ERIE COKE CORPORATION
ERIE, PENNSYLVANIA

Report on

COMPLIANCE DEMONSTRATION
COKE QUENCH CAR EXHAUST STACK

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EXECUTIVE SUMMARY

A compliance demonstration of the pushing emissions control for the coke batteries operated at Erie Coke Corporation was conducted on April 18 and 19, 1995. A quench car / scrubber system controls the particulate matter emissions which result from the pushing operations of the battery ovens. The purpose of the testing was to measure the particulate matter concentration and mass emissions rate in the quench car scrubber exhaust gas stream and compare the measured values with the allowable concentration or mass emissions rate promulgated by Pennsylvania Air Pollution Control Regulations. Testing was performed by Messrs. Mark Grunebach, Patrick Stockton, and Kelly Ajala of Advanced Technology Systems, Inc. under the direction of Mr. Bill Wetzel of Erie Coke Corporation.

The average particulate matter concentration measured in this test program (0.0118 gr/dscf) is less than the PA DER allowable concentration (0.02 gr/dscf). The average particulate matter emissions rate measured in this test program (0.29 lb/hr) is less than PA DER allowable emission rate (2.20 lb/hr).

1.0 INTRODUCTION

A compliance demonstration of the pushing emissions control for the coke batteries operated at Erie Coke Corporation was conducted on April 18 and 19, 1995. A quench car / scrubber system controls the particulate matter emissions which result from the pushing operations of the battery ovens. The purpose of the testing was to measure the particulate matter concentration and mass emissions rate in the quench car scrubber exhaust gas stream and compare the measured values with the allowable concentration or mass emissions rate promulgated by Pennsylvania Air Pollution Control Regulations. Testing was performed by Messrs. Mark Grunebach, Patrick Stockton, and Kelly Ajala of Advanced Technology Systems, Inc. under the direction of Mr. Bill Wetzel of Erie Coke Corporation.

2.0 METHODOLOGIES

Particulate matter sampling was performed in accordance with EPA Reference Methods 1 through 5 and Sections 139.11 and 139.12 of Pennsylvania Department of Environmental Resources (PA DER) Source Testing Manual (Revision Number 1, January 1983) with the exception that the PA DER requirement of sampling 50 cubic feet of exhaust gas per test run was replaced with the requirement of sampling the emissions from 12 pushes per test run. The emissions from each push were sampled for two minutes, resulting in a total sample test duration of 24 minutes per test run. Two test runs were completed as part of the test effort, with one test run completed on April 18, 1995 and the second test run completed on April 19, 1995. Testing was performed only during periods of normal plant operation.

The quench car scrubber exhausts through a horizontally-aligned rectangular duct with dimensions of 48 inches (depth) by 23 inches (height). Sampling was conducted through three equally spaced sampling ports located in the same vertical plane. The test ports are located at least two equivalent stack diameters downstream of any stack disturbance and at least one-half equivalent stack diameter upstream of any stack disturbance. Each traverse for the duct included four traverse points as calculated from EPA Reference Method 1. Sampling was conducted along a total of three traverses, or 12 traverse points, with each push sampled for two minutes at each traverse point. A schematic diagram of the duct and traverse points is presented in Figure 1.

In accordance with EPA Method 2, velocities and volumetric flow rates of the exhaust gas stream were measured using a calibrated S type pitot tube. Positive and negative pitot lines were leak-checked at the beginning and end of each test run. Gas velocity differential pressures along with exhaust gas temperatures were recorded at each sampling point. Static pressure of the exhaust gas stream was measured with the same pitot tube.

During each test, gas concentrations of carbon dioxide (CO_2), oxygen (O_2), and nitrogen (N_2, by difference), were measured with the use of Fyrite apparatus as specified by EPA Reference Method 3. Gas concentrations were used to obtain molecular weight of the exhaust gas on a dry basis. Two runs of EPA Reference Method 3 were conducted during each test.

Percent moisture content, by volume, of the exhaust gas was calculated by knowledge of the weight gain of the four EPA Reference Method 5 sample train impingers and dry gas volume sampled. The calculation was performed in accordance with EPA Reference Method 4.

As specified by EPA Reference Method 5, each sample train was assembled as required by the method, leak-checked on site at the beginning and end of each test run, and operated so that isokinetic conditions were maintained. Clean up of the sampling train included a distilled deionized water rinse followed by an acetone rinse of the front-half sample train components (nozzle, probe liner, and top half of filter holder). The water and acetone rinses were collected in separate bottles (identified as Bottle #1 for the water rinse and Bottle #2 for the acetone rinse). The impinger catches were collected in a separate bottle (identified as Bottle #3). The empty impingers and the other back-half sample train components (bottom half of the filter holder plus connecting glassware between the filter holder and the impingers) were then rinsed with distilled deionized water. These washings were added to Bottle #3. After the water rinse, all back-half sample train components were rinsed with acetone. This final rinse was collected in a separate bottle (identified as Bottle #4). All acetone and water samples excluding Bottle #3 were evaporated to dryness, desiccated, and weighed to a constant weight. The contents of Bottle #3 was filtered under suction through a preweighed 0.22 micrometer membrane filter to determine water soluble and insoluble portions. The filter used to capture the insoluble material was dried, desiccated, and weighed to a constant weight. After filtration, the soluble back-half water was evaporated to dryness, desiccated, and weighed to a constant weight. Sample train filters were desiccated for 24 hours and weighed to a constant weight. Rinse residue weights and filter weights were measured to the nearest 0.1 mg. One sample train filter blank, one acetone blank, and one deionized distilled water blank were prepared in the same manner as the test samples. The blank weights were subtracted from the test sample weights. After blank correction, front-half water and acetone rinse residue weights, sample train filter weights, and back-half water insoluble filter weights were used to determine total particulate matter catch.

3.0 RESULTS

The particulate matter emissions test results have been summarized in Table 1. Particulate matter concentrations are listed in units of grains per dry standard cubic foot (gr/dscf). Particulate matter mass emission rates are listed in units of pounds per hour of sampling (lb/hr sampling) and pounds per clock hour (lb/hr). The reason for listing the emission rates in units of (i) pounds per hour of sampling and (ii) pounds per clock hour is that emissions from this source do not occur on a continuous basis, and as such, the "clock-hour" emissions rate (lb/hr) is calculated from the knowledge of the measured emissions rate (lb/hr sampling) and the coke production rate (number of ovens pushed per hour during the testing periods). The equation used to calculate emission rates in units of lb/hr is shown at the bottom of Table 1. The test results showed an average particulate matter concentration and emissions rate in the exhaust gas steam of 0.0118 gr/dscf and 0.29 lb/hr, respectively.

As promulgated in Pennsylvania Air Pollution Control Regulations, Section 123.13, the emissions can not exceed 0.02 gr/dscf or the mass emissions rate calculated from the following formula, whichever is greater:

$$A = 0.76\, E^{0.42}$$

where A = Allowable Emissions (lb/hr)
E = Emissions Index = F x W
F = Process Factor (pounds per unit)
W = Production or Charging Rate (units per hour)

For this test effort, the parameter F is equal to 1 lb/ton coke pushed, and the parameter W is equal 12.55 ton coke/push. Substituting the appropriate values into the formula listed above yields an allowable particulate matter emission rate of 2.20 lb/hr.

The average particulate matter concentration measured in this test program (0.0118 gr/dscf) is less than the PA DER allowable concentration (0.02 gr/dscf). The average particulate matter emissions rate measured in this test program (0.29 lb/hr) is less than PA DER allowable emission rate (2.20 lb/hr).

Table 1 also lists other stack and sampling parameters which include exhaust gas flow rate in units of actual cubic feet per minute (acfm), standard cubic feet per minute (scfm), and dry standard cubic feet per minute (dscfm), moisture content of the exhaust gas (percent by volume), exhaust gas temperature (^{O}F), gas volume sampled for each test in units of dry standard cubic feet (dscf), and the isokinetics value for each test. The isokinetics value is equal to the ratio of the average linear gas velocity sampled through the probe nozzle to the average stack gas velocity. An isokinetics value between 90 percent and 110 percent is considered acceptable. The isokinetics values are in the acceptable range of values.

Copies of the field data sheets, pre-test and post-test equipment calibration data, plant operational data, gravimetric results, and emissions calculations for each test can be found in the Appendix.

(lb/hr) values refer to the average over push and non-push periods
(lb/hr sampling) values refer to only push periods (i.e., actual sampling

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TABLE 1

COKE QUENCH CAR EXHAUST STACK
PARTICULATE MATTER EMISSIONS DATA

		Run 1	Run 2	Average	
Test Number		EC-QC-1	EC-QC-2		
Test Date		04-18-95	04-19-95		
Coke Production Rate	(# ovens/hr)	2.29	2.12		
	(ton coke/oven)	12.55	12.55		Maximum Allowables
		28.74 tons coke/hr	26.61 tons coke/hr		
Mass Emissions Rate and Concentration		= 34.80 tons coal/hr	= 32.23 tons coal/hr		
Particulate Matter	(lb/hr)	0.287	0.30	0.29 ←	2.20
	(lb/hr sampling)	3.358	4.282	3.970	
	(gr/dscf)	0.0117	0.0125	~~0.0130~~ 0.0118 ←	0.02
		~~0.0087 lb/ton~~ 0.0078 lb/ton coal	~~0.0093 lb/ton~~ 0.0083 lb/ton coal	~~avg 0.0088 lb/ton~~ avg 0.0085	
Stack Conditions					
Flow Rate	(acfm)	39700	40600	40200	
	(scfm)	39100	39700	39400	
	(dscfm)	38000	39200	38600	
Temperature	(°F)	72	71	72	
Moisture Content	(%)	2.6	1.2	1.9	
Sampling Conditions					
Test times	(EDT)	1008 to 1525	0912 to 1453		
Sampling Time	(minutes)	24	24		
Sample Volume	(dscf)	21.520	21.386		
Isokinetics	(%)	98.9	95.4		

PM Emission Rate (lb/hr) =
PM Emission Rate (lb/hr sampling) * (1 hr sampling/60 minutes sampling) * (2 minutes sampling/oven) * Coke Production Rate (# ovens/hr)

$\frac{3.58 \text{ lb/hr sampling}}{34.80 \text{ tons coal/hr}} = 0.103$ lb/ton