AP-42 Section Number: 9.9.1

Reference Number: 34

Title: Written Communcation From W. James Wagoner, Butte County Air Pollution Control Agency, Durham, CA, To Dallas Safriet, USEPA RTP, NC October 11, 1993

AP-42 Section 9.9.1
Reference 34
Report Sect.
Reference

Butte County
AIR POLLUTION CONTROL DISTRICT
9287 MIDWAY, SUITE 1A
DURHAM, CALIFORNIA 95938 (916) 891-2882

October 11, 1993

Dallas Safriet
U.S. Environmental Protection Agency
Emission Inventory Branch (MD-14)
Research Triangle Park, NC 27711

Mr. Safriet:

I am providing you with information on rice dryers for consideration in the upcoming issue of AP-42 Section 6.9.1. In particular, the following information is provided:

1. "Sacramento Valley Air Basin Report - Emission Factors" This is a compilation of emission factors prepared for the Sacramento Valley Air Basin Technical Advisory Committee. Dryer emission factors were developed based upon data from reference items 2, 3, 4, 5 and 7 below.
2. 1981 source test of Butte County Rice Growers Richvale Dryer #1.
3. 1981 source test of Butte County Rice Growers Richvale Dryer #2.
4. 1981 source test of Butte County Rice Growers Riceton Dryer.
5. 1981 source test of Red Top Dryer.
6. 1980 source test of Rice Growers Association Dryer.
7. 1974 California Air Resources Board report on rice dryers.
8. California Warehouse Association Letter dated 8/12/93.

Much of the data presented in the draft Section 6.9.1 is at least 10 years old, as is all of the information available to us. Industry has noted that there have been significant changes in the harvesting techniques and improvements in rice varieties that will positively impact emissions (see item 8 above). It is suggested that more current source test data be emphasized in the data analyses.

In addition, industry has questioned whether it is the intent to apply the emission factor for each ton processed. Some drying facilities may pass each ton received through the dryer 2-3 times. Industry feels that a process factor of 2 or 3 is not realistic. It is pointed out that a typical ratio of 0.3 tons processed per ton received is included in table 6.9.1-3 and 6.9.1-4 for country elevator drying. It is suggested that the typical ratios provided in tables 6.9.1-3 and 6.9.1-4 be reviewed.

Thank you for the opportunity to review the draft AP-42 Section 6.9.1. If you have any questions on the information provided, please contact me at (916) 891-2882.

Sincerely,

W. James Wagoner

W. James Wagoner
Air Quality Engineer

WJW:jw
Enclosures

(apcorres\safriet.ltr)

SACRAMENTO VALLEY AIR BASIN REPORT - EMISSION FACTORS

Sacramento Valley Air Quality
Engineering and Enforcement Professionals

DRAFT

Date: March 3, 1993
Source type: Rice Dryers
SIC Codes: 0723

Emission factors are for an uncontrolled source and are expressed in pounds per unit:

PROCESS	UNITS	TSP	PM-10	NOx	TOG	SO_2	CO	REFERENCE
Unloading (Receiving)	tons received	0.60	0.22					1, 2, & 3
Cleaning	tons cleaned	3.0	1.08					2, 3, & 4
Drying (Screen)	tons dried	0.70	0.25					4 & 5
Drying (Baffle)	tons dried	1.56	0.56					4 & 6
Transfer & Turning	tons transferred	1.00	0.36					2, 3, & 4
Loading (Shipping)	tons shipped	0.30	0.11					2, 3, & 4
Natural Gas Fired Dryer	$MMft^3$ burned	7.5	4.5	100	11	0.6	21	3 & 7
Propane Fired Dryer	Mgal burned		0.4	14	0.5	0.10s	1.9	8
Diesel Fired Dryer	Mgal burned	2.0		20	0.556	142s	5	9

Footnotes:
1) All emission factors are for uncontrolled processes. Control efficiencies should be assigned based upon average control efficiencies and inspector observations.
2) AP-42 Table 6.4-1
3) AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Pollutants (EPA 450/4-90-003) with errata.
4) Assumption: 36% of TSP is PM-10. California Air Resources Board Report 74-8-8.
5) SVAQEEP - Average of 13 screen dryers source tested.
6) SVAQEEP - Average of 10 baffle dryers source tested.
7) AP-42 Table 1.4-1. PM-10 is the filterable PM, TSP is the condensable PM.
8) AP-42 Table 1.5-1 (commercial). S = sulfur content expressed in gr./100 ft^3 of vapor. PM-10 is the filterable PM.
9) AP-42 Table 1.3-1 (commercial). S = weight % of sulfur in the oil multiplied by given value.
10) Emission factors for TSP and PM-10 may be expressed in terms of lbs/ton received by applying a ratio of tons processed per ton received. It is recommended that this adjustment be made to consider multiple passes on the drying process.
11) Any facilities having their own source test data will use factors derived from the source test results.
12) The version of AP-42 referenced includes Supplement E.

SACRAMENTO VALLEY AIR BASIN REPORT - EMISSION FACTORS

Sacramento Valley Air Qualtiy
Engineering and Enforcement Professionals

Date: March 3, 1993
Source type: Rice Dryers
SIC Codes: 0723

Rice Drying - Typical Equipment and Control Devices for Particulate Matter Only

Process	Equipment	Control Device	Control Efficiency
Receiving*	Receiving Pit		
Cleaning	Screen Cleaner	Cyclone	65-75%
	Drum Scalper	Baghouse	95-99%
	Chain Scalper	Settling Chamber	60%
	Barrel Aspirator	Water Spray Curtain	95-99%
	Floor Sweep	Building Enclosure	25-95%
Drying*	Screen/Baffle Dryer		
	Flathouse		
	Bin Drying/Aerating		
Storage/Aeration*	Bin		
	Silo		
	Flathouse		
Transfer*	Auger		
	Elevator		
	Conveyor		
	Drop Point		

* Use **Cleaning** "Control Device" and "Control Efficiency" where appropriate.

Dryer Type: Screen Dryer

Dryer	Drying Air (cfm)	Process Rate (Tons/Hr)	Pass No.	Emissions gr/dscf	lbs/hr	lbs/ton
Red Top	176,729	200		0.015	22.72	0.11
BUCRA #1 (Richvale)	316,659	220		0.005	13.52	0.06
BUCRA (Riceton	177,468	125		0.0044	6.70	0.05
ARB-A	150,000	60	1 & 3	0.019	24	0.40
ARB-B	160,000	60	1 & 2	0.034	46	0.77
ARB-C	94,170	18	1	0.038	31	1.70
ARB-D	50,000	22.5	2	0.040	17	0.76
ARB-E	50,000	29.5	1	0.007	2.8	0.10
ARB-F	50,000	22.5	4 & 5	0.022	9.4	0.42
ARB-G	180,000	50	3	0.027	42	0.85
ARB-G	180,000	50	2	0.031	48	0.96
ARB-H	160,000	50	2	0.061	84	1.8
ARB-I	39,900	30	3	0.037	36	1.20

DRAFT

Notes: 1. uncontrolled emissions
2. Average = 0.70 lbs/Ton
3. Red Top dryer source test dated 10/10/81
4. BUCRA #1 and BUCRA (Riceton) source tests dated 10/29/81
5. ARB-A → ARB-I dryer source tests per ARB report 74-8-B, dated 4/11/74

Dryer Type: Baffle Dryer

Dryer	Drying Air (cfm)	Process Rate (Tons/Hr)	Pass No.	Emissions gr/dscf	lbs/hr	lbs/ton
BUCRA #2 (Richvale)	291,249	240		0.0158	39.4	0.16
ARB-L	100,000	50	2	0.049	42	0.83
ARB-L	100,000	42.5	1	0.17	150	3.0
ARB-M	150,000	50	1	0.021	27	0.54
ARB-M	150,000	50	2	0.083	110	2.1
ARB-N	160,000	80	3 & 4	0.15	210	2.6
ARB-O	200,000	90	1	0.14	230	2.6
ARB-P	160,000	220	1 & 3			
ARB-P	160,000	220	4	0.11	150	0.70
ARB-P	160,000	220	6			
ARB-Q	60,000	70	3	0.071	37	0.52
ARB-R	113,000	69.5	1	0.11	100	1.5
ARB-S	23,500	37.5	1	0.23	46	1.2
ARB-T	120,000	90	6	0.12	120	1.3

DRAFT

Notes: 1. Uncontrolled emissions

2. BUCRA #2 is a 2-screen, 2-baffle drying facility

3. ARB-T is an aeration dryer

4. Average, excluding BUCRA #2 & ARB-T = 1.56 lbs/Ton

5. BUCRA #2 dryer source test dated 10/29/81

6. ARB-L → ARB-T dryer source tests per ARB report 74-8-8, dated 4/11/74

WJW 10/2/95

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SUMMARY REPORT

HIGH-VOLUME SAMPLING

PLANT NAME AND LOCATION: BUTTE COUNTY RICE GROWERS RICHVALE PLANT

SOURCE IDENTIFICATION: NEW SOURCE: GAS FIRED SCREEN DRYER

DATE TESTED: OCTOBER 29, 1981 BY: E.C. Butchino

RESULTS

Barometric Pressure	Po	"Hg	30.39
Moisture Content	Ms	%	3.87
Gas Temperature	Ts	°F	84
Sampling Time	t	min.	40
Sample Volume	Q	scf	1141.3
Gas Flow	Q_s	scfm	316659
Grain Loading	Cg	gr/dscf	0.005
Emission Rate	E	lbs/hr	13.52
Production Rate	P	tons/hr	220

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HIGH VOLUME SAMPLING DATA SHEET

AMBIENT AND ENCLOSED SPACE SAMPLES

SOURCE: Butte County Rice Growers LOCATION: Richvale, California

New Source Gas Fired Screen Dryer #1

DATE: Oct. 29, 1981 TIME: 1318-1420 BY: E.C. Butchino.

Symbol	Description	Sample 1	Sample 2	Average	Total
P_o	Barometric Pressure "Hg	30.39	30.39	30.39	
T_d	Dry Bulb Temperature °F	84.	84.	84.	
T_w	Wet Bulb Temperature °F	84	84	84	-
$\%H_2O$	Percent Moisture	3.87	3.87	3.87	
Ms	$\%H_2O/100$	.0387	.0387	.0387	
ΔH	Orifice Dif. Pressure "H_2O	0.44	0.44	0.44	
q_o	Orifice Flow acfm	30.0	30.0	30.0	
T_o	Orifice Temperature °F	84	84	84	
Δt	Sampling Time minutes	20.0	20.0	20.0	40.0
Q_o	Total Sample Volume acf	600	600		1200
Q	Dry Sample Volume scf				1141.3
	Filter Number	126	127		
	Gross Filter Wt. g.	3.7559	3.7440		
	Net Filter Wt. g.	0.1669	0.1895		
	Blank Filter Wt. g.	+0.0001	+0.0001		
	Adj. Sample Wt. g.	0.1668	0.1894		.3562
	Sampler Wash Wt. g.				.0.1310
W	Total Sample Wt. g.				.3693
	Air Flow acfm				320 000
V	Air Flow scfm				316 659
Cg	Emissions gr/dscf			.005	
E	Emissions lbs/hr				13.52
P	Production Rate tons/hr			220.	

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CALCULATING EQUATIONS

Q - Dry Sample Volume = $\frac{(17.71)(Q_o)(P_o)}{T_o}(1-Ms)$

where: Q_o = Sample volume @ Orifice Temperature
T_o = Orifice Temperature + 460
P_o = Barometric Pressure
Ms = % Moisture/100

Cg-Particulate Concentration gr/dscf = $\frac{0.0154\ W}{Q}$

where: W = Particulate weight mg.
Q = Dry Sample Volume scf

E - Emission Rate lbs/hr = (0.00857)(Cg)(V)

Where: Cg = Particulate Concentration gr/dscf
V = Total Air Flow scfm

% H_2O - Percent by Volume Water Vapor = $\frac{e'' - \frac{(P_o-e'')(t_d-t_w)}{2800-1.3(t_w)}}{P_o} \times 100$

where: P_o = Barometric Pressure
t_d = Dry bulb temperature °F
t_w = Wet bulb temperature °F
e" = Vapor Pressure of H_2O at t_w inches Mercury

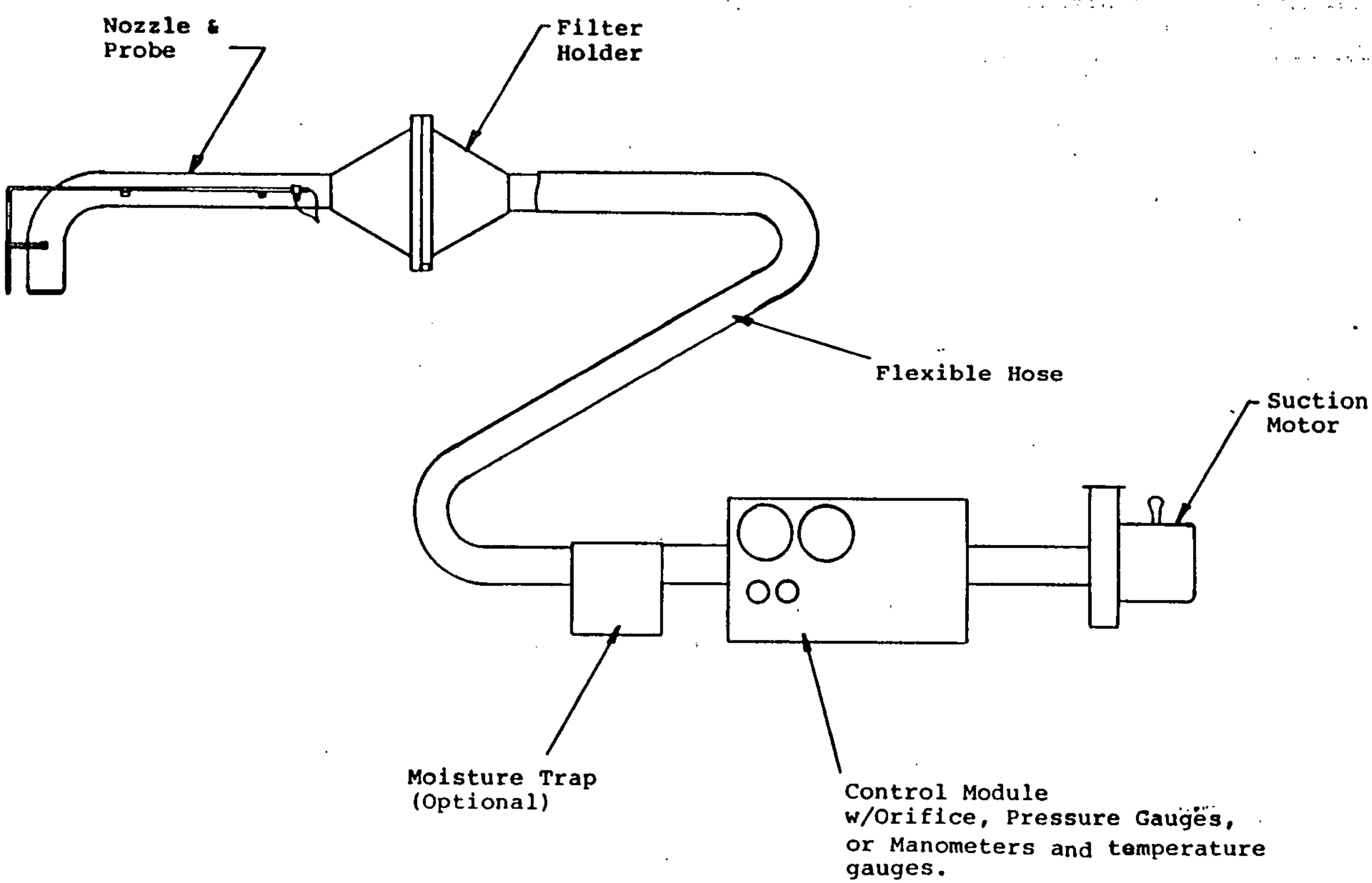

FIG. 1

HIGH VOLUME SAMPLER SCHEMATIC

TABLE 1. CALIBRATION DATA

Plant Name & Location [illegible]TE COUNTY RICE GROWERS RICHVALE, CALIFORNIA

Dates Tested OCTOBER 29, 1981 By E.A.WELLMAN & E.C.BUTCHINO

EQUIPMENT	DATE OF CALIB.	PLACE OF CALIB.	METHOD
Pitot Tube	9-27-81	BWR ASSOC. LAB.	WIND TUNNEL vs. STANDARD "P" TYPE TUBE
Orifice Meter	9-27-81	"	vs. STANDARD ORIFICE CALIBRATOR
Velocity Pressure Meter	9-27-81	"	vs. STANDARD INCLINED-VERTICAL MANOMETER
Orifice Pressure Meter	9-27-81	"	"
Thermometer	9-27-81	"	vs. STANDARD NBS TRACEABLE THERMOMETER
Other (list)	AT TIME OF SAMPLE WEIGHINGS	"	vs. NBS TRACEABLE WEIGHTS

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SUMMARY REPORT

HIGH-VOLUME SAMPLING

PLANT NAME AND LOCATION: BUTTE COUNTY RICE GROWERS RICHVALE PLANT

SOURCE IDENTIFICATION: EXISTING SOURCE: DRYER #2.

DATE TESTED: OCTOBER 29, 1981 BY: E.C. Butchino

RESULTS

Barometric Pressure	Po	"Hg	30.39
Moisture Content	Ms	%	3.66
Gas Temperature	Ts	^{o}F	94.5
Sampling Time	t	min.	40
Sample Volume	Q	scf	1234.4
Gas Flow	Q_s	scfm	291249
Grain Loading	Cg	gr/dscf	0.0158
Emission Rate	E	lbs/hr	39.4
Production Rate	P	tons/hr	240

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HIGH VOLUME SAMPLING DATA SHEET

AMBIENT AND ENCLOSED SPACE SAMPLES

SOURCE: Butte County Rice Growers LOCATION: Richvale, California.

Existing - Screen - Baffle Dryer #2

DATE: Oct. 29, 1981 TIME: 1430 - 1515 BY: E.C. Butchino

Symbol	Description	Sample 1	Sample 2	Average	Total
P_o	Barometric Pressure "Hg	30.39	30.39	30.39	
T_d	Dry Bulb Temperature ^oF	95	94	94.5	
T_w	Wet Bulb Temperature ^oF	85	85	85.	
$\%H_2O$	Percent Moisture	3.64	3.67	3.655	
Ms	$\%H_2O/100$	.0364	.0367	.03655	
ΔH	Orifice Dif.Pressure "H_2O	0.50	0.50	0.50	
q_o	Orifice Flow acfm	33.0	33.0	33.0	
T_o	Orifice Temperature ^oF	95	94	94.5	
Δt	Sampling Time minutes	20	20	20	40
Q_o	Total Sample Volume acf	660	660		1320
Q	Dry Sample Volume scf				1234.4
	Filter Number	128	125		
	Gross Filter Wt. g.	4.1990	4.1510		
	Net Filter Wt. g.	0.5970	0.6075		
	Blank Filter Wt. g.	+0.0001	+0.0001		
	Adj. Sample Wt. g.	0.5969	0.6074		1.2043
	Sampler Wash Wt. g.	0.0271	0.0337		.0608
W	Total Sample Wt. g.				1.2651
	Air Flow acfm				300000
V	Air Flow scfm				291249
Cg	Emissions gr/dscf			.0158	
E	Emissions lbs/hr				39.4
P	Production Rate tons/hr			240	

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BVWR ASSOCIATES ENVIRONMENTAL CONSULTANTS

CALCULATING EQUATIONS

Q - Dry Sample Volume = $\dfrac{(17.71)(Q_o)(P_o)}{T_o}$ (1-Ms)

where: Q_o = Sample volume @ Orifice Temperature
T_o = Orifice Temperature +460
P_o = Barometric Pressure
Ms = % Moisture/100

Cg-Particulate Concentration gr/dscf = $\dfrac{0.0154\ W}{Q}$

where: W = Particulate weight mg.
Q = Dry Sample Volume scf

E - Emission Rate lbs/hr = (0.00857)(Cg)(V)

Where: Cg = Particulate Concentration gr/dscf
V = Total Air Flow scfm

% H_2O - Percent by Volume Water Vapor = $\dfrac{e'' - \dfrac{(P_o - e'')(t_d - t_w)}{2800 - 1.3(t_w)}}{P_o} \times 100$

where: P_o = Barometric Pressure
t_d = Dry bulb temperature °F
t_w = Wet bulb temperature °F
e" = Vapor Pressure of H_2O at t_w inches Mercury

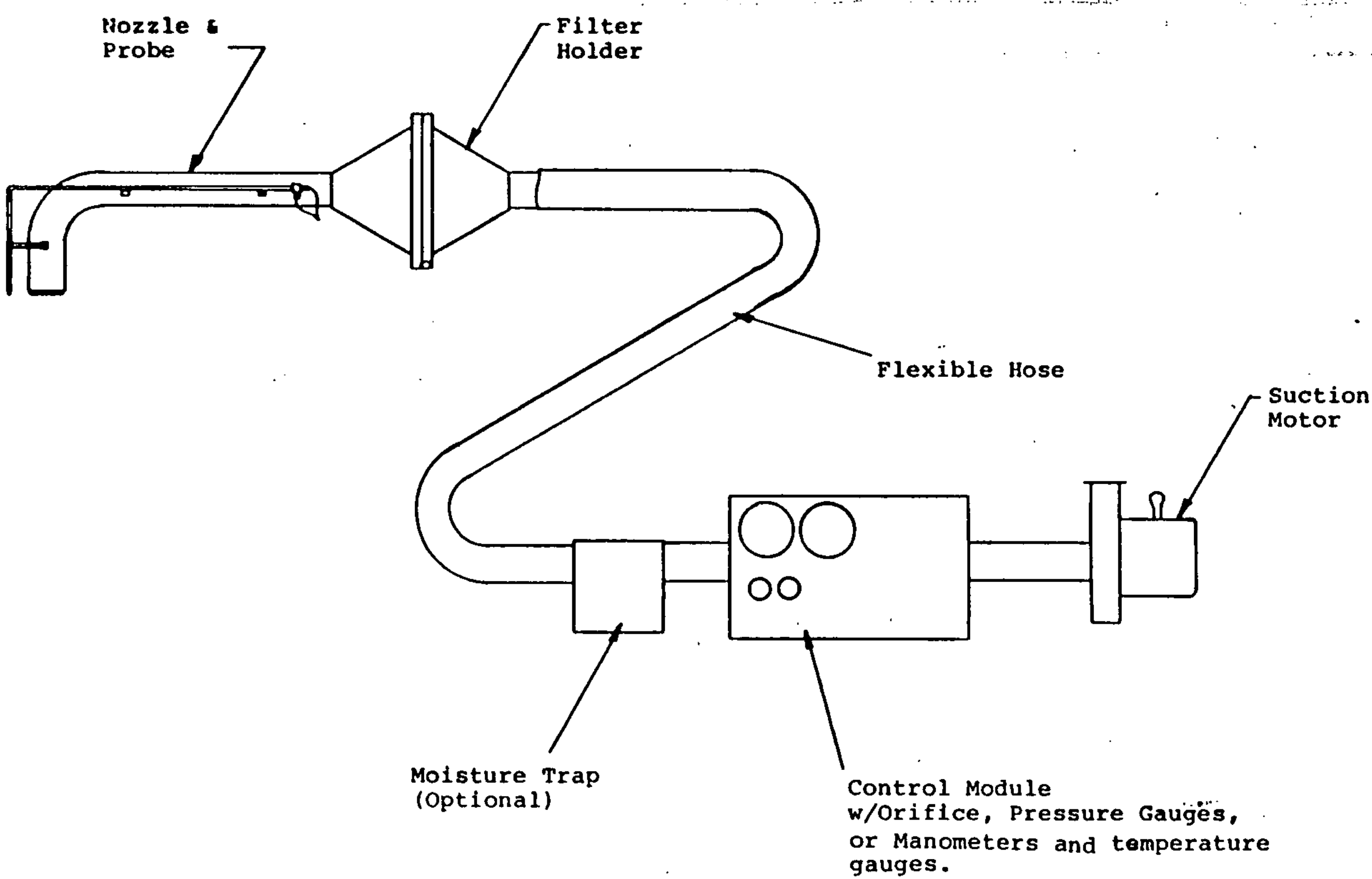

FIG. 1

HIGH VOLUME SAMPLER SCHEMATIC

TABLE 1. CALIBRATION DATA

Plant Name & Location BUTTE COUNTY RICE GROWERS RICHVALE, CALIFORNIA

Dates Tested OCTOBER 29, 1981 By E.A.WELLMAN & E.C.BUTCHINO

EQUIPMENT	DATE OF CALIB.	PLACE OF CALIB.	METHOD
Pitot Tube	9-27-81	BWR ASSOC. LAB.	WIND TUNNEL vs. STANDARD "P" TYPE TUBE
Orifice Meter	9-27-81	"	vs. STANDARD ORIFICE CALIBRATOR
Velocity Pressure Meter	9-27-81	"	vs. STANDARD INCLINED-VERTICAL MANOMETER
Orifice Pressure Meter	9-27-81	"	"
Thermometer	9-27-81	"	vs. STANDARD NBS TRACEABLE THERMOMETER
Other (list)	AT TIME OF SAMPLE WEIGHINGS	"	vs. NBS TRACEABLE WEIGHTS

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SUMMARY REPORT

HIGH-VOLUME SAMPLING

PLANT NAME AND LOCATION: BUTTE COUNTY RICE GROWERS RICETON PLANT

SOURCE IDENTIFICATION: NEW SOURCE: GAS FIRED SCREEN DRYER

DATE TESTED: OCTOBER 29, 1981 BY: E.C.Butchino

RESULTS

Barometric Pressure	Po "Hg	30.39
Moisture Content	Ms %	2.75
Gas Temperature	Ts °F	86
Sampling Time	t min.	40
Sample Volume	Q scf	1150.3
Gas Flow	Q_s scfm	177468
Grain Loading	Cg gr/dscf	0.0044
Emission Rate	E lbs/hr	6.70
Production Rate	P tons/hr	125

i, tested @ max.

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HIGH VOLUME SAMPLING DATA SHEET

AMBIENT AND ENCLOSED SPACE SAMPLES

SOURCE: Butte County Rice Growers. LOCATION: Riceton Plant

New Source Gas Fired Screen Dryer Near Richvale, California

DATE: Oct. 29, 1981 TIME: 1038-1130 BY: E. C. Butchino.

Symbol	Description	Sample 1	Sample 2	Average	Total
P_o	Barometric Pressure "Hg	30.39	30.39	30.39	
T_d	Dry Bulb Temperature °F	86	86	86	
T_w	Wet Bulb Temperature °F	77	77	77	
$\%H_2O$	Percent Moisture	2.75	2.75	2.75	
Ms	$\%H_2O/100$	.0275	.0275	.0275	
ΔH	Orifice Dif. Pressure "H_2O	0.44	0.44	0.44	
q_o	Orifice Flow acfm	30.0	30.0	30.0	
T_o	Orifice Temperature °F	85	86	85.5	
Δt	Sampling Time minutes	20.0	20.0	20.0	40.0
Q_o	Total Sample Volume acf	600	600		1200.
Q	Dry Sample Volume scf				1150.3
	Filter Number	121	124		
	Gross Filter Wt. g.	3.7096	3.7429		
	Net Filter Wt. g.	0.1730	0.1299		
	Blank Filter Wt. g.	+0.0001	+0.0001		
	Adj. Sample Wt. g.	0.1729	0.1298		0.3027
	Sampler Wash Wt. g.				0.0265
W	Total Sample Wt. g.				0.3292
	Air Flow acfm				180,000
V	Air Flow scfm				177468
Cg	Emissions gr/dscf			.0044	
E	Emissions lbs/hr				6.70
P	Production Rate tons/hr			125	

1) NO ΔP ∴ NO V_S AT TEST POINT
2) NO DP
3) NO VELOCITY TRAVERSE ∴ NO CFM [illegible]FICATION
4) NO [illegible] OF [illegible]
[illegible]

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CALCULATING EQUATIONS

Q - Dry Sample Volume = $\frac{(17.71)(Q_o)(P_o)}{T_o}$ (1-Ms)

where: Q_o = Sample volume @ Orifice Temperature
T_o = Orifice Temperature +460
P_o = Barometric Pressure
Ms = % Moisture/100

Cg-Particulate Concentration gr/dscf = $\frac{0.0154\ W}{Q}$

where: W = Particulate weight mg.
Q = Dry Sample Volume scf

E - Emission Rate lbs/hr = (0.00857)(Cg)(V)

Where: Cg = Particulate Concentration gr/dscf
V = Total Air Flow scfm

% H_2O - Percent by Volume Water Vapor = $\frac{e'' - \frac{(P_o - e'')(t_d - t_w)}{2800 - 1.3(t_w)}}{P_o} \times 100$

where: P_o = Barometric Pressure
t_d = Dry bulb temperature °F
t_w = Wet bulb temperature °F
e" = Vapor Pressure of H_2O at t_w inches Mercury

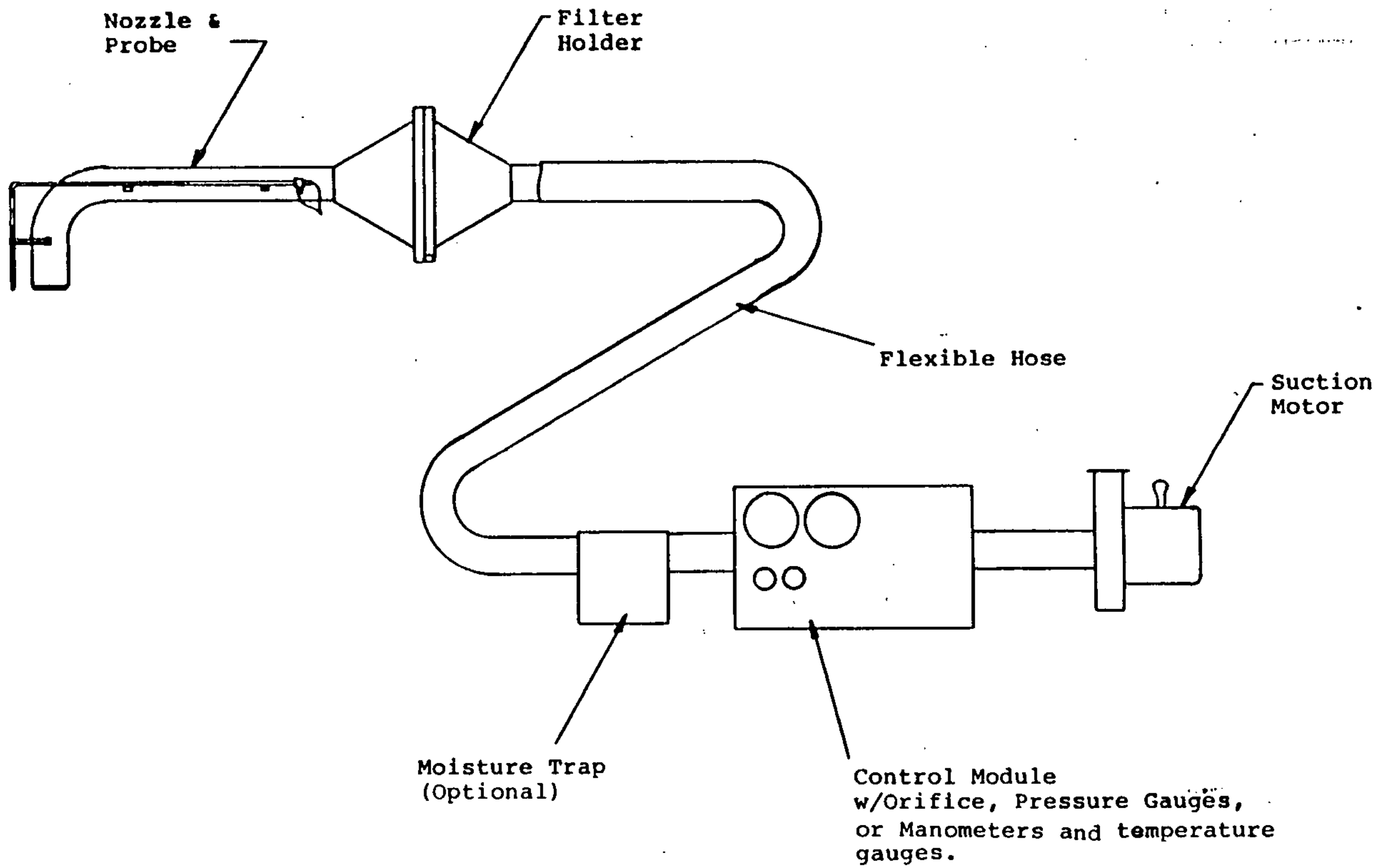

FIG. 1

HIGH VOLUME SAMPLER SCHEMATIC

TABLE 1. CALIBRATION DATA

Plant Name & Location BUTTE COUNTY RICE GROWERS RICHVALE, CALIFORNIA

Dates Tested OCTOBER 29, 1981 By E.A.WELLMAN & E.C.BUTCHINO

EQUIPMENT	DATE OF CALIB.	PLACE OF CALIB.	METHOD
Pitot Tube	9-27-81	BWR ASSOC. LAB.	WIND TUNNEL vs. STANDARD "P" TYPE TUBE
Orifice Meter	9-27-81	"	vs. STANDARD ORIFICE CALIBRATOR
Velocity Pressure Meter	9-27-81	"	vs. STANDARD INCLINED-VERTICAL MANOMETER
Orifice Pressure Meter	9-27-81	"	"
Thermometer	9-27-81	"	vs. STANDARD NBS TRACEABLE THERMOMETER
Other (list)	AT TIME OF SAMPLE WEIGHINGS	"	vs. NBS TRACEABLE WEIGHTS

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S U M M A R Y   R E P O R T

HIGH-VOLUME SAMPLING

PLANT NAME AND LOCATION: RED TOP RICE GROWERS   BIGGS, CALIFORNIA

SOURCE IDENTIFICATION: NEW SOURCE: GAS FIRED SCREEN DRYER

DATE TESTED: OCTOBER 10, 1981   BY: E.C.Butchino & E.A.Wellman

R E S U L T S

Barometric Pressure	Po "Hg	30.18
Moisture Content	Ms %	3.2
Gas Temperature	Ts °F	84.5
Sampling Time	t min.	40.
Sample Volume	Q scf	1150.99
Gas Flow	Q_s scfm	176729.
Grain Loading	Cg gr/dscf	0.015
Emission Rate	E lbs/hr	22.72
Production Rate	P tons/hr	200.

Product: Third-pass rice @ 13.6% Moisture

@ 4000 CWT/HR

@ 5000 CWT/HR
or 25% increase
emissions ≅ 28.4 #/HR
OR 682 #/DAY

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ECS 11/1/81
ECB 11/2/81

HIGH VOLUME SAMPLING DATA SHEET

AMBIENT AND ENCLOSED SPACE SAMPLES

SOURCE: RED-TOP RICE GROWERS LOCATION: BIGGS, CALIFORNIA

NEW SOURCE - GAS FIRED SCREEN DRYER

DATE: OCTOBER 10, 1981 TIME: 0930-1045 BY: E.C. BUTCHINO & E.A. WELLMAN

Symbol	Description	Sample 1	Sample 2	Average	Total
P_o	Barometric Pressure "Hg	30.18	30.18	30.18	
T_d	Dry Bulb Temperature °F	84	85	84.5	
T_w	Wet Bulb Temperature °F	78	81	79.5	
$\%H_2O$	Percent Moisture	2.99	3.39	3.2	
Ms	$\%H_2O/100$	.030	.034	.032	
ΔH	Orifice Dif. Pressure "H_2O	0.44	0.44	0.44	
q_o	Orifice Flow acfm	30.0	30.0	30.0	
T_o	Orifice Temperature °F	78.0	80.0	79.0	
Δt	Sampling Time minutes	20.0	20.0	20.	40
Q_o	Total Sample Volume acf	600.	600		1200
Q	Dry Sample Volume scf				1150.99
	Filter Number	119	120		
	Gross Filter Wt. g.	3.8687	4.2215		
	Net Filter Wt. g.	0.3463	0.5890		
	Blank Filter Wt. g.	+ 0.0001	0.0001		
	Adj. Sample Wt. g.	0.3462	0.5889		0.9351
	Sampler Wash Wt. g.				0.1929
W	Total Sample Wt. g.				1.1280
	Air Flow acfm				180,000
V	Air Flow scfm				176,729.
Cg	Emissions gr/dscf			0.015	
E	Emissions lbs/hr				22.72
P	Production Rate tons/hr			200.	

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CALCULATING EQUATIONS

Q -Dry Sample Volume = $\frac{(17.71)(Q_o)(P_o)}{T_o}(1-Ms)$

where: Q_o = Sample volume @ Orifice Temperature
T_o = Orifice Temperature +460
P_o = Barometric Pressure
Ms = % Moisture/100

Cg-Particulate Concentration gr/dscf = $\frac{0.0154\ W}{Q}$

where: W = Particulate weight mg.
Q = Dry Sample Volume scf

E -Emission Rate lbs/hr = (0.00857)(Cg)(V)

Where: Cg = Particulate Concentration gr/dscf
V = Total Air Flow scfm

% H_2O - Percent by Volume Water Vapor = $\frac{e'' - \frac{(P_o-e'')(t_d-t_w)}{2800-1.3(t_w)}}{P_o} \times 100$

where: P_o = Barometric Pressure
t_d = Dry bulb temperature ^oF
t_w = Wet bulb temperature ^oF
e" = Vapor Pressure of H_2O at t_w inches Mercury

SAMPLING DATA AND FILTER ANALYSIS

Plant Name and Location RED TOP RICE GROWERS

Source Location or Identification NEW SOURCE SCREEN-DRIER BIGGS, CALIF

Date OCTOBER 10 1981 Time 1000-1100 By (Name) EAW/ECB

Process Operation During Test 3RD PASS 4000 CWT/HR.

Temperature: Dry Bulb 84.5 °F = T = 544.5 °R Wet Bulb 79.5 °F Ambient 58 °F Moisture 3.2 $\%H_2O$ by volume

Gas Composition (Combustion Sources) — $\%CO_2$ — $\%O_2$ Pitot Tube Corr. Factor Fp= 0.99 Bar. Pressure Pa= 30.18 in Hg

Nozzle Dia. 1 1/8 in. Nozzle Area An = 2.76117 inches²

Pt.	Location X	Location Y	Velocity ΔP	Pressure ΔP_s				Orifice ΔH Pre-Set (inches)	Orifice ΔH Actual (inches)	Orifice Temp. To, °F.	Time (min)	Rate at Orifice Temp. (cfm)	Vol. at Orifice Temp. (cu.ft.)	Comment
1								0.44	0.44	75	20	30	600	
2								0.44	0.44	80	20	30	600	
3														
4														
5														
6														
Total (T) or Average (A)				(A)						77.5 (A)	40 (T)		1200 (T)	

							Probe Washings	Total Adjusted Sample Weight
Filter Number	118	119	120					
Filter & Sample Weight	3.6236	3.8687	4.2215				— —	
Filter Tare Weight	3.6235	3.5224	3.6325					
Sample Weight +	0.0001	0.3463	0.589					W = 1128.0 mg.
Blank Weight		0.0001	0.0001					
Sample Adjusted Weight		0.3462	0.5889				0.1929	

To = Average Orifice Temp. + 460 = 537.5 °R

Qo = Total Volume at Orifice Temp. = 1200 cu. ft.

Ms = % H_2O/100 = 0.032

Dry Sample Volume Q = Qo $\frac{530}{To}$ $\frac{Pa}{29.92}$ (1-Ms) = 1150.99 scf

Particulate Concentration Cg = $\frac{0.0154W}{Q}$ = 0.015 gr/scf

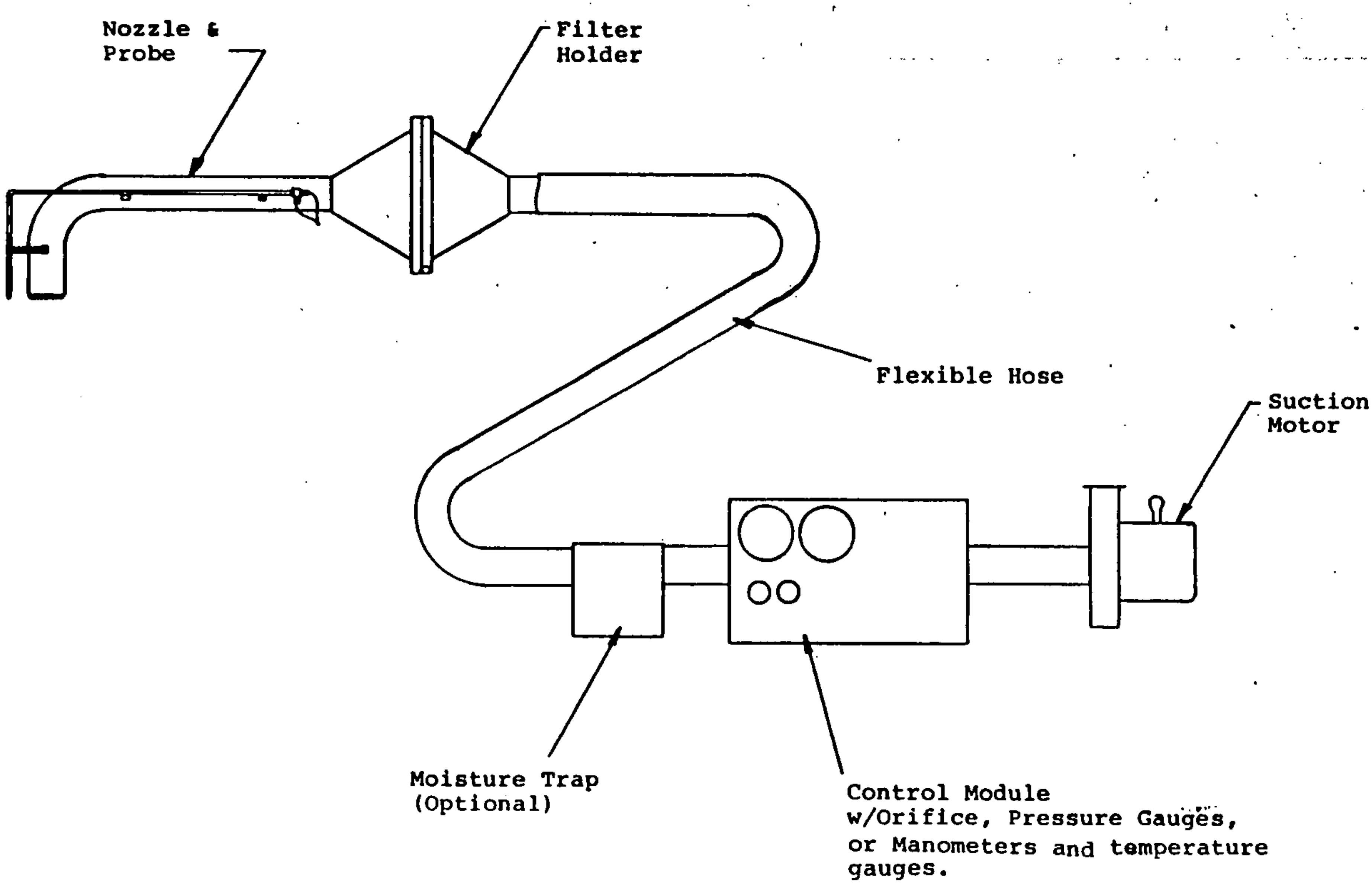

FIG. 1

HIGH VOLUME SAMPLER SCHEMATIC

CALIBRATION DATA

Plant Name and Location RED TOP RICE GROWERS BIGGS, CALIFORNIA

Dates Tested OCTOBER 10, 1981 **By** E.A.Wellman & E.J.Butchino

EQUIPMENT	DATE OF CALIB.	PLACE OF CALIB.	METHOD
Pitot Tube	9-27-81	BWR ASSOC. LAB.	Wind Tunnel vs. Standard "P" type tube
Orifice Meter	"	"	Vs. Standard Orifice calibrator
Velocity Pressure Meter	"	"	Vs. Standard Inclined-vertical manometer
Orifice Pressure Meter	"	"	"
Thermometer	"	"	Vs. Standard NBS Traceable Thermometer
Other (list) Mettler Balance	At time of weighing of samples.	"	Vs. NBS Traceable weig[illegible]

EDWARD C. BUTCHINO
598 Vista Park Drive
Eagle Point, Oregon 97524 ☐
503/826-5679

BWAI ASSOCIATES WWR
Environmental Consultants

EUGENE A. WELLMAN
Route 5 Box 1405
☒ Klamath Falls, Oregon 97601
503/884-7538

SUMMARY REPORT

HIGH-VOLUME SAMPLING

PLANT NAME AND LOCATION: RICE GROWERS ASSOCIATION, BIGGS, CALIFORNIA

SOURCE IDENTIFICATION: VERTICAL SCREEN RICE DRYER

DATE TESTED: OCTOBER 21, 1980 BY: E. A. WELLMAN

RESULTS

Barometric Pressure	Po	"Hg	29.61
Moisture Content	Ms	%	4.0
Gas Temperature	Ts	°F	85.
Sampling Time	t	min.	60.
Sample Volume	Q	scf	1335.4
Gas Flow	Q_s	scfm	179694
Grain Loading	Cg	gr/dscf	0.0118
Emission Rate	E	lbs/hr	18.14
Isokinetic Rate	I	%	110.7

Allowable Emissions: 52.2 lbs/hr at 110. tons/hr production

0.16 lbs/Ton

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VELOCITY PRE-SURVEY

Plant Name and Location: RICE GROWERS ASSOCIATION BIGGS

Date: 10-21-80 Time: 1010 By (Name): [illegible]

Source Location or Identification: EAST RICE DRYER.

[X] Low Pressure System [ ] High Pressure System

Type of Exhaust:

[ ] Straight Vertical [ ] China Hat

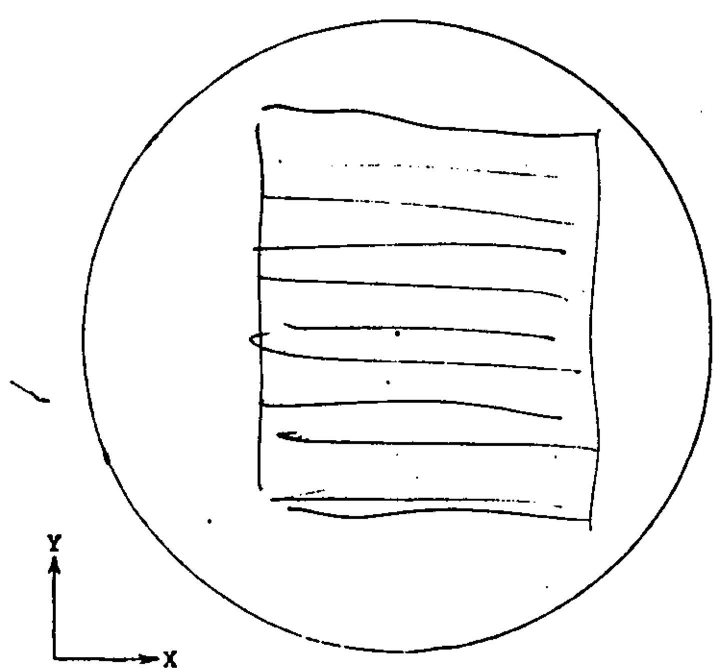
[ ] Goose-Neck [X] Other (Specify) LOUVERED VENTS-

Temperature: Dry Bulb 85 °F Wet Bulb 85

VELOCITY SURVEY: Record velocity head at enough points to roughly map the velocity distribution across the exhaust cross-section. Select six points for sample collection and show in diagram.

Point	X inches	Y inches	ΔP in. H_2O	Check if selected (✓)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

Top



uniform 0.1" H_2O Δp.

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PARTICULATE CALCULATIONS

PROGRAM DATA SHEET

CLIENT: Rice Growers Association SOURCE IDENT: Dryer.

APPROACH DUCT DATA:

SYMBOL	UNITS	SOURCE	CODE	EAST DRYER RUN 14		WEST DRYER*
Pa	"Hg	Volume Data Sheet	01	29.61		
Ma	%/100	"	02	.004		
Fp	-	"	03	0.85		
√PA	"H_2O	"	04	.3493		
Ta	°R	"	05	580		
Aa	ft^2	"	06	80.		

CYCLONE EXHAUST DATA

SYMBOL	UNITS	SOURCE	CODE	EAST DRYER RUN 14		WEST DRYER*
Po	"Hg	Sampling Data Sheet	07	29.61		
Ms	%/100	"	08	.004		
Fp	-	"	09	.85		
√PS	"H_2O	"	10	.3162		
Ts	°R	"	11	545		
Qo	ft^3	"	12	1410.		
t	min	"	13	60		
An	$in.^2$	"	14	2.76		
To	°R	"	15	549.5		
W	mg.	"	16	1012.3		

EMISSION CALCULATIONS

SYMBOL	UNITS	SOURCE	CODE	EAST DRYER RUN 14		WEST DRYER*
Va	fpm	Program Calculated	17	1251.6		
Qa	scfm	"	18	89847		89847
Vs	fpm	"	19	1098		
Vn	fpm	"	20	1216		
I	%	"	21	110.7		
Q	scf	"	22	1335.4		
Cg	gr/scf	"	23	.0118		.0118
E	lbs/hr	"	24	9.069		9.069

by: __________
date: __________

COMMENTS: E allowable = $55 P^{.11} - 40 = (55)(110^{.11}) - 40 = 52.2$ lbs/hr

* ASSUMED VALUES Total E - Both Dryers 18.14 lbs/hr.

67x96"

SAMPLING DATA AND FILTER ANALYSIS

Plant Name and Location: RICE GROWERS ASSOCIATION. BIGGS CALIF

Source Location or Identification: EAST DRYER.

Date: 10-21-80 Time: 1045 - 215 By (Name): E. Wellman

Process Operation During Test: 2200 CWT/hr. - FIRST PASS OPERATION. (110 t/hr)

Temperature: Dry Bulb 85 °F - Ts = 545 °R Wet Bulb 85 °F Ambient ______ °F Moisture 4.0 % H_2O by volume

Gas Composition (Combustion Sources) < 1% CO_2 ______ % O_2 Pitot Tube Corr. Factor Fp = .85 Bar. Pressure Pa = 29.61 in Hg

Nozzle Dia. 1 7/8 in. Nozzle Area An = 2.76 inches²

Pt.	Location X	Location Y	Velocity ΔP	Pressure ΔP_s	Vs	Q@T°	Q@60	Orifice ΔH Pre-Set (inches)	Orifice ΔH Actual (inches)	Orifice Temp. To, °F.	Time (min)	Rate at Orifice Temp. (cfm)	Vol. at Orifice Temp. (cu.ft.)	Comment
1			.1	.3162	1250	23.5	23.0	0.26	0.26	92	15	23.5 cfm	352.5	LOWER SE DUCT. Run 1
2			.1	.3162						90	15	23.5 cfm	352.5	" " " " 2
3			.1	.3162						88	15	23.5 cfm	352.5	UPPER EAST DUCT Run 1
4			.1	.3162						88	15	23.5 cfm	352.5	" " " " 2
5														
6														
Total (T) or Average (A)				.3162 (A)						89.5 (A)	60 (T)		1410 (T)	

Filter Number	40	41	42	43		BLANK	Probe Washings	Total Adjusted Sample Weight
Filter & Sample Weight	3.7015	4.0521	3.7725	3.5933		3.6011	40: .0288	
Filter Tare Weight	3.5425	3.5559	3.5475	3.5373		3.6000	41: .0145	
Sample Weight	.1590	0.4962	0.2250	0.0560			92: .0171	W = 1021.3 mg.
Blank Weight	.0011	.0011	.0011	-.0011		-.0011	43: .0291	
Sample Adjusted Weight	.1579	0.4951	0.2239	0.0549				

FAN RATING 100,000 acfm
89,850 scfm.

Air heater Inlet temp 130°F.

State of California

AIR RESOURCES BOARD

No.: 74-8-8

Date: April 11, 1974

ITEM: Report on Emissions from Rice Dryers in the Sacramento Valley Air Basin.

RECOMMENDATION: Refer to the Technical Committee for evaluation.

SUMMARY: The Board, at its meeting on March 7, 1973 deferred action on a proposal to hold a public hearing under Section 39054 to consider revised regulations for Glenn County APCD. The Board at that meeting instructed the staff to obtain data and report back to the Board on particulate emissions concentrations, particle size distributions under 10 microns from uncontrolled and controlled rice dryers, the types of control equipment and the effectiveness of control equipment. The staff conducted a study of emissions from 21 rice dryers in the Sacramento Valley Air Basin during the fall of 1973. A report on the study is attached.

State of California

AIR RESOURCES BOARD

Division of Implementation and Enforcement

April 11, 1974

Staff Report on Emissions from Rice Dryers in the Sacramento Valley Air Basin

I. Introduction

As requested by the Board in its meeting on March 7, 1973, emission tests were conducted on rice dryers in the Sacramento Valley Air Basin from September 17, 1973 through November 2, 1973.

The regulations of the Glenn County Air Pollution Control District specifically exclude existing agricultural processing plants from control. In order to assess the effect of this exclusion, the Board asked that data be obtained on particulate matter concentration and particle size mass distribution under 10 microns of emissions from rice dryers with and without controls, the type of control equipment used, and the effectiveness of the control equipment.

II. Summary

A. Particulate matter emission concentrations from the 21 dryers tested ranged from 0.005 to 0.23 grain per standard dry cubic foot (gr/sdcf) with an average of 0.068. Therefore, all of these dryers complied with the allowable concentration of 0.3 gr/sdcf.

B. The three controlled dryers tested complied with the process weight rules of the APCDs in the Basin. Six of the nine uncontrolled screen dryers tested complied and one of the nine uncontrolled baffle dryers tested complied.

C. The particulate size mass distributions on the 15 dryers tested show that from 15 to 65 weight percent of the emissions were in the size range below 10 microns, with an average of 36 weight percent for all dryers.

D. Seven of the 83 rice dryers in the Sacramento Valley Air Basin have emission controls.

E. For the three controlled dryers tested, control efficiencies were estimated to be low with emissions varying from higher than the average for uncontrolled dryers to 78 percent lower than that average.

F. The annual average daily emissions of particulate matter from heated air rice dryers in the Basin are estimated to be 3.7 tons based on the average emissions from all tested dryers and the 1972 figures for rice production. The comparable 1972 emissions from all "Food and Agricultural Processing" in the Basin are 16.2 tons per day, and from all stationary sources are 212 tons per day.

G. Fugitive emissions at most dryers were adequately controlled by hood systems exhausting to cyclones or baghouses. Fugitive emissions were considerable at the dryers without such controls.

H. A preliminary discussion with the State Department of Health disclosed that there is little information on the health effects of rice dryer emissions, but that such emissions could cause health effects.

III. Rice Drying Operation

Rice is generally harvested with a moisture content of 20 to 27 percent. Grain at this moisture content deteriorates from several causes, most of them connected with the fact that these moisture contents result in high equilibrium relative humidity (above 70 percent) of the inter-granule air. This condition encourages the growth of microflora, particularly the aerobic species of molds. The respiration of the microflora, as well as increased respiration of the rice itself because of high moisture content, produces heat and more moisture to complicate the problem. In addition to the deterioration of the rice, self-heating can result in spontaneous combustion.

To prevent deterioration, the rice is dried to a moisture content of about 14 percent. During rapid drying, the outer layers of the rice kernel become drier than the center and checking of the surface results from mechanical stresses. To prevent checking, the moisture must be removed slowly by passing the rice through the dryer a number of times, and allowing it to cool between passes long enough to allow moisture equilibrium to be established. In a few dryers the rice is dried to 16 percent moisture content and finish dried in a deep-bed grain dryer.

The drying air is usually, but not always heated. The average air temperature in the dryers tested was 110°F with a maximum of 140°F. This latter is the maximum permissible temperature. Natural gas or liquefied petroleum gas or diesel are used for fuel.

Unwanted material, such as straw, joints, weed seeds and unfilled heads, is usually removed by a vibrating screen when the rice is first received from the fields.

Particulate matter is generated in the rice handling operations by the rubbing and fracturing of kernels of rice. This particulate matter is entrained by the drying air stream and the smaller fractions are exhausted to atmosphere.

IV. Types of Rice Dryers

The four basic types of rice dryers used in the Sacramento Valley Air Basin are 1) screen dryers, 2) baffle dryers, 3) Louisiana State University dryer, and 4) deep-bed grain dryers.

A. Screen Dryers - The screen type dryer is schematically shown in Figure 1. The rice enters the top of the dryer and moves down through two legs or columns. The columns are 16 to 60 feet high by 9 to 15 feet wide (the direction normal to the sketch) by 6 to 12 inches deep (the horizontal direction on the sketch) and are spaced four feet apart to form an inner plenum. The inner and outer faces of the column are of stainless steel screen about 1/16 inch mesh horizontally and 1/2 inch mesh vertically.

The rice is metered from each column by a metering roll in the bottom of each column. Heated air is forced by a fan into the plenum and through the columns as shown. This dryer is housed in a dryer building. The air from the dryer exhausts through openings in the building walls.

B. Baffle Dryers - The baffle dryer is shown schematically in Figure 2. This dryer is similar to the screen type dryer except that the rice moves downward through a series of baffles in the columns and there are no screen faces. The heated air moves through the columns as shown in the sketch. The dryer is housed in a dryer building.

C. Louisiana State University Dryer - The Louisiana State University dryer is shown schematically in Figure 3. Layers of inverted trough-shaped air channels are installed in a large bin. Each layer is offset from the one above. Rice flows downward between the troughs in a zig-zag path. Heated air enters through the underside of the troughs in one layer, passes through the rice and exits through the troughs in an adjacent layer.

D. Deep-Bed Dryers - The deep-bed dryer is shown schematically in Figures 4a and 4b. The flat house is filled with rice up to a depth of twenty feet. In one variation shown in Figure 4a, air is forced through ducts in the floor up through the rice. In another variation, as shown in Figure 4b, air is forced up through a perforated false floor. Although there is usually provision for heating the drying air, it may not be done if the ambient air is warm and dry.

V. Control Equipment

The four types of control equipment used on the dryers in the Sacramento Valley Air Basin are 1) the Cam-Vac Filter, 2) the Wiedenmann Screen, 3) cyclones, and 4) a baghouse. Two dryers have Cam-Vac Filters, three dryers have Wiedenmann screens, one dryer has cyclones, and one dryer has a baghouse.

A. Cam-Vac Filter - The Cam-Vac Filter is a modular piece of equipment mounted in the dryer building wall. It has a hemi-cylindrical filter screen through which air from the dryer exhausts to atmosphere. The screen has a radius of about five feet and length of about 10 feet. It may be faced with another filter material such as porous polyester foam. The inner face of the screen is continuously vacuumed by a reciprocating nozzle pivoted at the axis of the cylinder. A group of such modules are mounted in a wall of the building which houses the dryer.

B. Wiedenmann Screen - The Wiedenmann Screen is a circular, flat filter screen about 14 feet in diameter mounted in the wall of the dryer building. It is continuously vacuumed by a rotating nozzle pivoted at the center of the screen. Air from the dryer exhausts through the screen to atmosphere.

C. Cyclones - One dryer had 10 cyclones of conventional design about six feet in diameter through which the drying air is exhausted to atmosphere.

D. Baghouse - The RGA dryer in West Sacramento has a conventional baghouse to control emissions.

VI. Description of Tests

Tests were conducted for particulate matter concentration from 11 screen dryers and 10 baffle dryers, including one Louisiana State University dryer. Particle size mass distribution tests were conducted on emissions from six screen dryers, and nine baffle dryers including the Louisiana State University dryer. Samples were taken at eight dryers for microscopic analysis. Tests were also conducted for particulate matter concentration in emissions from cyclones at three dryers and from baghouses at three dryers, that were controlling fugitive emissions from sources other than the dryers themselves.

Samples were taken for particulate matter concentration with a Rader Hi-Vol Sampler. The sampling train in this instrument consists of a nozzle, a probe, an eight by ten inch filter, a metering orifice and a suction blower. A thermometer indicates sample gas temperature. A manometer was used to measure the pressure drop across the metering orifice. The instrument contains an integral pitot tube to measure velocity head. A manometer was used in conjuction with the pitot tube. When the velocity was too low for the use of the pitot tube, a vane-type anemometer was used. The probe was rinsed after each run and the rinsings were evaporated to determine the probe rinse catch. The filter catch was determined by weighing the filter before and after the run. Two runs were made on each dryer and the results were averaged.

Particle size mass distribution was determined with the use of eight-stage Andersen Impactors. A cross-section of the Andersen Impactor is shown in Figure 5. The collection plates were prepared by cleaning with toluene. A coating material, vaseline, was dissolved in toluene in the ratio of one part of vaseline to nine parts of toluene. This solution was painted onto the collection plates and the toluene was evaporated for two hours at room temperature. The impactor sampler was assembled and tape was wrapped externally around the stages to prevent leakage.

The impactor sampler was attached to the Rader Hi-Vol Sampler and operated in a vertical position with its nozzle as near as possible to the nozzle of the Rader Sampler. ~~A special 40-mesh brass screen was placed over the impactor sampler to prevent overloading the zero stage with large particles.~~ A 47 millimeter diameter millipore filter, with a micron retention of 0.3 was used as backup filter. The sampling rate of the impactor sampler was constantly maintained at one cubic foot per minute for 30 minutes.

ESTIMATE 30% ERR

After sampling the impactor sampler was carefully detached from the Rader Sampler. The impactor sampler was disassembled and the collection plates were placed in their respective Petri dishes. A Nuclepore filter was prepared to receive the deposit from a plate by prewashing it in toluene to remove any soluble component, drying it for three hours at $90^{o}C$ and weighing it. The deposit on a collection plate was rinsed onto the prepared Nuclepore filter with toluene. The Nuclepore filter was then dried for three hours and weighed.

A seven-stage Andersen Impactor was used to collect samples for microscopic observations. The collection plates were clean and uncoated. The sampling time for these runs was 1/2 minute. This short sampling time restricted the amount of deposition on the sampling plates so that the microscopic analysis could be made. The impactor sampler was operated in a vertical position with its nozzle as close as possible to the Rader Hi-Vol Sampler. The special screen and back-up filter were not used during these runs.

VII. Discussion of Test Results

A. Dryer emission concentrations and rates - Table I and II show the dryer sizes, the operating data and the emissions for the screen dryers and the baffle dryers, respectively.

Table I shows that the emission concentrations for screen dryers varied from 0.005 gr/sdcf for a controlled dryer to 0.061 for an uncontrolled dryer, ~~with an average of [illegible]~~. For uncontrolled dryers, the mass emission rates varied from 0.10 lb/ton of rice to 1.8. For controlled dryers, the mass emission rates varied from 0.12 lb/ton of rice to 1.4. The average of emissions from all dryers was 0.87 lb/ton of rice. Emissions from the two controlled dryers and from six of the nine uncontrolled dryers complied with the process weight rule.

Table II shows that the emission concentrations for uncontrolled baffle dryers varied from 0.02 gr/sdcf to 0.23. The average for all baffle dryers was 0.11 gr/sdcf. Mass emission rates varied from 0.30 lbs/ton of rice for the controlled dryer to 3.0 for an uncontrolled dryer, with an average of 1.4. Emissions from the controlled dryer and from one of the nine uncontrolled dryers complied with the process weight rule.

B. Emission concentrations from fugitive dust controls - Table III shows the results of tests on emissions from six control systems on fugitive dust emissions other than from the dryers themselves. The table shows that the emissions varied from less than 0.001 to 0.39 gr/sdcf. ~~The cyclone having the latter emission was not in compliance with the particulate emissions rule of 0.3 gr/sdcf.~~

C. Dryer emission particle size distributions - Figures 6 and 7 are plots of particle size versus weight percent of particles emitted for the screen dryers and the baffle dryers, respectively. The dotted line on each figure is the plot of the average.

Figure 6 shows for screen dryers that the particulate emissions in the size range less than 10 microns varied from 15 to 56 percent of the total emissions, averaging about 38 percent. Emissions in the size range less than five microns varied from five to forty percent of the total emissions, averaging about 20 percent.

Figure 7 shows for baffle dryers that the particulate emissions in the size range less than 10 microns varied from 20 to 65 percent of the total emissions, averaging about 36 percent. Emissions in the size range less than five microns varied from five to 40 percent of the total emissions, averaging about 16 percent.

Figure 8 is the average plot for all rice dryers tested of weight percent particulate emissions in a size range versus particulate size. The figure shows that the rice dryers averaged about 37 percent of total emissions in the size range less than 10 microns, and about 17 percent of emissions in the size range less than five microns.

Figure 9 consists of a plot, for each category of rice dryer tested, of particle size versus emissions for various size ranges in pounds per ton of rice. The emissions in the size range less than 10 microns varied from 0.12 pounds per ton for the screen dryer with a Cam-Vac control unit to 0.85 pounds per ton for the Louisiana State University type dryer. The emissions in the size range less than five microns varied from 0.024 pounds per ton for the screen dryer with a Wiedenmann and a settling room to 0.54 pounds per ton for the Louisiana State University type dryer.

VIII. Health Effects

The California Department of Health was contacted to obtain information on the health effects of rice dust, and its opinion is given below.

The effects of particulate matter on the respiratory system is shown in Table 4.

The health effects of rice dryer emissions are dependent upon the concentration of the rice dust in the air, the duration of exposure, and the response of the individual.

Rice dust produces a mechanical irritation to the skin, throat and eyes and may cause infections. It may cause allergic sensitization (allergic response) and aggravate existing allergies. Acting as a vector, the rice dust may carry fungus or spores and cause infection. In high concentrations and long exposure times it could result in silicosis, but for ambient concentrations such an effect is unlikely.

IX. Conclusions

A. There are less emissions from screen type dryers than from baffle type dryers.

B. Screen type dryers are not a regulatory problem.

* C. Baffle type dryers generally do not comply with process weight regulations.

* D. Although the three controlled dryers tested complied with the APCD regulations, some uncontrolled dryers tested also complied. Therefore, the effectiveness of controls was not established.

E. There is no significant difference in particulate emission size distributions among screen dryers, baffle dryers, controlled dryers and uncontrolled dryers.

F. The possible health effects of rice dryer emissions should be further investigated.

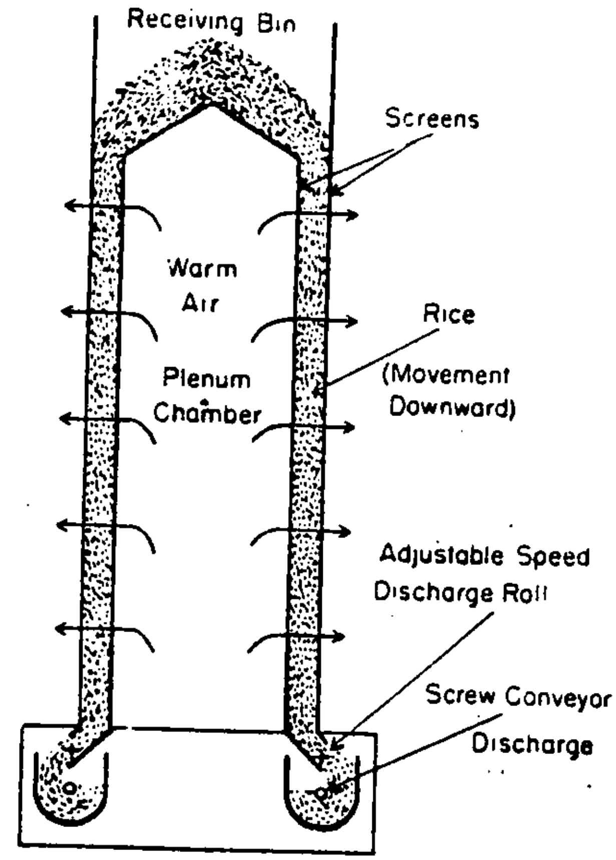


Fig. 1 - Schematic of air and rice flow in a screen dryer

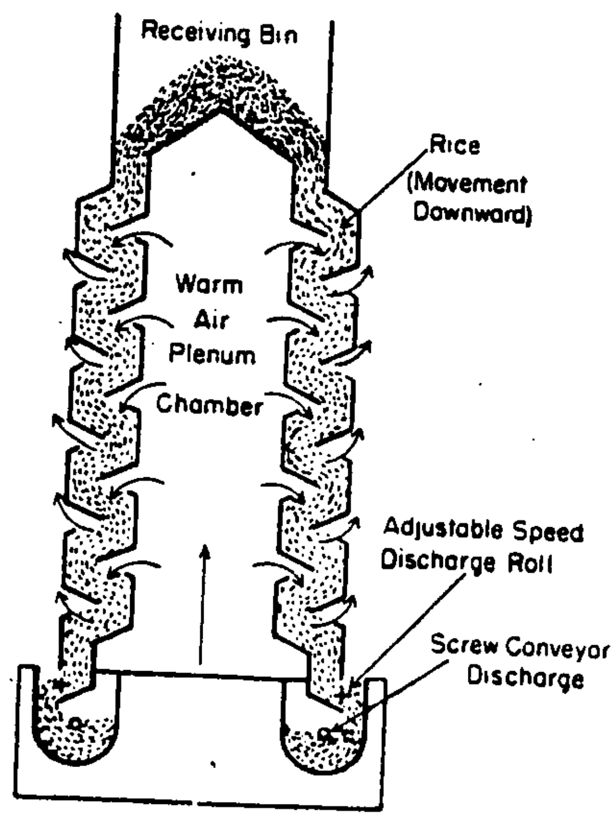


Fig. 2 - Schematic of air and rice flow in a baffle dryer

RICE DRYER

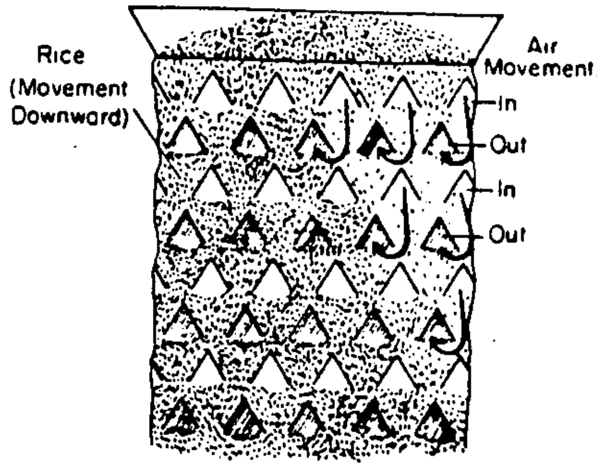


Fig. 3 - Schematic of air and rice flow in a Louisiana State University Dryer

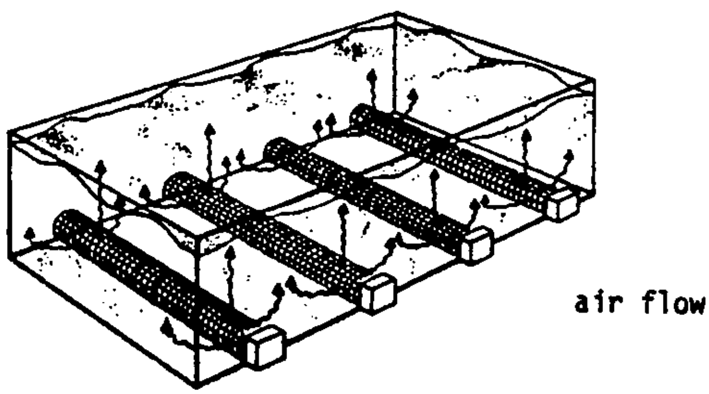


Fig. 4a - Flat House Dryer with perforated ducts on a solid floor

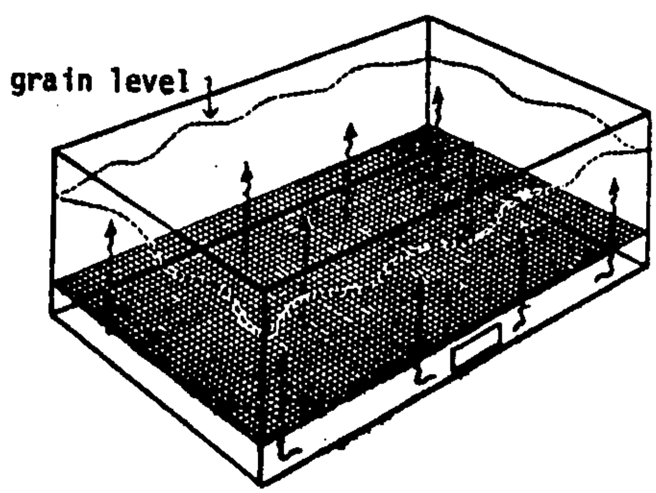


Fig. 4b - Flat House Dryer with a perforated floor

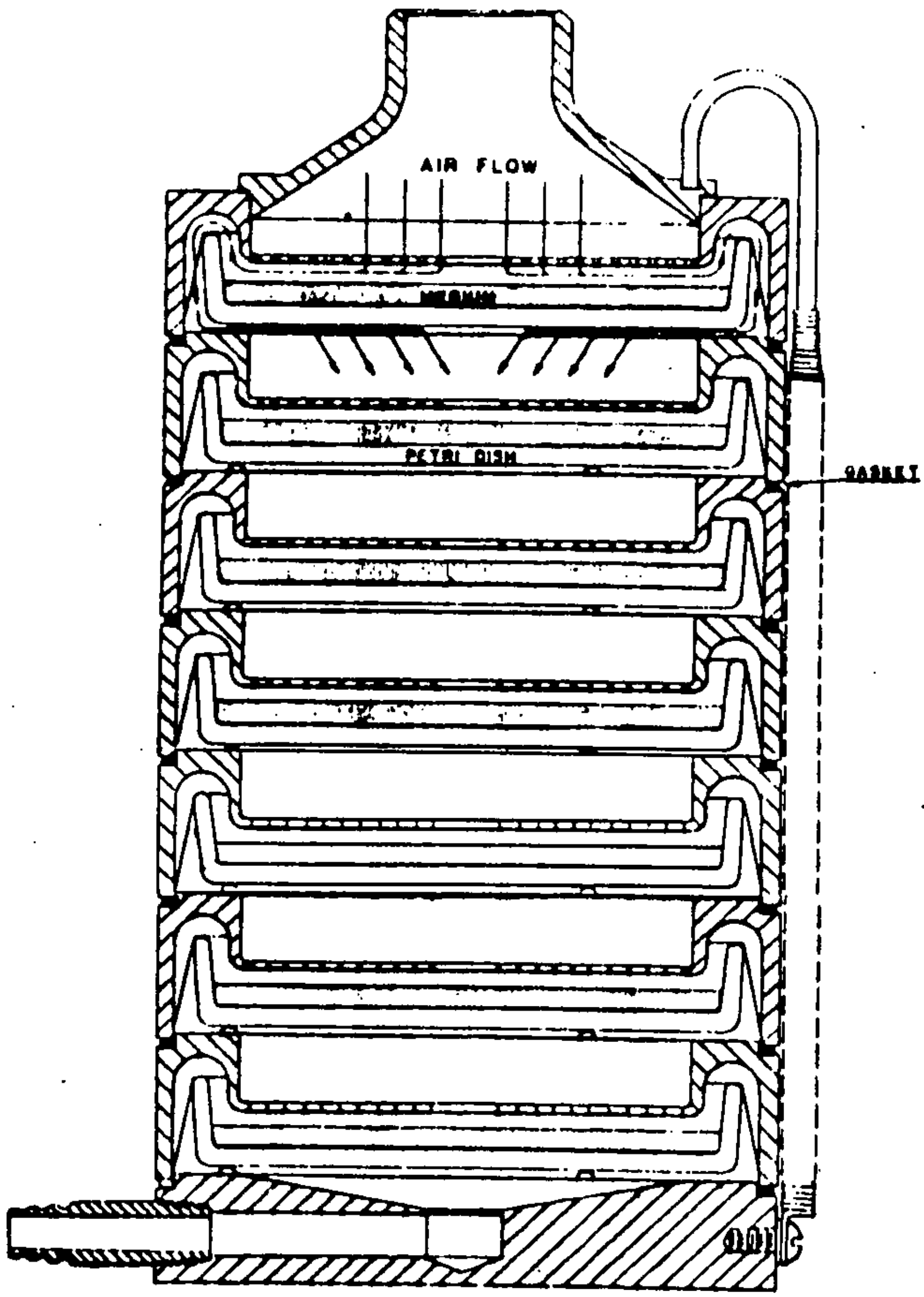


FIGURE 5: ANDERSEN IMPACTOR

FIGURE 6

SCREEN DRYERS
WEIGHT PERCENT PARTICULATE EMISSIONS IN A SIZE
RANGE VERSUS PARTICLE SIZE

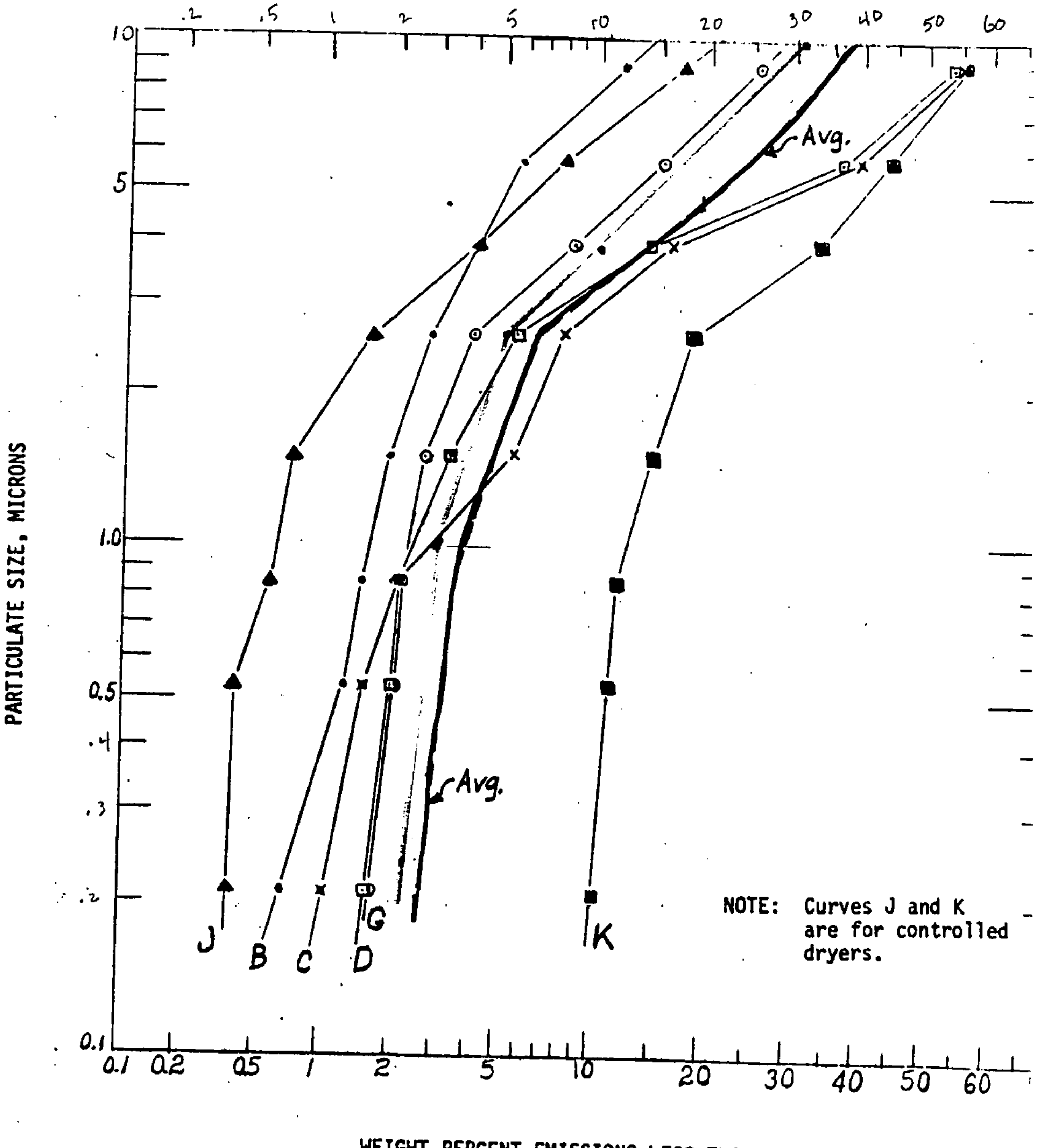


FIGURE 7

BAFFLE DRYERS

WEIGHT PERCENT PARTICULATE EMISSIONS IN A SIZE RANGE VERSUS PARTICLE SIZE

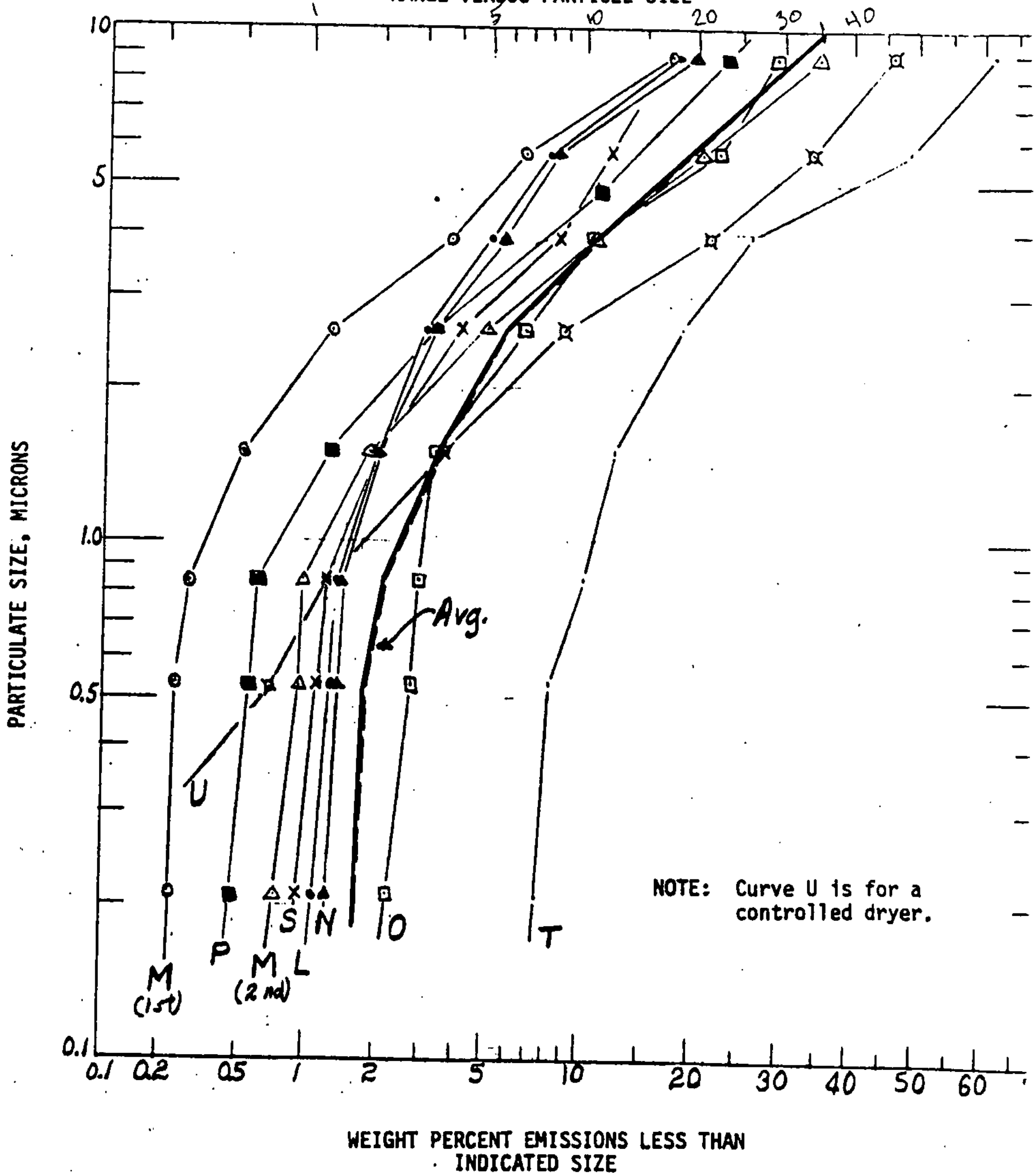


FIGURE 8

AVERAGE FOR SCREEN AND BAFFLE DRYERS
WEIGHT PERCENT PARTICULATE EMISSIONS IN A SIZE
RANGE VERSUS PARTICLE SIZE

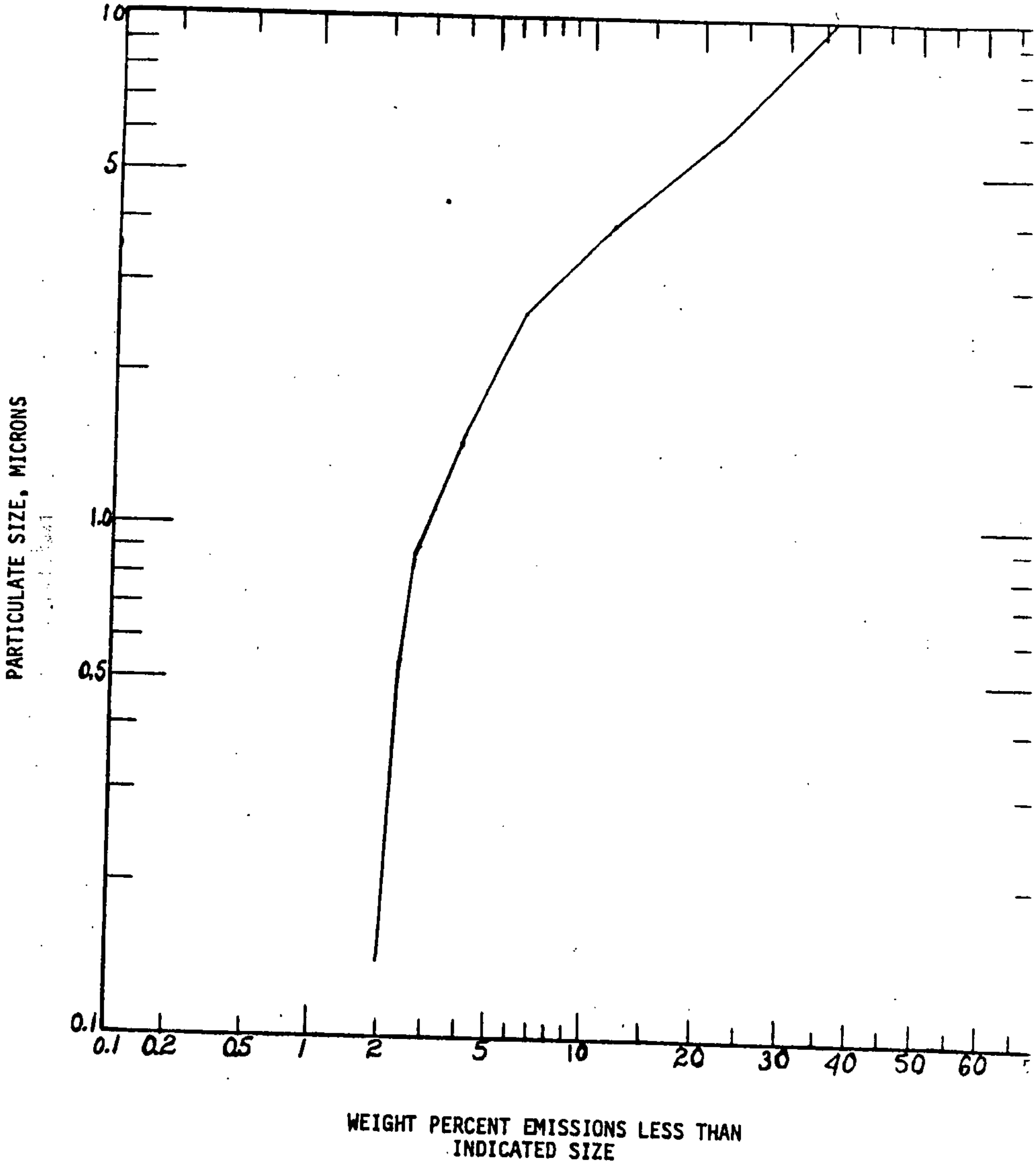


FIGURE 9

PARTICULATE SIZE EMISSIONS FROM VARIOUS DRYER CATEGORIES

PARTICLE SIZE VERSUS POUNDS EMISSIONS LESS THAN INDICATED SIZE PER TON OF RICE

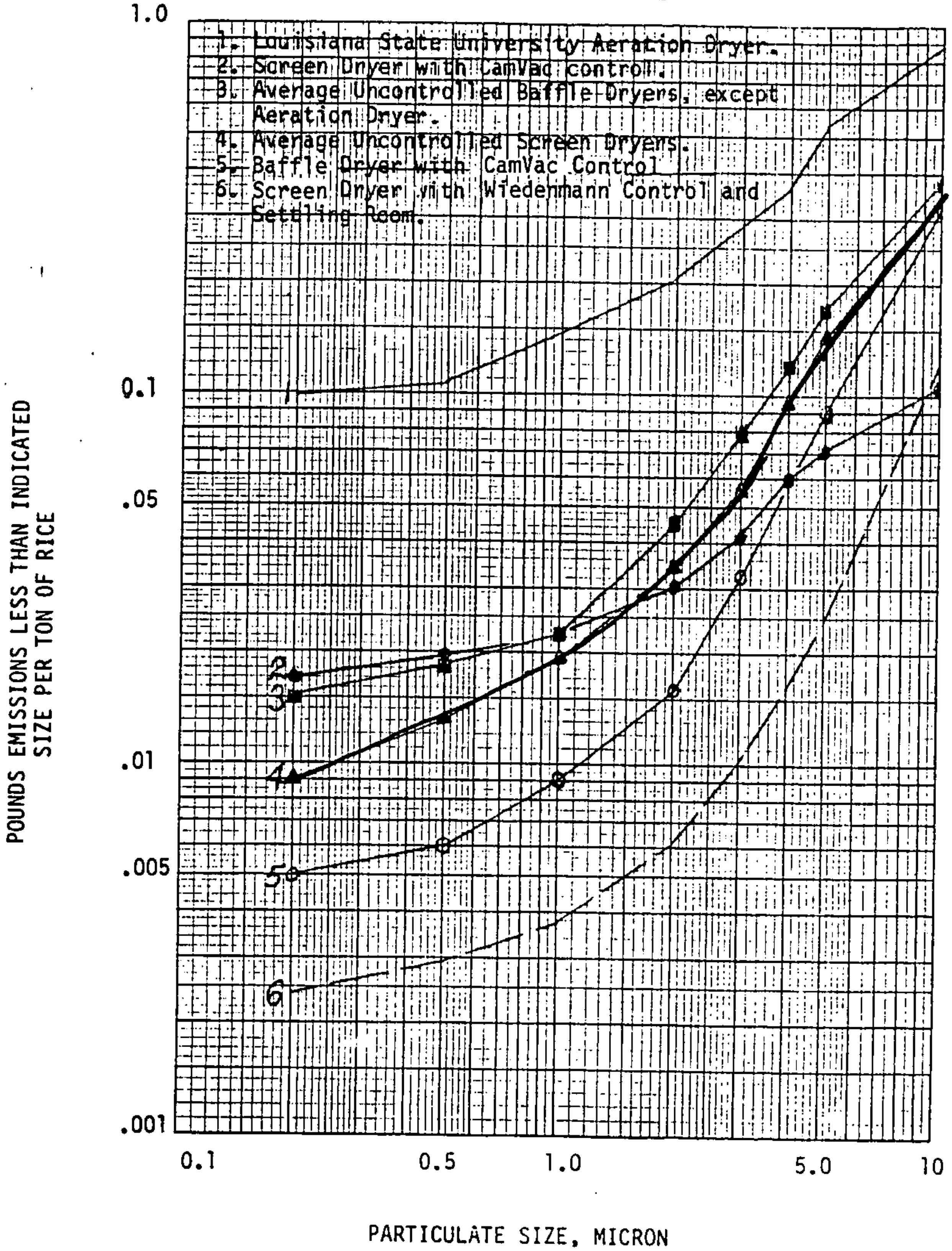


TABLE I

SCREEN DRYERS
DATA AND TEST RESULTS FOR
CONTROLLED AND UNCONTROLLED DRYERS

DRYER	UNITS	SIZE OF DRYER LENGTH, FT.	HEIGHT, FT.	DEPTH, IN.	DRYING AIR, CFM*	FACE VELOCITY FPM	PROCESS WEIGHT RATE, T/HR	PASS NO.	EMISSIONS GR/SDCF**	LBS/HR	RATE LBS/T	ALLOWABLE
A	4	12	40	12	150,000	39.06	60	1 & 3	0.019	24	0.40	46.3
[redacted]												
D	1	12	35	6	50,000	52.08	22.5	2	0.040	17	0.76	33.0
E	1	12	40	6	50,000	59.52	29.5	1	0.007	2.8	0.10	39.6
F	1	12	40	6	50,000	52.08	22.5	4 & 5	0.022	9.4	0.42	33.0
G	3	12	30	6	180,000	83.33	50	3	0.027	42	0.85	44.6
G	3	12	30	6	180,000	83.33	50	2	0.031	48	0.96	44.6
H	1	15	50	9	160,000	[redacted]	50	2	0.061	84	1.8	44.6
I	1	10	30	6-1/2	39,900	66.50	30	3	0.037	36	1.20	40.0
WITH CONTROLS											8.46/10 = .90 AVERAGE	
J (1)	4	12	20	6	80,000	41.67	22.6	2	0.046	32 (2)	1.40	33.0
J (1)	5 (3)	12	20	6	100,000	41.67	21.45	2	0.032	27 (2)	1.3	32.0
K (4)	1	12	40	10	150,000	89.29	50	3	0.007	8.7	0.17	44.6
	1	9	40	10								
K (4)	1	12	40	10	150,000	89.29	50	1	0.005	6.2	0.12	44.6
	1	9	40	10								
Average							38		0.03	30	0.87	

*Drying air temperature range 110-124°F, except Dryer C, 80°F
**Allowable emissions are 0.3 gr/sdcf.

NOTE: (1) Control - Wiedenmann 50 mesh screen and settling room.
(2) Calculated from test data.
(3) Fifth unit in operation as a cooler.
(4) Control - CamVac with type 2625 polyester filter.

B ⇒ RGA
C ⇒ MET
L ⇒ Roeger

NOTE: LINEAR REGRESSION (AIRFLOW, PROCESS) ⇒ Y = .2498X + 9.875

TABLE II

BAFFLE DRYERS

DATA AND TEST RESULTS FOR
UNCONTROLLED AND CONTROLLED DRYERS

DRYER	UNITS	SIZE OF DRYER LENGTH, FT.	SIZE OF DRYER HEIGHT, FT.	SIZE OF DRYER DEPTH, IN.	DRYING AIR, CFM*	FACE VELOCITY FPM	PROCESS WEIGHT RATE, T/HR	PASS NO.	EMISSIONS GR/SDBF**	EMISSIONS LBS/HR	EMISSIONS RATE LBS/T	EMISSIONS ALLOWABLE
[redacted]												
M	3	10	60	12	150,000	83	50	1	0.021	27	0.54	44.6
M (1)	3	10	60	12	150,000	83	50	2	0.083	110	2.1	44.6
N	4	16	30	6	160,000	167	80	3 & 4	0.15	210	2.6	49.1
O	4	12	50	9	200,000	111	90	1	0.14	230	2.6	50.2
P	2	10	45	12	160,000	81	220	1 & 3	0.11	150	0.70	59.6
	1	12	45	16				4				
	1	12	45	18				6				
Q	1	12	60	16	60,000	83	70	3	0.071	37	0.52	47.6
R	3	10	40	5	113,000	226	69.5	1	0.11	100	1.5	47.7
S	1	10	30	5	23,500	188	37.5	1	0.23	46	1.2	41.9
T (3)	1	16	30	72	120,000	--	90	6	0.12	120	1.3	50.2
WITH CONTROLS											$\frac{16.19}{11} = 1.54$ Average	
U (2)	2	12	30	6	66,700	185	32.5	1	0.17	9.9	0.30	40.7
Average							82		0.11	110	1.40	

*Drying air temperature range 105-125°F, except Dryer T, 140°F
**Allowable Emissions are 0.3 gr/sdcf

DRYER: (1) Rice contained 80% CSM3, 20% Cal Rose
(2) Control CamVac with 80 mesh screen
(3) Louisiana State University Aeration Dryer.

TABLE III

EMISSION CONCENTRATIONS FROM FUGITIVE DUST CONTROL EQUIPMENT

DRYER	SOURCES CONTROLLED	TYPE OF CONTROL	EMISSION CONCENTRATION GR/SDCF
A	Transfer Points	Baghouse	<0.001
B	Transfer Points	Baghouse	0.015
C	Scalper	Cyclone	0.18
D	Transfer Points	Cyclone	0.25
J	Transfer Points	Baghouse	0.056
M	Transfer Points	Cyclone	0.39

TABLE IV

HEALTH EFFECTS OF PARTICULATE MATTER

PARTICULATE SIZE RANGE	EFFECT ON RESPIRATORY SYSTEM
5 μ to 10 μ	Retained by hairs in the nostrils. Penetration into the pharynx and trachea region will be coughed up.
3 μ to 5 μ	Particles will be caught up by the cilia in the middle bronchi and coughed up.
1 μ to 3 μ	Will be deposited in the lower bronchi and may or may not be removed. Particles may be retained in the alveoli.
0.1 μ to 1 μ	Suspended particles will be breathed in and out of the alveoli without being deposited.

State of California

AIR RESOURCES BOARD
June 12, 1975

Staff Report

75-12-7

Consideration of Basinwide Regulations for the Control of Emissions from Agricultural Processing Operations in the Sacramento Valley

I. INTRODUCTION

On April 25, 1975, the Coordinating Council for the Sacramento Valley Air Basin adopted a new regulation concerning emissions from agricultural processing facilities. This regulation thus becomes a part of the Sacramento Valley Air Basin Coordinated Basinwide Air Pollution Control Plan.

II. THE ADOPTED REGULATION

Basically, the regulation limits the particulate-matter increase above "background levels" as determined by data from hi-vol samplers placed at selected sites near the plants. Agricultural processing facilities would not be permitted to "add to the ambient air over a populated area or any point more than 1/2 mile from the facility" more than 35 micrograms per cubic meter (ug/m^3) of particulate matter.

"Ambient samples" would be taken, concurrently at two or more locations approved by the APCO for at least one hour during a period when weather conditions are such that different samples taken concurrently can "reasonably be judged to include and exclude particulate matter emitted from the facility." Sampling sites would be selected by the APCO on the basis of "reasonable indication of significance" and must include locations where "maximum concentrations as estimated by diffusion calculations can be expected (emphasis added)". For the purposes of this regulation, populated areas include residences, schools, commercial establishments, Federal and State highways.

Attachment 1 is the text of the regulation.

III. BACKGROUND

For air pollution control purposes, the Sacramento Valley Air Basin Coordinated Basinwide Air Pollution Control Plan (Basin Plan) treats the agricultural business in two functional parts, agricultural operations (plowing, planting, harvest, etc.) and agricultural processing (canning, rice drying, etc.). The Basin Plan does not require control of particulate matter emissions from agricultural operations. The Plan also exempts agricultural implements used in agricultural operations from control requirements. The Plan does, however, require control of particulate matter emissions from agricultural processing plants.

The Basin Plan has five rules which apply to agricultural processing plants for control of particulate-matter emissions. Two of these rules are the nuisance law and the opacity law which prohibits emissions of greater than 40% opacity except for three minutes in any one hour period.

The other three rules are the process-weight rate rule, particulate-matter-concentration rule and permit rule. The process-weight rule prohibits emissions greater than a specified amount based on the weight of materials introduced into the process during a one-hour period. The particulate-matter-concentration rule prohibits particulate-matter concentrations in the exhaust air greater than 0.3 grains per standard dry cubic foot (SDCF). The permit rule requires existing plants to be registered with the local District and new plants to obtain permits to operate.

The Basin Plan was approved on September 24, 1971. The Implementation Programs adopted by the local air pollution control districts (APCDs) in the Sacramento Valley Air Basin have to be at least as restrictive as the approved Basin Plan.

On March 7, 1973 the Board instructed the staff to prepare a report on emissions from agricultural processing operations. Rice drying is the major agricultural processing operation in the Sacramento Valley Air Basin.

The staff conducted a study of emissions from 3 controlled and 18 uncontrolled rice dryers in the fall of 1973. Particulate matter concentrations and size distributions were measured. The staff also studied the types and effectiveness of control equipment. The Board considered the staff report on emissions from rice dryers at its April 11, 1974 meeting, and solicited comments and suggestions from the Sacramento Valley Air Basin Coordinating Council.

On October 25, 1974 the Coordinating Council submitted a rule to regulate emissions from agricultural processing operations to the Board. On November 14, 1974, the Board found that the proposed rule would not be effective in controlling emissions from agricultural processing plants.

The Board asked that these findings be communicated to the Coordinating Council and instructed the staff to work with the Coordinating Council and its staff to develop an acceptable regulation to control emissions from agricultural processing facilities.

On February 13, 1975, the Coordinating Council submitted a revised agricultural-processing regulation to the ARB staff for evaluation.

On March 12, 1975, the staff advised the members of the Coordinating Council and its Technical staff by letter that the proposed regulation was unenforceable and unacceptable. On March 14, 1975, the staff presented its objections to the regulation at the meeting of the Coordinating Council's Technical Advisory Committee (TAC). The TAC recommended adoption of the regulation by the Coordinating Council, despite the ARB staff's opinion, that the rule was unenforceable. On April 25, 1975 the Coordinating Council adopted the proposed regulation.

IV. DISCUSSION

A discussion of the regulation follows:

A. This regulation depends upon ambient-air-quality measurements taken some distance from the source in question.

It is assumed that the contribution of the source can be measured as the difference between the concentrations of particulate matter measured at two points - one "upwind" of the source and one "downwind". The existence of other sources of dust which can contribute differentially to concentrations at both sites, is not considered. Existence of other nearby sources is important in the case of agricultural processing facilities because typically these facilities are located in areas where other activities (notably agricultural operations such as "disking", rolling, planting, harvesting or even burning) can contribute to localized particulate-matter-concentrations. Also, there are frequently unpaved roads in the vicinities of these facilities. Thus, samples collected "upwind" of a source might show higher concentrations than samples from "downwind". Separating collected particulate matter according to source, when possible, cannot be easily done; thus extraneous contributions to the measured concentrations cannot be taken into account.

B. This regulation calls for a minimum of two measuring sites (possibly more). The APCO is to select these sites, using good judgement and the results of diffusion calculations.

It has not been established that it is valid to use diffusion equations to describe the behavior of particulate matter in the size ranges expected from typical agricultural processing facilities. The opinions of various authors differ greatly to the particle size beyond which settling becomes as important as diffusion. Thus, the use of diffusion calculations to establish compliance with the 35 ug/m^3-half-mile provision is in considerable doubt.

The use of diffusion calculations to pick sites for sampling involves prior knowledge of the meteorological conditions (wind-speed, vertical temperature profile, cloud cover and insolation). Thus, the choice of sites is dependent not only on the questionable diffusion-calculation approach, but also on the predictability of the weather, which may or may not behave as expected.

Sampling sites indicated on the basis of diffusion calculations may be inaccessible, forcing the selection of alternate sites that less accurately fit the stated criteria.

An additional consideration with respect to diffusion calculations is accuracy. Under the best of assumed meteorological conditions, describing the behavior of true gases or gas-like aerosols, calculations based on the Gaussian approximation yield results accurate to no better than a factor of two.[1/] Under most meteorological conditions, predictions may be in error by an order of magnitude or more (a factor of 10).

C. The variations of meteorological conditions have a profound effect on the concentrations measured "downwind" of the source in question. From the poorest to the best meteorological conditions for dispersion of gaseous pollutants, calculations of concentrations at a given site downwind show a variation of a factor of 20 in predicted concentrations. Determination of compliance or non-compliance by a facility would depend on the day chosen for the test. A facility tested on a poor day for dispersion may be found in violation, while another facility, emitting 20 times as much particulate matter, may be found to be in compliance, if tested on a meteorologically favorable day.

Table 1 and Figure 1 illustrate the sensitivity of dispersion to meteorology. Table 1 contains a set of emission-rates from a hypothetical source, calculated under various assumed conditions, which could result in a concentration of 35 ug/m^3, one-half mile downwind of the hypothetical source.

Figure 1 shows predicted concentrations of pollutants downwind from two different hypothetical sources, each yielding concentrations, one half-mile downwind, of 35 ug/m^3. Calculations for one source are based on the assumption of favorable conditions for dispersion; for the other, calculations are based on the assumption of least favorable conditions.

D. Dispersion calculations are based on the assumption of unchanging wind direction and velocity, a situation not likely to prevail in the Sacramento Valley.

The staff has performed preliminary calculations of the effect of variations in the direction of the wind on measured concentrations. These calculations indicate that if the standard deviation of the azimuth of the wind is 15°, predicted concentrations decrease to only 50% of steady-wind predictions. If the standard deviation of the azimuth is 10°, predicted concentrations decrease to 60% of steady-wind predictions. Wind speed changes were not evaluated.

IV. CONCLUSIONS

The adopted regulation is unenforceable; it is based on the assumption that the contribution of the source in question to the particulate-matter concentrations can be separated from the contributions of other nearby sources - farming operations, etc. The choice of sites for measurement of concentrations is to be based upon diffusion calculations whose applicability to particulate matter has not been established. Variations in meteorology alone can introduce a variation of a factor of 20 in concentrations downwind. Successful prosecution of enforcement actions based on this regulation is very unlikely. The defense in such a case would undoubtedly offer many of the criticisms of the rule found in this report as reasons for having the case dismissed; the courts would almost certainly rule in favor of the defense.

V. RECOMMENDATIONS

The staff recommends that the Board affirm the staff's position, that the regulation adopted by the Sacramento Valley Air Basin Coordinating Council on April 25, 1975, is unenforceable and unacceptable, and inform the Coordinating Council of this decision. The staff recommends that the Basin Plan retain the opacity, process-weight and particulate-matter-concentration regulations for application to agricultural processing operations in the Sacramento Valley Air Basin.

References

1. Turner, D.B., Workshop of Atmospheric Dispersion Estimates, U.S. Environmental Protection Agency, 1970.

TABLE 1

Particulate Emissions from a Hypothetical Rice Dryer
Varying Meteorological Conditions*

Emission Rate, lbs. per Hour

Wind Velocity Miles/Hour	Stability Classification**					
	A	B	C	D	E	F
1	51	12	4.8	1.7	1.0	0.57
2	100	25	9.7	3.5	2.0	1.1
3	150	37	14.5	5.3	3.0	1.7
4	210	50	19.0	7.0	4.0	2.3
5	260	62	24.0	8.8	5.0	2.8

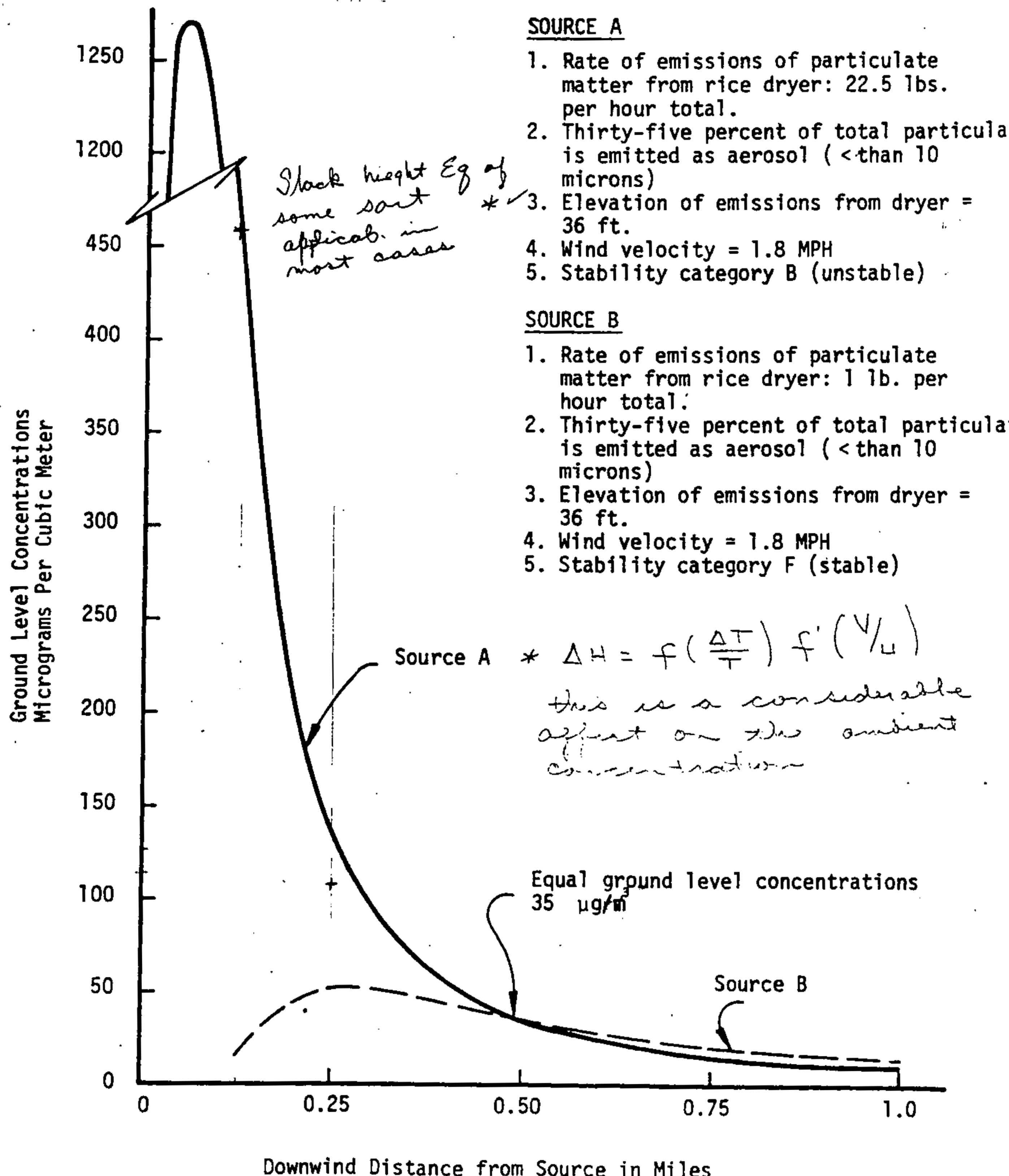
*All tabulated emission rates would produce equal ground level concentrations (35 micrograms per cubic meter) on the plume axis, one half mile downwind from the source, assuming 35% by weight of emissions less than 10 microns.

**A = Extremely unstable, B = Unstable, C = Slightly unstable
D = Neutral, E = Slightly stable, F = Stable

This system of classifying stability is based on the findings of Dr. F. Pasquill. Stability near the ground is dependent primarily upon net radiation and wind speed.

Figure I

Predicted Ground Level Concentrations From Two Sources



State of California

AIR RESOURCES BOARD

No: 75-12-8a

Date: June 12, 1975

Item: The Development of Action Plans and Abatement Strategies for Air Pollution Emergencies

The staff report will be distributed to the Board at the meeting.

State of California

AIR RESOURCES BOARD

No: 75-12-8 b

Date: June 12, 1975

Item: Revision of the Los Angeles County APCD Regulation VII regarding Emergency Episode oxidant levels.

Summary: The oxidant episode criteria included in the California Air Pollution Emergency Plan were revised on May 15, 1975. The APCDs specified in the Plan are required to comply with this revision. If the Los Angeles County APCD does not give notice prior to June 12, 1975 of its intent to change its episode criteria to provide such compliance, the Board should give notice of its intent to hold a public hearing for the purpose of revising the appropriate section of the Los Angeles County APCD Regulation VII.

CWA

CALIFORNIA WAREHOUSE ASSOCIATION

1715 Capitol Avenue
Sacramento, CA 95814
916/441-1149
916/446-1063 FAX

TO: Sacramento Technical Advisory Committee

FROM: Farmers Rice Cooperative and the California Warehouse Association

DATE: August 12, 1993

SUBJECT: Sacramento Valley Air Basin Report - Proposed Emission Factors

BACKGROUND

On April 23, 1993 Gary Schmidt of Farmers Rice Cooperative and Tom Vogel of the California Warehouse Association attended the Sacramento Valley TAC meeting in Willows, California, where the proposed emission factors for rice driers were to be approved and implemented. Questions regarding the origin of the proposed factors and the extent of industry involvement in the process of determining the factors were raised but the subcommittee members who worked on the plan were not available for comment. Consequently, the issue was tabled until more information was available from the subcommittee.

On July 1, 1993 Mike Sandrock and Gary Schmidt of Farmers Rice Cooperative, and Richard Matteis of the California Warehouse Association attended an Industry Coalition Committee meeting in Chico, California, where the proposed emission factors for rice driers were discussed. Members of the Sacramento Valley TAC subcommittee which revised the current emission standards were present to answer questions from the audience.

At the July 1 meeting it was learned that the proposed factors were derived from a variety of sources, including information from tables in EPA AP-42, source test results from 13 screen driers and 10 baffle driers taken in the Sacramento Valley Basin in 1974, and from the California Air Resources Board Report 74-8-8. A request was made by Farmers Rice Cooperative and the California Warehouse Association to have the proposed emission factors presented by a member of the TAC at the Rice Industry Warehouse meeting in Arbuckle on August 12, 1993. Members of the TAC and the Industrial Coalition Committee agreed to present the data at the meeting and to allow 30 days for a formal response.

DISCUSSION

Upon review of the proposed emission factors, there may be more accurate information available which depicts the current state of the industry, and relates more closely to the emission factors currently in use in Colusa County. In addition, as we understand it, the proposed factors will be applied to each pass through a drier stand or to each time the product is moved from one place to another, rather than being based solely on tons of grain processed at the facility. In effect, this could mean that the total calculated emissions a facility generates could increase by perhaps as much as ten times. We question if this is realistic. Table 6.4-1 (Country Elevators) in EPA AP-42 was used to obtain the TAC proposed emission factors for each process except baffle drying.

When the factors for unloading, cleaning, transferring, and loading are totaled, the cumulative emission factors is 4.9 pounds of particulate emitted for each ton of product handled, which is close to the number currently being used in Colusa County. However, we feel this number should be based solely on tons of grain processed by the facility, and not be applied each time the product is handled. As stated in EPA AP-42, "Since the amount of grain passing through each individual operation is often difficult to determine, it is sometimes convenient to express the emission factors in terms of the quantity of grain received or shipped by the elevator. Therefore, the emission factors in Table 6.4-1 have been modified and are expressed in Table 6.4-5 as a function of the amount of grain received or shipped". When the same emission factors are taken from Table 6.4-5 (Country Elevators) they total 3.4 pounds of particulate per ton of product received, which is 1.5 pounds of particulate per ton of product received less than noted in Table 6.4-1 (Country Elevators).

As stated in EPA AP-42, Section 6.4.2.1, "The emission rate can be affected by the quantity of foreign material in the grain (dirt, seeds, sticks, stones, etc., known as "dockage") and by the type of grain. While it is difficult to quantify the effect of dockage, observations indicate that soybeans, oats, and sorghum are usually very dusty, whereas wheat and corn are comparatively clean. Total particulate emission factors for the principal operations at grain elevators are presented in Table 6.4-1. Since data differentiating these emission factors by grain types are sparse, all of these factors are approximate average values intended to apply to a variety of grains." Table 6.4-6 gives emission factors in pounds of particulate per ton of product handled for various operations specific to certain types of grains, one of which is rice. The emission factors on Table 6.4-6 may be the most accurate numbers, for they are crop specific and are not a compilation of emission factors including other types of grains.

Regarding the rice drier source test data taken in 1974, we would like to refer to additional source test data taken in 1981 at the Butte County Rice Growers Richvale plant where four source tests were performed on screen driers. At an average drying rate of 196.25 tons per hour, an average of 20.59 pounds of particulate matter was emitted per hour. This equates to a ratio of 20.59/196.25, or an emission factor of 0.10 pounds of particulate matter per ton of rice dried per pass in the drier. Depending on the time of harvest, weather conditions, etc. rice usually passes through the drier stand an average of two to three times. If the emission factor of 0.10 is applied to three passes through the drier stand, the resulting emission factor would be 0.30, which equates to the current emission factor being used in Colusa County and the emission factor noted in EPA AP-42, Table 6.4-6.

These later test bring up another consideration when discussing emission factors for rice driers and country elevators in general. The grain is much cleaner now when it is received at the country elevator than it was in the 1970's. The efficiencies of the harvesters are higher, but more importantly the rice varieties have changed significantly. In the 1970's the rice hull had more fine fibers on its exterior and a longer awn. Today, the rice kernel has a smoother hull with a very short awn. The smoother hull and shorter awn mean that this material is no longer lost in the transfer and drying processes, thus yielding an overall cleaner product.

CONCLUSION AND RECOMMENDATIONS

To recap, all parties would like to see uniform emission factors established for rice dryers and country elevators so a basin wide standard can be developed which will apply to all facilities equitably. The emission factors noted for rice drying in EPA-42, Table 6.4-6 and the emission factors used in Colusa county appear to be substantiated by the 1981 source test data obtained from the Butte County Rice Growers Richvale plant. Therefore, we feel current emission standards for the specific commodity based on tons of product processed by the facility are accurate. Please contact us and the Industry Coalition Committee so we can all work together to determine which emission factors are the most representative for our industry, and on future matters relating to our industry. Both industry and the TAC will benefit from working on new policies or policy revisions together, for each party has something to offer the other.

Proposed Emission Factors Compared to Other Sources

Operation and Emission Factor
Pounds of Particulate Per Ton of Product Handled

	Receiving	Cleaning	Transfer	Loading	Drying	Total
TAC Proposed (Table 6.4-1)	0.60	3.00	1.00	0.30	0.70	5.60*
EPA Table 6.4-5	0.60	0.40	2.00	0.40	0.20	3.60
EPA Table 6.4-6**	0.64	----	5.00	----	0.30	5.94

*Note: This factor is not in pounds per ton processed, but in pounds per ton each time the product is moved.

**Note: These factors are currently being used in Colusa County.

Butte County Rice Growers Association
1981 Screen Drier Source Test Data

		Process Rate Tons/Hour	Emissions Pounds/Hour	Emission Factor Pounds/Ton
BUCRA #1 (Screen)	Test #1	200 220	13.52	0.06
BUCRA #2 (Screen/Baffle)	Test #2	240	39.40	0.16
Red Top (Screen)	Test #3	200	22.72	0.11
BUCRA/Riceton (Screen)	Test #4	125	6.70	0.05
				0.16
RGA (Screen)	Average	196.25	20.59	0.10

which these
first run
or second
or third run