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AC031

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**PARTICULATE AND GASEOUS EMISSION
DIAGNOSTIC STUDY
PERFORMED FOR
BETHLEHEM STEEL CORPORATION
AT THE
NO. 1 COKE BATTERY
PUSHING CONTROL STACK
BURNS HARBOR, INDIANA
MARCH 21 THROUGH 23, 1995**

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PROJECT NO: 51203B
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CERTIFICATION SHEET

Having supervised and worked on the test program described in this report, and having written this report, I hereby certify the data, information, and results in this report to be accurate and true according to the methods and procedures used.

Data collected under the supervision of others is included in this report and is presumed to have been gathered in accordance with recognized standards.

MOSTARDI-PLATT ASSOCIATES, INC.

Edward A. Peterson (Jr)

Edward A. Peterson
Project Supervisor



MOSTARDI-PLATT ASSOCIATES, INC.

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PARTICULATE AND GASEOUS EMISSION DIAGNOSTIC STUDY

Performed For

BETHLEHEM STEEL CORPORATION

At The

No. 1 Coke Battery

Pushing Control Stack

Burns Harbor, Indiana

March 21 through 23, 1995

1.0 INTRODUCTION

A particulate and gaseous emission diagnostic test program was performed by MOSTARDI-PLATT ASSOCIATES, INC. (MPA) on the Pushing Control Stack at the No. 1 Coke Battery of Bethlehem Steel Corporation (Bethlehem Steel) in Burns Harbor, Indiana on March 21 through 23, 1995. The tests were authorized by and performed for Bethlehem Steel.

The purpose of this test program was to determine particulate and gaseous emission rates during normal coke oven pushing operations.

The tests were conducted by Messrs. M. Simmons, J. Langer, K. Taylor, B. Hannagan, S. Burton, L. Hochmuth, and E. Peterson of MPA. Mr. Tom Gerstle of Environmental Quality Management Inc. provided assistance and coordinated plant operating conditions during the test program.

2.0 SUMMARY OF RESULTS

The test program consisted of three (3) gaseous, three (3) particulate, and two (2) semi-volatile organic compound tests performed at the Pushing Control Stack. One (1) Summa canister was filled during each particulate test for analysis of volatile organics by GC-MS. Results of tests are presented on pages 8 through 28.

3.0 DISCUSSION OF RESULTS

No problems were encountered with the testing equipment during the course of the test program. Source operation appeared normal during the entire test program. The particulate (Method 5) tests were performed on March 21, 22, and 23, 1995. Each test consisted of 2-3 minutes of sampling during each of the 29-30 pushes in order to obtain at least 60 minutes of sampling time per test.

Summa canisters for VOC were sampled concurrently with the particulate sampling. Gaseous (CO, O₂, THC) was sampled continuously during the test day with periodic calibrations. Three (3) one-minute averages were averaged for the tables located on pages 9 through 11.

Semi-volatile organic testing consisted of one (1) 42-minute test performed on March 21, 1995 and one (1) 112-minute test performed over two test days, March 22 and 23, 1995.

4.0 TEST PROCEDURES

All testing, sampling, analytical, and calibration procedures used for this test program were performed as described in the Code of Federal Regulations, Title 40, Part 60, Appendix A (40CFR60), Methods 1, 2, 3, 4, 5, 10, and 25A and the latest revisions thereof. Additional test methods utilized were Method 0030 and 8240, SW-846. Where applicable, the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, USEPA 600/4-77-027b was used to determine the precise procedures.

4.1 Volumetric Flowrate Determination

The stack gas velocity and volumetric flowrate were determined using reference Method 2.

Velocity pressures were determined by traversing the test location with an S-type pitot tube. Temperatures were measured using a K-type thermocouple with a calibrated digital temperature indicator. The molecular weight and moisture content of the gases were determined to permit the calculation of the volumetric flowrate. Sampling points utilized were determined using Method 1, 40CFR60.

4.2 Oxygen (O₂)/Carbon Dioxide (CO₂) Determination

Oxygen (O₂) and carbon dioxide (CO₂) gas content were determined during the particulate tests in accordance with Method 3, 40CFR60. This method analyzed samples collected in a grab or integrated manner using a Hays Orsat gas analyzer. Several passes of the gas were made during each run to ensure a stable reading. Mandatory leak checks were performed prior to and following each use. Chemicals were changed frequently and inspected for reactivity prior to each use.

4.3 Oxygen (O₂) Determination

An oxygen (O₂) analyzer was used to determine O₂ concentrations in the stack gas in accordance with Method 3A, 40CFR60. This instrument has an electrochemical cell or paramagnetic-based

detector and operates in the range of 0-25% O₂. High-range calibrations were performed using ambient air @ 20.9% O₂. Zero nitrogen (low ppm pollutants in balance nitrogen calibration gases were used as zero gas on these analyzers) was introduced during other instrument calibrations to check instrument zero and a mid-range %O₂ level in balance nitrogen was also introduced. Mid-range calibrations were performed using certified standard gas prior to and between each test run.

4.4 Carbon Dioxide (CO₂) Determination

A carbon dioxide (CO₂) analyzer was used to determine CO₂ concentrations in the stack gas in accordance with Method 3A, 40CFR60. These instruments have nondispersive infrared-based detectors and operate in a range of 0-20% CO₂. A high- and mid-range calibration was performed using certified standard gases, and non-CO₂-containing gas mixtures were used for the CO₂ zero. Mid-range and zero calibrations were performed prior to and between each test run.

4.5 Particulate Determination

A total of 30 test points were sampled using 2 ports at the No. 1 Pushing Control Stack test location.

The particulate sampling train was manufactured by Nutech Corporation of Durham, North Carolina and meets all specifications required by Method 5. A stainless steel-lined probe was used. Drawings depicting the sampling ports, test point locations, and sampling trains are appended to this report. Velocity pressures were determined simultaneously during sampling with a calibrated S-type pitot tube and inclined manometer. All temperatures were measured using K-type thermocouples with calibrated digital temperature indicators.

The filter media were Whatman 934-AH glass microfibre filters exhibiting a $\geq 99.97\%$ efficiency on 0.3 micron DOP smoke particles in accordance with ASTM Standard Method D-2986-71. All sample contact surfaces of the train were washed with HPLC reagent-grade acetone. These washes were placed in sealed and marked containers for analysis.

All sample recovery was performed at the test site and MPA laboratory by the test crew. All final particulate sample analyses were performed by MPA personnel at the MPA laboratory in Elmhurst, Illinois. Copies of all sample analysis sheets, explanations of nomenclature and calculations, and raw field data sheets are appended to this report.

4.6 Carbon Monoxide (CO) Determination

The Method 10 test procedure was used to determine the carbon monoxide (CO) concentrations. A continuous gas sample was extracted from a sampling point and analyzed for CO content using a nondispersive infrared analyzer (NDIR). The gas stream was conditioned by condensing moisture and filtering particulate prior to the analyzer. This instrument employs an internal gas correlation filter wheel which eliminates potential detector interference. Instruments so equipped do not require the use of an interference removal trap.

After an appropriate warm up time, the analyzer was calibrated using certified calibration gases at concentrations corresponding to approximately 30, 60, and 90% of the applicable instrument range of 1000 ppm, with a CO free calibration gas used as a zero gas.

The analyzer was recalibrated with the mid-range and zero gases between each test and after the final test run.

The analyzer was then recalibrated with the mid-range and zero gases between tests and a full range calibration check was performed after the final test run.

4.7 Total Organic Concentration Determination

The Method 25A sampling and measurement system meets the requirements for stack sampling of volatile organic compounds (VOCs) set forth by the USEPA. In particular, it meets the requirements of USEPA Reference Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer," 40CFR60, Appendix A. This method applies to the measurement of total gaseous organic concentration of hydrocarbons. With this method, a gas sample was extracted from the stack through a heated Teflon sample line to the analyzer.

The flame ionization detector (FID) used during this program was a JUM Model VE-7 High-Temperature Total Hydrocarbon Analyzer. It is a highly sensitive FID that provides a direct reading of total organic vapor concentrations with linear ranges of 0-10, 100, 1000, 10,000, and 100,000 ppm by volume. The instrument was calibrated using ultra-zero air and propane in air certified standards. The calibrations were performed before and after sampling with calibration checks performed between each test run. Sampling was conducted continuously for three one-hour periods. Sample times and locations were logged simultaneously on data loggers.

Calculations were performed by hand. An explanation of the nomenclature and calculations along with the complete test results is included in the appendix. Also appended are calibration data and copies of the raw field data sheets.

4.8 Semi-Volatile Organics Determination

The Modified Method 5 (MM5) and SW-846-0010 sampling train is a comprehensive sampling system based upon the design of units normally employed for sampling under Method 5, 40CFR60. The modified system consisted of a glass-lined probe, a high-efficiency glass fiber filter stage, a sorbent module, and four impingers. The XAD Resin sorbent module, one of the modifications to the basic system which permits trapping of volatile organic vapors, was mounted vertically atop the first impinger of the train. This impinger was empty and was used to collect the condensate that percolates through the sorbent resin module. A diagram of this system is appended.

The glass-lined probe was wrapped with heating wire and a stainless steel jacket and heated to a gas temperature of $250^{\circ}\text{F} \pm 25^{\circ}\text{F}$. The filter holder was equipped with a very coarse, fritted glass filter support and a tared glass fiber filter. The filter medium was a Pallflex 2500QAT-UP filter exhibiting a 99.99 % efficiency on 0.3 micron DOP smoke particles. The filter holder was contained in an electrically heated box, thermostatically maintained at a temperature of $250^{\circ}\text{F} \pm 25^{\circ}\text{F}$, which is sufficient to prevent water condensation in this portion of the train.

Downstream of the heated filter, the sampled gas passed through a water-cooled condenser and then to a sorbent module that was filled with 40 grams of XAD Resin sorbent. XAD Resin is a porous polymer resin capable of absorbing a broad range of organic species. A diagram of the sorbent module is appended. Before the sampled gas reached the sorbent resin, it was cooled to a temperature of $< 70^{\circ}\text{F}$. This condensed the water vapor in the sampled stream and, in turn, some organic vapor became entrained in the condensate. For this reason, the condensate was allowed to percolate through the resin bed prior to being discharged into a collection vessel. At the downstream side of the sorbent module, four impingers were connected in series and immersed in an ice bath. The first impinger, connected to the outlet of the sorbent module, was modified to have a very short stem so that the sampled gas would not bubble through the collected condensate. The second impinger was a modified version of a Greenburg-Smith design; initially, it was filled with 100 mls of deionized water. The third impinger was a Greenburg-Smith impinger with a tip. It was also filled with 100 mls of deionized water. The fourth impinger was filled with silica gel to absorb any remaining moisture.

The XAD-2 resin modules for the MM5 samplers were prepared by cleaning each module with soap and water, followed by rinses with multiple solvents. They were then packed with prepurified XAD-2 resin purchased from Supelco that had been further purified by extraction with benzene.

All sample contact surfaces of the outlet train were washed with a 1:1 v/v mixture of methanol/methylene chloride solvent. These washes were placed in sealed and marked containers for analysis.

4.9 Volatile Organic Determination by Summa Canister

The flue gas was drawn via a Teflon-lined probe through a Teflon sample line and into a leak checked evacuation Summa canister. The sample line was purged prior to sampling. The sample was then drawn into the Summa canister from a single point for 7-8 hours. Sufficient gas was sampled to fill the canister. The sample canister was kept out of direct sunlight and immediately packed for shipment to the laboratory. Samples were analyzed by GC/MS under conditions specified by TO-14. Method TO-14 can be used to quantify most volatile organic compounds that have boiling points below 200°C and that are insoluble or slightly soluble in water.

A combination of exponential dilution, high vacuum and heat is used to clean Summa air sampling canisters. First of all, the canister is connected to a purge manifold. Here it is pressurized to 20 psi with ultra high purity nitrogen. The nitrogen is allowed to vent through an activated charcoal trap. This fill-drain-refill sequence occurs 8-10 times. This removes up to 99% of the original contents of the canisters. After purging, the canister is placed in an oven and connected to a high vacuum system. The canister is evacuated to 10 mTorr while at 125°C. After cooling, the canister is removed from the oven, capped and placed in inventory. Each cleaning step is recorded in a laboratory notebook using the unique serial number of each canister. Normally, 1 in 10 canisters are certified using GC/MS - full scan. Canisters must exhibit less than 0.2 ppbv/target species in order to be "certified."

Sample recovery was performed at the test site by the test crew. Samples were transported to an approved lab for analysis.

Copies of all sample analysis sheets are appended to this report.

Calculations were performed by computer and hand and an explanation of the nomenclature and calculations along with the complete test results are appended. Also appended are the calibration data and copies of the raw field data sheets.

Raw data are kept on file at the MPA offices in Elmhurst, Illinois. All samples from this test program (not already used in analysis) will be retained for 60 days after the submittal of the report, after which they will be discarded unless MPA is advised otherwise.

5.0 QUALITY ASSURANCE PROCEDURES

MPA recognizes the previously described reference methods to be very technique oriented and attempts to minimize all factors which can increase error by implementing its Quality Assurance Program into every segment of its testing activities.



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Shelf life of chemical reagents prepared at the MPA laboratory or at the jobsite did not exceed those specified in the above mentioned methods; and, those reagents having a shelf life of one week were prepared daily at the jobsite. When on-site analyses were required, all reagent standardizations were performed daily by the same person performing the analysis.

Dry test meters and wet test meters were calibrated according to methods described in the Quality Assurance Handbook, Sections 3.3.2., 3.4.2 and 3.5.2. Percent error for the wet test meter according to the methods was less than the allowable error of 1.0 percent. The dry test meters measured the test sample volumes to within 2 percent at the flowrate and conditions encountered during sampling.

Calibration gases were either Protocol One standard gases or certified standard gases which had been verified in accordance with alternative Number 2, Section 6.1.2 of Method 6C, 40CFR60.

6.0 ACKNOWLEDGMENTS

MOSTARDI-PLATT ASSOCIATES, INC. would like to thank all personnel involved in this project for their assistance in completing this test program, especially Mr. Tom Gerstle of Environmental Quality Management Inc.

Respectfully submitted,

MOSTARDI-PLATT ASSOCIATES, INC.

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9.0 SEMI-VOLATILE ORGANICS SUMMARY

Test 1 Bethlehem Steel Corporation No. 1 Coke Battery Pushing Control Stack March 21, 1995					
Semi-Volatile Organics	Detection Limit μg	Sample Results μg	Emission Rate lbs/hr	lbs/total tons coke processed	lbs/total tons coal processed
Acenaphthylene	10	25.5	0.001474	1.99×10^{-6}	1.51×10^{-6}
Benzoic Acid	150	243	0.014050	1.90×10^{-5}	1.44×10^{-5}
Dibenzofuran	10	17.8	0.001029	1.39×10^{-6}	1.05×10^{-6}
Diethyl Phthalate	10	79.8	0.004614	6.23×10^{-6}	4.72×10^{-6}
2,4-Dimethylphenol	10	45.4	0.002625	3.54×10^{-6}	2.68×10^{-6}
2-Methylnaphthalene	10	14.7	0.000850	1.15×10^{-6}	8.69×10^{-7}
Naphthalene	30	161	0.009309	1.26×10^{-5}	9.51×10^{-6}
Phenanthrene	10	21.9	0.001266	1.71×10^{-6}	1.29×10^{-6}

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Test 2 Bethlehem Steel Corporation No. 1 Coke Battery Pushing Control Stack March 22 and 23, 1995					
Semi-Volatile Organics	Detection Limit μg	Sample Results μg	Emission Rate lbs/hr	lbs/total tons coke processed	lbs/total tons coal processed
Acenaphthylene	10	28.4	0.000628	8.22×10^{-7}	6.22×10^{-7}
Benzoic Acid	250	415	0.009175	1.20×10^{-5}	9.09×10^{-6}
Bis(2-ethylhexyl)phthalate	10	14.7	0.000325	4.25×10^{-7}	3.22×10^{-7}
Dibenzofuran	10	15.2	0.000336	4.40×10^{-7}	3.33×10^{-7}
Diethyl phthalate	10	35.2	0.000778	1.02×10^{-6}	7.71×10^{-7}
2,4-Dimethylphenol	10	57.8	0.001278	1.67×10^{-6}	1.27×10^{-6}
Di-N-Butyl-phthalate	10	10.1	0.000223	2.92×10^{-7}	2.21×10^{-7}
2-Methylnaphthalene	10	11.6	0.000256	3.35×10^{-7}	2.54×10^{-7}
Naphthalene	50	198	0.004377	5.73×10^{-6}	4.34×10^{-6}
Phenanthrene	10	17.8	0.000394	5.16×10^{-7}	3.90×10^{-7}
Phenol	10	12.5	0.000276	3.61×10^{-7}	2.73×10^{-7}



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Test 1 Bethlehem Steel Corporation No. 1 Coke Battery Pushing Control Stack March 21, 1995			
Semi-Volatile Organics	Detection Limit μg	Sample Results μg	Emission Rate (lbs/hr)
Acenaphthene	10	ND	ND
Acenaphthylene	10	25.5	0.001474
Anthracene	10	ND	ND
Benzo(a)anthracene	10	ND	ND
Benzo(a)pyrene	10	ND	ND
Benzo(b & k)fluoranthene	10	ND	ND
Benzo(g,h,i)perylene	10	ND	ND
Benzoic Acid	150	243	0.014050
Benzyl alcohol	10	ND	ND
Bis(2-chloroethoxy)methane	10	ND	ND
Bis(2-chloroethyl)ether	10	ND	ND
Bis(2-chloroisopropyl)ether	10	ND	ND
Bis(2-ethylhexyl)phthalate	10	ND	ND
4-Bromophenyl phenyl ether	10	ND	ND
Butyl benzyl phthalate	10	ND	ND
2-Chlorophenol	10	ND	ND
4-Chlorophenyl phenyl ether	10	ND	ND
Chrysene	10	ND	ND
4-Chloroaniline	10	ND	ND
4-Chloro-3-methylphenol	10	ND	ND
2-Chloronaphthalene	10	ND	ND
Dibenzo(a,h)anthracene	10	ND	ND
Dibenzofuran	10	17.8	0.001029
1,2-Dichlorobenzene	10	ND	ND



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Test 1 Bethlehem Steel Corporation No. 1 Coke Battery Pushing Control Stack March 21, 1995			
Semi-Volatile Organics	Detection Limit μg	Sample Results μg	Emission Rate (lbs/hr)
1,3-Dichlorobenzene	10	ND	ND
1,4-Dichlorobenzene	10	ND	ND
3,3'-Dichlorobenzidine	20	ND	ND
2,4-Dichlorophenol	10	ND	ND
Diethyl phthalate	10	79.8	0.004614
2,4-Dimethylphenol	10	45.4	0.002625
Dimethyl phthalate	10	ND	ND
Di-N-Butyl-phthalate	10	ND	ND
4,6-Dinitro-2-methylphenol	50	ND	ND
2,4-Dinitrophenol	50	ND	ND
2,4-Dinitrotoluene	10	ND	ND
2,6 Dinitrotoluene	10	ND	ND
Di-N-octyl phthalate	10	ND	ND
Fluoranthene	10	ND	ND
Fluorene	10	ND	ND
Hexachlorobenzene	10	ND	ND
Hexachlorobutadiene	10	ND	ND
Hexachlorocyclopentadiene	10	ND	ND
Hexachloroethane	10	ND	ND
Indeno (1,2,3-cd) pyrene	10	ND	ND
Isophorone	10	ND	ND
2-Methylnaphthalene	10	14.7	0.000850
2-Methylphenol	10	ND	ND
4-Methylphenol	10	ND	ND



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Test 1			
Bethlehem Steel Corporation			
No. 1 Coke Battery			
Pushing Control Stack			
March 21, 1995			
Semi-Volatile Organics	Detection Limit µg	Sample Results µg	Emission Rate (lbs/hr)
Naphthalene	30	161	0.009309
2-Nitroaniline	50	ND	ND
3-Nitroaniline	50	ND	ND
4-Nitroaniline	50	ND	ND
Nitrobenzene	10	ND	ND
2-Nitrophenol	10	ND	ND
4-Nitrophenol	50	ND	ND
N-Nitroso-di-N-propylamine	10	ND	ND
N-Nitrosodiphenylamine	10	ND	ND
Pentachlorophenol	50	ND	ND
Phenanthrene	10	21.9	0.001266
Phenol	10	ND	ND
Pyrene	10	ND	ND
1,2,4-Trichlorobenzene	10	ND	ND
2,4,5-Trichlorophenol	50	ND	ND
2,4,6-Trichlorophenol	10	ND	ND

ND - Not present above the stated limit of detection.

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Test 2 Bethlehem Steel Corporation No. 1 Coke Battery Pushing Control Stack March 22 and 23, 1995			
Semi-Volatile Organics	Detection Limit µg	Sample Results µg	Emission Rate (lbs/hr)
Acenaphthene	10	ND	ND
Acenaphthylene	10	28.4	0.000628
Anthracene	10	ND	ND
Benzo(a)anthracene	10	ND	ND
Benzo(a)pyrene	10	ND	ND
Benzo(b & k)fluoranthene	10	ND	ND
Benzo(g,h,i)perylene	10	ND	ND
Benzoic Acid	250	415	0.009175
Benzyl alcohol	10	ND	ND
Bis(2-chloroethoxy)methane	10	ND	ND
Bis(2-chloroethyl)ether	10	ND	ND
Bis(2-chloroisopropyl)ether	10	ND	ND
Bis(2-ethylhexyl)phthalate	10	14.7	0.000325
4-Bromophenyl phenyl ether	10	ND	ND
Butyl benzyl phthalate	10	ND	ND
2-Chlorophenol	10	ND	ND
4-Chlorophenyl phenyl ether	10	ND	ND
Chrysene	10	ND	ND
4-Chloroaniline	10	ND	ND
4-Chloro-3-methylphenol	10	ND	ND
2-Chloronaphthalene	10	ND	ND
Dibenzo(a,h)anthracene	10	ND	ND
Dibenzofuran	10	15.2	0.000336



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Test 2			
Bethlehem Steel Corporation			
No. 1 Coke Battery			
Pushing Control Stack			
March 22 and 23, 1995			
Semi-Volatile Organics	Detection Limit µg	Sample Results µg	Emission Rate (lbs/hr)
1,2-Dichlorobenzene	10	ND	ND
1,3-Dichlorobenzene	10	ND	ND
1,4-Dichlorobenzene	10	ND	ND
3,3'-Dichlorobenzidine	20	ND	ND
2,4-Dichlorophenol	10	ND	ND
Diethyl phthalate	10	35.2	0.000778
2,4-Dimethylphenol	10	57.8	0.001278
Dimethyl phthalate	10	ND	ND
Di-N-Butyl-phthalate	10	10.1	0.000223
4,6-Dinitro-2-methylphenol	50	ND	ND
2,4-Dinitrophenol	50	ND	ND
2,4-Dinitrotoluene	10	ND	ND
2,6 Dinitrotoluene	10	ND	ND
Di-N-octyl phthalate	10	ND	ND
Fluoranthene	10	ND	ND
Fluorene	10	ND	ND
Hexachlorobenzene	10	ND	ND
Hexachlorobutadiene	10	ND	ND
Hexachlorocyclopentadiene	10	ND	ND
Hexachloroethane	10	ND	ND
Indeno (1,2,3-cd) pyrene	10	ND	ND
Isophorone	10	ND	ND
2-Methylnaphthalene	10	11.6	0.000256



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Test 2 Bethlehem Steel Corporation No. 1 Coke Battery Pushing Control Stack March 22 and 23, 1995			
Semi-Volatile Organics	Detection Limit µg	Sample Results µg	Emission Rate (lbs/hr)
2-Methylphenol	10	ND	ND
4-Methylphenol	10	ND	ND
Naphthalene	50	198	0.004377
2-Nitroaniline	50	ND	ND
3-Nitroaniline	50	ND	ND
4-Nitroaniline	50	ND	ND
Nitrobenzene	10	ND	ND
2-Nitrophenol	10	ND	ND
4-Nitrophenol	50	ND	ND
N-Nitroso-di-N-propylamine	10	ND	ND
N-Nitrosodiphenylamine	10	ND	ND
Pentachlorophenol	50	ND	ND
Phenanthrene	10	17.8	0.000394
Phenol	10	12.5	0.000276
Pyrene	10	ND	ND
1,2,4-Trichlorobenzene	10	ND	ND
2,4,5-Trichlorophenol	50	ND	ND
2,4,6-Trichlorophenol	10	ND	ND

ND - Not present above the stated limit of detection.



10.0 VOLATILE ORGANICS SUMMARY

Volatile Organic Compounds (TO-14) Emission Rates of Detected Compounds Bethlehem Steel Battery 1 Pushing Control Stack			
Compound	lbs/hr	lbs/total tons of coke	lbs/average tons of coal
Test 1			
Benzene	0.2930	3.77×10^{-4}	2.85×10^{-4}
Toluene	0.0584	7.51×10^{-5}	5.68×10^{-5}
Styrene	0.0611	7.85×10^{-5}	5.95×10^{-5}
1,1,2,2-Tetrachloroethane	0.0985	1.27×10^{-4}	9.59×10^{-5}
Methanol	17.3	2.22×10^{-2}	1.68×10^{-2}
Ethanol	0.106	1.36×10^{-4}	1.03×10^{-4}
Isopropanol	0.138	1.77×10^{-4}	1.34×10^{-4}
Acrolein	0.129	1.66×10^{-4}	1.26×10^{-4}
Acetone	13.2	1.70×10^{-2}	1.28×10^{-2}
Acetonitrile	0.0944	1.21×10^{-4}	9.19×10^{-5}
Acrylonitrile	0.122	1.57×10^{-4}	1.19×10^{-4}
Vinyl Acetate	0.198	2.55×10^{-4}	1.93×10^{-4}
Tetrahydrofuran	0.166	2.13×10^{-4}	1.62×10^{-4}
1,4-Dioxane	0.203	2.61×10^{-4}	1.98×10^{-4}
2-Butanone	0.166	2.13×10^{-4}	1.62×10^{-4}
Methyl Methacrylate	0.230	2.96×10^{-4}	2.24×10^{-4}
4-Methyl-2-Pentanone	0.230	2.96×10^{-4}	2.24×10^{-4}



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Volatile Organic Compounds (TO-14) Emission Rates of Detected Compounds Bethlehem Steel Battery 1 Pushing Control Stack			
Compound	lbs/hr	lbs/total tons of coke	lbs/average tons of coal
Test 2			
Benzene	0.191	2.54×10^{-4}	1.92×10^{-4}
Methanol	2.83	3.76×10^{-3}	2.85×10^{-3}
Acetone	18.5	2.46×10^{-2}	1.86×10^{-2}
Test 3			
Benzene	0.0773	9.94×10^{-5}	7.52×10^{-5}
Toluene	0.0142	1.83×10^{-5}	1.38×10^{-5}
Methylene Chloride	0.00616	7.92×10^{-6}	6.00×10^{-6}
Methanol	0.134	1.72×10^{-4}	1.30×10^{-4}
Acetone	19.2	2.47×10^{-2}	1.87×10^{-2}



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VOLATILE ORGANIC COMPOUNDS

Bethlehem Steel
Pushing Stack-Test 1
3/21/95

Compound	Concentration		Emission Rate
	(pptv)	(lbs/dscf)	(lbs/hr)
Benzene	160	3.25E-08	2.93E-01
Toluene	27	6.46E-09	5.84E-02
Ethyl Benzene	< 25	< 6.89E-09	< 6.23E-02
m,p-Xylene	< 25	< 6.89E-09	< 6.23E-02
o-Xylene	< 25	< 6.89E-09	< 6.23E-02
1,3,5-Trimethylbenzene	< 25	< 7.81E-09	< 7.05E-02
1,2,4-Trimethylbenzene	< 25	< 7.81E-09	< 7.05E-02
Freon 12	< 25	< 7.85E-09	< 7.10E-02
Freon114	< 25	< 1.11E-08	< 1.00E-01
Chloromethane	< 25	< 3.28E-09	< 2.96E-02
Vinyl Chloride	< 25	< 4.06E-09	< 3.67E-02
Bromomethane	< 25	< 6.17E-09	< 5.57E-02
Chloroethane	< 25	< 4.19E-09	< 3.79E-02
Freon 11	< 25	< 8.92E-09	< 8.06E-02
1,1 Dichloroethene	< 25	< 6.30E-09	< 5.69E-02
Freon 113	< 25	< 1.22E-08	< 1.10E-01
Methylene Chloride	< 25	< 5.52E-09	< 4.98E-02
cis-1,2 Dichloroethene	< 25	< 6.30E-09	< 5.69E-02
Chloroform	< 25	< 7.75E-09	< 7.01E-02
1,1,1 Trichloroethane	< 25	< 8.53E-09	< 7.71E-02
Carbon Tetrachloride	< 25	< 9.99E-09	< 9.03E-02
1,2 Dichloroethane	< 25	< 6.43E-09	< 5.81E-02
Trichloroethene	< 25	< 8.66E-09	< 7.83E-02
1,2 Dichloropropane	< 25	< 7.34E-09	< 6.63E-02
1,1 Dichloroethane	< 25	< 6.43E-09	< 5.81E-02
cis-1,3 Dichloropropene	< 25	< 7.21E-09	< 6.51E-02
trans-1,3-Dichloropropene	< 25	< 7.21E-09	< 6.51E-02
1,1,2 Trichloroethane	< 25	< 8.66E-09	< 7.83E-02
Tetrachloroethene	< 25	< 1.08E-08	< 9.73E-02
Chlorobenzene	< 25	< 7.31E-09	< 6.60E-02
Ethylene Dibromide	< 25	< 1.22E-08	< 1.10E-01
Volumetric flow rate (dscfm)	150611		



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VOLATILE ORGANIC COMPOUNDS

Bethlehem Steel
Pushing Stack-Test 1
3/21/95

Compound	Concentration		Emission Rate
	(ppbv)	(lbs/dscf)	(lbs/hr)
Styrene	< 25	6.76E-09	6.11E-02
1,1,2,2-Tetrachloroethane	< 25	1.09E-08	9.85E-02
1,3-Dichlorobenzene	< 25	< 9.55E-09	< 8.63E-02
1,4-Dichlorobenzene	< 25	< 9.55E-09	< 8.63E-02
Chlorotoluene	< 25	< 8.22E-09	< 7.43E-02
1,2-Dichlorobenzene	< 25	< 9.55E-09	< 8.63E-02
1,2,4-Trichlorobenzene	< 25	< 1.18E-08	< 1.07E-01
Hexachlorobutadiene	< 25	< 1.69E-08	< 1.53E-01
Methanol	23000	1.91E-06	1.73E+01
Ethanol	< 98	1.17E-08	1.06E-01
Isopropanol	< 98	1.53E-08	1.38E-01
Acrolein	< 98	1.43E-08	1.29E-01
Acetone	9700	1.46E-06	1.32E+01
Acetonitrile	< 98	1.04E-08	9.44E-02
Acrylonitrile	< 98	1.35E-08	1.22E-01
Vinyl Acetate	< 98	2.19E-08	1.98E-01
Tetrahydrofuran	< 98	1.84E-08	1.66E-01
1,4-Dioxane	< 98	2.24E-08	2.03E-01
2-Butanone	< 98	1.84E-08	1.66E-01
Methyl Methacrylate	< 98	2.55E-08	2.30E-01
4-Methyl-2-Pentanone	< 98	2.55E-08	2.30E-01
Volumetric flow rate (dscfm)	150611		



MOSTARDI-PLATT ASSOCIATES, INC.

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VOLATILE ORGANIC COMPOUNDS Bethlehem Steel Pushing Stack-Test 2 3/22/95

Compound	Concentration		Emission Rate
	(ppbv)	(lbs/dscf)	(lbs/hr)
Benzene	100	2.03E-08	1.91E-01
Toluene	< 36	< 8.61E-09	< 8.13E-02
Ethyl Benzene	< 36	< 9.93E-09	< 9.37E-02
m,p-Xylene	< 36	< 9.93E-09	< 9.37E-02
o-Xylene	< 36	< 9.93E-09	< 9.37E-02
1,3,5-Trimethylbenzene	< 36	< 1.12E-08	< 1.06E-01
1,2,4-Trimethylbenzene	< 36	< 1.12E-08	< 1.06E-01
Freon 12	< 36	< 1.13E-08	< 1.07E-01
Freon114	< 36	< 1.60E-08	< 1.51E-01
Chloromethane	< 36	< 4.72E-09	< 4.46E-02
Vinyl Chloride	< 36	< 5.84E-09	< 5.52E-02
Bromomethane	< 36	< 8.88E-09	< 8.38E-02
Chloroethane	< 36	< 6.03E-09	< 5.69E-02
Freon 11	< 36	< 1.28E-08	< 1.21E-01
1,1 Dichloroethene	< 36	< 9.07E-09	< 8.56E-02
Freon 113	< 36	< 1.75E-08	< 1.65E-01
Methylene Chloride	< 36	< 7.94E-09	< 7.50E-02
cis-1,2 Dichloroethene	< 36	< 9.07E-09	< 8.56E-02
Chloroform	< 36	< 1.12E-08	< 1.05E-01
1,1,1 Trichloroethane	< 36	< 1.23E-08	< 1.16E-01
Carbon Tetrachloride	< 36	< 1.44E-08	< 1.36E-01
1,2 Dichloroethane	< 36	< 9.25E-09	< 8.73E-02
Trichloroethene	< 36	< 1.25E-08	< 1.18E-01
1,2 Dichloropropane	< 36	< 1.06E-08	< 9.97E-02
1,1 Dichloroethane	< 36	< 9.25E-09	< 8.73E-02
cis-1,3 Dichloropropene	< 36	< 1.04E-08	< 9.79E-02
trans-1,3-Dichloropropene	< 36	< 1.04E-08	< 9.79E-02
1,1,2 Trichloroethane	< 36	< 1.25E-08	< 1.18E-01
Tetrachloroethene	< 36	< 1.55E-08	< 1.46E-01
Chlorobenzene	< 36	< 1.05E-08	< 9.93E-02
Ethylene Dibromide	< 36	< 1.76E-08	< 1.66E-01
Volumetric flow rate (dscfm)	157297		



MOSTARDI-PLATT ASSOCIATES, INC.

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VOLATILE ORGANIC COMPOUNDS

Bethlehem Steel
Pushing Stack-Test 2
3/22/95

Compound	Concentration		Emission Rate
	(ppmv)	(lbs/dscf)	(lbs/hr)
Styrene	< 36	< 9.74E-09	< 9.19E-02
1,1,2,2-Tetrachloroethane	< 36	< 1.57E-08	< 1.48E-01
1,3-Dichlorobenzene	< 36	< 1.38E-08	< 1.30E-01
1,4-Dichlorobenzene	< 36	< 1.38E-08	< 1.30E-01
Chlorotoluene	< 36	< 1.18E-08	< 1.12E-01
1,2-Dichlorobenzene	< 36	< 1.38E-08	< 1.30E-01
1,2,4-Trichlorobenzene	< 36	< 1.70E-08	< 1.60E-01
Hexachlorobutadiene	< 36	< 2.44E-08	< 2.30E-01
Methanol	3600	3.00E-07	2.83E+00
Ethanol	< 140	< 1.67E-08	< 1.58E-01
Isopropanol	< 140	< 2.19E-08	< 2.06E-01
Acrolein	< 140	< 2.04E-08	< 1.92E-01
Acetone	13000	1.96E-06	1.85E+01
Acetonitrile	< 140	< 1.49E-08	< 1.41E-01
Acrylonitrile	< 140	< 1.93E-08	< 1.82E-01
Vinyl Acetate	< 140	< 3.13E-08	< 2.95E-01
Tetrahydrofuran	< 140	< 2.62E-08	< 2.47E-01
1,4-Dioxane	< 140	< 3.20E-08	< 3.02E-01
2-Butanone	< 140	< 2.62E-08	< 2.48E-01
Methyl Methacrylate	< 140	< 3.64E-08	< 3.43E-01
4-Methyl-2-Pentanone	< 140	< 3.64E-08	< 3.43E-01
Volumetric flow rate (dscfm)	157297		

MOSTARDI-PLATT ASSOCIATES, INC.

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VOLATILE ORGANIC COMPOUNDS

Bethlehem Steel
Pushing Stack-Test 3
3/23/95

Compound	Concentration		Emission Rate
	(ppbv)	(lbs/dscf)	(lbs/hr)
Benzene	45	9.13E-09	7.73E-02
Toluene	7	1.68E-09	1.42E-02
Ethyl Benzene	< 1.9	< 5.24E-10	< 4.43E-03
m,p-Xylene	< 1.9	< 5.24E-10	< 4.43E-03
o-Xylene	< 1.9	< 5.24E-10	< 4.43E-03
1,3,5-Trimethylbenzene	< 1.9	< 5.93E-10	< 5.02E-03
1,2,4-Trimethylbenzene	< 1.9	< 5.93E-10	< 5.02E-03
Freon 12	< 1.9	< 5.97E-10	< 5.05E-03
Freon114	< 1.9	< 8.44E-10	< 7.14E-03
Chloromethane	< 1.9	< 2.49E-10	< 2.11E-03
Vinyl Chloride	< 1.9	< 3.08E-10	< 2.61E-03
Bromomethane	< 1.9	< 4.69E-10	< 3.97E-03
Chloroethane	< 1.9	< 3.18E-10	< 2.70E-03
Freon 11	< 1.9	< 6.78E-10	< 5.74E-03
1,1 Dichloroethene	< 1.9	< 4.78E-10	< 4.05E-03
Freon 113	< 1.9	< 9.24E-10	< 7.82E-03
Methylene Chloride	3.3	7.28E-10	6.16E-03
cis-1,2 Dichloroethene	< 1.9	< 4.78E-10	< 4.05E-03
Chloroform	< 1.9	< 5.89E-10	< 4.99E-03
1,1,1 Trichloroethane	< 1.9	< 6.48E-10	< 5.49E-03
Carbon Tetrachloride	< 1.9	< 7.59E-10	< 6.43E-03
1,2 Dichloroethane	< 1.9	< 4.88E-10	< 4.13E-03
Trichloroethene	< 1.9	< 6.58E-10	< 5.57E-03
1,2 Dichloropropane	< 1.9	< 5.58E-10	< 4.72E-03
1,1 Dichloroethane	< 1.9	< 4.88E-10	< 4.13E-03
cis-1,3 Dichloropropene	< 1.9	< 5.48E-10	< 4.64E-03
trans-1,3-Dichloropropene	< 1.9	< 5.48E-10	< 4.64E-03
1,1,2 Trichloroethane	< 1.9	< 6.58E-10	< 5.57E-03
Tetrachloroethene	< 1.9	< 8.18E-10	< 6.93E-03
Chlorobenzene	< 1.9	< 5.55E-10	< 4.70E-03
Ethylene Dibromide	< 1.9	< 9.27E-10	< 7.85E-03
Volumetric flow rate (dscfm)	141073		



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VOLATILE ORGANIC COMPOUNDS

Bethlehem Steel
Pushing Stack-Test 3
3/23/95

Compound	Concentration		Emission Rate
	(ppbv)	(lbs/dscf)	(lbs/hr)
Styrene	< 1.9	< 5.14E-10	< 4.35E-03
1,1,2,2-Tetrachloroethane	< 1.9	< 8.28E-10	< 7.01E-03
1,3-Dichlorobenzene	< 1.9	< 7.26E-10	< 6.14E-03
1,4-Dichlorobenzene	< 1.9	< 7.26E-10	< 6.14E-03
Chlorotoluene			
1,2-Dichlorobenzene			
1,2,4-Trichlorobenzene			
Hexachlorobutadiene			
Methanol			
Ethanol			
Isopropanol			
Acrolein			
Acetone			
Acetonitrile			
Acrylonitrile			
Vinyl Acetate			
Tetrahydrofuran			
1,4-Dioxane			
2-Butanone			
Methyl Methacrylate			
4-Methyl-2-Pentanone			
Volumetric flow rate (dscfm)	141073		

Handwritten notes and calculations:

BDL's $\frac{.37}{2} = 3$

Ethyl benzene 2.74×10^{-3}

m,p-xylene 2.73×10^{-3}

o-xylene 2.73×10^{-3}

1,3,5-Trim 3.09×10^{-3}

1,2,4-Trim 3.09×10^{-3}

Frans 12 3.12×10^{-3}

Frans 14 4.40×10^{-3}

Vinyl Chloride 1.61×10^{-3}

Bromochloroethane 2.46×10^{-3}

Chloroethane 2.34×10^{-3}

2,600 ppb 4.8×10^{-3}

1000 ppb 4.6×10^{-3}

26000 - .082

8000, 4.8×10^{-3}

320, 1.43×10^{-3}

320, 1.25×10^{-3}

8000, 2.05×10^{-3}

8000, 0.24

9200, 1.49×10^{-4}

2300, 6.14×10^{-4}

9200, 7.91×10^{-4}

9200, 9.52×10^{-3}

2300, 7.66×10^{-3}

Process Summary
 Bethlehem Steel
 No. 1 Coke Oven Battery
 Pushing Emissions Control Stack Emissions Tests

Test Date	Run Number	Run Time (24 hr)	Number of Pushes	Coke Production tons/hour ³	Total Coke Production ⁴ tons	Total Coal Usage ⁵ ton
3-21-95	1 MM5	1231-1714	20	110.3	518.6	685.0
3-22-95	2 MM5	1019-1616 1020-1642	55 ¹	115.9	1,426.2	1,883.8
3-21-95	1 M5	1002-1712	30	108.5	777.9	1,027.5
3-22-95	2 M5	0927-1615	29	110.6	752.0	993.3
3-23-95	3 M5	1020-1642	30	122.1	777.9	1,027.5
3-21-95	1 Gaseous ²	1002-1712	30	108.5	777.9	1,027.5
3-22-95	2 Gaseous	0927-1615	29	110.6	752.0	993.3
3-23-95	3 Gaseous	1020-1642	30	122.1	777.9	1,027.5
3-21-95	1 TO-14	1000-1710	30	108.5	777.9	1,027.5
3-22-95	2 TO-14	0927-1615	29	110.6	752.0	993.3
3-23-95	3 TO-14	1000-1642	30	116.1	777.9	1,027.5

¹ Run Number 2 MM5 was conducted over a 2 day period to increase sample volume.
² Represents O₂, CO₂, THC, CO.
³ Based upon a charging weight of 68,500 pounds. Coke production is equivalent to 75.71 % of charge weight per Bill item.
⁴ Number of pushing during test period x coal charge (68,500 lbs) x 0.7571/2,000 lbs/ton
⁵ Number of pushes during test period x coal charge (68,500 lbs)/2,000 lbs/ton