Background Report Reference

AP-42 Section Number: 11.17

Background Chapter: 4

Reference Number: 46

Title: Stack Measurements at Austin White Lime, McNeil TX

Texas State Department of Health

Texas State Department of Health

October 1971

see NEDS data

S ORUM

17 IWC

0.3067×10^{-5} lb/DSCF

.029 Gr/DSCF

10.3% O_2

1.963

0.0569 GR/DSCF @ 0% O_2

Sampling non-isokinetic

4.9 lb/hr

220 TPD lime

18.3 TPH stone

ave 0.267 lb/ton stone

or .53 lb/ton product

or lb/hr

STACK MEASUREMENTS
at
Austin White Lime
McNeil, Texas
October 13-14, 1971

NOT USED

NOT ISOKINETIC

PART

8.2 4.0 2.4

0.498 0.219 0.131

Conducted by
State Department of Health
Air Pollution Control Program

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Introduction

In response to a request from the Compliance Group of the Air Pollution Control Services, Texas State Department of Health, stack samples were taken from the rotary kiln stack at Austin White Lime, McNeil, Texas. The object was to determine if this stack was in compliance with Regulation I of the Texas Air Control Board as defined in Appendix C of Regulation I. This regulation covers particulate pollution. The rotary kiln stack was under a variance which had expired. A wet scrubber had been installed to control the particulate emissions as part of the conditions of the variance.

Conclusion

It is concluded that the emissions from the rotary kiln stack are not in violation of Regulation I. of the Texas Air Control Board. The average allowable emission rate (for three traverses) was 38.4 pounds per hour. Actual emission rate (found by averaging the pollutant mass rates based on area ratio and concentration) was averaged for the three traverses and found to be 4.9 pounds per hour.

Background Information

These samples were taken on the 13th and 14th of October, 1971, by the Technical Programs group of Air Pollution Control Services. Mr. Bill Harris, P.E., engineer, was in charge of the stack sampling team.

Kiln operation is fairly continuous and no unusual peaks in the amount of pollution entering the air would be expected from this operation. The kiln was reported to be operating at 100% of its capacity.

There are additional stacks at this plant that vent emissions from the hydrator units. These may require sampling at some future time.

Discussion of Data Reduction

Data reduction has been performed on each traverse as though it were an independent test. Next, the results from all of the traverses for that stack (usually three traverses are taken) are averaged to give typical values for each stack. The following major output items are calculated: Percent Water, Percent Dry Gas, Specific Gravity relative to air, Specific Heat in Btu/lb°F, Molecular Weight, Density in lb/ft^3, Average Velocity in ft/sec, Mass flow rate in lb/hr, Volume flow rate in ft^3/hr, Effective stack height in feet, Allowable emission rate in lb/hr, Pollutant

Mass Rate in lb/hr, Percent isokinetic, Downwind concentration in $\mu g/M^3$. A computer printout showing additional output items and all input items will be found in the "Computer Printout of Calculations" section of this report.

One traverse has been selected at random and all calculations for this traverse are shown in detail (with units) in the "Sample Calculations" section of this report.

Austin White Lime
Rotary Lime Kiln
SUMMARY OF RESULTS

Average Percent Water		16.19 %
Average Specific Heat	0.2753	Btu/lb °F
Average Density of Stack Gas	0.06441	lb/ft^3
Average Velocity	29.29	ft/sec
Average Stack Temperature		138. °F

	Traverse One	Traverse Two	Traverse Three	Average Value
time date	1454 - 1544 10/13/71	1054 - 1144 10/14/71	1430 - 1520 10/14/71	
Mass Flow Rate of Stack lb/hr	1.57×10^5	1.55×10^5	1.57×10^5	1.57×10^5
Effective Stack Height in feet	127	127	126	127
Allowable Emission Rate in lb/hour (Based on 100 $\mu g/M^3$)	38.6	38.5	38.1	38.4
Pollutant Mass Rate in lb/hour (Based on Average PMR)	8.2	4.0	2.4	4.9
Percent Isokinetic	119	130	122	124
Downwind Concentration at Xmax $\mu g/M^3$	21.3	10.4	6.2	12.6
Downwind Distance, Xmax in feet	3524	3521	3499	3515
Total Gas Emission Rate, ft^3/hour	2.45×10^6	2.43×10^6	2.42×10^6	2.43×10^6

SAMPLE CALCULATIONS

ROTORY KILN

Data collected while taking the first traverse will be used to show how the calculations were performed.

First, the percent of water is calculated:

$$\text{Percent Water} = \frac{\dfrac{\text{weight } H_2O \text{ grams} \times 24.1 \ \frac{\text{liters}}{\text{mole}}}{18 \text{ grams/mole}} \times 100\%}{\dfrac{\text{weight } H_2O \text{ grams} \times 24.1 \ \frac{\text{liters}}{\text{mole}}}{18 \text{ grams/mole}} + \text{Dry Gas Volume in ft}^3 \ \dfrac{28.3 \text{ liters}}{\text{ft}^3} \ \dfrac{530^\circ R}{\text{Temp. meter } ^\circ R}}$$

One hundred five and nine tenth grams of water were caught while sampling the dry gas volume of twenty seven and forty-eight hundredths cubic foot.

$$\text{Percent Water} = \frac{\dfrac{105.9 \text{ gm}}{18 \text{ gm/mole}} \times 24.1 \ \dfrac{\text{liters}}{\text{mole}} \times 100\%}{\dfrac{105.9 \text{ gm}}{18 \text{ gm/mole}} \times 24.1 \ \dfrac{\text{liters}}{\text{mole}} + 27.48 \text{ ft}^3 \times \dfrac{28.3 \text{ liters}}{\text{ft}^3} \times \dfrac{530 \ ^\circ R}{546 \ ^\circ R}}$$

$$= 15.8 \%$$

The percent dry gas is the complement, 84.2 percent.

Next, the orsat analysis and the percent of water are used to calculate the molecular weight from a weighted average as follows:

$$\text{Molecular Weight} = \left(\frac{\% H_2O}{100}\right)\left(\text{Molecular weight of } H_2O\right) + \frac{\% \text{ Dry Gas}}{100} \times \sum_{i=1}^{i=4} \frac{\% \ Xi}{100}\left(\text{Molecular weight of } Xi\right)$$

10.3% O_2

$$\text{Molecular Weight} = \frac{15.8}{100} \times 18 + \frac{84.2}{100}\left(0.107 \times 44 + 0.103 \times 32 + 0.0 \times 28 + 0.790 \times 28\right) = 28.2$$

Note that the numbers; 18, 44, 32, 28, 28; are the molecular weights of H_2O CO_2, O_2, CO, N_2 respectively. Molecular weight of the stack gas is considered accurate to two significant figures only. Xi stands for one of the gases, CO_2, O_2, CO, N_2, the percent of which is determined from an Orsat Test.

Now, the density is calculated from perfect gas law considerations:

$$\text{density in } \frac{\text{lbs}}{\text{ft}^3} = \frac{\begin{pmatrix}\text{molecular}\\ \text{weight in}\\ \text{lb/lbm-mole}\end{pmatrix}\begin{pmatrix}\text{stack}\\ \text{press. in}\\ \text{inches Hg}\end{pmatrix}\left(\frac{70.73 \text{ lb/ft}^3}{\text{inches Hg}}\right)}{\left(1545.33 \frac{\text{ft lb}}{\text{lbm-mole } ^\circ\text{R}}\right)\begin{pmatrix}\text{stack temp}\\ \text{in } ^\circ\text{R}\end{pmatrix}}$$

$$\text{density in } \frac{\text{lbs}}{\text{ft}^3} = \frac{\left(28 \ \frac{\text{lb}}{\text{lbm-mole}}\right)\left(29.9 \ \frac{\text{inches}}{\text{Hg}}\right)\left(\frac{70.73 \text{ lb/ft}^3}{\text{inches Hg}}\right)}{\left(1545.33 \frac{\text{ft lb}}{\text{lbm-mole } ^\circ\text{R}}\right)\left(600 \ ^\circ\text{R}\right)} = \underline{\underline{0.0643}} \ \frac{\text{lbs}}{\text{ft}^3}$$

The buoyance term in the equation for effective stack height will require the heat capacity, or "specific heat" of the stack gas, this is also found from a weighted sum. Specific heat is a function of temperature and molecular weight. The equations and constants used below have been taken from "Chemical Process Principles" Part II, second edition. Specific heat, Cp, is calculated for each of the gases associated with the orsat test. Note that Ts refers to the stack temperature in degrees Rankine.

$$\text{Cp for } H_2O = 0.4274 + 1.416 \times 10^{-5}(Ts) + 4.319 \times 10^{-8}(Ts^2) - 8.173 \times 10^{-12}(Ts^3)$$

$$\text{Cp for } CO_2 = 0.1208 + 18.03 \times 10^{-5}(Ts) - 5.864 \times 10^{-8}(Ts^2) + 6.95 \times 10^{-12}(Ts^3)$$

$$\text{Cp for } O_2 = 0.1902 + 6.304 \times 10^{-5}(Ts) - 1.726 \times 10^{-8}(Ts^2) + 1.679 \times 10^{-12}(Ts^3)$$

$$\text{Cp for } CO = 0.2401 + 0.7936 \times 10^{-5}(Ts) + 1.364 \times 10^{-8}(Ts^2) - 3.288 \times 10^{-12}(Ts^3)$$

$$\text{Cp for } N_2 = 0.2464 - 0.7442 \times 10^{-5}(Ts) + 2.126 \times 10^{-8}(Ts^2) - 4.199 \times 10^{-12}(Ts^3)$$

Substituting the stack temperature of 600 °R into the equations above gives Cp for H_2O equal to 0.450 , Cp for CO_2 equal to 0.209 , Cp for O_2 equal to 0.222 , Cp for CO equal to 0.249 , and Cp for N_2 equal to 0.249 ; the units are Btu/lb°F. A weighted sum is now performed with weighting factors based on the orsat test and the percent of water present in the stack gas. Cp for the stack gas is found as follows:

$$\text{Cp for stack gas} = \left(\frac{\% \ H_2O}{100}\right)\begin{pmatrix}Cp\\ H_2O\end{pmatrix} + \frac{\% \text{ Dry Gas}}{100} \times \sum_{i=1}^{i=4} \frac{\% \ Xi}{100} \ (CpXi)$$

$$\text{Cp for stack gas} = (.158)(.450) + (.842)(0.107 \times 0.209 + 0.103 \times 0.222 + 0.00 \times 0.249 + 0.790 \times 0.249) = \underline{\underline{0.275}} \ \frac{\text{Btu}}{\text{lb}^\circ\text{F}}$$

Average velocity will be needed in the velocity term in the equation for effective stack height and for calculation of the total gas emission rate (TGER). Average velocity for the traverse is calculated as follows:

$$\text{Average Velocity in ft/sec} = (85.48) \times \begin{pmatrix}\text{Pitot}\\ \text{Tube}\\ \text{Corr.}\\ \text{Factor}\end{pmatrix} \sqrt{\frac{\text{Stack Temp } ^{\circ}R \times \text{Aver.}\Delta p \text{ inches } H_2O}{\text{Molecular Weight} \times \text{stack press. inches Hg}}}$$

Note that the "average" Δp must be calculated by first taking the sum of the square roots of the Δp's, then dividing by the number of Δp's, and finally squaring this number.

The following table is presented to show these calculations:

Δp	.21	.25	.27	.26	.26	.24	.24	.23	.24	.20		
$\sqrt{\Delta p}$	.458	.500	.519	.509	.509	.489	.489	.480	.489	.447		

Sum of Δp = 4.89

$$\text{Aver. } \Delta p = \left(\frac{4.89}{10}\right)^2 = 0.239 \text{ inches } H_2O$$

Now the average velocity is calculated:

$$\text{Average Velocity} = 85.48 \times .835 \times \sqrt{\frac{600 \times .239}{28 \times 29.9}} = \underline{29.5} \text{ feet/second}$$

Next, the Total Gas Emission Rate is calculated:

$$\text{TGER cu ft/hr} = \frac{\pi \begin{pmatrix}\text{Dia}\\ \text{stack}\\ \text{ft}\end{pmatrix}^2 \begin{pmatrix}3600\\ \text{sec/hr}\end{pmatrix} \begin{pmatrix}\text{Aver.}\\ \text{Vel.}\\ \text{ft/sec}\end{pmatrix}}{4}$$

$$\text{TGER} = \frac{\pi \times (29.38 \text{ ft}^2) \begin{pmatrix}3600\\ \text{sec/hr}\end{pmatrix} \begin{pmatrix}29.5\\ \text{ft/sec}\end{pmatrix}}{4} = \underline{2.45 \times 10^6 \text{ ft}^3\text{/hr}}$$

The mass flow rate, Qm, is equal to the product of the TGER times the density.

$$Qm = (2.45 \times 10^{6} \text{cuft/hr})(.0643 \text{ lbs/cuft}) = \underline{\underline{1.574 \times 10^{5} \text{lbs/hr}}}$$

Effective stack height, He, can now be calculated from:

$$He = H + 0.1203(VeDe) + 2.471 \times 10^{-6}\ Qm\ Cp\ (T-68)$$

where He is the effective stack height in feet, H is the physical stack height, VeDe is the velocity and diameter at the stack exit, Qm is the mass flow rate, Cp is the specific heat and T is the stack temperature in degrees Fahrenheit. (Note that some stacks have a smaller diameter at the exit than at the sample port. Velocity at the exit is equal to the velocity at the sample port times the square of the ratio: diameter at the sample port divided by the diameter at the exit.) The units are those that have been used in the above calculations. These results are now substituted into the equation for effective stack height.

$$He = 100 + 0.1203(29.5 \times 5.42) + 2.471 \times 10^{-6} \times 1.57 \times 10^{5}$$

$$\times .275 (140 - 68) = \underline{\underline{127}} \text{ feet}$$

The allowable emission rate* (based on 100 $\mu g/M^3$ downwind) is equal to He^2 times 2.394×10^{-3}.

For this example:

allowable emission rate at X max $= (127)^2 \times 2.394 \times 10^{-3} = \underline{\underline{38.6 \text{ lbs/hr}}}$

X max is the downwind distance for which the concentration "downwind" is theoretically maximum, consequently the allowable emission rate at this point is minimum.

$$X\ max = 13.9\ He^{1.143}$$

$$X\ max = 13.9\ (127)^{1.143} = \underline{\underline{3524 \text{ ft}}}$$

* Allowable emission rate is defined in Regulation I (appendix C, page I-C1) of the Texas Air Control Board. The constant, 2.394×10^{-3}, corresponds to that downwind distance for which the curve on page I-C5 of Regulation I changes from a vertical straight line to a curved line. At this point, X, downwind distance, is equal to $13.9\ He^{1.143}$.

The pollutant mass rate will now be calculated by the area ratio method (PMRa) and by the concentration method (PMRc). First, the area ratio is calculated:

$$\frac{\text{Area Stack}}{\text{Area Nozzle}} = \frac{22.89 \quad ft^2}{3.41 \quad \times 10^{-4} ft^2} = 6.712 \quad \times 10^4$$

Now the pollutant mass rate, PMRa, can be calculated:

$$PMRa = \frac{As}{An} \times \frac{\text{(grams particulate caught)}}{\theta \text{ hours} \times 453.6 \text{ gm/lb}}$$

$$PMRa = \frac{6.712 \times 10^4 (0.0499 \quad \text{grams})}{\frac{50}{60} \text{ hours} \times 453.6 \text{ grams/lb}} = \underline{\underline{8.9 \quad \text{lb/hr}}}$$

Calculation of pollutant mass rate based on concentration (PMRc) requires calculation of the concentration in the stack:

$$\text{Concentration, } C = \frac{\text{grams particulate caught}}{\left(\text{Vol. through nozzle stack cond.}\right) \times 453.6 \text{ gm/lb}}$$

Before the concentration can be calculated, the volume through the nozzle at stack conditions must be calculated as follows:

$$\text{Vol. through nozzle} = \frac{\text{Vol. meter cond.} \times \frac{Ts}{Tm} \times \frac{Pm}{Ps}}{\text{Dry Gas Fraction}}$$

34.7

$$\text{Vol. through nozzle} = \frac{27.48 \quad ft^3}{.842} \times \frac{600 \quad {}^oR \times 29.9 \quad \text{in Hg}}{546 \quad {}^oR \times 29.9 \quad \text{in Hg}} = 35.86 \quad ft^3$$

Now the concentration is:

$$C = \frac{0.0499 \quad gm}{35.86 \quad ft^3 \times 453.6 \text{ gm/lb}} = 0.3067 \quad \times 10^{-5} \text{ lb/ft}^3$$

ORT

and the pollutant mass rate (PMRc) can be calculated as follows:

$$PMRc = \left(\text{area stack}\right) \times \left(\text{Aver. Vel.}\right) \times \left(3600 \text{ sec/hr}\right) \times C$$

$$PMRc = (22.89 \quad ft^2)(29.5 \quad ft/sec)(3600 \text{ sec/hr})(.3067 \times 10^{-5} \text{ lb/ft}^3)$$

$$PMRc = \underline{\underline{7.5 \quad \text{lb/hr}}}$$

.029 G/SCF

The average pollutant mass rate is found from:

$$\text{Aver. PMR} = \frac{\text{PMRa} + \text{PMRc}}{2} = \frac{8.9 + 7.5}{2} = \underline{8.2 \quad \text{lbs/hr}}$$

Percent isokinetic is the ratio of PMRa to PMRc:

$$\text{Percent Isokinetic} = 100\% \times \frac{\text{PMRa}}{\text{PMRc}} = 100 \times \frac{8.9}{7.5} = \underline{119 \quad \%}$$

For this example, the downwind concentration will be calculated from the pollutant mass rate based on the average pollutant mass rate.

$$\text{DWC} = \frac{\text{PMR (Aver.)}}{\text{Allowable Emission Rate}} \times 100 = \frac{8.9}{38.6} \times 100 = \underline{21.3 \quad \mu g/M^3}$$

INPUT DATA   REPORT N13003

AUSTIN WHITE LIME   MCNEIL,TEX.

ROTARY KILN STACK   3 TRAVERSES   TAKEN

TRAVERSE NO. 1 WAS TAKEN   OCTOBER 13,1971   2154 PM

TIME REQ, FOR TRAVERSE 50.00 MINUTES

BAROMETRIC PRESS 29.900 INCHES MERCURY ABSO

PRESS, DRYGAS METER 29.900 INCHES MERCURY ABSO

PRESS, STATIC, STACK   0.000 INCHES WATER GAGE

PRESS DROPS, PITOT TUBE   INCHES WATER GAGE

0.210	0.250	0.270	0.260	0.260	0.240
0.240	0.230	0.240	0.200		

TEMP, AMBIENT 85. DEGREES FAHRENHEIT

TEMP, DRYGAS METER 86. DEGREES FAHRENHEIT

TEMP, STACK, AVERAGE 140. DEGREES FAHRENHEIT

ORSAT ANALYSIS: CO2= 0.107   O2= 0.103   CO= 0.000   N2= 0.790

AREA OF NOZZLE 0.341E-03 SQUARE FEET   D: .25"

PITOT TUBE CALIB FACTOR 0.835

DISTANCE TO NEAREST PROP. LINE   1000.0 FEET

PHYSICAL STACK HEIGHT 100.0 FEET

SAMPLE VOLUME, DRYGAS METER 27.48 CUBIC FEET

MASS OF WATER CAUGHT   105.9 GRAMS

MASS OF PARTICULATE CAUGHT 0.0499 GRAMS

SILICA GEL, MOISTURE FRACTION 0.000

OVERIDE, VELOCITY   0.0 FEET PER SECOND

DIAMETER OF STACK, EXIT 5.42 FEET

DIAMETER OF STACK, SAMPLE PORT 5.42 FEET

PARTICAL SIZE FLAG MIXED

CALCULATION RESULTS   REPORT N13003

AUSTIN WHITE LIME MCNEIL, TEX.

ROTARY KILN STACK   3 TRAVERSES TAKEN

TRAVERSE NO. 1 WAS TAKEN   OCTOBER 13, 1971   2:54 PM

15.80 PERCENT WATER   84.20 PERCENT DRYGAS

FOR COMPARISON ONLY BW2= 0.000   SPECIFIC GRAVITY= 0.974   AIR=1.00

SPECIFIC HEATS AT SAMPLE POINT TEMPERATURE BTU/LB DEG. F
H2O= 0.4497   CO2= 0.2094   O2= 0.2222   CO= 0.2491
N2= 0.2487   COMBINED SPHEAT= 0.2746

MOLECULAR WEIGHT 28.21   DENSITY 0.06434 LBS/CUFT

AVERAGE VELOCITY 29.46 FEET PER SECOND

MASS FLOW RATE 0.15742963E 06 LBS/HOUR

VOL FLOW RATE 0.24468130E 07 CUFT/HOUR

NOZZLE VOLUME 35.863 CUBIC FEET

EFFECTIVE STACK HEIGHT 126.9 FEET

ALLOWABLE EMISSION RATE AT XMAX 38.6 LBS/HOUR

DOWNWIND DISTANCE, XMAX 3524.3 FEET

ALLOWABLE EMISSION RATE, REG. I, PROP. LINE 0.38552948E 02 LBS/HOUR

POLLUTANT MASS RATE, AREA RATIO 8.9 LBS/HOUR -

CONCENTRATION 0.30669335E-05 LBS/CUFT   - DACFM

POLLUTANT MASS RATE, CONCENTRATION 7.5 LBS/HOUR

PERCENT ISOKINETIC 119.0 PERCENT

POLLUTANT MASS RATES AVERAGED 8.2 LBS/HOUR

DOWNWIND CONCENTRATION 21.32 MICROGRAMS/CUBIC METER

INPUT DATA REPORT N13003

AUSTIN WHITE LIME MCNEIL,TEX.

ROTARY KILN STACK 3 TRAVERSES TAKEN

TRAVERSE NO. 2 WAS TAKEN OCTOBER 14,1971 10:54 PM

TIME REQ. FOR TRAVERSE 50.00 MINUTES

BAROMETRIC PRESS 29.900 INCHES MERCURY ABSO

PRESS, DRYGAS METER 29.900 INCHES MERCURY ABSO

PRESS, STATIC, STACK 0.000 INCHES WATER GAGE

PRESS DROPS, PITOT TUBE INCHES WATER GAGE

0.220	0.250	0.300	0.280	0.230	0.230
0.220	0.220	0.220	0.190		

TEMP, AMBIENT 80. DEGREES FAHRENHEIT

TEMP, DRYGAS METER 78. DEGREES FAHRENHEIT

TEMP, STACK, AVERAGE 140. DEGREES FAHRENHEIT

ORSAT ANALYSIS, CO2= 0.107 O2= 0.103 CO= 0.000 N2= 0.790

AREA OF NOZZLE 0.341E-03 SQUARE FEET

PITOT TUBE CALIB FACTOR 0.835

DISTANCE TO NEAREST PROP. LINE 1000.0 FEET

PHYSICAL STACK HEIGHT 100.0 FEET

SAMPLE VOLUME, DRYGAS METER 28.90 CUBIC FEET

MASS OF WATER CAUGHT 127.3 GRAMS

MASS OF PARTICULATE CAUGHT 0.0253 GRAMS

SILICA GEL, MOISTURE FRACTION 0.000

OVERIDE, VELOCITY 0.0 FEET PER SECOND

DIAMETER OF STACK, EXIT 5.42 FEET

DIAMETER OF STACK, SAMPLE PORT 5.42 FEET

PARTICAL SIZE FLAG MIXED

Austin White Lime — Source Test

From TAYCB concentration = .30669335 × 10^{-5} lb/DACF

$$= \frac{.30669335 \times 10^{-5} \text{ lb grains}}{1.43 \times 10^{-4} \text{ lb} \quad \text{DACF}}$$

T_{stack} = 140°F + 460

$T_{D\ gas\ meter}$ = 86°F + 460

T_{std} = 70°F = 530

= .0214 grains/DACF

$$= \frac{.0214 \text{ gr}}{\text{DACF}} \times \frac{600°}{530°} = \frac{.0242 \text{ grains}}{\text{DSCF}}$$

34.77

.3067 × 10^{-5} lb/DACF

.143 × 10^{-5} " "

.0877

1.5374 × 10^{-5} lb/DACF

Temp 135, 140, 138

Temp ave = 138°
460
598°

Ave results .179 × 10^{-5} lb/DACF

$$\frac{.179 \times 10^{-5}}{1.43 \times 10^{-4}} = .01252 \text{ grains/DACF}$$

$$.01252 \times \frac{598}{530} = .0141 \text{ grains/DSCF}$$

PLANT: JUSTIN
LOCATION: [illegible]
OPERATOR: TEXAS

PARTICULATE SUMMARY IN ENGLISH UNITS

NAME	9	AVERAGE
	10-[illegible]3-75	
	10-[illegible]3-75	
[illegible]	23,043	
TIME	50.[illegible]	
PBAR	29.[illegible]0	
[illegible]	.[illegible]	
[illegible]	[illegible]7,38	
[illegible]	[illegible]7,48	
[illegible]	85.9	
[illegible]	[illegible].70	
[illegible]	105.9	
VWSTD	5.02	
[illegible]	15.8	
[illegible]	.842	
[illegible]	.842	
PCT [illegible]	1[illegible].7	
PCTO2	10.3	
PCT [illegible]	.0	
PCTN2	79.0	
[illegible]	[illegible].12	
MOLWT	30.12	
[illegible]	[illegible]	
[illegible]	18.0	
[illegible]	14.0	
NOPTS	1	
PSTACK	29.40	
QACTL	29.4[illegible]	[illegible].4
[illegible]	[illegible]6.	[illegible]

VUACTL	40778.	40778.
ISOK [illegible]	94.1	[illegible]
MOOL F	49.[illegible]0	[illegible]
MOOL T	49.90	49. 0
CSCMFG	.02878	.0287[illegible]
CSCMTG	.02878	.02878
CSCMFC	.03228	.03228
CSCMTC	.03228	.03[illegible]8
CSCMFA	.02705	.02705
CSCMTA	.02705	.02705
CSCMFL	9.46	9.46
CSCMTL	9.46	9.46
LBTON[illegible]	***[illegible]	[illegible]
PCTEA	97.6	97.6

PLANT: AUSTIN
LOCATION: MCNEAL
OPERATOR: TEXAS

PARTICULATE SUMMARY IN METRIC UNITS

NAME	0	AVERAGE
	10-[illegible]3-75	
AS[illegible]	2.141	
TIME	50.0	
[illegible]	7 9.46	
PD[illegible]AVG	.000	
VMACTL	.78	
TMAV[illegible]	29.4	
TMAVAV	29.4	
VMSTD	.76	
VMSTD	.76	
VLATO[illegible]	105.9	
VWSTD	.14	
MOIST	15.8	
MD	.842	
PCTCO2	10.7	
PCTO2	10.3	
PCTCO	.0	

PLANT ________ DATE ________ RUN # ________

HP 35 FIELD ISOKINETIC CALCULATION FORM

Clr
② Pm 0
↑
13.6
÷
③ Pb 29.9
+
④ Vm 27.48
x
17.7
x
⑤ Tmr 546
÷
= ⑥ Vms 26.64

Clr
⑦ Vw 105.9
↑
.0474
x
= ⑧ Vw gas 5.02

Clr
⑧ Vwg 5.02
↑
⑥ Vms 26.64
+
Sto
⑧ Vwg 5.02
↑
100
x
Rcl
÷
= ⑨ %M 15.86 ~~13.06~~

Clr
100
↑
⑨ %M 15.86
−
100
÷
= ⑩ Md .844

ORSAT DATA

Clr
%CO2 10.7
↑
.44
x
Sto
%O2 10.3
↑
.32
x
Rcl
+
Sto
%CO 0.0
↑
%N2 79.
+
.28
x
Rcl
+
= ⑪ Mwd 30.12

Clr
1
↑
⑩ Md .8414
−
18
x
Sto
⑩ Md .8414
↑
⑪ Mwd 30.12
x
Rcl
+
= ⑫ Mw 28.20

Clr
③ Pb
↑
⑬ Pst
+ or −
= ⑭ Ps 29.9

Clr
⑫ Mw 28.2
↑
⑭ Ps 29.9
x
Sto
1
↑
Rcl
÷
√
⑯ √ΔPxT 11.92
x
⑮ Cp .835
x
5128.8
x
= ⑰ Vs 1758

29.30

Clr
1032
↑
⑱ Ts°R 600
x
⑥ Vms 26.64
x
⑰ Vs 1758
÷
⑲ Tt 60
÷
⑭ Ps 29.9
÷
⑩ Md .844
÷
⑳ Dn² .0625
÷
= %I 119

.0296/dscf

D = DATA
C - CALCULATED

	②	D	P
	③	D	P
	④	D	V
*	⑤	D	Tm
	⑥	C	Vm
	⑦	D	Vw
	⑧	C	Vw
	⑨	C	%[illegible]
	⑩	C	Md
	⑪	C	Mw
	⑫	C	Mw
	⑬	D	Pst
	⑭	C	Ps
	⑮	D	Cp
*	⑯	C	√ΔP
	⑰	C	Vs
*	⑱	D	Ts°R
	⑲	D	Tt m
*	⑳	D	Dn

⑯ INDIVIDUAL VALUES

CIA
ΔP1
↑
Ts°R1
x
Sto
ΔP2
↑
Ts°R2
x
Rcl
+
Sto
.
.
.
ΔPN
↑
Ts°RN
x
Rcl
+
N
÷
= ⑯

CALCULATION RESULTS   REPORT N13003

AUSTIN WHITE LIME MCNEIL,TEX.

ROTARY KILN STACK   3 TRAVERSES TAKEN

TRAVERSE NO. 2 WAS TAKEN OCTOBER 14,1971   10:54 PM

17.44 PERCENT WATER   82.56 PERCENT DRYGAS

FOR COMPARISON ONLY BW2= 0.000   SPECIFIC GRAVITY= 0.968   AIR=1.00

SPECIFIC HEATS AT SAMPLE POINT TEMPERATURE BTU/LB DEG. F
H2O= 0.4497   CO2= 0.2094   O2= 0.2222   CO= 0.2491
N2= 0.2487   COMBINED SPHEAT= 0.2780

MOLECULAR WEIGHT 28.01   DENSITY 0.06389 LBS/CUFT

AVERAGE VELOCITY 29.29 FEET PER SECOND

MASS FLOW RATE 0.15539488E 06 LBS/HOUR

VOL FLOW RATE 0.24324010E 07 CUFT/HOUR

NOZZLE VOLUME 39.040 CUBIC FEET

EFFECTIVE STACK HEIGHT 126.8 FEET

ALLOWABLE EMISSION RATE AT XMAX 38.5 LBS/HOUR

DOWNWIND DISTANCE, XMAX 3520.5 FEET

ALLOWABLE EMISSION RATE, REG. I, PROP. LINE 0.38481339E 02 LBS/HOUR

POLLUTANT MASS RATE, AREA RATIO 4.5 LBS/HOUR

CONCENTRATION 0.14303996E-05 LBS/CUFT

POLLUTANT MASS RATE, CONCENTRATION 3.5 LBS/HOUR

PERCENT ISOKINETIC 130.3 PERCENT

POLLUTANT MASS RATES AVERAGED 4.0 LBS/HOUR

DOWNWIND CONCENTRATION 10.41 MICROGRAMS/CUBIC METER

INPUT DATA   REPORT N13003

AUSTIN WHITE LIME MCNEIL,TEX.

ROTARY KILN STACK 3 TRAVERSES TAKEN

TRAVERSE NO.3 WAS TAKEN OCTOBER 14,1971 2:30 PM

TIME REQ, FOR TRAVERSE 50.00 MINUTES

BAROMETRIC PRESS 29.900 INCHES MERCURY ABSO

PRESS, DRYGAS METER 29.900 INCHES MERCURY ABSO

PRESS, STATIC, STACK 0.000 INCHES WATER GAGE

PRESS DROPS, PITOT TUBE INCHES WATER GAGE

0.200	0.260	0.280	0.250	0.260	0.240
0.240	0.230	0.220	0.190		

TEMP, AMBIENT 76. DEGREES FAHRENHEIT

TEMP, DRYGAS METER 82. DEGREES FAHRENHEIT

TEMP, STACK, AVERAGE 135. DEGREES FAHRENHEIT

ORSAT ANALYSIS: CO2= 0.107 O2= 0.103 CO= 0.000 N2= 0.790

AREA OF NOZZLE 0.341E-03 SQUARE FEET

PITOT TUBE CALIB FACTOR 0.835

DISTANCE TO NEAREST PROP, LINE 1000.0 FEET

PHYSICAL STACK HEIGHT 100.0 FEET

SAMPLE VOLUME, DRYGAS METER 28.05 CUBIC FEET

MASS OF WATER CAUGHT 105.0 GRAMS

MASS OF PARTICULATE CAUGHT 0.0145 GRAMS

SILICA GEL, MOISTURE FRACTION 0.000

OVERIDE, VELOCITY 0.0 FEET PER SECOND

DIAMETER OF STACK, EXIT 5.42 FEET

DIAMETER OF STACK, SAMPLE PORT 5.42 FEET

PARTICAL SIZE FLAG MIXED

CALCULATION RESULTS   REPORT N13003

AUSTIN WHITE LIME   MCNEIL,TEX.

ROTARY KILN STACK   3 TRAVERSES TAKEN

TRAVERSE NO.3 WAS TAKEN OCTOBER 14,1971   2:30 PM

15.32 PERCENT WATER   84.68 PERCENT DRYGAS

FOR COMPARISON ONLY BW2= 0.000   SPECIFIC GRAVITY= 0.976   AIR=1.00

SPECIFIC HEATS AT SAMPLE POINT TEMPERATURE BTU/LB DEG. F
H_2O= 0.4494 CO_2= 0.2088 O_2= 0.2220   CO= 0.2490
N_2= 0.2486   COMBINED SPHEAT= 0.2734

MOLECULAR WEIGHT 28.27   DENSITY 0.06501 LBS/CUFT

AVERAGE VELOCITY   29.11 FEET PER SECOND

MASS FLOW RATE   0.15716288E 06 LBS/HOUR

VOL FLOW RATE   0.24173390E 07 CUFT/HOUR

NOZZLE VOLUME   36.363   CUBIC FEET

EFFECTIVE STACK HEIGHT   126.1 FEET

ALLOWABLE EMISSION RATE AT XMAX   38.1 LBS/HOUR

DOWNWIND DISTANCE, XMAX 3498.6 FEET

ALLOWABLE EMISSION RATE, REG. I, PROP. LINE   0.38063736E 02 LBS/HOUR

POLLUTANT MASS RATE, AREA RATIO   2.6 LBS/HOUR

CONCENTRATION   0.87729239E-06 LBS/CUFT   Y = 1/1.43×10^-9

POLLUTANT MASS RATE, CONCENTRATION   2.1 LBS/HOUR

PERCENT ISOKINETIC 122.1 PERCENT

POLLUTANT MASS RATES AVERAGED   2.4   LBS/HOUR

DOWNWIND CONCENTRATION   6.19   MICROGRAMS/CUBIC METER

AVERAGE RESULTS   REPORT N13003

AUSTIN WHITE LIME MCNEIL,TEX.

ROTARY KILN STACK   3 TRAVERSES TAKEN

16.19 PERCENT WATER   83.81 PERCENT DRYGAS

FOR COMPARISON ONLY BW2= 0.000   SPECIFIC GRAVITY= 0.973   AIR=1.00

SPECIFIC HEATS AT SAMPLE POINT TEMPERATURE BTU/LB DEG. F
H2O= 0.4496   CO2= 0.2092   O2= 0.2221   CO= 0.2490
N2= 0.2487   COMBINED SPHEAT= 0.2753

MOLECULAR WEIGHT 28.16   DENSITY 0.06441 LBS/CUFT

AVERAGE VELOCITY   29.29 FEET PER SECOND

MASS FLOW RATE   0.15666244E 06 LBS/HOUR

VOL FLOW RATE   0.24321840E 07 CUFT/HOUR

NOZZLE VOLUME   36.363   CUBIC FEET

EFFECTIVE STACK HEIGHT   126.6 FEET

ALLOWABLE EMISSION RATE AT XMAX   38.4 LBS/HOUR

DOWNWIND DISTANCE, XMAX 3514.5   FEET

ALLOWABLE EMISSION RATE, REG. I, PROP. LINE   0.38365997E 02 LBS/HOUR

POLLUTANT MASS RATE, AREA RATIO   5.4 LBS/HOUR

CONCENTRATION   0.17915418E-05 LBS/CUFT

POLLUTANT MASS RATE, CONCENTRATION   4.4 LBS/HOUR

PERCENT ISOKINETIC 123.8 PERCENT

POLLUTANT MASS RATES AVERAGED   4.9   LBS/HOUR

DOWNWIND CONCENTRATION   12.64   MICROGRAMS/CUBIC METER

APPENDIX A

Texas Air Control Board
1100 West 49th Street
Austin, Texas - 78756

Date ______________

SAMPLING DATA AND PLANT OPERATIONAL STATUS

Firm Name AUSTIN WHITE LIME
Location of Plant McNEIL, TEXAS
Type of Operation ______________

SAMPLING DATA*

Type of Sample	Location	Duration
10/12/71 PARTICULATE	ROTARY KILN STACK	From 1454 to 1544
10/14/71 PARTICULATE	" " "	From 1054 to 1144
10/14/71 PARTICULATE	" " "	From 1430 to 1520
10/15/71 PARTICULATE	HYDRATOR STACK	FROM 1525 to 1615

Special Conditions ______________

I certify that the above sample(s) is(are) representative of conditions at the time of the investigation:

Signature Seaman H. Harris
Title Engineering Assistant

PLANT OPERATIONAL STATUS (During the sampling period)**

Process	Percent Capacity	Abatement Controls
LIME CALCINING	100	WET SCRUBBER
"	"	" "
"	"	" "
LIME HYDRATING	"	" "

Special Conditions ______________

I certify that the above statement is true to the best of my knowledge and belief:

Signature A. H. Robinson III
Title Partner

* To be completed and acknowledged by Air Control Program representative.
** To be completed and acknowledged by plant representative. It is understood that all the above information will be considered confidential.

BASIS FOR REVISIONS TO SECTION 8.18; PHOSPHATE ROCK PROCESSING

1.0 Introduction

The current AP-42 Section on Phosphate Rock Processing has not been revised since early 1972. It is based on the following references: Air Pollution, Vol. III, 2nd ed., Sources of Air Pollution and Their Control by A. Stern (Ed.); unpublished data from phosphate rock preparation plants in Florida by Midwest Research Institute (June, 1970) and an EPA internal document on control of fluoride emissions. More recent and extensive information is now available in a Draft Background Information Document for Proposed New Source Performance Standards for Phosphate Rock Processing (September, 1979). This document discusses the various processing steps used, quantifies and characterizes emissions from these processing steps, and discusses available control technology. This document was used to revise and expand the process description, the discussion of emissons and controls, and the emission factor table. These revisions are discussed in the following sections.

2.0 Process Description

The current AP-42 process description for phosphate rock processing is very brief (only four lines long). It does not include a process flow diagram, and discusses only processing steps for Florida rock. The Background Information Document was used to expand this description and to prepare a process flow diagram. The major processing steps discussed are beneficiation, drying/calcining, grinding, and ground rock transfer. Calcining is not discussed in the current AP-42 description, but is a necessary processing step in the treatment of rock mined in North Carolina and in the Western reserves. Rock from these reserves had a higher organic content than Florida rock, and must be calcined to drive off these organics while Florida rock can simply be dried.

3.0 Emissions and Controls

The discussion of emissions and controls in the current AP-42 section is also very brief. The Background Information Document was used to expand this discussion. Emissions from the major processing steps are discussed in the revised section. A particle size distribution for dryer and calciner emissions is given. Particulate control equipment used to control emissions from the various processing steps and typical control efficiencies are also discussed.

4.0 Emission Factors

Emission factors for drying and grinding were revised and factors for calcining were developed according to information in the draft Background Information Document. The factor for transfer and storage was not changed, since the current factor was reported and referenced in the BID. Wet beneficiated rock is commonly stored in open piles, but dried and ground rock is normally stored in enclosed silos or bins. Emissions from the storage silos are frequently controlled by fabric filters. The existing and revised emission factors are compared in Table 1.

TABLE 1. EXISTING AND REVISED UNCONTROLLED PARTICULATE EMISSION FACTORS FOR PHOSPHATE ROCK PROCESSING[a]

Type of Source	Emissions				Reference for Revision
	Revised		Existing		
	lb/ton	kg/MT	lb/ton	kg/MT	
Drying	5.7 (1.4-14.0)	2.9 (0.7-7.0)	15	7.5	1,p. 6-5
Calcining	15.4 (3.8-38)	7.7 (1.9-19.0)	-	-	1,p. 6-5
Grinding	1.5 (0.4-4.0)	0.8 (0.2-2.0)	20	10	1,p. 6-5
Transfer and storage	2	1	2	1	2,p. 8.18-1 and 1,p. 4-19
Open storage piles	40	20	40	20	2,p. 8.18-1 and 1,p. 3-22, 4-18, 4-19
Particle size distribution					1,p. 4-11

[a]Emission factors expressed in units per unit weight of phosphate rock processed.

References

1. Background Information: Proposed Standards for Phosphate Rock Plants, Draft Report, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1978.

2. Compilation of Air Pollutant Emission Factors, Second Edition, April 1973, U.S. Environmental Protection Agency, Publication No. AP-42.