
thylbenzene	BDL	BDL
-Xylene	BDL	BDL
-Xylene	BDL	BDL
yrene	BDL	BDL
-Xylene	BDL	BDL
3 Benzenes	BDL	BDL
aphthalene	BDL	BDL
1 Naphthalenes	BDL	BDL
2 Naphthalenes	BDL	BDL

Component Name	Mole %	Wt %
Paraffins		
Hexanes	BDL	BDL
Heptanes	0.0001%	0.0004%
2,2,4-Trimethylpentane	BDL	BDL
Octanes	BDL	BDL
Nonanes	BDL	BDL
Decanes	BDL	BDL
Undecanes	BDL	BDL
Dodecanes	BDL	BDL
Tridecanes	BDL	BDL
Tetradecanes	BDL	BDL
Pentadecanes	BDL	BDL
Hexadecanes	BDL	BDL
Heptadecanes	BDL	BDL
Octadecanes	BDL	BDL
Nonadecanes	BDL	BDL
Eicosanes +	BDL	BDL

	Mole %	Wt %
Total from Cyclopentane to Eicosanes +	0.0001%	0.0004%

otes: BDL = below detection limit (0.0001 mole %).
Flowing liquid and black solid material were present in the sample cylinder.

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98148702
Sample Description: 84634-003
Date Analyzed: 11/17-20/98 Analyst: RJB

Component	Mol %	Det. Limit	Weight %
Helium	N.D.	0.001%	N.D.
Hydrogen	2.15%	0.04%	0.14%
Carbon Dioxide	15.8%	0.03%	22.8%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	9.28%	0.03%	9.88%
Nitrogen	58.5%	0.03%	53.9%
Methane		0.03%	
Carbon Monoxide	14.3%	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		0.0001%	
Carbonyl Sulfide	0.00139%	0.000002%	0.00275%
Unidentified		0.03%	
Water	N.D.	0.001%	N.D.
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] =	0.99926	0.99925
Relative Density =	1.0492	1.0492
Gross HV (DRY) =	53.3	53.4
Gross HV (SAT.) =	52.3	52.5
Wobbe Index =	52.0	52.1
Net HV (Dry) =	51.8	51.9
Net HV (Sat.) =	50.9	51.0

Notes: All blank values are below detection limit
N.D. - Not Determined

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98148702
Sample Description: 84634-003
Date Analyzed: 11/17-20/98
Analyst: RJB

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide		Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	13.9	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan		Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	13.9
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As PPMV	13.9
Di-t-Butyl Disulfide		As Grains/100 SCF	0.87
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes:
Component Detection Limit:
1 ppmv for Hydrogen Sulfide
0.1 ppmv for all other compounds per sulfur
All blank values are below detection limit.

EXTENDED GAS ANALYSIS BY GC/FID

GT Sample Number: 98148702
Sample Description: 84634-003
Date Analyzed: 12/2/98
Analyst: RJB

mponent Name	Mole %	Wt %
pentane	BDL	See
entane	BDL	SynGas
ntane	BDL	Data
loalkanes		
lopentane	BDL	BDL
hylcyclopentane	BDL	BDL
lohexane	BDL	BDL
hylcyclohexane	BDL	BDL
matics		
zene	BDL	BDL
ıene	BDL	BDL
ylbenzene	BDL	BDL
ylene	BDL	BDL
ylene	BDL	BDL
ene	BDL	BDL
ylene	BDL	BDL
Benzenes	BDL	BDL
hthalene	BDL	BDL
Naphthalenes	BDL	BDL
Naphthalenes	BDL	BDL

Component Name	Mole %	Wt %
Paraffins		
Hexanes	BDL	BDL
Heptanes	BDL	BDL
2,2,4-Trimethylpentane	BDL	BDL
Octanes	BDL	BDL
Nonanes	BDL	BDL
Decanes	BDL	BDL
Undecanes	BDL	BDL
Dodecanes	BDL	BDL
Tridecanes	BDL	BDL
Tetradecanes	BDL	BDL
Pentadecanes	BDL	BDL
Hexadecanes	BDL	BDL
Heptadecanes	BDL	BDL
Octadecanes	BDL	BDL
Nonadecanes	BDL	BDL
Eicosanes +	BDL	BDL

Total from Cyclopentane to Eicosanes +	BDL	BDL

es: BDL = below detection limit (0.0001 mole %).

IGT Institute of Gas Technology

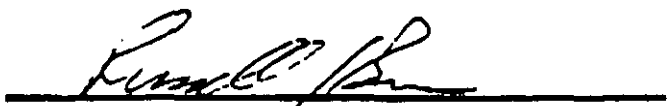
7-Dec-98 **Analytical Report** Log # : 981509.doc

urchase Order #:	20997
ompany :	Mostardi-Platt Associates, Inc.
eport Address :	945 Oaklawn Avenue Elmhurst IL 60126
equester :	Frank Jarke
hone:	(630) 993-9000
ax:	(630) 993-9017
ork Description :	Project # 84634
eceived Date :	4-Dec-98
umber of Samples :	1
ample Description :	See attached Chain of Custody Report

isclaimer:

either IGT nor any person acting on behalf of IGT assumes any liability with respect to the use of, or for damages sulting from the use of, any information presented in this report.

Submitted by: Sherman Chao, Ph.D., (847) 768-0587
Chemical Research Services

Technical Contact: 

Russell J. Bora, (847) 768-0693

Institute of Gas Technology

Analytical Report

12/17/98
IGT Log # : 98150901 xls

Major Component Gas Analysis By Gas Chromatography

Client Name: Maxwell-Platt Associates, Inc.
IGT Sample Number: 98150901
Sample Description: 84634-004
Date Analyzed: 12/4-17/98 Analyst: RJB

Component	Mol %	Det. Limit	Weight %
Helium	N.D.	0.001%	N.D.
Hydrogen	8.23%	0.04%	8.57%
Carbon Dioxide	28.6%	0.03%	31.1%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	8.84%	0.03%	8.93%
Nitrogen	48.3%	0.03%	46.4%
Methane		0.03%	
Carbon Monoxide	21.9%	0.03%	21.8%
Ethyne		0.002%	
Propene		0.002%	
Propane		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	0.0022%	0.0001%	0.0025%
Carbonyl Sulfide	0.00181%	0.00002%	0.00372%
Unidentified		0.03%	
Water	N.D.	0.001%	N.D.
Total	100.0%		100.0%

Calculated Real Gas Properties per ASTM D3588-91		
Temp. (°F)=	68.0	68.0
Press. (psia)=	14.696	14.73
Compressibility Factor (z) =	0.99919	0.99919
Relative Density =	1.0090	1.0090
Gross HV (DRY) =	98.6	98.8
Gross HV (SAT.) =	96.9	97.1
Wobbe Index =	98.1	98.4
Net HV (Dry) =	93.0	93.2
Net HV (Sat.) =	91.3	91.6

Notes: All blank values are below detection limit
N.D. - Not Determined

IT Institute of Gas Technology

Analytical Report

12/17/98
IGT Log # : 98150901.xls

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98150901
Sample Description: 84634-004
Date Analyzed: 12/4-17/98
Analyst: RJB

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	21.6	Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	18.1	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan	0.26	Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	40.0
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As PPMV	40.0
Di-t-Butyl Disulfide		As Grains/100 SCF	2.50
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes: Component Detection Limit:
1 ppmv for Hydrogen Sulfide
0.1 ppmv for all other compounds per sulfur
All blank values are below detection limit.

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98148703
Sample Description: 84634-005
Date Analyzed: 11/17-20/98 **Analyst:** RJB

Component	Mol %	Det. Limit	Weight %
Helium	N.D.	0.001%	N.D.
Hydrogen	14.1%	0.04%	0.95%
Carbon Dioxide	34.4%	0.03%	50.9%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	0.67%	0.03%	0.73%
Nitrogen	44.7%	0.03%	42.1%
Methane	1.30%	0.03%	0.70%
Carbon Monoxide	4.82%	0.03%	4.54%
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	0.0011%	0.0001%	0.0013%
Carbonyl Sulfide	0.00072%	0.00002%	0.00145%
Unidentified		0.03%	
Water	N.D.	0.001%	N.D.
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] =	0.99875	0.99875
Relative Density =	1.0277	1.0277
Gross HV (DRY) =	76.8	77.0
Gross HV (SAT.) =	75.5	75.6
Wobbe Index =	75.8	75.9
Net HV (Dry) =	65.9	66.0
Net HV (Sat.) =	64.7	64.9

Notes: All blank values are below detection limit
N.D. - Not Determined
Flowing liquid and black solid material were present in the sample cylinder.

Institute of Gas Technology

Analytical Report

12/3/98
IGT Log # : 98148703.xls

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98148703
Sample Description: 84634-005
Date Analyzed: 11/17-20/98
Analyst: RJB

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide	11.4	Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	7.21	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	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	18.6
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As PPMV	18.6
Di-t-Butyl Disulfide		As Grains/100 SCF	1.16
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes:

Component Detection Limit:
1 ppmv for Hydrogen Sulfide
0.1 ppmv for all other compounds per sulfur
All blank values are below detection limit.
Flowing liquid and black solid material were present in the sample cylinder.

EXTENDED GAS ANALYSIS BY GC/FID

Γ Sample Number: 98148703
ample Description: 84634-005
Date Analyzed: 12/1/98
Analyst: RJB

ponent Name	Mole %	Wt %
ıtane	BDL	See
tane	BDL	SynGas
ane	BDL	Data
ıfkanes		
entane	BDL	BDL
lcyclopentane	BDL	BDL
iexane	BDL	BDL
lcyclohexane	BDL	BDL
atics		
ne	BDL	BDL
ıe	BDL	BDL
enzene	BDL	BDL
lene	BDL	BDL
ene	BDL	BDL
ıe	BDL	BDL
ene	BDL	BDL
nzenes	BDL	BDL
thalene	BDL	BDL
aphthalenes	BDL	BDL
aphthalenes	BDL	BDL

Component Name	Mole %	Wt %
Paraffins		
Hexanes	BDL	BDL
Heptanes	BDL	BDL
2,2,4-Trimethylpentane	BDL	BDL
Octanes	BDL	BDL
Nonanes	BDL	BDL
Decanes	BDL	BDL
Undecanes	BDL	BDL
Dodecanes	BDL	BDL
Tridecanes	BDL	BDL
Tetradecanes	BDL	BDL
Pentadecanes	BDL	BDL
Hexadecanes	BDL	BDL
Heptadecanes	BDL	BDL
Octadecanes	BDL	BDL
Nonadecanes	BDL	BDL
Eicosanes –	BDL	BDL

Total from Cyclopentane to Eicosanes –	BDL	BDL

s: BDL = below detection limit (0.0001 mole %).
wing liquid and black solid material were present in the sample cylinder.

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98148704
Sample Description: 84634-007
Date Analyzed: 11/17-20/98 Analyst: RJB

Component	Mol %	Det. Limit	Weight %
Helium	N.D.	0.001%	N.D.
Hydrogen	2.98%	0.04%	0.20%
Carbon Dioxide	19.8%	0.03%	28.6%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	0.63%	0.03%	0.67%
Nitrogen	54.9%	0.03%	50.5%
Methane		0.03%	
Carbon Monoxide	21.7%	0.03%	20.0%
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		0.0001%	
Carbonyl Sulfide	0.00129%	0.00002%	0.00255%
Unidentified		0.03%	
Water	N.D.	0.001%	N.D.
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] =	0.99917	0.99917
Relative Density =	1.0512	1.0512
Gross HV (DRY) =	79.8	80.0
Gross HV (SAT.) =	78.4	78.6
Wobbe Index =	77.8	78.0
Net HV (Dry) =	77.7	77.9
Net HV (Sat.) =	76.4	76.6

Notes: All blank values are below detection limit
N.D. - Not Determined

Analytical Report

Institute of Gas Technology

12/2/98
IGT Log # : 98148704.xls

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98148704
Sample Description: 84634-007
Date Analyzed: 11/17-20/98
Analyst: RJB

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide		Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	12.9	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan		Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	12.9
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As PPMV	12.9
Di-t-Butyl Disulfide		As Grains/100 SCF	0.81
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes:

Component Detection Limit:
1 ppmv for Hydrogen Sulfide
0.1 ppmv for all other compounds per sulfur
All blank values are below detection limit.

EXTENDED GAS ANALYSIS BY GC/FID

Sample Number: 98148704
mple Description: 84634-007
Date Analyzed: 12/2/98
Analyst: RJB

onent Name	Mole %	Wt %
ıane	BDL	See
ıne	BDL	SynGas
ıe	BDL	Data
kanes		
ntane	BDL	BDL
yclopentane	BDL	BDL
xane	BDL	BDL
yclohexane	BDL	BDL
ics		
:	0.0003%	0.0007%
	BDL	BDL
nzene	BDL	BDL
ne	BDL	BDL
e	BDL	BDL
	BDL	BDL
e	BDL	BDL
enes	BDL	BDL
iene	BDL	BDL
nthalenes	BDL	BDL
hthalenes	BDL	BDL

Component Name	Mole %	Wt %
Paraffins		
Hexanes	BDL	BDL
Heptanes	BDL	BDL
2,2,4-Trimethylpentane	BDL	BDL
Octanes	BDL	BDL
Nonanes	BDL	BDL
Decanes	BDL	BDL
Undecanes	BDL	BDL
Dodecanes	BDL	BDL
Tridecanes	BDL	BDL
Tetradecanes	BDL	BDL
Pentadecanes	BDL	BDL
Hexadecanes	BDL	BDL
Heptadecanes	BDL	BDL
Octadecanes	BDL	BDL
Nonadecanes	BDL	BDL
Eicosanes +	BDL	BDL

Total from Cyclopentane to Eicosanes +	0.0003%	0.0007%

BDL = below detection limit (0.0001 mole %).

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi-Platt Associates, Inc.

IGT Sample Number: 98148705

Sample Description: 84634-009

Date Analyzed: 11/17-20/98 **Analyst:** RJB

Component	Mol %	Det. Limit	Weight %
Helium	N.D.	0.001%	N.D.
Hydrogen	2.99%	0.04%	0.20%
Carbon Dioxide	21.9%	0.03%	31.3%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	0.66%	0.03%	0.69%
Nitrogen	52.0%	0.03%	47.3%
Methane		0.03%	
Carbon Monoxide	22.5%	0.03%	20.5%
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	0.00199%	0.00002%	0.00389%
Unidentified		0.03%	
Water	N.D.	0.001%	N.D.
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] =	0.99910	0.99910
Relative Density =	1.0626	1.0626
Gross HV (DRY) =	82.4	82.6
Gross HV (SAT.) =	81.0	81.2
Wobbe Index =	80.0	80.1
Net HV (Dry) =	80.4	80.6
Net HV (Sat.) =	79.0	79.2

Notes: All blank values are below detection limit
N.D. - Not Determined

Analytical Report

Institute of Gas Technology

12/2/98
IGT Log # : 98148705.xls

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98148705
Sample Description: 84634-009
Date Analyzed: 11/17-20/98
Analyst: RJB

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide		Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	19.9	C2-Thiophenes	
Carbon Disulfide		C3-Thiophenes	
Methyl Mercaptan		Benzothiophene	
Ethyl Mercaptan		C1-Benzothiophenes	
i-Propyl Mercaptan		C2-Benzothiophenes	
n-Propyl Mercaptan			
t-Butyl Mercaptan		Thiophane	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	19.9
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		**Total Sulfur Content**	
n-Propyl t-Butyl Disulfide		As PPMV	19.9
Di-t-Butyl Disulfide		As Grains/100 SCF	1.24
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes: Component Detection Limit:
1 ppmv for Hydrogen Sulfide
0.1 ppmv for all other compounds per sulfur
All blank values are below detection limit.

EXTENDED GAS ANALYSIS BY GC/FID

[Sample Number: 98148705
ample Description: 84634-009
Date Analyzed: 12/2/98
Analyst: RJB

ponent Name	Mole %	Wt %
itane	BDL	See
ane	BDL	SynGas
ne	BDL	Data
lkanes		
entane	BDL	BDL
cyclopentane	BDL	BDL
exane	BDL	BDL
cyclohexane	BDL	BDL
tics		
e	0.0001%	0.0003%
e	BDL	BDL
enzene	BDL	BDL
ene	BDL	BDL
ne	BDL	BDL
e	BDL	BDL
ne	BDL	BDL
nzenes	BDL	BDL
aiene	BDL	BDL
phthalenes	BDL	BDL
phthalenes	BDL	BDL

Component Name	Mole %	Wt %
Paraffins		
Hexanes	BDL	BDL
Heptanes	BDL	BDL
2,2,4-Trimethylpentane	BDL	BDL
Octanes	BDL	BDL
Nonanes	BDL	BDL
Decanes	BDL	BDL
Undecanes	BDL	BDL
Dodecanes	BDL	BDL
Tridecanes	BDL	BDL
Tetradecanes	BDL	BDL
Pentadecanes	BDL	BDL
Hexadecanes	BDL	BDL
Heptadecanes	BDL	BDL
Octadecanes	BDL	BDL
Nonadecanes	BDL	BDL
Eicosanes +	BDL	BDL

Total from Cyclopentane to Eicosanes +	0.0001%	0.0003%

: BDL = below detection limit (0.0001 mole %).

Major Component Gas Analysis By Gas Chromatography

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98148706
Sample Description: 84634-011
Date Analyzed: 11/17-20/98 **Analyst:** RJB

Component	Mol %	Det. Limit	Weight %
Helium	N.D.	0.001%	N.D.
Hydrogen	3.05%	0.04%	0.20%
Carbon Dioxide	21.1%	0.03%	30.3%
Ethene		0.03%	
Ethane		0.03%	
Oxygen/Argon	0.58%	0.03%	0.61%
Nitrogen	54.3%	0.03%	49.7%
Methane		0.03%	
Carbon Monoxide	21.0%	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	0.00204%	0.00002%	0.00400%
Unidentified		0.03%	
Water	N.D.	0.001%	N.D.
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] =	0.99913	0.99913
Relative Density =	1.0576	1.0576
Gross HV (DRY) =	77.8	78.0
Gross HV (SAT.) =	76.4	76.6
Wobbe Index =	75.6	75.8
Net HV (Dry) =	75.7	75.9
Net HV (Sat.) =	74.4	74.6

Notes: All blank values are below detection limit
N.D. - Not Determined

Institute of Gas Technology

Analytical Report

12/2/98
IGT Log # : 98148706.xls

TRACE SULFUR DETERMINATION BY GAS CHROMATOGRAPHY

Client Name: Mostardi-Platt Associates, Inc.
IGT Sample Number: 98148706
Sample Description: 84634-011
Date Analyzed: 11/17-20/98
Analyst: RJB

Component Name	PPMV	Component Name	PPMV
Hydrogen Sulfide		Thiophene	
Sulfur Dioxide		C1-Thiophenes	
Carbonyl Sulfide	20.4	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	
		Thiophenol	
Dimethyl Sulfide			
Methyl Ethyl Sulfide		Individual Unidentified	
Diethyl Sulfide		Sulfur Compounds	
Di-t-Butyl Sulfide		(all as monosulfides)	
Dimethyl Disulfide			
Methyl Ethyl Disulfide			
Methyl i-Propyl Disulfide			
Diethyl Disulfide			
Methyl n-Propyl Disulfide			
Methyl t-Butyl Disulfide			
Ethyl i-Propyl Disulfide			
Ethyl n-Propyl Disulfide			
Ethyl t-Butyl Disulfide			
Di-i-Propyl Disulfide		Total Unidentified:	0.00
i-Propyl n-Propyl Disulfide		Total Identified:	20.4
Di-n-Propyl Disulfide			
i-Propyl t-Butyl Disulfide		*Total Sulfur Content*	
n-Propyl t-Butyl Disulfide		As PPMV	20.4
Di-t-Butyl Disulfide		As Grains/100 SCF	1.28
Dimethyl Trisulfide			
Diethyl Trisulfide			
Di-t-Butyl Trisulfide			

Notes: Component Detection Limit:
1 ppmv for Hydrogen Sulfide
0.1 ppmv for all other compounds per sulfur
All blank values are below detection limit.

EXTENDED GAS ANALYSIS BY GC/FID

Sample Number: 98148706
mple Description: 84634-011
Date Analyzed: 12/1/98
Analyst: RJB

onent Name	Mole %	Wt %
ane	BDL	See
ne	BDL	SynGas
e	BDL	Data
kanes		
ntane	BDL	BDL
yclopentane	BDL	BDL
xane	BDL	BDL
yclohexane	BDL	BDL
ics		
	BDL	BDL
	BDL	BDL
nzene	BDL	BDL
ne	BDL	BDL
e	BDL	BDL
	BDL	BDL
e	BDL	BDL
zenes	BDL	BDL
lene	BDL	BDL
hthalenes	BDL	BDL
hthalenes	BDL	BDL

Component Name	Mole %	Wt %
Paraffins		
Hexanes	BDL	BDL
Heptanes	BDL	BDL
2,2,4-Trimethylpentane	BDL	BDL
Octanes	BDL	BDL
Nonanes	BDL	BDL
Decanes	BDL	BDL
Undecanes	BDL	BDL
Dodecanes	BDL	BDL
Tridecanes	BDL	BDL
Tetradecanes	BDL	BDL
Pentadecanes	BDL	BDL
Hexadecanes	BDL	BDL
Heptadecanes	BDL	BDL
Octadecanes	BDL	BDL
Nonadecanes	BDL	BDL
Eicosanes +	BDL	BDL

Total from Cyclopentane to Eicosanes +	BDL	BDL

BDL = below detection limit (0.0001 mole %).

Blast Furnace Granulated Coal Injection
Environmental Monitoring Report

Appendix II – Wastewater Monitoring Summaries

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)
10/01/98	141.2	0.12	146		
10/02/98	144.5				
10/03/98	142.4				
10/04/98	104.4	0.30	264	<0.005	0.00
10/05/98	129.8				
10/06/98	125.7	0.42	441		
10/07/98	122.6				
10/08/98	121.1	0.25	253		
10/09/98	127.5				
10/10/98	95.5				
10/11/98	85.5	0.33	238	<0.005	0.00
10/12/98	115.8				
10/13/98	124.7	0.41	424		
10/14/98	120.5				
10/15/98	134.4	0.27	307		
10/16/98	123.4				
10/17/98	104.9				
10/18/98	95.0	0.22	173	<0.005	0.00
10/19/98	101.9				
10/20/98	112.4	0.34	321		
10/21/98	106.7				
10/22/98	109.0	0.28	252		
10/23/98	104.9				
10/24/98	93.2				
10/25/98	72.7	0.39	239	<0.005	0.00
10/26/98	118.2				
10/27/98	127.3	0.44	462		
10/28/98	130.3				
10/29/98	152.7	0.47	603		
10/30/98	143.7				
10/31/98	115.9				
Average	117.7	0.33	317.0	<0.005	0.00
Maximum	152.7	0.47	602.7	<0.005	0.00
Minimum	72.7	0.12	146.1	<0.005	0.00

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)
11/01/98	92.2	0.15	114	<0.005	0.00
11/02/98	113.2				
11/03/98	120.7	0.23	230		
11/04/98	119.2				
11/05/98	113.9	0.20	186		
11/06/98	105.7				
11/07/98	105.7				
11/08/98	73.0	0.17	102	<0.005	0.00
11/09/98	123.8				
11/10/98	116.3	0.33	319		
11/11/98	113.8				
11/12/98	121.8	0.27	273		
11/13/98	121.8				
11/14/98	108.4				
11/15/98	99.6	0.30	245	<0.005	0.00
11/16/98	121.7				
11/17/98	118.2	0.22	215		
11/18/98	116.4				
11/19/98	114.7	0.20	195		
11/20/98	140.0				
11/21/98	91.0				
11/22/98	51.8	0.40	174	<0.005	0.00
11/23/98	52.6				
11/24/98	56.5	0.47	219		
11/25/98	60.5				
11/26/98	59.8	0.30	147		
11/27/98	89.8				
11/28/98	74.4				
11/29/98	79.3	0.31	202	<0.005	0.00
11/30/98	117.4				
Average	99.8	0.27	201.7	<0.005	0.00
Maximum	140.0	0.47	319.3	<0.005	0.00
Minimum	51.8	0.15	101.7	<0.005	0.00

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)
12/01/98	114.2	0.26	245		
12/02/98	115.1				
12/03/98	114.0	0.27	254		
12/04/98	120.0				
12/05/98	113.7				
12/06/98	112.7	0.28	265	<0.005	0.00
12/07/98	125.0				
12/08/98	129.9	0.33	361		
12/09/98	131.8				
12/10/98	131.5	0.30	334		
12/11/98	144.3				
12/12/98	113.9				
12/13/98	102.0	0.38	323	<0.005	0.00
12/14/98	126.4				
12/15/98	126.3	0.34	360		
12/16/98	135.7				
12/17/98	125.1	0.27	283		
12/18/98	138.0				
12/19/98	131.6				
12/20/98	112.8	0.17	159	<0.005	0.00
12/21/98	130.0				
12/22/98	124.3	0.29	303		
12/23/98	136.0	0.21	237		
12/24/98	89.0				
12/25/98	108.3				
12/26/98	131.5				
12/27/98	117.0	0.25	248	<0.005	0.00
12/28/98	126.3				
12/29/98	126.8	0.36	379		
12/30/98	127.3	0.35	369		
12/31/98	116.1				
Average	122.5	0.29	294.2	<0.005	0.00
Maximum	144.3	0.38	378.8	<0.005	0.00
Minimum	89.0	0.17	159.1	<0.005	0.00

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)
10/01/98	97.4	0.30	240	<0.005	0.00
10/02/98	95.3				
10/03/98	93.2				
10/04/98	49.1	0.68	279	<0.005	0.00
10/05/98	76.0				
10/06/98	96.5	0.42	337	0.006	4.83
10/07/98	98.7				
10/08/98	92.9	0.33	258	<0.005	0.00
10/09/98	103.8				
10/10/98	60.1				
10/11/98	46.7	0.75	290	<0.005	0.00
10/12/98	76.4				
10/13/98	98.9	0.50	410	<0.005	0.00
10/14/98	97.9				
10/15/98	98.1	0.43	353	<0.005	0.00
10/16/98	96.5				
10/17/98	58.0				
10/18/98	44.5	0.58	216	0.005	1.86
10/19/98	79.2				
10/20/98	97.0	0.38	305	<0.005	0.00
10/21/98	94.2				
10/22/98	95.9	0.37	295	<0.005	0.00
10/23/98	92.9				
10/24/98	64.3				
10/25/98	45.7	0.94	360	<0.005	0.00
10/26/98	84.9				
10/27/98	96.2	0.46	371	<0.005	0.00
10/28/98	97.0				
10/29/98	96.5	0.44	351	<0.005	0.00
10/30/98	98.3				
10/31/98	77.0				
Average	83.8	0.51	312.6	0.001	0.51
Maximum	103.8	0.94	410.2	0.007	4.83
Minimum	44.5	0.30	215.8	<0.005	0.00

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)
11/01/98	41.4	0.56	195	<0.005	0.00
11/02/98	81.4				
11/03/98	97.3	0.43	352	<0.005	0.00
11/04/98	98.2				
11/05/98	94.0	0.42	333	<0.005	0.00
11/06/98	101.6				
11/07/98	59.1				
11/08/98	43.4	0.77	279	<0.005	0.00
11/09/98	80.0				
11/10/98	95.5	0.52	416	<0.005	0.00
11/11/98	95.0				
11/12/98	101.2	0.48	401	<0.005	0.00
11/13/98	105.0				
11/14/98	78.2				
11/15/98	80.9	0.48	325	<0.005	0.00
11/16/98	95.2				
11/17/98	95.9	0.37	294	<0.005	0.00
11/18/98	89.8				
11/19/98	94.3	0.34	269	0.007	5.51
11/20/98	96.4				
11/21/98	73.5				
11/22/98	47.2	0.63	248	<0.005	0.00
11/23/98	50.0				
11/24/98	50.0	0.44	185	0.008	3.34
11/25/98	42.5				
11/26/98	37.8	0.46	146	<0.005	0.00
11/27/98	45.8				
11/28/98	43.8				
11/29/98	44.0	0.61	225	<0.005	0.00
11/30/98	77.3				
Average	74.5	0.50	282.1	0.001	0.68
Maximum	105.0	0.77	416.0	0.008	5.51
Minimum	37.8	0.34	146.4	<0.005	0.00

Monitor

Sample Date	Flow (MGD)	Amı
12/01/98	90.8	
12/02/98	96.0	
12/03/98	88.1	
12/04/98	97.7	

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)
10/01/98		
10/02/98		
10/03/98		
10/04/98		
10/05/98		
10/06/98		
10/07/98	38.20	0.330
10/08/98		
10/09/98		
10/10/98		
10/11/98		
10/12/98		
10/13/98		
10/14/98	46.00	0.009
10/15/98		
10/16/98		
10/17/98		
10/18/98		
10/19/98		
10/20/98		
10/21/98	52.60	0.014
10/22/98		
10/23/98		
10/24/98		
10/25/98		
10/26/98		
10/27/98	40.80	0.011
10/28/98		
10/29/98		
10/30/98		
10/31/98		
Average	44.4	0.091
Maximum	52.6	0.330
Minimum	38.2	0.009

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)
11/01/98		
11/02/98		
11/03/98		
11/04/98	46.50	0.022
11/05/98		
11/06/98		
11/07/98		
11/08/98		
11/09/98		
11/10/98		
11/11/98	40.60	0.010
11/12/98		
11/13/98		
11/14/98		
11/15/98		
11/16/98		
11/17/98		
11/18/98	37.40	<0.005
11/19/98		
11/20/98		
11/21/98		
11/22/98		
11/23/98		
11/24/98		
11/25/98	35.60	0.021
11/26/98		
11/27/98		
11/28/98		
11/29/98		
11/30/98		
Average	40.0	0.013
Maximum	46.5	0.022
Minimum	35.6	<0.005

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)
12/01/98		
12/02/98	32.50	0.010
12/03/98		
12/04/98		
12/05/98		
12/06/98		
12/07/98		
12/08/98		
12/09/98	48.10	0.229
12/10/98		
12/11/98		
12/12/98		
12/13/98		
12/14/98		
12/15/98		
12/16/98	36.80	0.025
12/17/98		
12/18/98		
12/19/98		
12/20/98		
12/21/98		
12/22/98		
12/23/98	34.70	0.021
12/24/98		
12/25/98		
12/26/98		
12/27/98		
12/28/98		
12/29/98		
12/30/98	25.90	0.028
12/31/98		
Average	35.6	0.063
Maximum	48.1	0.229
Minimum	25.9	0.010