

Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources*. AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

Background Report Reference

AP-42 Section Number: 11.17

Background Chapter: 4

Reference Number: 43

Title: Supplementary Report on Particulate Emissions form Bethlehem Mines Corporations Millard Quarry Hydrate Plant Scrubber

Bethlehem Steel Corp

Bethlehem Steel Corp

August 1975

see NEDS data

Supplementary Report on Particulate Emissions From Bethlehem Mines Corporation's Millard Quarry Hydrate Plant Scrubber (Source No. 38-309-007)

On June 13, 1975 Bethlehem Mines Corporation submitted to the Region III Office of the Pennsylvania Department of Environmental Resources a test report on emissions tests conducted on the subject source. On July 14, 1975 the Department requested Bethlehem to retest the source. The retesting was performed on August 7 and 8, 1975 and the following supplementary report summarizes the results of those tests. Since the sampling, analytical and plant operating procedures for these tests were identical to those described in the June 13 report, they will not be repeated here.

Mr. N. N. Desai of the Department's Region III Office was present on August 7 and 8, 1975 and observed both particulate Tests 5 and 6.

Test Results

Results after next analysis.

Sampling during both Tests 5 and 6 was conducted at each of the 16 sampling points. Except for the sample through Port B during Test No. 5, all samples were collected eight minutes at a point (Test 5, Port B sample was collected at seven minutes per point).

The attached tables and field data sheets are included to show that all tests were conducted in accordance with the requirements of Chapter 139 of the Department's Rules and Regulations and that required isokinetic sampling rates were maintained. The results shown in Table S1 show that particulate emissions from the scrubber at concentrations of 0.027 gr/dscf (1.1 lb/hr) and lower are well within the allowable limit of 0.04 gr/dscf.

Hydrator scrubber

0.065 lb/ton produced
AVE = 0.056 lb/ton

R. M. Harvey
Air Pollution Control Engineer
Environmental Quality Control Division
Bethlehem Steel Corporation

R. M. McMullen

Approved by: R. M. McMullen
Chief Air Pollution Control Engineer
Environmental Quality Control Division
Bethlehem Steel Corporation

Note: From Table 1: 2 runs at 20 ton hydrate/hr output
= showed 0.5 lb/ton hydrate (0.25 lb/ton feed)

NOT USED
ISOKINETICS
NOT WITHIN
90-110%

Table S1 - Sampling Results Summary

St #	Process Rates (TPH) Feed Product	Scrubber Water Rate (GPM)	Measured Outlet Concentrations (gr/dscf)		Emission Rates (lb/hr)		Iso-kinetic (%)	Sampling Time (Min.)
			Front Half Train	Full Train	Front Half Train	Full Train		
14	17	45	0.023	0.026	0.8	0.9	108	120
14	17	45	0.025	0.027	1.1	1.1	107	128

$\frac{16}{40} \text{ feed} = 0.057$ (#5)
 $= 0.079$ (#6)
 AVE = 0.068

Table S2 - Sample Weights and Volumes

St #	Sample Volume (dscf)	Sample Wts. (gm.)			Impinger Section*			Full Train Total Wt.
		Filter	Front Half Train Probe & Nozzle	Total	Soluble	Insoluble	Acetone Rinse	
54.2	0.0478	0.0323	0.0801	0.0044	0.0044	0.0019	0.0107	0.0908
67.5	0.0814	0.0275	0.1089	0.0057	0.0037	0.0015	0.0109	0.1198

Sample weights are blank corrected - see Table S2(a)

Table S2 (a) - Impinger Section Sample Weights
and Blank Corrections

Test No.	Actual (uncorrected) Sample Weights (gm.)			Blank Corrected Sample Weights (gm.) *		
	Soluble	Insoluble	Acetone Rinse Total	Soluble	Insoluble	Acetone Rinse Total
5	0.0128	0.0068	0.0097 0.0293	0.0044	0.0044	0.0019 0.0107
Blank*	0.0014	0.0004	0.0013 -			
6	0.0069	0.0073	0.0081 0.0223	0.0057	0.0037	0.0015 0.0109
Blank**	0.0002	0.0006	0.0011 -			

One blank impinger for each test was exposed to ambient conditions at the site in the same manner as all sample impingers were exposed while setting up and dismantling the sample train. Contamination is due to exposure to sampling site conditions and not to contamination of distilled water. The blank weight for each category was multiplied times the number of sample impingers (six for each test due to high moisture content) and the resultant figure was then subtracted from the uncorrected sample weight to obtain the corrected sample weight.

REGION III SOURCE TEST FIELD SUMMARY

Date September 29, 1975

Source Hydrator/Pug Mill Observed By N. N. Desai NND

Owner Bethlehem Mines Corporation Firm Code 24-0794481

Location Millard Quarry Case File No. 38-011
N. Londonderry Township
Lebanon County Plan Approval No. 38-309-007

Date Tested August 7 and 8, 1975 Test Required By:
Environmental Quality Control Div. Plan Approval x

Tested By Bethlehem Steel Corporation Department Order _____
 Consent Decree _____

Compliance Schedule Deadline March 31, 1975 Settlement Agreement _____

CHAPTER 127 STATUS:

Temporary x Permit _____ Expires November 1, 1975

Plan Approval Conditions	Compliance (Yes or No)
<u>With the exception of Bethlehem's failure to</u>	_____
<u>submit the test reports in a timely manner, all</u>	_____
<u>conditions have been met.</u>	_____
_____	_____
_____	_____

PROCESS:

Type Hydrator/Pug Mill

Rated Capacity 16 Tons/hr.

Rate During Test 14 Tons/hr. % of Rated Capacity 87.5

Does report indicate process conditions were representative relative to maximum emission rates? Yes _____ No x

If No, explain Tests Nos. 5 and 6 were run at a feed rate of 14 Tons/hr. Mr. R. M. Harvey (Air Pollution Control Engineer) indicated that Bethlehem is going to operate, at all times, at a feed rate of 14 Tons/hr due to the poor quality of lime.

CONTROL EQUIPMENT:

Type Ducon UW4 Scrubber

Operating Data (temperature, pressure drop, water flow rate, etc.)

Parameter	Value
Water Flow Rate	54 GPM

RESULTS:

TESTS:

(5)

(6)

Reported Emission Rate(s) 0.026 gr/dscf 0.027 gr/dscf

Allowable Emission Rate(s) 0.04 gr/dscf 0.04 gr/dscf

COMMENTS AND RECOMMENDATIONS:

The emission rates during tests Nos. 5 and 6 were 0.026 gr/dscf and 0.027 gr/dscf at 108% and 107% isokinetics respectively. The tests were conducted with an Emission Parameter Analyzer Train manufactured by Joy - Western Precipitation Division. The nozzle diameter was .269 inches.

cc: Abatement and Compliance
Lancaster District

Particulate Emissions Sampling Results, Source No. 38-309-007
Hydrate Plant Scrubber, Bethlehem Mines Corporation
Millard Quarry, Annville, Pennsylvania

Particulate emissions samples were collected at the outlet of the subject Ducon UW-4 Scrubber in accordance with the outlined test procedures approved by the Department of Environmental Resources on April 28, 1975 and the provisions of Chapter 139 of the Department's Rules and Regulations. The results and an evaluation of the compliance tests, and a review of plant operating procedures are included in this report.

Mr. N. N. Desai of the Department of Environmental Resources was present on April 29, 1975 prior to the first day of testing and observed the set-up of sampling equipment and inspected the test site.

Sampling Equipment and Procedure

The sampling train, and testing and analytical procedures employed were the same as those outlined in Bethlehem's letter of March 12, 1975 (copy attached). In addition to the procedures outlined in Bethlehem's letter, those changes recommended in the Department's April 10, 1975 letter (copy attached) were also included.

Figure 1 is a drawing of the sampling train employed. All samples were collected using a 16-point traverse (8 points through each of two ports, 90° apart). All samples were collected seven minutes at a point, except for Test No. 1. During Test No. 1, the sample was collected five minutes at a point. Also, for Tests 1, 2, and 3, sampling at points B-1, 2 and 3 could not be done because of space and sampling probe length restrictions. Therefore, sampling for those points was done at point B-4. A different probe was used for Test No. 4 allowing sampling at each of the 16 points.

The filter employed for all tests was a Gelman Type A Glass Fiber Filter, 5 inches in diameter. It is equivalent to the MSA-1106 BH filter cited by the Department and is used regularly (in 8" x 10" sheets) as a hi-vol filter for ambient air sampling. The manufacturer's rating is a 99.7% efficiency by the DOP Penetration Test.

Process and Control Equipment Description

As described in the Plan Approval Application, a Ducon UW-4 Model III Size 54, Dynamic Wet Scrubber is used to control emissions generated at the pug mill and lime hydrator (seasoning chamber) at the Hydrate Plant. Figures 2 and 3 show a layout of the scrubber and the sources controlled.

As is the case with the startup of many new installations, the startup of this installation has necessitated revisions in various planned operating procedures. Initially the plant was designed for a lime feed rate of 16 tons/hour, yielding hydrated lime (quicklime) at a rate of 20 tons/hour. Due to the fact that the feed material is not of the quality anticipated, a steady-state operation of the plant is currently not possible at a feed rate of 16 tons/hour. A relatively steady-state operation does exist at 14 tons/hour. Therefore, future operation of the plant will be at a maximum feed rate of 14 tons/hour until quality of the feed improves or additional changes in the process can be made to accommodate a higher feed rate.

As noted in Figure 2 certain adjustments were made to the inlet ducting to the scrubber. Early operation of the plant indicated that direct drafting of the pug mill (with damper 4 open) was not necessary and that feed material was actually being sucked up out of the pug mill and into the scrubber. It was discovered that the closing of damper 4 did not hinder plant operation, and that drafting of the pug mill was affected through the hydrator. It was also discovered that with dampers 1, 2 and 3 completely closed, drafting from the top of the hydrator was such that product was being sucked out of the hydrator into the gas cleaning system. (Ideal operation of this source would allow only that particulate naturally rising from the hydrator to be carried to and controlled by the scrubber.) Therefore, bleeding of ambient air through dampers 1, 2 and 3 was employed to reduce the high negative static pressure at the hydrator outlet. This same practice has been employed successfully at an identical plant at the City of Industry in Los Angeles, California.

The manufacturer's description of the UW-4 (size 54) scrubber is also attached. Although the brochure lists a scrubber water rate of 24 GPM, Ducon (in their attached September 20, 1973 letter) recommends a scrubber water rate on the order of 42 GPM. In addition, Ducon has stated that water rates in excess of 42 GPM could also be handled by the scrubber and could improve gas cleaning.

Future operation of the plant will employ both a feed rate of 14 tons/h and the bleed-in of ambient air through dampers 1, 2 and 3. (Further discussion of this situation is made in the test results section of this report.)

Discussion of Test Results

The attached tables, figures and field sampling data are included to show that the tests reported herein were conducted as per the requirements of Chapter 139. It is noted, however, that the percent isokinetics for the tests did not fall in the required range of 90-110%. However, for reasons discussed later in this report, this deficiency does not adversely affect the conclusions drawn from the test results.

Observations of visible emissions from the outlet stack indicated that, except for steam, emissions are invisible, and therefore, comply with Chapter 123.41 and 123.42 of the regulations.

Table 1 is a summary of the sampling results. Table 2 is a listing of all sample weights and sample volumes and Table 2(a) includes the results of the impinger water and acetone blank samples. Table 3 is a summary of all measured exhaust gas volumes, moisture contents and scrubber outlet temperatures. It also includes measured static pressures and process feed rates. Table 4 is a summary of process operating conditions and includes the process rates, the scrubber water rate, and the pug mill temperature for the four particulate tests.

A review of the results listed in Table 1 indicates that scrubber emissions for a process feed rate of 16 tons/hour are in excess of the 0.04 gr/dscf concentration limit, while emissions for a process feed rate of 14 tons/hour are in compliance. However, this is not necessarily the case since Tests 1 and 2 were conducted while all bleed-in dampers were closed. As evidenced by the results of traverses T1 and T2 in Table 3, the hydrator outlet static pressure during particulate Tests 1 and 2 while the dampers were closed was very high at -1.1 inches H₂O, as compared to a static pressure of -0.15 inches H₂O while the dampers were open (Tests 3 and 4). As shown by the measured static pressures and flow rates in Table 3 and also by observations, adequate drafting of the seasoning chamber and the pug mill is provided with the dampers open. Emissions from both sources are well controlled in that there are no fugitive emissions observed escaping the hydrator and pug mill. Further examination of the flow measurements included in Table 3 shows that dilution of the scrubber outlet gases did not occur as a result of opening the three dampers. The actual flow rates of Tests 1 and 2 are the same as those for Tests 3 and 4. In addition the results of Table 1 show that the emission rates for Tests 3 and 4 were reduced by over 60% which is further evidence that the introduction of ambient air, through the dampers to the scrubber inlet, did not dilute the scrubber outlet concentration.

The operating conditions of the plant during Tests 3 and 4 are representative of the future plant operation and only those tests should be considered for purposes of evaluating compliance with the regulations. Table 1 shows that both the front half and full train outlet concentrations for each test are within the limit of 0.04 gr/dscf.

As noted earlier, isokinetic rates for the sampling did not fall within the acceptable 90-110% range. Since the moisture content of the stack gases ranged from 41 to 85% during the tests, it was very difficult to maintain the isokinetic rate. Temperature variations of 5 degrees (from 170 to 175 F) and 10 degrees (from 170 to 180 F) change the moisture content by 5% and 11% respectively, accounting for the isokinetic rate problems. Although isokinetic variation would not significantly affect the concentration measurements for small particles emitted from the scrubber, it is noted that the highest emission concentrations were obtained when the isokinetic rate was below the required rate. Since low isokinetic rate would tend to bias the sample results toward higher concentration if large particles are present, the results of Test 3 indicate that even if the isokinetic deviation was significant for this source, the corrected concentration would be within the applicable emission limits.

Based on the foregoing evaluation of the test data, the emissions from the hydrate plant scrubber are in compliance with DER emission limits.

Robert M. Hawley

Table 1 - Sampling Products Summary

t #	Process Rates (TPH) Feed Product	Measured Outlet Concentrations (gr/dscf)		Emission Rates (lb/hr)		Isokinetics (%)	Sample Time (mins.)
		Front half train	Full train	Front half train	Full train		
16	20	0.126	0.140	4.0	4.5	71	80
16	20	0.152	0.160	4.0	4.2	87	112
14	17	0.034	0.040	1.4	1.8	56	112
14	17	0.013	0.016	0.5	0.7	135	112

Table 2 - Sample Weights and Volumes

t #	Sample Volume (dscf)	Front half train		Impinger Section		Full Train Total Weight		
		Filter	Probe & Nozzle	Soluble	Insoluble		Acetone rinse	Total
41.2	0.2854	0.0514	0.3368	0.0103	0.0071	0.0186	0.0360	0.3728
58.1	0.4868	0.0844	0.5712	0.0161	0.0089	0.0061	0.0311	0.6023
58.6	0.0981	0.0321	0.1302	0.0000*	0.0111*	0.0102*	0.0213*	0.1515
69.5	0.0491	0.0110	0.0601	0.0000*	0.0064*	0.0064*	0.0128*	0.0729

Blank corrected. See Table 2(a) and text for explanation.

Table 3 - Exhaust Volume, Moisture Content and Temperature

#	Location	Date, Time	Exhaust Volume (acfm)	Exhaust Volume (dscfm)	Temp. (°F)	Moisture Content (%)	Static Pressure ("H ₂ O)	Process Feed Rate (TPH)
	Scrubber outlet	4/30/75 1300	9440	3715	180	52	0.5	16
	"	5/1/75 1045	9470	3080	185	60	0.5	16
	"	5/20/75 1050	9770	4770	170	41	-0.3	14
	"	5/21/75 1013	9390	4600	170	41	-0.5	14
	outlet	5/22/75 0910	11,140	4950	175	46	-0.5	14
	outlet	5/22/75 0920	11,025	4325	180	52	-0.5	14
	inlet	5/22/75 0900	6050	710	210	85	-0.15	14
	Hydrator outlet	5/22/75 0930	9100	1060	210	85	-1.1	14

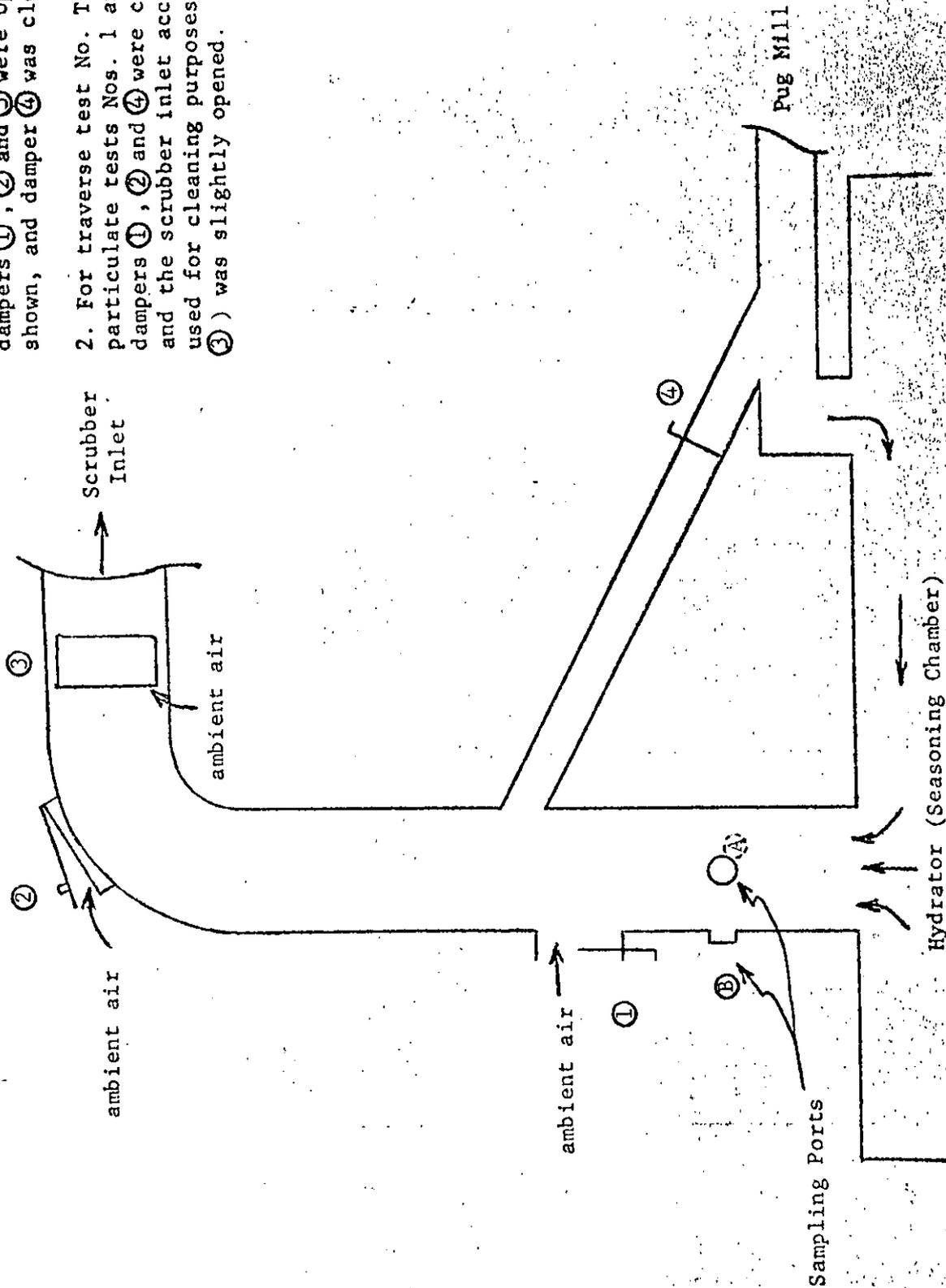
a - ambient dampers open; b - ambient dampers closed

Table 4 - Process Operating Conditions

#	Process Rates (TPH)	Scrubber Water Rate (GPM)	Pug Mill Temperature (°F)
	Feed	Product	
	16	20	220
	16	20	220
	14	17	225

Figure 2 - Hydrator Outlet and Scrubber Inlet Duct Configuration

- Notes:
1. For traverse test No. T1 and particulate tests Nos. 3 and 4, dampers ①, ② and ③ were open as shown, and damper ④ was closed.
 2. For traverse test No. T2 and particulate tests Nos. 1 and 2, dampers ①, ② and ④ were closed, and the scrubber inlet access (damper ③) was slightly opened.



REGION III SOURCE TEST FIELD SUMMARY

Source Hydrator/Pug Mill
 Owner Bethlehem Mines Corporation
 Location Millard Quarry
N. Londonderry Twp.
Lebanon County

Date July 1, 1975
 Observed By N. N. Desai
 Firm Code 24-0794481
 Case File No. 38-011
 Plan Approval No. 38-309-007

Date Tested April 29, 30 & May 1, 20, & 21, 1975
 Tested By Environmental Quality Control Div.
Bethlehem Steel Corporation
 Compliance Schedule Deadline March 31, 1975

Test Required By:
 Plan Approval X
 Department Order _____
 Consent Decree _____
 Settlement Agreement _____

CHAPTER 127 STATUS:

Temporary X Permit _____ Expires July 1, 1975

Plan Approval Conditions

Installation shall be completed on or before 2/3/75	Compliance (Yes or No)
Test procedure, sketch, data submission before 3/15/75	Yes
Stack test on or before 4/30/75	Yes
Two weeks prior to the test inform the Department	Yes
Within 30 days after stack test submission of a test report	Yes (first 3 days)
	No

PROCESS:

Type Hydrator & Pug Mill
 Rated Capacity 16 Tons/hr.
 Rate During Test 14 to 16 Tons/hr. % of Rated Capacity 87.5 to 100

Does report indicate process conditions were representative relative to maximum emission rates? Yes _____ No _____ (See Comments)

If No, explain _____

CONTROL EQUIPMENT:

Type Ducon UW4 Scrubber

Operating Data (temperature, pressure drop, water flow rate, etc.)

Parameter	Value
Water Flow Rate	44 gpm

RESULTS:

Tests:	(1)	(2)	(3)	(4)
Reported Emission Rate(s)	0.140 gr/dscf	0.160 gr/dscf	0.04 gr/dscf	0.016
Allowable Emission Rate(s)	0.04 gr/dscf	0.04 gr/dscf	0.04 gr/dscf	0.04

COMMENTS AND RECOMMENDATIONS:

On April 29, 1975 a test was not performed due to an unexpectedly high moisture content in the exhaust stream. The nomograph which Bethlehem's R. D. Joyce had brought for the test did not have the correct moisture content range. Mr. Joyce did not remember the calculations necessary to perform the test without a nomograph.

Tests Nos. 1 and 2 were conducted on April 30, and May 1, 1975 at process feed rates of 16 T/hr. The air bleed in dampers between the hydrator and the scrubber were closed. Bethlehem contends that excess negative pressure in the hydrator and pug mill caused product to be entrained in the gas stream yielding the high emission rates.

The dampers were adjusted to provide influent air and the system was retested on May 20 and 21, 1975. The Regional Office was not advised of these two tests. Test 3 shows an emission rate equal to the allowable, .04 gr/dscf at 56% isokinesis. The emission rate during Test 4 was .016 gr/dscf at 135% isokinesis. These two tests were run at feed rate of 14 T/hr. which Bethlehem now claims is the true maximum rate due to the poor quality of the lime.

cc: Lancaster District
 Abatement & Compliance
 Region III

