Section 5.16
Reference #28

MEMORANDUM

TO: Texasgulf Soda Ash (Granger) Compliance File

THROUGH: Chuck Collins, Air Quality Administrator
Bernie Dailey, Air Quality Supervisor

FROM: Lee Gribovicz, District Air Quality Engineer

SUBJECT: Test Reviews, Sources #3 and #16

DATED: December 21, 1987

During the FY '87 Annual Inspection of this plant, it was discovered that the latest test data on two plant sources indicated that these sources were not complying with their allowable particulate emission rates. In the inspection transmittal letter of October 16, 1987, Texasgulf was requested to supply a schedule to test the current emission rate from these stacks. The testing was promptly scheduled for the week of November 9, 1987 as confirmed by Texasgulf's October 28, 1987 letter. I was on plant November 9-10 to observe portions of this testing and my memo of November 16, 1987 describes my observations of this test work.

Texasgulf submitted their test report under cover of their December 14, 1987 letter. Testing was conducted for total particulate (back-half included) on two stacks; source #3, the ore crushing area housekeeping baghouse, and on source #16, the plant coal ash handling baghouse. Additionally, it was discovered that the coal ash handling system picked up an undetermined amount of SO2 which is exhausted from the source #16 stack and in order to quantify this emission, Texasgulf agreed to conduct reference method testing for this pollutant as well. A summary of results of this test work is shown below. My test review worksheets are attached as appendices to this memo.

	Test #1	Test #2	Test #3	Avg.
Ore Crushing Baghouse				
Calciner Design Process Rate (TPH)				127
#1 Actual Process Rate (TPH)			(11/10/87 avg)	129
#2 Actual Process Rate (TPH)			(11/10/87 avg)	132
Allowable Emission Rate (pph)	2.14	2.14	2.14	2.14
Tested Emission Rate (pph)	1.07	0.74	0.46	0.76
Ash Handling Baghouse				
Calciner Design Process Rate (TPH)				127
#1 Actual Process Rate (TPH)			(11/13/87 avg)	127
#2 Actual Process Rate (TPH)			(11/13/87 avg)	129
Boiler Design Steam Rate (pph)				330,000
#1 Actual Steam Rate (%)			(11/13/87 avg)	75%
#2 Actual Steam Rate (%)			(11/13/87 avg)	70%

(Particulate)				
Allowable Emission Rate (pph)	0.43	0.43	0.43	0.43
Tested Emission Rate (pph)	0.25	0.14	0.19	0.19
(Sulfur Dioxide)				
Allowable Emission Rate (pph)	----------Not Regulated----------			
Tested Emission Rate (pph)	0.02	0.01	0.20	0.08

As can be seen from the table both sources tested well within their allowable emission rates for particulate, #3 @ 36% of the allowable and #16 @ 44% of the allowable, while the process units were run at or near full load. I recommend that the Division accept these tests as proof of compliance for these two emission points.

The emission of sulfur dioxide from the ash handling system has been acceptably quantified and it appears this stack is a relatively insignificant source of the pollutant.

LG/jw

STACK EMISSION REVIEW

COMPANY Evanger's Soda Ash LOCATION Granger

TESTING FIRM WEST Inc TESTS CONDUCTED BY Bruce Kinchey
Alan Roylance

DATE TESTED 11/10/87

TEST OBSERVED BY Not Observed

TEST EVALUATED BY Lee Hilbrecq

STACK DATA

Stack ht (ft) _____

Stack dia (~~OD~~) 40 inches (3'4")

Process venting through stack #3 Ore Crushing Area Baghouse

TRAVERSE POINTS

Nozzle diameter: Test 1 0.239" Test 2 0.239" Test 3 0.239"

Location of sampling ports 30'3" (9.1 dia) downstream ; 12' (3.6 dia) upstream

Number of traverse points per test: Test 1 6 Test 2 6 Test 3 6

Do sampling points follow EPA guidelines? Yes X No ____

Comments:

EMISSIONS

	Test 1	Test 2	Test 3	
Process wt rate (ton/hr)	#1 129 TPH daily avg ; #2 132 TPH daily avg		127 TPH design	
Allowable emission (lb/hr)	2.14	2.14	2.14	NO-69 Permit Condition
Measured emission (lb/hr)	1.07	0.74	0.46	(0.76 avg)
% Isokinetic	100%	100%	100%	

Comments and recommendations:

Tests Show Compliance @ Plant Operating Rate over Design

Accept as Proof of Compliance

12/20/87

TSP
DATA SHEET

P_{std} = 29.92 in Hg

T_{std} = 528°R

		Test 1	Test 2	Test 3
P_{bar}	= barometric pressure at site (in Hg)	29.00	→	→
P_s	= absolute stack gas pressure (in Hg)	29.96	→	→
T_s	= absolute average stack gas temp. (°R)	541	539	541
T_m	= absolute average dry gas meter temp. (°R)	504	508	506
V_{ic}	= total volume of water collected (ml)	25.1	30.6	24.8
V_m	= volume of gas through dry gas meter (ft^3)	59.753	60.461	60.509
ΔH	= average pressure drop across orifice (in H_2O)	2.375	2.425	2.446
C_p	= pitot tube coefficient	0.82	→	→
$(\sqrt{\Delta P})_{ave}$	= average velocity head of stack gas (in H_2O)	0.946	0.957	0.957
A_s	= cross-sectional area of stack (ft^2)	8.73	→	→
M_n	= total amount of particulate collected (g)	0.0173	0.0119	0.0074
Θ	= total sampling time (min.)	60	→	→
A_n	= cross-sectional area of nozzle (ft^2)	3.115×10^{-4}	→	→

ORSAT ANALYSIS

	Test 1	Test 2	Test 3
% CO_2	0	→	→
% O_2	21	→	→
% CO	0	→	→
% N_2	79	→	→

CALCULATIONS

1. $V_{w\ std}$ = volume of water vapor in gas @ STP (ft^3)

$V_{w\ std} = 0.0474\ ft^3/ml \cdot V_{ic}$

$V_{w\ std} =$ 1.19, 1.45, 1.18 ft^3

2. $V_{m\ std}$ = volume of gas sample through dry gas meter @ STP (ft^3)

$$V_{m\ std} = \left(17.65\ \frac{°R}{in\ Hg}\right) V_m \left(\frac{P_{bar} + \frac{H}{13.6}}{T_m}\right)$$

$V_{m\ std} =$ 50.59, 50.79, 51.03 ft^3

3. B_{wo} = proportion by volume of water vapor in gas stream (dimensionless)

$$B_{wo} = \frac{V_{w\ std}}{V_{w\ std} + V_{m\ std}}$$

$B_{wo} =$ 0.02, 0.03, 0.02

4. Molecular weight (lb/lb mole)

$M_d = 0.44\ (\%\ CO_2) + .32\ (\%\ O_2) + .28\ (\%\ N_2 + \%\ CO)$

$M_d =$ 28.84, 28.84, 28.84 lb/lb mole

$M_s = M_d\ (1 - B_{wo}) + 18\ B_{wo}$

$M_s =$ 28.59, 28.54, 28.60 lb/lb mole

5. V_s = stack gas velocity (ft/sec)

$$V_s = 85.48\ Cp\ (\sqrt{\Delta p})ave \sqrt{\frac{T_s}{P_s\ M_s}}$$

$V_s =$ 58.93, 59.56, 59.61 ft/sec

6. Q_s = volumetric flow rate, dry basis, @ STP (ft^3/min)

$$Q_s = 60\ (1 - B_{wo})\ V_s \cdot A_s \left(\frac{530}{T_s}\right)\left(\frac{P_s}{29.92}\right)$$

$Q_s =$ 23,560, 23,783, 23,843 ft^3 min

$Q_a =$ 30,854 31,183 31,210 avg $Q_s =$ 31,082

PARTICULATE
CALCULATIONS (CONTINUED)

7. C_s = concentration (lb/ft^3)

$$C_s = 2.205 \times 10^{-3} \frac{M_n}{V_{m\ std}}$$

C_s = 7.54 X10^{-7}, 5.17X10^{-7}, 3.20X10^{-7} lb/ft^3

8. E = emission rate lb/hr

$$E = C_s \cdot Q_s \cdot 60$$

E = 1.07, 0.74, 0.46 lb/hr

9. % Isokinetic

$$I = \frac{1.667\ T_s \left(0.00267\ V_{ic} + \frac{V_m}{T_m} \left[P_{bar} + \frac{\Delta H}{13.6} \right] \right)}{\theta\ V_s\ P_s\ A_n}$$

I = 100.3, 99.69, 99.92 %

STACK EMISSION REVIEW

COMPANY Texasgulf Soda Ash LOCATION Granger

TESTING FIRM WEST Inc. TESTS CONDUCTED BY Bruce Hinckley
Alan Rogbarn

DATE TESTED 11/13/87

TEST OBSERVED BY Not Observed

TEST EVALUATED BY Joe Gribovicz

STACK DATA

Stack ht (ft) _____

Stack dia 12.25 inches (1.02 ft)

Process venting through stack #16 Coal Ash Handling Baghouse

TRAVERSE POINTS

Nozzle diameter: Test 1 0.180" Test 2 0.180" Test 3 0.180"

Location of sampling ports 23ft (22.5 3 dia) downstream; 3' (2.9 dia) upstream

Number of traverse points per test: Test 1 6 Test 2 6 Test 3 6

Do sampling points follow EPA guidelines? Yes X No ____

Comments:

Boilers Process Rate 330,000 pph design } #1 ~75%
#2 ~70%

Dryers Process Rate (TPH) #1 69 TPH, #2 70 TPH } 73 TPH design

EMISSIONS

	Test 1	Test 2	Test 3	
Calciners Process wt rate (ton/hr)	#1 127 TPH avg, #2 129 TPH avg		127 TPH Design	
Allowable emission (lb/hr)	0.43	0.43	0.43	MD-69 Permit Condition
Measured emission (lb/hr)	0.25	0.14	0.19	(0.19 avg)
% Isokinetic	102%	104%	104%	

Comments and recommendations:

Tests Show Compliance @ Plant Operating Rate Near 100% of Capacity

∴ Accept as Proof of Compliance

JG 12/20/87

TC Source #16 TSP
tested 11/13/87

TSP
DATA SHEET

P_{std} = 29.92 in Hg

T_{std} = 528°R

		Test 1	Test 2	Test 3
P_{bar}	= barometric pressure at site (in Hg)	23.60	→	
P_s	= absolute stack gas pressure (in Hg)	2362	→	
T_s	= absolute average stack gas temp. (°R)	641	641	635
T_m	= absolute average dry gas meter temp. (°R)	519	518	520
V_{ic}	= total volume of water collected (ml)	8.4	14.6	15.5
V_m	= volume of gas through dry gas meter (ft^3)	33.131	37.549	38.004
ΔH	= average pressure drop across orifice (in H_2O)	0.673	0.849	0.863
C_p	= pitot tube coefficient	0.82	→	
$(\sqrt{\Delta P})_{ave}$	= average velocity head of stack gas (in H_2O)	0.937	1.051	1.059 → 1.016 avg
A_s	= cross-sectional area of stack (ft^2)	0.82	→	
M_n	= total amount of particulate collected (g)	0.0246	0.0140	0.0193
Θ	= total sampling time (min.)	60	→	
A_n	= cross-sectional area of nozzle (ft^2)	1.767×10^{-4}	→	

ORSAT ANALYSIS

	Test 1	Test 2	Test 3
% CO_2	0	0	2.4
% O_2	21	21	18.6
% CO	0	0	0
% N_2	79	79	79

TG Source #16 TSP

Tested 11/13/87

CALCULATIONS

1. $V_{w\ std}$ = volume of water vapor in gas @ STP (ft^3)

   $V_{w\ std} = 0.0474\ ft^3/ml \cdot V_{ic}$

   $V_{w\ std} =$ 1.40, 0.69, 0.73 ft^3

2. $V_{m\ std}$ = volume of gas sample through dry gas meter @ STP (ft^3)

   $$V_{m\ std} = \left(17.65\ \frac{°R}{in\ Hg}\right) V_m \left(\frac{P_{bar} + \frac{H}{13.6}}{T_m}\right)$$

   $V_{m\ std} =$ 26.65, 30.27, 30.52 ft^3

3. B_{wo} = proportion by volume of water vapor in gas stream (dimensionless)

   $$B_{wo} = \frac{V_{w\ std}}{V_{w\ std} + V_{m\ std}}$$

   $B_{wo} =$ 0.01, 0.02, 0.02

4. Molecular weight (lb/lb mole)

   $M_d = 0.44\ (\%\ CO_2) + .32\ (\%\ O_2) + .28\ (\%\ N_2 + \%\ CO)$

   $M_d =$ 28.94, 28.84, 29.13 lb/lb mole

   $M_s = M_d\ (1 - B_{wo}) + 18\ B_{wo}$

   $M_s =$ 28.88, 28.80, 28.87 lb/lb mole

5. V_s = stack gas velocity (ft/sec)

   $$V_s = 85.48\ Cp\ (\sqrt{\Delta p})_{ave} \sqrt{\frac{T_s}{P_s\ M_s}}$$

   $V_s =$ 63.89, 71.76, 71.63 ft/sec

6. Q_s = volumetric flow rate, dry basis, @ STP (ft^3/min)

   $$Q_s = 60\ (1 - B_{wo})\ V_s \cdot A_s \left(\frac{528}{T_s}\right)\left(\frac{P_s}{29.92}\right)$$

   $Q_s =$ 2010, 2240, 2255 ft^3 min

$Q_A =$ 3137 3524 3518 → 3393 avg acfm

TG Source #16 TSP

Tested 11/13/67

PARTICULATE
CALCULATIONS (CONTINUED)

7. C_s = concentration (lb/ft^3)

$$C_s = 2.205 \times 10^{-3} \frac{M_n}{V_{m\ std}}$$

C_s = 2.04×10^{-6}, 1.02×10^{-6}, 1.41×10^{-6} lb/ft^3

8. E = emission rate lb/hr

$$E = C_s \cdot Q_s \cdot 60$$

E = 0.25, 0.14, 0.19 lb/hr

9. % Isokinetic

$$I = \frac{1.667\ T_s \left(0.00267\ V_{ic} + \frac{V_m}{T_m} \left[P_{bar} + \frac{\Delta H}{13.6} \right] \right)}{\theta\ V_s\ P_s\ A_n}$$

I = 102.32, 104.30, 104.49 %

The average $\sqrt{\Delta P}$ for the runs was 1.016

The "High" average measured $\sqrt{\Delta P}$ was 1.218 (normal operation)

The "Low" average measured $\sqrt{\Delta P}$ was 0.767 (during baghouse cleaning)

The average Qa = 3393 acfm ∴ by ratio the high flow is ~4068 acfm

&

the low flow is ~2561 acfm

SO_2

STACK EMISSION REVIEW

COMPANY Texasgulf Soda Ash LOCATION Granger

TESTING FIRM WEST INC TESTS CONDUCTED BY Bruce Hinckley
Alan Roylance

DATE TESTED 11/13/87

TEST OBSERVED BY Not Observed

TEST EVALUATED BY Ken Stribovicz

STACK DATA

Stack ht (ft) _____

Stack dia 17.25 inches (1.02 ft)

Process venting through stack #16 Coal Ash Handling Baghouse

TRAVERSE POINTS

Nozzle diameter: Test 1 N/A → Test 2 _____ Test 3 _____

Location of sampling ports 23 ft (27.5 dia) downstream, 3' (2.9 dia) upstream

Number of traverse points per test: Test 1 3 Test 2 3 Test 3 3

Do sampling points follow EPA guidelines? Yes X No ____

Comments:

EMISSIONS

	Test 1	Test 2	Test 3	
Process wt rate (ton/hr)	____	____	____	
Allowable emission (lb/hr)	N/A →			
Measured emission (lb/hr)	0.02	0.01	0.20	(0.08 avg)
% Isokinetic	N/A →			

Comments and recommendations:

Tests show negligible SO_2 rates
- no permitting necessary

LL 12/20/87

$P_{STD} = 29.92$ "Hg $T_{STD} = 528°R$

T6. Source #16 SO_2

~~Tested~~ 11/13/87

INPUT DATA FOR SO2 TEST PROGRAM		TEST 1	TEST 2	TEST 3
AMBIENT PRESSURE (in Hg)	P_{BAR}	23.60	→	→
ABS. STACK GAS PRESSURE (in Hg)	P_s	23.62	→	→
ABS. AVG. STACK GAS TEMP (in Hg)	T_s	641	641	635
ABS. AVG. DGM TEMP (°R)	T_m	519	518	520
TOT VOL H2O COLLECTED + SO2 (ml)	V_{ic}	8.4	14.6	15.5
VOL. THRU DGM: Y ADJUSTED (FT3)	$V_m \times Y$	33.131	37.549	38.004
AVG DEL P ACROSS ORIFICE (in H2O)	ΔH	0.673	0.849	0.863
PITOT TUBE COEFFICIENT	C_p	0.82	→	→
AVG SQRT VEL HEAD STACK GAS (in H2O)	$\sqrt{\Delta P}_{avg}$	0.937	1.051	1.059
X-SECT AREA OF STACK (FT2)	A_s	0.82	→	→
AVG VOL TITRANT USED IMPINGER 2 (ml)	V_t	0.20	0.10	1.65
AVG VOL TITRANT USED IMPINGER 3 (ml)		0.05	0.05	0.05
VOL TITRANT USED FOR BLANK (ml)	V_{tb}	0.05	0.05	0.05
VOL IMP2 SOLUTION CONTAINING SO2 (ml)	V_{soln}	241	237	208
VOL IMP3 SOLUTION CONTAINING SO2 (ml)		218	208	203
VOL SAMPLE ALIQUOT TITRATED (ml)	V_a	5	5	5
NORMALITY OF TITRANT (meq/ml)	N	0.00955	→	→
ORSAT ANALYSIS				
% CO2		0	0	2.4
% O2		21	21	18.6
% CO		0	0	0
% N2		79	79	79

NOTE IF ALIQUOT FACTOR IS GREATER THAN 1.0 DIVIDE THE APPROPRIATE IMPINGER SOLUTION BY THE ALIQUOT FACTOR AND USE THAT VALUE FOR THE IMPINGER SOLUTION AND USE 1.0 FOR THE ALIQUOT FACTOR

$$V_{m(std)} = \frac{(V_m)(Y)(T_{std})(P_{bar})}{(T_m)(P_{std})} \quad \text{(dscfm)}$$

$$C_{SO_2} = \frac{(7.05 \times 10^{-5})(V_t - V_{tb})(N)(V_{soln})}{(V_{m(std)})(V_a)} \quad \text{(lb/dscf)}$$

Σ of impingers 2 + 3 if necessary

$$E_{SO_2} = (C_{SO_2})(Q_s)(60 \quad \text{(lb/hr)}$$

TO Source #16 SO_2

~~Eq 60~~ 11/13/87

CALCULATIONS

1. $V_{w\ std}$ = volume of water vapor in gas @ STP (ft^3)

$V_{w\ std} = 0.0474\ ft^3/ml \cdot V_{ic}$

$V_{w\ std} =$ 0.40, 0.69, 0.73 ft^3

2. $V_{m\ std}$ = volume of gas sample through dry gas meter @ STP (ft^3)

$$V_{m\ std} = \left(17.65\ \frac{°R}{in\ Hg}\right) V_m \left(\frac{P_{bar} + \frac{H}{13.6}}{T_m}\right)$$

$V_{m\ std} =$ 26.65, 30.27, 30.52 ft^3

3. B_{wo} = proportion by volume of water vapor in gas stream (dimensionless)

$$B_{wo} = \frac{V_{w\ std}}{V_{w\ std} + V_{m\ std}}$$

$B_{wo} =$ 0.01, 0.02, 0.02

4. Molecular weight (lb/lb mole)

$M_d = 0.44\ (\%\ CO_2) + .32\ (\%\ O_2) + .28\ (\%\ N_2 + \%\ CO)$

$M_d =$ 28.84, 28.84, 29.13 lb/lb mole

$M_s = M_d\ (1 - B_{wo}) + 18\ B_{wo}$

$M_s =$ 28.88, 28.80, 28.87 lb/lb mole

5. V_s = stack gas velocity (ft/sec)

$$V_s = 85.48\ Cp\ (\sqrt{\Delta p})ave \sqrt{\frac{T_s}{P_s\ M_s}}$$

$V_s =$ 63.89, 71.76, 71.63 ft/sec

6. Q_s = volumetric flow rate, dry basis, @ STP (ft^3/min)

$$Q_s = 60\ (1 - B_{wo})\ V_s \cdot A_s \left(\frac{528}{T_s}\right)\left(\frac{P_s}{29.92}\right)$$

$Q_s =$ 2010, 2240, 2255 ft^3 min

$Q_A =$ 3137 3524 3518

SO_2 Calculations (Continued)

For Source #16 SO_2 Tested 11/13/87

7. C_{so2} = concentration of SO_2 at STP, dry basis (lb/ft^3)

$$C_{so2} = \left(7.05 \times 10^{-5} \frac{\text{lb} - 1}{\text{g} - \text{ml}}\right) \frac{(V_t - V_{tb})\, N\left(\frac{V_{soln}}{V_a}\right)}{V_{m\,std}}$$

Impinger #2 C_{so_2} = 1.83×10^{-7}, 0.53×10^{-7}, 1.468×10^{-7}

Impinger #3 C_{so2} = 0.00×10^{-7}, 0.00×10^{-7}, 0.00×10^{-7} lb/ft^3

8. E = emission rate (lb/hr)

$$E = C_{so2} \cdot Q_s \cdot 60$$

Impinger #2 E = 0.0220, 0.0071, 0.1986 lb/hr

Impinger #2 E = 0.0000 0.0000 0.0000 lb/hr

Total E = 0.0220 0.0071 0.1986