EVALUATOR CMC EVALUATION DATE 7/14/92

METHOD 5: SECONDARY EMISSIONS TEST REPORT EVALUATION

STATE: WY FACILITY: FMC - Wyoming Corp. TEST DATE: 6/5/95

PROCESS(ES) TESTED: sesqui plant
RA-26 fluid bed calciner w/ scrubber

SAMPLING DURATION 3
must have at least 3 runs, each ≥ 1 hour duration, with sampling ≥ 2 minutes at each traverse point, and total sampling volume ≥ 30 dscf

PRODUCTION RATE 3
is process or production rate during testing representative of normal rates

CONTROL DEVICE(S) 2
are devices described, and their efficiencies given
na

METHOD 1 2
are calculations accurate, and is figure provided
no

METHODS 2,3 2
are data and calculations included for gas velocity, cyclonic flow, and molecular weight determination, and is source of barometric pressure noted
no

METHOD 4 3
are data and calculations included for moisture content determination, and is moisture content realistic [< saturation]

FIELD DATA is field data on standard forms, and does raw data correspond with printout 3

BOILER TESTS N/A
calculation of F_0 from Orsat accurate

SAMPLING TEMPERATURE 3
both probe and filter must be maintained at 248 ± 25°F or other temperature specified in NSPS

BACK-HALF 2
if any, what method was used to catch and recover condensible matter
none reported

EQUIPMENT were a borosilicate glass probe liner and a glass fiber filter used 2
no doc

CALIBRATION were both pre- and post-test calibrations performed for
meter box 2
pitot tube 2
temperature sensor 2
nozzle (3 #) 2
no doc.

LEAK CHECKS both pre- and post-test 3

BLANKS were filter and reagent blanks analyzed, and were any problems addressed 3

SAMPLE PREP 3
filter desiccation and tare weights documented

ISOKINETICS within 100±10% for all runs 3

Certified Mail No: P 25 4537564

FMC Wyoming Corporation

Box 872
Green River Wyoming 82935
307 875 2580

August 28, 1985

FMC

RECEIVED

AUG 30 1985

AIR QUALITY DIVISION
LANDER WYOMING

Mr. Randolph Wood, Administrator
Air Quality Division
Department of Environmental Quality
Herschler Building
122 West 25th Street
Cheyenne, Wyoming 82002

Re: CT-534
Sesqui Fluid-Bed Calciner

Dear Mr. Wood:

Enclosed you will find the report for the compliance tests run on the new RA-26 fluid-bed calciner, which is located in our sesqui process as a replacement for two steam-tube calciners RA-13 and RA-14. The report contains the following information:

- o A discussion of the testwork
- o A summary of the results
- o Supporting field and laboratory data
- o Calculation of feed rate
- o Control room logsheet to document operating conditions

The method used to calculate the feed rate to the fluid bed and the control room logsheet are presented in a separate packet marked CONFIDENTIAL , as provided for in § 35-11-1101 of the Wyoming Environmental Quality Act. We consider this information to be trade secret and proprietary, and would appreciate you treating it as such.

If you have any questions about the report or the testwork which was done, please call Dee Peverley at extension 273.

Very truly yours,

J.W. Coykendall
Resident Manager

cc: Lee Gribovicz - DEQ, Lander
JE Lyon*, GD Peverley* - Office

Compliance Test Report
Sesqui Fluid-Bed Calciner
RA-26
Permit No. CT-534

FMC Wyoming Corporation
Green River, Wyoming

Report Date: August 28, 1985

Compliance Test Report
RA-26

Section

Introduction

Compliance tests on the new fluid-bed calciner, located in the sesqui plant, were conducted on June 5. Construction of this unit was permitted by the Air Quality Division's Permit No. CT-534. Observing the testwork for the Department of Environmental Quality, Air Quality Division, were:

Mr. Lee Gribovicz	Air Quality District Engineer
Mr. Mike Crawford	Air Quality Engineering Associate

FMC Wyoming Corporation personnel taking part in the testwork were as follows:

Carl Demshar	Environmental Engineering Supervisor
Ted Brown	Environmental Engineer
Simon Lee	Environmental Engineering Aide
Keith Norris	Senior Laboratory Analyst

Summary of Results

This section summarizes the results of the compliance tests performed on RA-26 fluid-bed calciner. Table I is a summary of the compliance tests, identified as CT-534-1, CT-534-2, and CT-534-3. Details of the individual tests, including field data sheets, laboratory data sheets, and calculations sheets can be found in the Appendix.

From Table I, it is apparent that the RA-26 fluid-bed calciner emissions are well below the allowable of 12 pounds per hour.

Table I

SUMMARY OF STACK SAMPLING CALCULATIONS

Stack RA-26

	TEST 1	TEST 2	TEST 3
Test Code Number	CT534-1	CT534-2	CT534-3
Barometric pressure at site,(in Hg)	23.970	23.970	23.970
Absolute stack gas pressure,(in Hg)	23.970	23.970	23.970
Absolute average stack gas temp.,(R)	627.800	604.700	596.900
Absolute average dry gas meter temp.,(R)	546.400	544.800	546.700
Total volume of water collected,(ml)	309.200	317.900	293.200
Volume of gas through dry gas meter,(ft3)	45.244	47.110	46.080
Average pressure drop across orifice,(in H20)	1.514	1.580	1.523
Pitot tube coefficient	0.840	0.840	0.840
Average velocity head of stack gas,(in H20)	0.994	1.020	1.000
Cross sectional area of stack,(ft2)	19.630	19.630	19.630
Front-half particulate collected,(gm)	0.022	0.025	0.028
Back-half particulate collected,(gm)	0.000	0.000	0.000
Total particulate collected,(gm)	0.022	0.025	0.028
Total sampling time,(min)	60.000	60.000	60.000
Cross sectional area of nozzle,(ft2*10-4)	2.835	2.986	2.986
Gas volume,(acfm*1000)	84.371	84.933	82.546
Gas volume,(scfm*1000)	57.063	59.638	58.719
Percent isokinetic	101.490	95.854	93.402
Emission rate,(lb/hr)	3.323	3.811	4.331

AVG = 3.821

Sampling and Analysis Procedure

The compliance tests run on the fluid-bed calciner were done using EPA Method 5, "Determination of Particulate Emissions from Stationary Sources". Each test consisted of traversing both sample diameters, with six points sampled on each diameter for five minutes per point. Total testing time for each test was 60 minutes. During the second test, a restriction developed in the sampling train which made it impossible to maintain the sampling rate. Therefore, the testing was immediately suspended and the problem was found to be silica gel plugging the glassware stem in the fourth impinger. After the silica gel was removed the test was resumed and finished with no additional problems. To ensure continuity in the test, the starting and ending times of the unplanned interruption were recorded on the field data sheet.

After the second test, a problem developed with the product belt zero-speed switch which required the fluid bed to be shut down for approximately 30 minutes. After operation was restored, it was allowed to stabilize for about one hour, at which time the third compliance test was started. All sample recovery and laboratory work was performed in the FMC Wyoming Corporation Environmental Department work area.

Calculation of Fluid-Bed Production Rate

From the information shown on the control room logsheet, and the factors used to determine production, feed of centrifuge cake to the unit was 89.6 tons per hour during all three tests. Details of this calculation are contained in the attached CONFIDENTIAL packet.

APPENDIX

WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY

DIVISION OF AIR QUALITY

Company FMC CORPORATION

Address P O Box 872, Green River, Wyoming 82935

Unit Tested RA-26

Test Date June 5, 1985

STACK SAMPLING FIELD DATA

Company FMC Wyo. Corp.

Plant Location G.R. Wy.

Run No. CT-534-1

Sampling Location RA-26

Date 6-5-85

Start Time 08'57 / 09'34

Finish Time 09'27 / 10'04

Filter No.

Assumed Moisture, % 25

Probe Tip Diameter, in. 0.228

Probe Length, ft. 6

Ambient Temperature, °F

Bar. Pressure, in. Hg. 23.97

Initial Leak Check, CFS

CFM .002 at 15 in. Hg.

Final Leak Check, CFS

CFM .001 at 8.0 in. Hg.

.228"

Point No.	Time (min)	Dry Gas Meter FT³	Pitot in. H₂O P	Pitot in. H₂O VP	Orifice ΔH in. H₂O Desired	Orifice ΔH in. H₂O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum in. Hg Gauge	Sample Box Temp. °F	Impinger Temp. °F	Stack Press. in. Hg	S T
SE													
1	0	798.4	0.85	0.822	1.30	1.30	78	70	5.2	260	56		
2	5	801.8	1.0	1.00	1.53	1.53	86	74	6.9	267	65		115
3	10	805.5	1.05	1.026	1.60	1.60	92	75	7.5	266	63		116
4	15	809.3	1.01	1.00	1.53	1.53	93	76	7.3	256	62		116
5	20	813	1.0	1.000	1.53	1.53	103	91	7.5	247	70		117
6	25	816.9	0.95	0.975	1.45	1.45	93	94	6.9	229	56		117
	30	820.6											
NE													
1	0	820.6	0.85	0.922	1.30	1.30	106	95	5.6	244	68		116
2	5	824.1	0.9	0.951	1.38	1.39	113	97	6.0	249	72		117
3	10	827.6	0.99	0.995	1.61	1.61	113	93	6.3	250	67		116
4	15	831.3	1.1	1.049	1.68	1.69	108	92	7.0	246	60		116
5	20	835.2	1.1	1.049	1.68	1.69	107	92	7.3	243	66		116
6	25	839.3	1.1	1.049	1.68	1.68	112	99	7.3	239	68		116
	30	843.270											
44.86	X 1.0087	45.244	11.89				1040	93.33					
	η						100	13					
	Correction Factor						22	5²					
			.994		1.514		93.8	553.8					
Total	Vm	45.244	11.935		18.17		2073						201
Average			0.994		1.514		86.4°F						167
							546.4°R						627

TEST NO. CT534-1 DATE 06/05/85

VELOCITY AND VOLUME DETERMINATION

****

DRY GAS VOLUME

Vmstd=(17.71 deg R/in. Hg)*Vm*(Pbar+deltaH/13.6)/Tm)

Where Vmstd=Volume(ft3) of gas sample at 70F and 29.92 in. Hg
Vm=Volume (ft3) of gas at meter conditions
Tm=Average dry gas meter temperature (R)
Pbar=Barometric pressure (in. Hg)
deltaH=Pressure drop across orifice (in. WG)

Vmstd=17.71* 45.24*(23.97+1.514/13.6)/546.4 = 35.314 ft3

VOLUME OF WATER VAPOR

Where Vwstd=Volume (ft3) of water vapor
Vlc=Total volume of water collected (ml)

Vwstd = .00474* 309.2 = 14.656 ft3

MOISTURE CONTENT

Bwo=Vwstd*100/(Vwstd+Vmstd)

Where Bwo=Percent moisture

Bwo = 14.66*100/(14.66+ 35.31) = 29.330 percent

CONCENTRATION

Cs'=(15.43 grains/gm)*Mn/(Vmstd+Vwstd)

Where Cs'=Concentration (grains/scf)
Mn=Total particulate collected (gm)

Cs' = 15.43*0.0220/(35.31+ 14.66) = 0.0068 grains/scf

STACK VELOCITY

V=Kp*85.48*SQR(delta P)*SQR(Mw*Ps))

Where V=Stack velocity (ft/sec)
Ts=Stack absolute temperature (R)
deltaP=Average pitot reading (in. WG)
Mw=Molecular wt. of stack gas (lb/lb mole)
Kp=Pitot tube coefficient

Mw=0.18*29.33+0.44* 2.76+0.32*12.30+0.28*55.62 = 26.000 lb/mole

V=0.84*85.48*0.994*SQR(627.8/(26.00*23.97)) = 71.634 ft/sec

STACK VOLUME

ACFM=V*A*60 AND SCFM=ACFM*530*Ps/(Ts*29.92)

Where ACFM=Actual cubic Ft per minute at stack conditions
A=Stack area (ft2)
SCFM=Standard cubic ft. per min. (29.92 in. Hg & 530 R)

ACFM = 71.63* 19.630*60 = 84371 acfm

SCFM = 84371*530*23.97/(627.8*29.92) = 57063 scfm

CALCULATED DUST LOAD

lb/hr=Cs'*SCFM*60/7000 grains/lb

DUST LOAD= 0.0068* 57063*60/7000 = 3.32 Lb/Hr

ISOKINETIC RATE

I = 101.5012 %

LABORATORY DATA

Company FMC Run No. CT-534-1

Sampling Location RA-26 Date 6-5-85

MOISTURE COLLECTED

		GM/ML	Water Weight/Volume Gain GM/ML
IMPINGER 1	Final Weight/Volume	772.6	
	Initial Weight/Volume	553.0	
	Increase	219.6	219.6
IMPINGER 2	Final Weight/Volume	638.1	
	Initial Weight/Volume	570.9	
	Increase	67.2	67.2
IMPINGER 3	Final Weight/Volume	434.2	
	Initial Weight/Volume	426.2	
	Increase	8.0	8.0
IMPINGER 4	Final Weight/Volume	671.2	
	Initial Weight/Volume	656.8	
	Increase	14.4	14.4
	TOTAL MOISTURE CATCH		309.2

PARTICULATE COLLECTED

FRONT-HALF ANALYSIS (Nozzle, Probe, Cyclone, Filter Front-Half)

Orsat
%CO_2 = 3.9
%O_2 = 17.4
%CO = 0.0

Filter & Particulates	0.4862	#1 74.3803
Filter Tare Weight	0.4780	74.3680
Particulate	0.0082	0.0143
Washings	0.0143	
Particulate Catch	0.0225	
Acetone Blank	0.0005	
TOTAL FRONT CATCH	0.0220	

BACK-HALF ANALYSIS (Impingers, Filter Back-Half)

#1 76.4924
76.4919
0.0005

Extractable Weight	
Boil Down Weight	
Impinger Catch	
Water Blank	
TOTAL BACK CATCH	
TOTAL TRAIN CATCH	

CT-534-1

PRELIMINARY DATA

Company SMCW.Corp. Sampling Location RA-26

Stack inside diameter, in. 60 Stack area, sq. ft. 19.63

Port extension, in. 4.25 Pitot tube correction factor 0.84

Stack Pressure - 0 - Pitot tube traverse 12

Traverse Pt. No.	% of Diameter	Distance from inside Wall	Distance from outside of Port
1	4.4	2.64	6.89
2	14.7	8.82	13.07
3	29.5	17.7	21.95
4	70.5	42.3	46.55
5	85.3	51.18	55.43
6	95.6	57.36	61.61

Traverse Pt. No.	Velocity Head P	Velocity Head $\sqrt{P}$	Temperature Stack
SE			
1	0.94	0.969	
2	1.10	1.049	
3	1.10	1.049	
4	1.10	1.049	
5	1.05	1.025	
6	0.97	0.985	
NE			
1	0.85	0.922	163
2	0.93	0.964	163
3	1.0	1.000	167
4	1.1	1.049	166
5	1.1	1.049	166
6	1.05	1.025	166
Average $\sqrt{P}$		1.011	
Average Temperature			

STACK SAMPLING FIELD DATA

Company FMC Wy. Corp
Plant Location G.R., Wy
Run No. CT-534-2
Sampling Location RA-26
Date 6-5-85
Start Time 10:22 / 11:16 2nd Trg.
Finish Time 10:49 / 11:19 11:46
Filter No.

Assumed Moisture, % 25 7.986
Probe Tip Diameter, in. .234
Probe Length, ft. 6
Ambient Temperature, °F
Bar. Pressure, in. Hg. 23.97
Initial Leak Check, CFS
CFM 0.000 at 15 in. Hg.
Final Leak Check, CFS
CFM 0.000 at 14 in. Hg.

6/7/85

* off @ 11 min/30 sec. @ 10:33 hrs. Pressure Problem

Point No.	Time (min)	Dry Gas Meter FT³	Pitot in. H₂O P	Pitot in. H₂O VP	Orifice ΔH in. H₂O Desired	Orifice ΔH in. H₂O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum in. Hg Gauge	Sample Box Temp. °F	Impinger Temp. °F	Stack Press. in. Hg	St T c
	SE												
1	0	843.5	0.86	0.997	1.30	1.30	91	85	9.0	240	51		1/5
2	5	847.1	1.05	1.025	1.59	1.59	92	81	11.9	250	41		1/5
* 3	10	850.9	1.1	1.049	1.67	1.67	85	77	14.0 8.3	243	37		1/5
4	15	854.9	1.1	1.049	1.67	1.67	86	78	12.0	232	45		1/5
5	20	859.6	1.05	1.025	1.59	1.59	87	79	11.9	230	44		1/5
6	25	864.8	1.05	1.025	1.59	1.59	89	79	10.9	270	45		1/5
	30	866.7											
1	0	866.7	0.86	0.997	1.30	1.30	87	80	8.1	276	43		1/4
2	5	870.3	1.0	1.011	1.52	1.52	90	82	9.0	265	39		1/4
3	10	874.1	1.05	1.025	1.59	1.59	91	82	10.2	260	39		1/4
4	15	878.1	1.15	1.072	1.74	1.74	91	82	11.1	259	42		1/4
5	20	882.1	1.15	1.072	1.74	1.74	90	81	12.0	265	46		1/4
6	25	886.2	1.10	1.049	1.67	1.67	90	81	11.5	272	52		1/4
	31	890.279											
46.704	Vm	47.110					106	90					
							89.1	80.6					
*													
aft	a	t	11 m.	48 sec									
#4	imp	stem	—	clean									
						1.591		84.8 (544.8)					
Total	Vm	47.110	12.245		18.967		2036						173
Average			1.020		1.580		84.8°F						144
							544.8°R						

TEST NO. CT534-2 DATE 06/05/85

VELOCITY AND VOLUME DETERMINATION

****

DRY GAS VOLUME

Vmstd=(17.71 deg R/in. Hg)*Vm*(Pbar+deltaH/13.6)/Tm)

Where Vmstd=Volume(ft3) of gas sample at 70F and 29.92 in. Hg
Vm=Volume (ft3) of gas at meter conditions
Tm=Average dry gas meter temperature (R)
Pbar=Barometric pressure (in. Hg)
deltaH=Pressure drop across orifice (in. WG)

Vmstd=17.71* 47.11*(23.97+1.580/13.6)/544.8 = 36.886 ft3

VOLUME OF WATER VAPOR

Where Vwstd=Volume (ft3) of water vapor
Vlc=Total volume of water collected (ml)

Vwstd = .00474* 317.9 = 15.068 ft3

MOISTURE CONTENT

Bwo=Vwstd*100/(Vwstd+Vmstd)

Where Bwo=Percent moisture

Bwo = 15.07*100/(15.07+ 36.89) = 29.003 percent

CONCENTRATION

Cs'=(15.43 grains/gm)*Mn/(Vmstd+Vwstd)

Where Cs'=Concentration (grains/scf)
Mn=Total particulate collected (gm)

Cs' = 15.43*0.0251/(36.89+ 15.07) = 0.0075 grains/scf

STACK VELOCITY

V=Kp*85.48*SQR(delta P)*SQR(Mw*Ps))

Where V=Stack velocity (ft/sec)
Ts=Stack absolute temperature (R)
deltaP=Average pitot reading (in. WG)
Mw=Molecular wt. of stack gas (lb/lb mole)
Kp=Pitot tube coefficient

Mw=0.18*29.00+0.44* 2.72+0.32*12.19+0.28*56.09 = 26.022 lb/mole

V=0.84*85.48*1.020*SQR(604.7/(26.02*23.97)) = 72.112 ft/sec

STACK VOLUME

ACFM=V*A*60 AND SCFM=ACFM*530*Ps/(Ts*29.92)

Where ACFM=Actual cubic Ft per minute at stack conditions
A=Stack area (ft2)
SCFM=Standard cubic ft. per min. (29.92 in. Hg & 530 R)

ACFM = 72.11* 19.630*60 = 84933 acfm

SCFM = 84933*530*23.97/(604.7*29.92) = 59638 scfm

CALCULATED DUST LOAD

lb/hr=Cs'*SCFM*60/7000 grains/lb

DUST LOAD= 0.0075* 59638*60/7000 = 3.81 Lb/Hr

ISOKINETIC RATE

I = 95.86929 %

LABORATORY DATA

Company FMC Run No CT-534-2

Sampling Location RA-26 Date 6-5-85

MOISTURE COLLECTED

		GM/ML	Water Weight/Volume Gain GM/ML
IMPINGER 1	Final Weight/Volume	759.9	
	Initial Weight/Volume	540.4	
	Increase	219.5	219.5
IMPINGER 2	Final Weight/Volume	644.5	
	Initial Weight/Volume	574.1	
	Increase	70.7	70.7
IMPINGER 3	Final Weight/Volume	457.8	
	Initial Weight/Volume	446.0	
	Increase	11.8	11.8
IMPINGER 4	Final Weight/Volume	680.6	
	Initial Weight/Volume	664.7	
	Increase	15.9	15.9
	TOTAL MOISTURE CATCH		317.9

PARTICULATE COLLECTED

FRONT-HALF ANALYSIS (Nozzle, Probe, Cyclone, Filter Front-Half)

Orsat
%CO_2 : 3.83
%O_2 : 17.17
%CO : 0.0

Filter & Particulates	0.4855	
Filter Tare Weight	0.4795	#3 75.1052
Particulate	0.0060	75.1055
Washings	0.0197	0.0197
Particulate Catch	0.0257	
Acetone Blank	0.0006	
TOTAL FRONT CATCH	0.0251	

BACK-HALF ANALYSIS (Impingers, Filter Back-Half)

Extractable Weight		
Boil Down Weight		#1 75.4712
Impinger Catch		75.4706
Water Blank		0.0006
TOTAL BACK CATCH		
TOTAL TRAIN CATCH		

CT-534-2

PRELIMINARY DATA

Company Smcwy. Corp. Sampling Location RA-26

Stack inside diameter, in. 60 Stack area, sq. ft. 19.63

Port extension, in. 4.25 Pitot tube correction factor 0.84

Stack Pressure - 0 - Pitot tube traverse 12

Traverse Pt. No.	% of Diameter	Distance from inside Wall	Distance from outside of Port
1	4.4	2.64	6.89
2	14.7	8.82	13.07
3	29.5	17.7	21.95
4	70.5	42.3	46.55
5	85.3	51.15	55.43
6	95.6	57.36	61.61

Traverse Pt. No.	Velocity Head P	Velocity Head $\sqrt{P}$	Temperature Stack
SE			
1	0.85	0.922	165
2	1.10	1.049	166
3	1.10	1.049	165
4	1.05	1.025	164
5	1.0	1.000	163
6	0.98	0.990	161
NE			
1	0.98	0.990	144
2	1.05	1.025	144
3	1.10	1.049	143
4	1.15	1.072	143
5	1.2	1.095	143
6	1.05	1.025	
Average		$\sqrt{P}$ 1.024	154.6°F
Average Temperature			614.6°R.

STACK SAMPLING FIELD DATA

Company FMC Wy. Corp. | Assumed Moisture, % 25

Plant Location G.R. Wy. | Probe Tip Diameter, in. 0.234

Run No. GT-534-3 | Probe Length, ft. 6

Sampling Location RA-26 | Ambient Temperature, °F 23.97

Date 6-5-85 | Bar. Pressure, in. Hg.

Start Time 13:39 | 14:17 | Initial Leak Check, CFS

Finish Time 14:09 | 14:47 | CFM 0.001 at 15 in. Hg.

6/5/85

Filter No. | Final Leak Check, CFS

CFM 0.000 at 6.0 in. Hg.

Point No.	Time (min)	Dry Gas Meter FT³	Pitot in. H₂O P	Pitot in. H₂O VP	Orifice ΔH in. H₂O Desired	Orifice ΔH in. H₂O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum in. Hg Gauge	Sample Box Temp. °F	Impinger Temp. °F	Stack Press. in. Hg	St T
SE													
1	0	890.616	0.90	0.949	1.37	1.37	80	76	3.9	274	56		114
2	5	893.9	1.05	1.025	1.59	1.59	85	76	4.3	185	56		113
3	10	897.8	1.10	1.049	1.67	1.67	88	77	4.9	269	53		114
4	15	901.9	1.05	1.025	1.59	1.59	90	78	5.0	233	56		113
5	20	905.7	1.10	1.049	1.67	1.67	92	79	5.0	231	59		113
6	25	909.6	0.98	0.990	1.50	1.50	93	80	4.9	237	57		113
	30	913.5											
NE													
1	0	1913.5	0.75	0.866	1.14	1.14	89	81	3.9	242	57		130
2	5	1917.0	0.94	0.969	1.43	1.43	94	81	4.3	240	53		133
3	10	1920.7	0.97	0.985	1.46	1.46	95	82	4.5	254	50		133
4	15	1924.4	1.10	1.049	1.67	1.67	96	83	5.0	237	53		133
5	20	1928.4	1.10	1.049	1.67	1.67	97	83	5.1	251	53		133
6	25	1932.4	1.00	1.000	1.52	1.52	97	84	5.0	250	53		133
	30	1936.299											
46.683	1.0081	46.020					94.0	96.0					
							91.3	80.0					
								85.7 (95.7)					
Total	Vm	46.080	12.005		18.28		2056						
Average			1.000		1.523		85.7° F						136.9
							546.7°R						596.9

TEST NO. CT534-3 DATE 06/05/85

VELOCITY AND VOLUME DETERMINATION

****

DRY GAS VOLUME

Vmstd=(17.71 deg R/in. Hg)*Vm*(Pbar+deltaH/13.6)/Tm)

Where Vmstd=Volume(ft3) of gas sample at 70F and 29.92 in. Hg
Vm=Volume (ft3) of gas at meter conditions
Tm=Average dry gas meter temperature (R)
Pbar=Barometric pressure (in. Hg)
deltaH=Pressure drop across orifice (in. WG)

Vmstd=17.71* 46.08*(23.97+1.523/13.6)/546.7 = 35.948 ft3

VOLUME OF WATER VAPOR

Where Vwstd=Volume (ft3) of water vapor
Vlc=Total volume of water collected (ml)

Vwstd = .00474* 293.2 = 13.898 ft3

MOISTURE CONTENT

Bwo=Vwstd*100/(Vwstd+Vmstd)

Where Bwo=Percent moisture

Bwo = 13.90*100/(13.90+ 35.95) = 27.881 percent

CONCENTRATION

Cs'=(15.43 grains/gm)*Mn/(Vmstd+Vwstd)

Where Cs'=Concentration (grains/scf)
Mn=Total particulate collected (gm)

Cs' = 15.43*0.0278/(35.95+ 13.90) = 0.0086 grains/scf

STACK VELOCITY

V=Kp*85.48*SQR(delta P)*SQR(Mw*Ps))

Where V=Stack velocity (ft/sec)
Ts=Stack absolute temperature (R)
deltaP=Average pitot reading (in. WG)
Mw=Molecular wt. of stack gas (lb/lb mole)
Kp=Pitot tube coefficient

Mw=0.18*27.88+0.44* 2.60+0.32*12.76+0.28*56.76 = 26.138 lb/mole

V=0.84*85.48*1.000*SQR(596.9/(26.14*23.97)) = 70.085 ft/sec

STACK VOLUME

ACFM=V*A*60 AND SCFM=ACFM*530*Ps/(Ts*29.92)

Where ACFM=Actual cubic Ft per minute at stack conditions
A=Stack area (ft2)
SCFM=Standard cubic ft. per min. (29.92 in. Hg & 530 R)

ACFM = 70.09* 19.630*60 = 82546 acfm

SCFM = 82546*530*23.97/(596.9*29.92) = 58719 scfm

CALCULATED DUST LOAD

lb/hr=Cs'*SCFM*60/7000 grains/lb

DUST LOAD= 0.0086* 58719*60/7000 = 4.33 Lb/Hr

ISOKINETIC RATE

I = 93.41699 %

LABORATORY DATA

Company FMC Run No. CT-534-3

Sampling Location RA-26 Date 6-5-85

MOISTURE COLLECTED

		GM/ML	Water Weight/Volume Gain GM/ML
IMPINGER 1	Final Weight/Volume	794.9	
	Initial Weight/Volume	571.7	
	Increase	223.2	223.2
IMPINGER 2	Final Weight/Volume	613.9	
	Initial Weight/Volume	561.2	
	Increase	52.7	52.7
IMPINGER 3	Final Weight/Volume	422.3	
	Initial Weight/Volume	417.3	
	Increase	5.0 — 5.0	5.0
IMPINGER 4	Final Weight/Volume	689.5	
	Initial Weight/Volume	677.2	
	Increase	12.3	12.3
	TOTAL MOISTURE CATCH		293.2

PARTICULATE COLLECTED

FRONT-HALF ANALYSIS (Nozzle, Probe, Cyclone, Filter Front-Half)

Orsat
%CO_2 : 3.6
%O_2 : 17.7
%CO : 0.0

Filter & Particulates	0.4335	#5 83.3844
Filter Tare Weight	0.4783	83.3582
Particulate	0.0052	0.0262
Washings	0.0263	
Particulate Catch	0.0314	
Acetone Blank	0.0036	
TOTAL FRONT CATCH	0.0278	

BACK-HALF ANALYSIS (Impingers, Filter Back-Half)

#6 74.3645
74.3609
0.0036

Extractable Weight	
Boil Down Weight	
Impinger Catch	
Water Blank	
TOTAL BACK CATCH	
TOTAL TRAIN CATCH	

CT-534-3

PRELIMINARY DATA

Company FMC Wy. Corp. Sampling Location RA-26

Stack inside diameter, in. 60 Stack area, sq. ft. 19.63

Port extension, in. 4.25 Pitot tube correction factor 0.84

Stack Pressure - 0 - Pitot tube traverse 12

Traverse Pt. No.	% of Diameter	Distance from inside Wall	Distance from outside of Port
1	4.4	2.64	6.89
2	14.7	8.82	13.07
3	29.5	17.7	21.96
4	70.5	42.3	46.55
5	85.3	51.18	55.43
6	95.6	57.36	61.61

Traverse Pt. No.	Velocity Head P	Velocity Head $\sqrt{P}$	Temperature Stack
SE			
1	0.88	0.938	142
2	1.05	1.025	
3	1.10	1.049	
4	1.00	1.000	
5	0.95	0.975	
6	0.95	0.975	
NE			
1	0.87	0.933	
2	0.98	0.990	
3	1.05	1.025	
4	1.03	1.015	
5	1.05	1.025	
6	0.96	0.980	
Average $\sqrt{P}$		0.994	
Average Temperature			

DAN
File

MEMORANDUM

TO: FMC Soda Ash Plant (Green River)

THROUGH: Chuck Collins, Air Quality Supervisor
Lee Gribovicz, District Air Quality Engineer

FROM: Mike Crawford, Air Quality Associate Engineer

SUBJECT: Compliance Testing of CT-534

DATE: October 2, 1985

On March 29, 1984, the Air Quality Division granted to FMC permit CT-534. This permit was for the construction of a new fluid bed dryer (RA-26) in the sesqui plant. On March 22, 1985, this unit commenced operation and as required by Section 21(j) of the Wyoming Air Quality Standards and Regulations, FMC conducted performance testing on this unit June 5, 1985.

In permit CT-534 the allowable particulate emission rate for the fluid bed dryer is 12 pounds per hour. Another condition of this permit is FMC can have on-line any two of three remaining steam-tube dryer units (RA-14, RA-15, RA-16) simultaneously with the fluid bed dryer.

Lee Gribovicz and I were on site June 5, 1985 and we observed the end of the first test and all of the second and third test runs. Mr. Gribovicz's memo of June 6, 1985 describes our observations on plant this date.

FMC determined the minimum number of traverse points was 12, with 6 points per traverse. FMC sampled for 5 minutes at each point for a total sampling time of 60 minutes per test.

The tests were submitted under cover of FMC's letter of August 28, 1985. FMC reported only the "front-half" collection of the sampling train. Dee Peverly, manager of FMC's Environmental Group, said that the "back-half" collection of the sampling train were not measured (875-2580 ext. 273, 9-13-85). Mr. Peverly said it was his understanding that if the Air Quality Division wanted the "back-half" it would have been requested.

Other than the "back-half" not being reported, there were no other procedural errors noted. Table A lists some average process parameters and "front-half" measured particulate emission rate.

TABLE A

	TEST 1	TEST 2	TEST 3
Process Rate (tph)	89.6	89.6	89.6
Avg. Steam Flow (pph)	61,500	67,500	64,000
Scrubber Flow Rate (gpm)	1,050	1,050	1,050
Avg. Scrubber Press. Drop (in. H_2O)	24.5	26.0	26.0
Makeup Flow Rate	30	30	30
"Front-Half" Measured Emission (pph)	3.36	3.81	4.36

Table B compares the average of the three tests to the designed values.

TABLE B

	AVG. OF THE 3 TESTS	DESIGN VALUES
Process Rate (tph)	89.6	85.5
Steam Flow (pph)	64,333	CONFIDENTIAL*
Scrubber Flow Rate (gpm)	1,050	1,270
Scrubber Pressure Drop (in. H_2O)	25.5	30
Makeup Flow Rate (gpm)	30	70
"Front-Half" Measured Emission (pph)	3.84	--
Allowable Emission (pph)	--	12.0

* Per Letter of January 4, 1984

As seen in Table B, the process rate for the fluid bed dryer was 5% above the designed rate, while the scrubber was operating below its design parameters. The "front-half" average particulate emission rate of 3.84 pounds per hour is well below the allowable of 12 pounds per hour. If the "back-half" had been reported it is the Air Quality Division's opinion that these tests would still have passed. For example, if the "back-half" equalled 50% of the "front-half" the average particulate emission rate would be 5.75 pounds per hour well within the allowable emission rate of 12 pounds per hour.

I recommend these tests be accepted as proof of compliance for FMC's fluid bed dryer permitted as CT-534. I also recommend that a letter be sent to FMC stating that the "back-half" collection of the sampling train be included in future test reports.

STACK EMISSION REVIEW

COMPANY FMC WYOMING CORP. (SODA ASH) LOCATION Sect. 23, T19N, R110W

TESTING FIRM FMC ENVL Dept. Soda Plant TESTS CONDUCTED BY CARL DEMASHAR, TED BROWN, SIMON Lee, Keith Norris

DATE TESTED JUNE 5, 1985

TEST OBSERVED BY Lee Gribovicz & Mike Crawford

TEST EVALUATED BY Mike Crawford

STACK DATA

Stack ht (ft) 95.0' Height to ports = 90'

Stack dia (ft) 5.0'

Process venting through stack escaping from ore from calcining process

TRAVERSE POINTS

Nozzle diameter: Test 1 0.228" Test 2 0.234" Test 3 0.234"

Location of sampling ports 90' (18 eq. stk dia dwnstrm) 5' (1 eq stk dia upstrm)

Number of traverse points per test: Test 1 12 Test 2 12 Test 3 12

Do sampling points follow EPA guidelines? Yes X No ____

Comments:

EMISSIONS

	Test 1	Test 2	Test 3	
Process wt rate (ton/hr)	89.6	89.6	89.6	
Allowable emission (lb/hr)	12.0	12.0	12.0	
Measured emission (lb/hr)	3.358	3.812	4.358	AVG = 3.84 lb/HR
% Isokinetic	100.01	95.42	93.12	

Comments and recommendations:
Back half was not reported or conducted by FMC.

DATA SHEET

P_{std} = 29.92 in Hg

T_{std} = 530°R

			Test 1	Test 2	Test 3
P_{bar}	= barometric pressure at site (in Hg)	99	23.97	23.97	23.97
P_s	= absolute stack gas pressure (in Hg)	5	23.97	23.97	23.97
T_s	= absolute average stack gas temp. (°R)	7	627.8	604.7	596.9
T_m	= absolute average dry gas meter temp. (°R)	6	553.8	544.8	545.7
V_{ic}	= total volume of water collected (ml)	5	309.2	317.9	293.2
V_m	= volume of gas through dry gas meter (ft^3)	11	45.244	47.11	46.08
ΔH	= average pressure drop across orifice (in H_2O)	3	1.514	1.581	1.523
C_p	= pitot tube coefficient	2	0.84	0.84	0.84
$(\sqrt{\Delta P})_{ave}$	= average velocity head of stack gas (in H_2O)	1	0.994	1.020	1.000
A_s	= cross-sectional area of stack (ft^2)	0	19.63	19.63	19.63
M_n	= total amount of particulate collected (g)	89	0.0220	0.0251	0.028
θ	= total sampling time (min.)	88	60.0	60.0	60.0
A_n	= cross-sectional area of nozzle (ft^2)	7	$2.835(10^{-4})$	$2.986(10^{-4})$	$2.986(10^{-4})$

ORSAT ANALYSIS

		Test 1	Test 2	Test 3
% CO_2	6	3.9	3.83	3.6
% O_2	5	17.4	17.17	17.7
% CO	4	0.0	0.0	0.0
% N_2	3	78.7	79.0	78.7

CALCULATIONS

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

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

   $V_{w\ std} =$ 14.66, 15.07, 13.90 ft^3

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

   $$V_{m\ std} = \left(17.71\ \frac{°R}{in\ Hg}\right) V_m \left(\frac{P_{bar} + \frac{H}{13.6}}{T_m}\right)$$

   $V_{m\ std} =$ 34.84, 36.89, 36.01 ft^3

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

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

   $B_{wo} =$ 0.296, 0.290, 0.278

4. Molecular weight (lb/lb mole)

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

   $M_d =$ 29.32, 29.30, 29.28 lb/lb mole

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

   $M_s =$ 25.97, 26.02, 26.14 lb/lb mole

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

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

   $V_s =$ 71.68, 72.11, 70.08 ft/sec

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

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

   $Q_s =$ 40,191.5, 42,340.9, 42,365.5 ft^3 min

82,540

after 84,931

84,495

83,965 avg

CALCULATIONS (CONTINUED)

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

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

C_s = 1.3923, 1.5004, 1.7143 lb/ft^3 $\times 10^{-6}$

8. E = emission rate lb/hr

$E = C_s \cdot Q_s \cdot 60$

E = 3.3575, 3.8118, 4.3577 lb/hr AVG = 3.8423 $\frac{lb}{HR}$

(FMC 3.8217)

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 = 100.01, 95.42, 93.12 %

If 50% of Front-half = Back-half

Total M_n = "Front-half" + 50% "Front-half"

M_{n_1} = 0.0330 gm E_1 = 5.04 lb/Hr

M_{n_2} = 0.0377 gm E_2 = 5.72 lb/Hr

M_{n_3} = 0.0417 E_3 = 6.49 lb/Hr

E_{AVG} = 5.75 lb/Hr