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CF Industries, Inc. (CFII)
Plant City Phosphate Complex
Title V Permit No. 0570005-007-AV
Construction Permit Application
A & B Phosphoric Acid Units
Attachment 2

JACOBS ENGINEERING GROUP INC.

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December 15, 1999

Mr. Randy Charlot
Chief Process Engineer
CF Industries, Inc.
Drawer L
Plant City, FL 33564

Subject: **Evaluation of 'A' & 'B' Phosphoric Acid Scrubber Performance**
PN-28-U785-00

Dear Randy:

I have enclosed four copies of our Evaluation of 'A' & 'B' Phosphoric Acid Scrubber Performance. Please let me know if you need anything further.

Thank you for the opportunity to work with CF Industries, Inc.

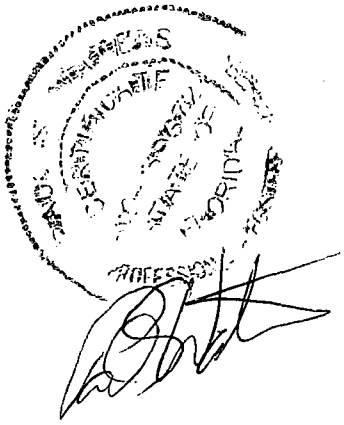
Sincerely,

JACOBS ENGINEERING GROUP INC.

Paul S. Waters
Principal Process Engineer

PSW:ked

Attachments



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EVALUATION OF

'A' & 'B' PHOSPHORIC ACID SCRUBBER PERFORMANCE

For

CF INDUSTRIES, INC.
PLANT CITY PHOSPHATE COMPLEX
PLANT CITY, FL

Prepared by

JACOBS ENGINEERING GROUP INC.
Lakeland, Florida USA

JEG PN 28-U785-00
December 1999

CF INDUSTRIES

AN EVALUATION OF 'A' and 'B' PAP SCRUBBER PERFORMANCE

Summary

Recent data from Annual Compliance Tests conducted in June 1999, and in January and February 1998, on both 'A' PAP and 'B' PAP Stack have been analyzed. This information has been supplemented with data from tests on the two scrubbers, conducted in July and September 1999. The data from these scrubber tests is given in an Appendix to this report. Data from Compliance Tests conducted in May and June 1997 was also available. However, scrubber modifications have been made since the 1997 tests and a new filter has been added to each plant. So this data has not been used in this evaluation

Both 'A' and 'B' PAP Scrubbers consist of a quench section, three cross-flow irrigated beds of 'Kimre' packing, and a mist eliminator of 'Kimre' packing. Also both scrubbers are sized for the current airflow, which will not change for the new production rate. This configuration is, in our opinion, BACT, and would also meet the requirements of MACT under recent changes to Federal Rule 40CFR63.

Predictions have been made of the performance of the 'A' Scrubber and the 'B' Scrubber if the production rates are increased to 1,699 TPD P_2O_5 and 2,528 TPD P_2O_5, respectively. These predictions are based on the performance demonstrated in the 1998 and 1999 Compliance Tests and the informal tests in July and September 1999.

In both cases the emissions are predicted to be significantly less than the current limits of 28.3 lb F/day and 24.9 lb F/day for the 'A' & 'B' PAP, respectively. In fact, the projected emissions in both cases are significantly less than the new source maximum achievable control technology (MACT) limits of 0.0135 lb F/ ton P_2O_5.

The lowest recorded emissions were achieved in June 1999 Compliance Tests which were run at 1560 TPD, or +10%, for A phosphoric acid plant and 2350 TPD, or +10%, for B phosphoric acid plant. Compliance Tests in the 1998 at 1310 TPD for A phosphoric acid plant and 1995 TPD for B phosphoric acid plant

gave significantly higher lb per day emissions for A phosphoric acid plant and essentially the same emissions for B phosphoric acid plant. Using conservative NTU values of 5.0 NTUs for 'A' PAP and 6.0 NTUs for 'B' PAP gives a calculated increase of 2.801 TPY fluoride emission over the average of the emissions achieved in the last two Compliance Tests in 1998 and 1999.

It is therefore concluded that no modifications are necessary to either scrubber, in order to satisfy the current and proposed permitted emission levels of fluorides, with the proposed increase in production throughput.

1. Introduction

Recent data from several sources has been gathered and analyzed to predict the performance of the 'A' and 'B' PAP Scrubbers. Table 1 following gives this data for the 'A' PAP Unit. Table 4 following gives this data for the 'B'' PAP Unit.

The standard mass transfer equation for gas absorption has been used to indicate the likely performance of this scrubber with an increase in production capacity. The scrubber outlet concentration has been calculated from:

$$P1 = [(P2 - P^*)/\text{Exp}(NTU)] + P^*$$

Where P2 = Inlet F concentration mg/SCF

P1 = Outlet F concentration mg/SCF

P* = Equilibrium F concentration mg/SCF

NTU = Number of Transfer Units determined from recent data

For the 'A' PAP phosphoric acid plant, the capacities evaluated are:

1416 TPD P_2O_5 Feed

1416 TPD P_2O_5 Feed + 10%

1416 TPD P_2O_5 Feed + 20%

For the 'B' PAP phosphoric acid plant, the capacities evaluated are:

2107 TPD P_2O_5 Feed

2107 TPD P_2O_5 Feed+ 10%

2107 TPD P_2O_5 Feed + 20%

2. Sources of Recent Data

2.1 Data Points 1 – 14 for 'A' PAP are shown in Table 1. Data Points 1 and 2 are taken from the results of the 9/15/99 'A' PAP Scrubber Test collected at the Reactor Fume Duct and at the Tank exit to scrubber duct. Data collected from the exit of cyclone duct has not been used since the reported fluoride includes fluoride that carried over in the pond water from the cyclone. Data Points 3 – 8 are taken from the 'A' Stack measurements taken 6/22/99 and 6/23/99, for the 1999 Annual Compliance Test. Data Points 9 – 14 are taken from the 'A' Stack measurements taken 2/18/98 to 2/20/98, for the 1998 Annual Compliance Test.

2.2 Data Points 15 - 25 for the B phosphoric acid plant are shown in Table 4. Data Points 15 – 17, and 21 – 22 are taken from the results of the 9/1/99 'B' PAP Scrubber Test. Data Points 18 - 20, and 23 - 25 are taken from the results of the 7/22/99 'B' PAP scrubber test. Data Points 26 - 31 are taken from the 'B' Stack measurements taken 6/7/99 and 6/8/99, for the 1999 Annual Compliance Test. Data Points 32 - 37 are taken from the 'B' Stack measurements taken 1/28/98 and 1/29/98, for the 1998 Annual Compliance Test.

3. Calculation and Interpretation of Recent Data given in Tables 1 and 4

3.1 Column B - Production Rate TPD P_2O_5

Taken directly from source data in all cases. For Data Points 3 – 8, the 6/99 'A' phosphoric acid plant Compliance Test measurements report Feed Rate. For Data Points 9 – 14, the 2/98 'A' phosphoric acid plant Compliance Test measurements report Feed Rate. For Data Points 1 & 2, the reported Production Rates are divided by 0.95 to obtain the P_2O_5 Feed Rates

For Data Points 26 - 31, the 6/99 'B' phosphoric acid plant Compliance Test measurements report Feed Rate. For Data Points 32 – 37, the 2/98 'B' phosphoric acid plant Compliance Test measurements report Feed Rate. For Data Points 15 - 25, the reported scrubber test Production Rates are divided by 0.95 to obtain the P_2O_5 Feed Rates

3.2 Columns C through G refer to Fume from the Reactor only

3.3 Column C - F lb/day

Taken directly from source data for Data Points 1, 2, and 15 – 25

The results of the 9/15/99 'A' PAP Scrubber Test give values of the evolved lb F/ ton P_2O_5 feed of 1.00 (for Data point 1) and 0.64 (for Data Point 2). The value of 1.00 has been used to calculate the fluoride arising from the reactor for Data Points 3 through 14.

The results of the 9/1/99 'B' PAP Scrubber Test give values of lb F/ ton P_2O_5 feed of between 0.84 and 1.47. No conclusive correlation could be made between fluoride evolved and P_2O_5 production rate and therefore a value of 1.20 has been used to calculate the fluoride arising from the reactor for Data Points 26 through 37.

3.4 Column D – lb F/ton Feed P_2O_5

Calculated from Column B and Column C.

3.5 Column E - Air Flow CFM

Taken directly from source data for 'A' Data Points 1 and 2 and 'B' Data Points 15 through 25. For Data Points 3 through 8, the higher value of 10,219 CFM has been assumed. For Data Points 26 through 37, the value of 20,499 CFM has been assumed.

3.6 Column F - Temperature °F

Taken directly from source data for Data Points 1 and 2. For Data Points 3 through 14 the averaged value of 172°F has been assumed. For the 'B' PAP, a fume inlet temperature from the reactor of 176°F has been assumed if the data has not been reported.

3.7 Column G - Air Flow SCFM

Calculated from Columns E and F in all cases.

3.8 Column H - F Inlet Loading mg/SCF

Calculated from Columns D and G in all cases.

3.9 Columns J through L refer to Fume from the Reactor and Filters combined.

3.10 Column I - F lb/day

Data from the 'A' Scrubber test on 9/15/99 has been used directly to add 150 lb F/day and 71.9 lb F/day to Data Points 1 and 2 respectively for the fluoride loading coming from the filters. An average of 111 lb F/day has been used for the other 'A' Data Points 3 – 8. The 'B' Scrubber test on 9/1/99 reported that 20,735 CFM at 95°F contributed 133.3 lb/day F to the scrubber inlet. This additional fluoride is added to Column C for Data Points 15 - 37

3.11 Column J- Combined Air Flow SCFM

Data from the 'A' Scrubber test on 9//15/99 has been used directly to add 28,291 SCFM and 28,787 SCFM to Data Points 1 and 2 respectively for the fluoride loading coming from the filters. An average of 28,539 SCFM has been used for the other 'A' Data Points 3 - 14. For Data Points 15 – 37, the 20,735 CFM from the Filters, measured during the scrubber tests, has been corrected to SCFM and added to Column G

3.12 Column K - F Inlet Loading mg/SCF Combined Fumes

Calculated from Columns I and J in all cases.

3.13 Column L - F Inlet loading lb/ton P_2O_5

Calculated from Columns B and I in all cases.

3.14 Column M - Scrubber Outlet Loading mg/SCF

Data from the 'A' Scrubber test on 9//15/99 has been used directly for Data Points 1 and 2 respectively. Values of stack gas flow in SCFM reported in the 6/99 'A' Compliance Tests, have been used with reported emissions of F in lb/day to calculate mg/SCF for Data Points 3 through 8. Values of stack gas flow in SCFM reported in the 2/98 'A' Compliance Tests, have been used with reported emissions of F in lb/day to calculate mg/SCF for Data Points 9 through 14.

A value of 0.1325 mg/CF reported from the 9/1/99 'B' Scrubber Test has been used for Data Points 15 through 20. A value of 0.1525 mg/CF reported from the 9/1/99 'B' Scrubber Test has been used for Data Points 21 through 25. Values of stack gas flow in SCFM reported in the 'B' PAP 6/99 Compliance Tests have been used with reported emissions of F in lb/day to calculate mg/SCF, for Data Points 26 through 31. Values of stack gas flow in SCFM reported in the 'B' PAP 1/98 Tests have been used with reported emissions of F in lb/day to calculate mg/SCF for Data Points 32 through 37.

3.15 Column N – NTU Number of Transfer Units.

Calculated from:

$$NTU = LN [(P2 - P^*)/(P1 - P^*)]$$

Where P2 = *Inlet F concentration mg/SCF*

P1 = Outlet F concentration mg/SCF

P* = Equilibrium F concentration mg/SCF

The 9/1/99 'A' Scrubber Test reports 1.05% F in the scrubber liquor. This equates to 1.28% H_2SiF_6. Fluoride vapor pressure above a liquor of this concentration at 94°F is reported in Hansen's Russian Data as 0.0011 mm Hg. This is equivalent to a vapor phase equilibrium concentration of 0.044 mg/SCF. This data has been used in NTU calculation for Data Points 1 through 8. For Data Points 9 – 14, a scrubbing liquor outlet temperature of 80 °F is assumed, (to reflect the February ambient). This is results in a vapor phase equilibrium concentration of 0.029 mg/SCF.

The 9/1/99 'B' Scrubber Test reports 1.01% F in the scrubber liquor. This equates to 1.27% H_2SiF_6. Fluoride vapor pressure above a liquor of this concentration at 118°F is reported in Hansen's Russian Data as 0.0025 mm Hg. This is equivalent to a vapor phase equilibrium concentration of 0.099 mg/SCF. This data has been used in NTU calculation for Data Points 15 through 25.

Scrubber outlet concentration reported in the 6/99 'B' Tests was lower than the equilibrium vapor concentration above. Therefore it has been assumed that the scrubber liquor is cooler. A temperature of 112°F is assumed for Data Points 26 through 31, giving a fluoride vapor pressure of 0.0017 mm Hg, from Hansen's Russian Data, equivalent to a vapor phase equilibrium concentration of 0.0679 mg/SCF. This data has been used in NTU calculation for Data Points 26 through 31

For Data Points 32– 37, the scrubbing liquor outlet temperatures are reported in the 1/98 Compliance Tests. The vapor phase equilibrium concentration at these temperatures has been used in the calculations.

3.16 Column P - Scrubber Outlet F lb/day

For Data Points 1 through 14, the actual reported values have been used.

The 9/1/99 'B' Scrubber Test reported a stack gas flowrate of 31,113 CFM at 110°F. This flow corrected to SCFM has been used with Column M to predict daily F discharge, for Data Points 15 - 25. The values are approximate to those reported in the 9/1/99 Scrubber Test.

For Data Points 26 through 31, the actual reported values have been used.

3.17 Column Q - Scrubber Outlet F lb/ton P_2O_5

Calculated from Column B and Column P in all Cases.

4. Observations on Recent Data – Scrubber 'A' – Table 1

4.1 From the 9/1/99 Scrubber Tests, it appears that the 'A' PAP scrubber operates at between 5½ and 7 Transfer Units. The performance extrapolated from the June 1999 stack measurements suggests that this could be higher, perhaps 6 or 7 Transfer Units, although the performance calculated from the February 1998 stack measurements suggests that this could be as low as 5 Transfer Units.

4.2 Fluoride emissions are calculated as about one third of the daily permit limit. Stack measurements in June 1999 confirm this. Stack measurements in February 1998 demonstrate emissions of about half of the daily limit.

4.3 Because of the uncertainty of some of the assumptions made, it is thought that the actual performance of the ' A' PAP Scrubber, without modification, may be equivalent to 5 or 6 Transfer Units

5. 'A' Scrubber Performance with Increased Capacity

5.1 No conclusive correlation could be made between fluoride evolved from the reactor and P_2O_5 production rate. It is conservatively assumed that the evolution of fluorides from the reactor will increase with production rate and be equivalent to about 1.0 lb/ton P_2O_5, and that the gas flow from the reaction section will be about 10,000 CFM at 172°F. There is no material change in the conclusions drawn if a value slightly higher or lower is chosen for this ratio. In addition, another 111 lb/day F comes from the Filtration Section, along with about 29,945 CFM. The scrubber outlet concentration has been calculated from:

$$P1 = [(P2 - P^*)/\text{Exp}(NTU)] + P^*$$

Where P2 = Inlet F concentration mg/SCF

P1 = Outlet F concentration mg/SCF

P* = Equilibrium F concentration mg/SCF

5.2 It is also assumed that the scrubber liquor temperature and H_2SiF_6 concentration will be maintained at about 94°F and 1.27%, respectively. Therefore a value of 0.044 mg/SCF has been assigned to P* above.

5.3 Table 2 predicts the performance of the 'A' PAP Scrubber with between 5 and 7 transfer units. From the recent data above, there is reasonable confidence that the actual number of transfer units will be between 6 and 7.

5.4 Table 3 shows fluoride emissions in lb/day and percent of permitted maximum for the permitted rate of 1416 TPD P_2O_5 and +20% or 1699 TPD P_2O_5 at a range of NTUs. The annual increase in emissions from the permitted rate to +20% is given. Also, the increased annual emissions over the average of the last two Compliance Tests is given.

5.5 At a conservative 5.0 NTUs, 'A' PAP fluoride emissions at the increased capacity of 1,699 TPD P_2O_5, are expected to increase 1.144 TPY over the average fluoride emissions recorded in the February 1998 and June 1999 Compliance Tests. The increase over calculated emissions with 5.0 NTUs at the permitted 1416 TPD P_2O_5 is only 0.365 TPY. Both calculated daily emissions and increased annual emissions are reduced as scrubber performance is improved with higher NTUs. At 6.0 NTUs and above, calculated emissions are lower than the 1998 and 1999 Compliance Test data average.

5.6 At an increased production rate of up to 1699 TPD P_2O_5, the existing and proposed permitted limits for fluoride emissions from the 'A' PAP Stack will not be exceeded nor will the combined increase in emissions from 'A' and 'B' PAP exceed 3 TPY. Therefore, no modifications to the scrubber are necessary to meet the required discharge levels.

6. Observations on Recent Data – Scrubber 'B' Table 4

6.1 From the 7/22/99 and the 9/1/99 Scrubber Tests, it appears that the 'B' PAP scrubber operates with an average of 6 Transfer Units. The performance calculated from the 6/99 stack measurements suggests that this could be higher, perhaps 8 or 9 Transfer Units. The performance calculated from the 2/98 stack measurements suggests 6 or 6½ NTUs.

6.2 From the 9/1/99 scrubber test, fluoride emissions are calculated as up to about half of the daily limit of 24.9 lb F/day and up to about 80% of the new source MACT limit of 0.0135lb F / ton P_2O_5. Stack measurements in June 1999 quote emissions of about 25% of the daily limit and about 20% of the lb F/ ton P_2O_5 Limit, and January 1998 quote 24% and 22% respectively.

6.3 Because of the uncertainty of some of the assumptions made, it is thought that the actual performance of the 'B' PAP Scrubber, without modification, may be equivalent to 6 or 7 Transfer Units

7. 'B' Scrubber Performance with Increased Capacity

7.1 No conclusive correlation could be made between fluoride evolved and P_2O_5 production rate. It is conservatively assumed that the evolution of fluorides from the reactor will increase with production rate and be equivalent to about 1.2 lb/ton P_2O_5, representing a worst case, and that the gas flow from the reaction section will be 20,499 CFM at 176°F. There is no material change in the conclusions drawn if a value slightly higher or lower is chosen for this ratio. In addition, another 133 lb/day F comes from the Filtration Section, along with about 20,735 CFM. The scrubber outlet concentration has been calculated from:

$$P1 = [(P2 - P^*)/\text{Exp}(NTU)] + P^*$$

Where P2 = Inlet F concentration mg/SCF

P1 = Outlet F concentration mg/SCF

P* = Equilibrium F concentration mg/SCF

7.2 It is also assumed that the scrubber liquor temperature and H_2SiF_6 concentration will be maintained at about 118°F and 1.27%, respectively. Therefore a value of 0.099 mg/SCF has been assigned to P* above.

7.3 Table 5 predicts the performance of the 'B' PAP Scrubber with 6, 7, and 8 NTUs. From the recent data above, there is reasonable confidence that the actual number of transfer units will be between 6 and 7. The June 1999 Compliance Test gave calculated NTUs above 8. The January 1998 Compliance Test gave calculated NTUs of 6 or 6½.

7.4 Table 6 shows fluoride emissions in lb/day and percent of permitted maximum for the permitted rate of 2107 TPD P_2O_5 and +20% or 2528 TPD P_2O_5 at a range of NTUs. The annual increase in emissions from the permitted rate to +20% is given. Also, the increased annual emissions over the average of the last two Compliance Tests is given.

7.5 At a conservative 6.0 NTUs, 'B' PAP fluoride emissions at the increased capacity of 2,528 TPD P_2O_5, are expected to increase 1.657 TPY over the average fluoride emissions recorded in the January 1998 and June 1999 Compliance Tests. The increase over calculated emissions with 6.0 NTUs at the permitted 2107 TPD P_2O_5 is only 0.183 TPY. Both calculated daily emissions and increased annual emissions are reduced as scrubber performance is improved with higher NTUs. Due to the excellent performance of the 'B' PAP scrubber in the last two Compliance Tests, emissions at 20% over the present permitted rate are not expected to be less than the average of the Compliance Tests.

7.6 At an increased production rate of up to 2528 TPD P_2O_5, the existing and proposed permitted limits for fluoride emissions from the 'B' PAP Stack will not be exceeded nor will the combined increase in emissions from 'A' and 'B' PAP exceed 3 TPY. Therefore no modifications to the scrubber are necessary to meet the permitted discharge levels.

Table 1 – 'A' PAP Recent Data

A		B	Reactor Fumes Only						Combined Reactor & Filter Fumes				M	N	P	Q
			C	D	E	F	G	H	I	J	K	L		Note 1		
Data Point	Test Date	Production Feed Rate TPD P_2O_5	F lb/day	lb F/ ton Feed P_2O_5	Air Flow CFM	Temperature °F	Air Flow SCFM	F Inlet Loading mg/SCF Reactor Fumes	F lb/day	Combined Air Flow SCFM	F Inlet Loading mg/SCF Combined Fumes	F Inlet loading lb/ton Feed P_2O_5	Scrubber Outlet Loading mg/SCF	NTU	Scrubber Outlet F lb/day	Scrubber Outlet F lb/ton Feed P_2O_5
1	9/15/99	700	735	1.00	9738	167	8,200	28.23	885	36,491	7.64	1.20	0.053	6.7	7.77	0.011
2	9/15/99	1200	807	0.64	10,219	177	8,470	30.01	879	37,257	7.43	0.70	0.081	5.5	12.76	0.010
3	6/99	1541	1,541	1.00	10,219	172 Assumed	8,537	56.86	1,652	37,076	14.03	1.07	0.059	6.8	9.35	0.006
4	6/99	1538	1,538	1.00	10,219	172 Assumed	8,537	56.75	1,649	37,076	14.01	1.07	0.062	6.7	9.34	0.006
5	6/99	1567	1,567	1.00	10,219	172 Assumed	8,537	57.82	1,678	37,076	14.26	1.07	0.065	6.5	9.52	0.006
6	6/99	1567	1,567	1.00	10,219	172 Assumed	8,537	57.82	1,678	37,076	14.26	1.07	0.051	15.5	8.15	0.005
7	6/99	1570	1,570	1.00	10,219	172 Assumed	8,537	57.93	1,681	37,076	14.28	1.07	0.059	6.9	8.98	0.006
8	6/99	1579	1,579	1.00	10,219	172 Assumed	8,537	58.26	1,690	37,076	14.36	1.07	0.065	6.5	9.51	0.006
9	2/98	1304	1,304	1.00	10219	172 Assumed	8,537	48.11	1,415	37,076	12.02	1.09	0.103	5.1	15.05	0.012
10	2/98	1301	1,301	1.00	10219	172 Assumed	8,537	48.00	1,412	37,076	12.00	1.09	0.097	5.2	14.12	0.011
11	2/98	1312	1,312	1.00	10219	172 Assumed	8,537	48.41	1,423	37,076	12.09	1.08	0.057	6.1	8.73	0.007
12	2/98	1312	1,312	1.00	10219	172 Assumed	8,537	48.41	1,423	37,076	12.09	1.08	0.094	5.2	14.38	0.011
13	2/98	1312	1,312	1.00	10219	172 Assumed	8,537	48.41	1,423	37,076	12.09	1.08	0.105	5.1	15.78	0.012
14	2/98	1325	1,325	1.00	10219	172 Assumed	8,537	48.89	1,436	37,076	12.20	1.08	0.112	5.0	16.64	0.013

Table 2 – 'A' PAP Fume Scrubber Predicted Performance at various NTU Assumptions

Production Rate TPD P_2O_5	F lb/day @ 1.0 lb/ton P_2O_5	Air Flow CFM	Temperature °F	Air Flow SCFM	F lb/day	Combined Air Flow SCFM	F Inlet Loading mg/SCF Combined Fumes	F lb/ton P_2O_5	NTU	Scrubber Outlet F mg/SCF	Scrubber Outlet F lb/day	Scrubber Outlet F lb/ton P_2O_5
1,416	1,491	10,219	Assumed 172	8,537	1,602	37,077	13.61	1.13	5	0.14	15.9	0.0107
1,558	1,640	10,219	Assumed 172	8,537	1,751	37,077	14.87	1.12	5	0.14	16.9	0.0103
1,699	1,789	10,219	Assumed 172	8,537	1,900	37,077	16.14	1.12	5	0.15	17.9	0.0100
1,416	1,491	10,219	Assumed 172	8,537	1,602	37,077	13.61	1.13	5.5	0.10	11.7	0.0079
1,558	1,640	10,219	Assumed 172	8,537	1,751	37,077	14.87	1.12	5.5	0.10	12.3	0.0075
1,699	1,789	10,219	Assumed 172	8,537	1,900	37,077	16.14	1.12	5.5	0.11	12.9	0.0072
1,416	1,491	10,219	Assumed 172	8,537	1,602	37,077	13.61	1.13	6.0	0.08	9.1	0.0061
1,558	1,640	10,219	Assumed 172	8,537	1,751	37,077	14.87	1.12	6.0	0.08	9.5	0.0058
1,699	1,789	10,219	Assumed 172	8,537	1,900	37,077	16.14	1.12	6.0	0.08	9.9	0.0055
1,416	1,491	10,219	Assumed 172	8,537	1,602	37,077	13.61	1.13	6.5	0.06	7.6	0.0051
1,558	1,640	10,219	Assumed 172	8,537	1,751	37,077	14.87	1.12	6.5	0.07	7.8	0.0048
1,699	1,789	10,219	Assumed 172	8,537	1,900	37,077	16.14	1.12	6.5	0.07	8.0	0.0045
1,416	1,491	10,219	Assumed 172	8,537	1,602	37,077	13.61	1.13	7	0.06	6.6	0.0045
1,558	1,640	10,219	Assumed 172	8,537	1,751	37,077	14.87	1.12	7	0.06	6.8	0.0041
1,699	1,789	10,219	Assumed 172	8,537	1,900	37,077	16.14	1.12	7	0.06	6.9	0.0039

Table 3 – 'A' PAP Increased Emission Comparison

Assumed	1416 TPD Production Rate		1699 TPD (+ 20% Rate)		Δ Emissions	1998 & 1999	Δ Over
Scrubber	Outlet F	% Permit Max.	Outlet F	% Permit Max.	TPY	Test Average	Test Average
NTU	lb/day		lb/day			lb/day	TPY
5.0	15.9	56	17.9	63	0.365	11.63	1.144
5.5	11.7	41	12.9	46	0.219	11.63	0.232
6.0	9.1	32	9.9	35	0.146	11.63	-0.316
6.5	7.6	27	8.0	28	0.073	11.63	-0.662
7.0	6.6	23	6.9	24	0.055	11.63	-0.863

JE Lakeland / 12/15/99

Table 4 – 'B' PAP Recent Data

A		B	Reactor Fumes Only						Combined Reactor & Filter Fumes				M	N	P	Q
			C	D	E	F	G	H	I	J	K	L		Note 1		
Data Point	Test Date	Production Feed Rate TPD P_2O_5	F lb/day	lb F/ ton Feed P_2O_5	Air Flow CFM	Temperature °F	Air Flow SCFM	F Inlet Loading mg/SCF Reactor Fumes	F lb/day	Combined Air Flow SCFM	F Inlet Loading mg/SCF Combined Fumes	F Inlet loading lb/ton Feed P_2O_5	Scrubber Outlet Loading mg/SCF	NTU	Scrubber Outlet F lb/day	Scrubber Outlet F lb/ton Feed P_2O_5
15	9/1/99	1000	1544	1.47	18123	176	15,046	32.33	1677.3	34,595	15.27	1.59	0.133	6.12	12.12	0.012
16	9/1/99	1000	1440	1.37	18123	176	15,046	30.15	1573.3	34,595	14.33	1.49	0.133	6.05	12.12	0.012
17	9/1/99	1000	1448	1.38	18123	174	15,093	30.22	1581.3	34,643	14.38	1.50	0.133	6.06	12.12	0.012
18	7/22/99	1200	1123	0.89	19569	176 Assumed	16,246	21.77	1256.3	35,796	11.06	0.99	0.133	5.79	12.12	0.010
19	7/22/99	1200	1110	0.88	19569	176 Assumed	16,246	21.52	1243.3	35,796	10.94	0.98	0.133	5.78	12.12	0.010
20	7/22/99	1200	1108	0.88	19569	176 Assumed	16,246	21.48	1241.3	35,796	10.92	0.98	0.133	5.78	12.12	0.010
21	9/1/99	1950	1829	0.89	18551	176	15,401	37.41	1962.3	34,951	17.69	0.96	0.153	6.03	13.95	0.007
22	9/1/99	1950	1606	0.78	18551	176	15,401	32.85	1739.3	34,951	15.68	0.85	0.153	5.91	13.95	0.007
23	7/22/99	2000	2250	1.07	20499	176 Assumed	17,018	41.65	2383.3	36,568	20.53	1.13	0.153	6.18	13.95	0.007
24	7/22/99	2000	2786	1.32	20499	176 Assumed	17,018	51.57	2919.3	36,568	25.15	1.39	0.153	6.39	13.95	0.007
25	7/22/99	2000	1,777	0.84	20499	176 Assumed	17,018	32.89	1910.3	36,568	16.46	0.91	0.153	5.96	13.95	0.007
26	6/99	2316	2,779	1.20	20,499	176 Assumed	17,018	51.44	2,913	36,568	25.09	1.26	0.068	12.43	5.88	0.003
27	6/99	2316	2,779	1.20	20,499	176 Assumed	17,018	51.44	2,913	36,568	25.09	1.26	0.075	8.17	6.03	0.003
28	6/99	2316	2,779	1.20	20,499	176 Assumed	17,018	51.44	2,913	36,568	25.09	1.26	0.072	8.72	5.64	0.003
29	6/99	2316	2,779	1.20	20,499	176 Assumed	17,018	51.44	2,913	36,568	25.09	1.26	0.07	9.39	5.86	0.003
30	6/99	2314	2,777	1.20	20,499	176 Assumed	17,018	51.40	2,910	36,568	25.07	1.26	0.077	7.92	6.16	0.003
31	6/99	2314	2,777	1.20	20,499	176 Assumed	17,018	51.40	2,910	36,568	25.07	1.26	0.072	8.72	5.53	0.003
32	1/98	1982	2,379	1.20	20499	176 Assumed	17,018	44.03	2,512.2	36,568	21.64	1.27	0.064	6.39	5.97	0.003
33	1/98	1970	2,364	1.20	20499	176 Assumed	17,018	43.77	2,497.8	36,568	21.52	1.27	0.064	6.38	5.96	0.003
34	1/98	2018	2,422	1.20	20499	176 Assumed	17,018	44.83	2,555.4	36,568	22.01	1.27	0.056	6.64	5.16	0.003
35	1/98	1987	2,385	1.20	20499	176 Assumed	17,018	44.14	2,517.9	36,568	21.69	1.27	0.061	6.43	5.7	0.003
36	1/98	2009	2,411	1.20	20499	176 Assumed	17,018	44.62	2,543.9	36,568	21.91	1.27	0.069	6.31	6.28	0.003
37	1/98	2006	2,408	1.20	20499	176 Assumed	17,018	44.56	2,541.0	36,568	21.89	1.27	0.075	6.16	6.83	0.003

Table 5 – 'B' PAP Fume Scrubber Predicted Performance at various NTU Assumptions

Production Rate TPD P_2O_5	F lb/day @ 1.2 lb/ton P_2O_5	Air Flow CFM	Temperature °F	Air Flow SCFM	F lb/day	Combined Air Flow SCFM	F Inlet Loading mg/SCF Combined Fumes	F lb/ton P_2O_5	NTU	Scrubber Outlet F mg/CF	Scrubber Outlet F lb/day	Scrubber Outlet F lb/ton P_2O_5
2107	2,661	20,499	Assumed 176	17,018	2,795	36,568	24.08	1.26	6	0.16	14.0	0.0053
2318	2,928	20,499	Assumed 176	17,018	3,062	36,568	26.38	1.25	6	0.16	14.5	0.0050
2528	3,193	20,499	Assumed 176	17,018	3,327	36,568	28.66	1.25	6	0.17	15.0	0.0047
2107	2,661	20,499	176	17,018	2,795	36,568	24.08	1.26	6.5	0.14	11.9	0.0045
2318	2,928	20,499	176	17,018	3,062	36,568	26.38	1.25	6.5	0.14	12.3	0.0042
2528	3,193	20,499	176	17,018	3,327	36,568	28.66	1.25	6.5	0.14	12.6	0.0039
2107	2,661	20,499	176	17,018	2,795	36,568	24.08	1.26	7	0.12	10.7	0.0040
2318	2,928	20,499	176	17,018	3,062	36,568	26.38	1.25	7	0.12	10.9	0.0037
2528	3,193	20,499	176	17,018	3,327	36,568	28.66	1.25	7	0.13	11.1	0.0035
2107	2,661	20,499	176	17,018	2,795	36,568	24.08	1.26	7.5	0.11	9.9	0.0037
2318	2,928	20,499	176	17,018	3,062	36,568	26.38	1.25	7.5	0.11	10.0	0.0034
2528	3,193	20,499	176	17,018	3,327	36,568	28.66	1.25	7.5	0.11	10.2	0.0032
2107	2,661	20,499	Assumed 176	17,018	2,795	36,568	24.08	1.26	8	0.11	9.5	0.0036
2318	2,928	20,499	Assumed 176	17,018	3,062	36,568	26.38	1.25	8	0.11	9.5	0.0033
2528	3,193	20,499	Assumed 176	17,018	3,327	36,568	28.66	1.25	8	0.11	9.6	0.0030

Table 6 – 'B' PAP Increased Emission Comparison

Assumed	2107 TPD Production Rate		2528 TPD (+ 20% Rate)		Δ Emissions	1998 & 1999	Δ Over
Scrubber	Outlet F	% Permit Max.	Outlet F	% Permit Max.	TPY	Test Average	Test Average
NTU	lb/day		lb/day			lb/day	TPY
6.0	14.0	56	15.0	60	0.183	5.92	1.657
6.5	11.9	48	12.6	51	0.128	5.92	1.219
7.0	10.7	43	11.1	45	0.073	5.92	0.945
7.5	9.9	40	10.2	41	0.055	5.92	0.781
8.0	9.5	38	9.6	39	0.018	5.92	0.672

JE Lakeland / 12/15/99

APPENDIX

TO: B. MAY, T. EDWARDS, M. MESSINA, R. CHARLOT, J. BYRD,H. FALLS 27-Sep-99
FROM: T. ORTOSKI

A PAP SCRUBBER TEST 9/15/99

Water Sample	F%	P_2O_5%	Temp °F
Scrubber Inlet	1.04	2.14	90.6
Scrubber Outlet	1.05	2.14	94.4

Sampling Data Points	Time	TPD	Temp °F	Hs	Vs	CFM	F mg/ft3	F lbs/day
Tank exit to scrubber duct	10:23 - 10:30	700	93 DB 89 WB	0.9068	51.328	29,630	1.482	150.34
Exit of cyclone duct	10:48 - 10:55	700	111 DB 108 WB	0.4997	28.742	12,490	36.31	1,515.40
Reactor fume duct	11:09 - 11:16	700	167 DB 162 WB	0.6725	38.066	9,738	22.04	734.81
A PAP Stack	11:39 - 11:51	700	106 DB 95 WB	0.6397	36.632	43,156	0.0526	7.77

Water Sample	F%	P_2O_5%	Temp °F
Scrubber Inlet	1.01	2.11	92.4
Scrubber Outlet	1.00	2.10	97.5

Sampling Data Points	Time	TPD	Temp °F	Hs	Vs	CFM	F mg/ft3	F lbs/day
Tank exit to scrubber duct	20:12 - 20:19	1200	95 DB 94 WB	0.9244	52.418	30,259	0.6936	71.86
Exit of cyclone duct	19:57 - 20:04	1200	122 DB 114 WB	0.4478	26.003	11,028	52.08	1,966.50
Reactor fume duct	19:27 - 19:34	1200	177 DB 174 WB	0.6558	39.840	10,219	23.06	806.82
A PAP Stack	19 :16 - 19:28	1200	101 DB 94 WB	0.6821	38.887	45,813	0.0814	12.76

APPENDIX

TO: B. MAY, T. EDWARDS, M. MESSINA, R. CHARLOT, J. BYRD,H. FALLS 27-Sep-99
FROM: T. ORTOSKI

B PAP SCRUBBER TEST 9/1/99

Water Sample	F%	P_2O_5%	Temp °F
Scrubber Inlet	1.01	2.04	99.4
Scrubber Outlet	1.01	1.95	118.0

Time	TPD	Temp °F	Hs	Vs	CFM	F mg/ft3	F lbs/day
11:43 - 11:49	1000	176	0.8918	54.094	18,123	24.89	1,544
11:56 - 12:02	1000	176	0.8918	54.094	18,123	23.21	1,440
12:09 - 12:15	1000	174	0.8918	54.094	18,123	23.33	1,448
B PAP Stack 12:03 - 12:13	1000	107.7	0.6967	39.934	30,109	0.1325	13.65

Water Sample	F%	P_2O_5%	Temp °F
Scrubber Inlet	1.01	2.01	101.6
Scrubber Outlet	1.01	2.04	122.4

Time	TPD	Temp °F	Hs	Vs	CFM	F mg/ft3	F lbs/day
4:30 - 4:37 South Leg	1950	100 DB 95 WB	0.6306	35.920	20,735	1.88	133.32
5:08 - 5:15	1950	176 DB 172 WB	0.9120	55.360	18,551	28.80	1,829
5:23 - 5:29	1950	176 DB 172 WB	0.9120	55.360	18,551	25.29	1,606
5:18 - 5:28 B PAP Stack	1950	110 DB 100 WB	0.7181	41.264	31,113	0.1525	16.24

Environmental and Quality Control Laboratory
Special Sample Analysis

Submitted By: BPAD Fume Scrubber
Date Submitted: 7/22/99
Date Completed:
Reason for Test:

Sample	(TPD) RATE	°F Temp	"H2O Hs	FT/Sec Vs	CFM	PM3/FT3	Ft #/DAY	Sample Vol	Analysis Requested							
(1) 11:08AM-11:19AM	1200	176°	.9616	58.324	19,567	16.76	1,123	9,625+3								
(2) 11:27-11:39AM	1200	175°	.9616	58.324	19,569	16.57	1,110									
(3) 11:44AM-11:57AM	1200	175°	.9616	58.324	19,569	16.34	1,108									
(4) 1:18PM-1:25PM	2000	177°	1.0057	61.097	20,499	32.06	2,260									
(5) 1:32PM-1:42PM	2000	177°	1.0057	61.097	20,499	39.70	2,786									
(6) 1:50-2:02PM	2000	177°	1.0057	61.097	20,499	26.32	1,777	✓								
D=32"																