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

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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.

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°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.

RICE DRYERS

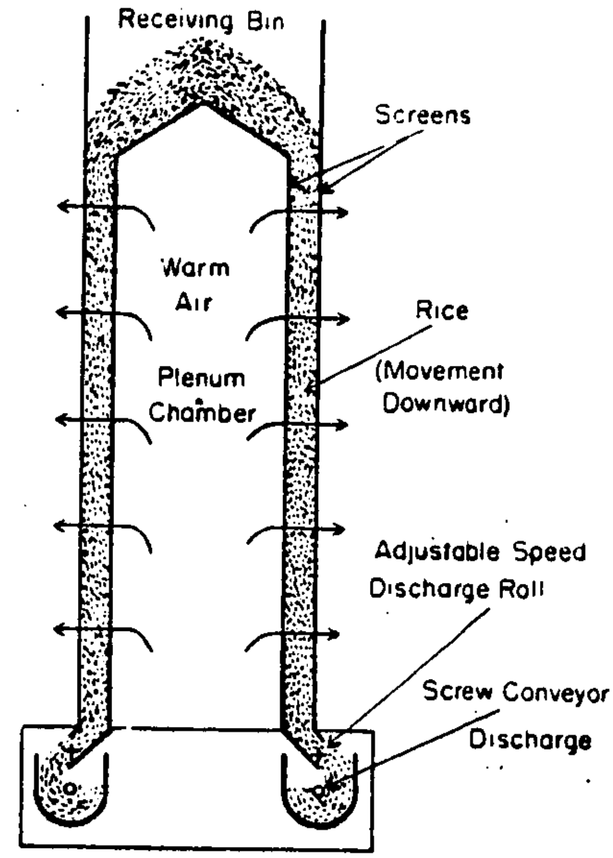


Fig. 1 - Schematic of air and rice flow in a screen dryer

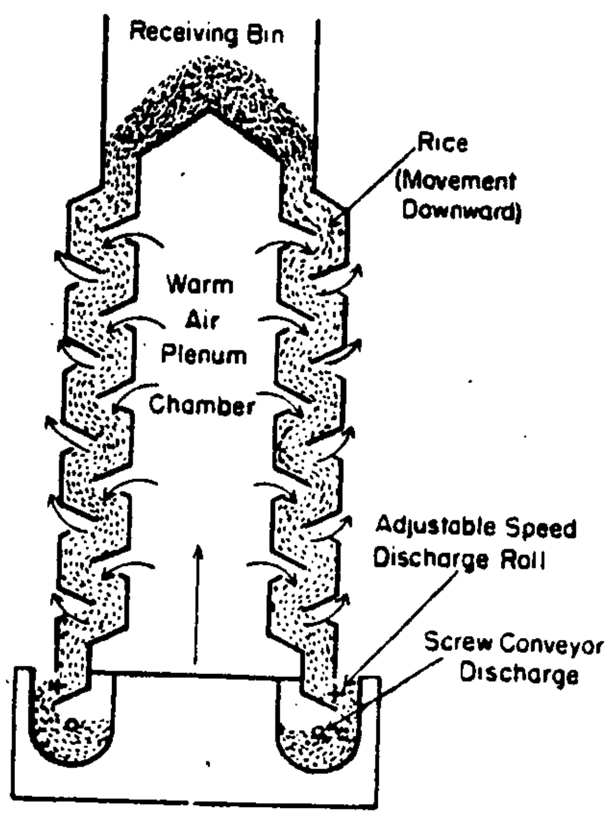


Fig. 2 - Schematic of air and rice flow in a baffle dryer

RICE DRYER

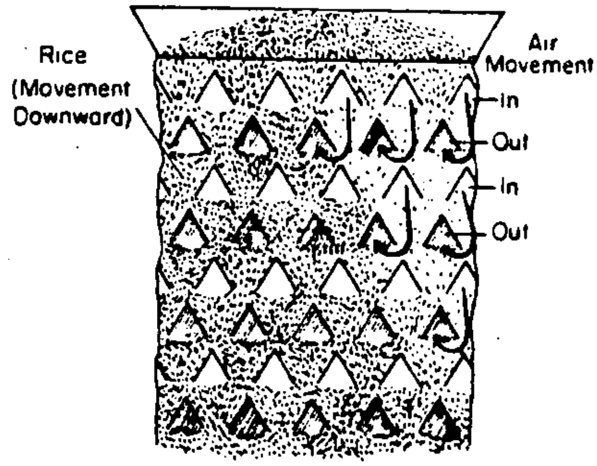


Fig. 3 - Schematic of air and rice flow in a Louisiana State University Dryer

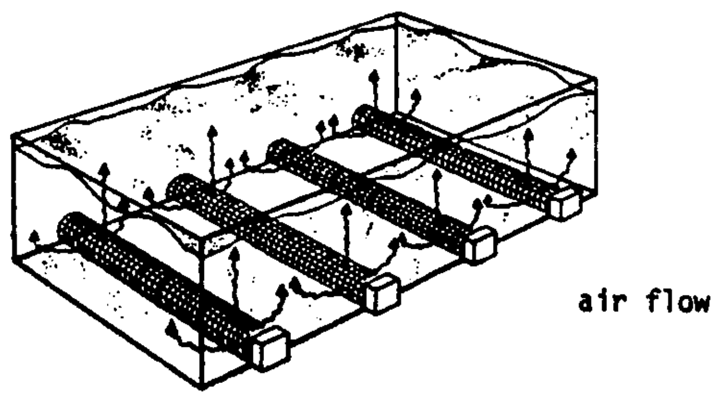


Fig. 4a - Flat House Dryer with perforated ducts on a solid floor

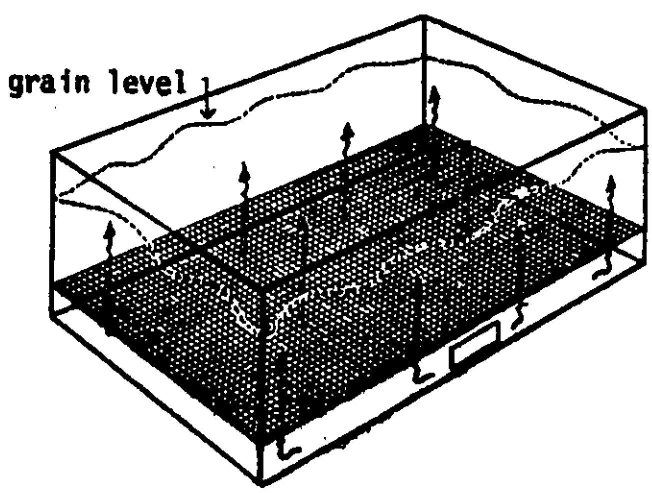


Fig. 4b - Flat House Dryer with a perforated floor

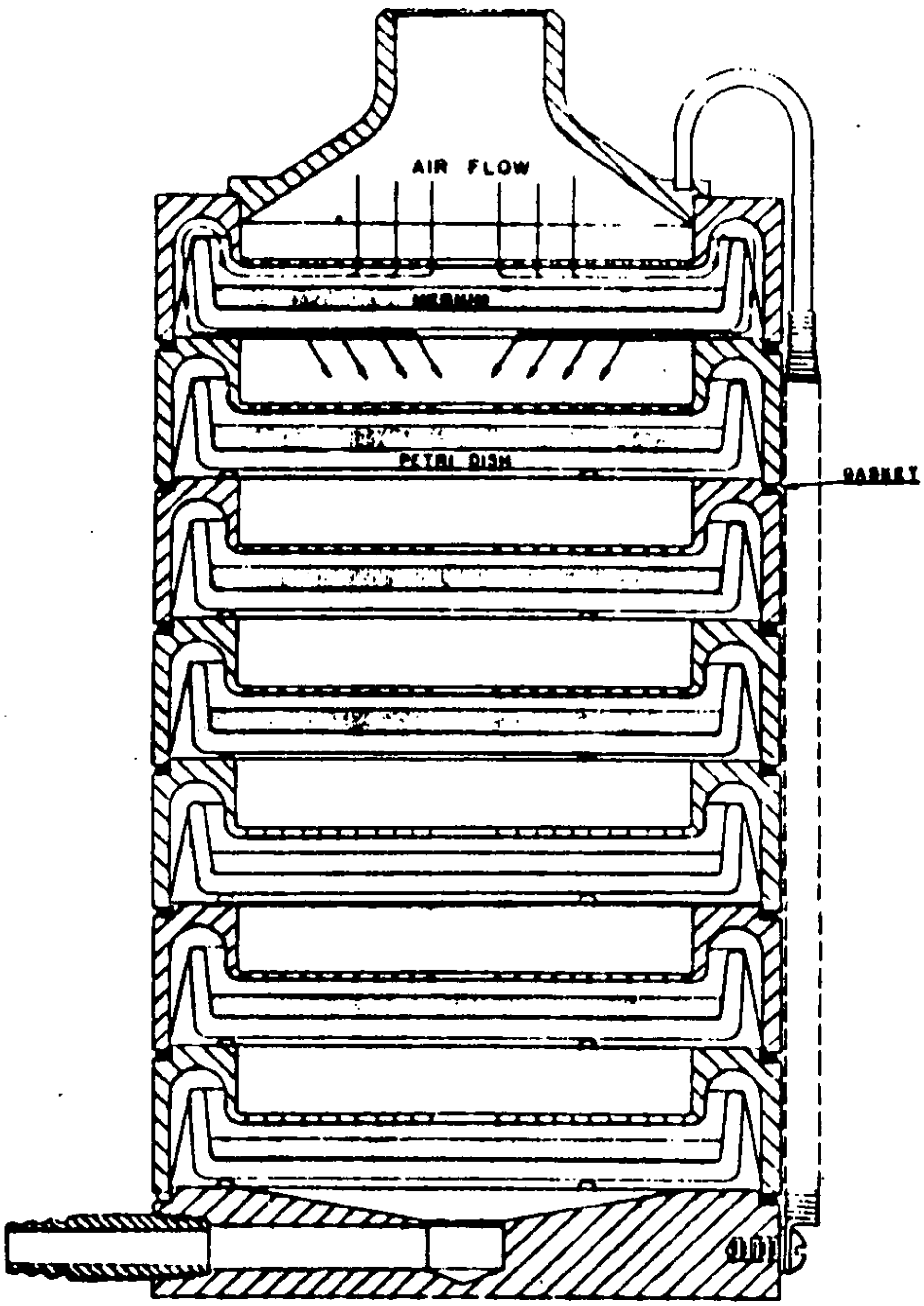


FIGURE 5: ANDERSEN IMPACTOR

Correct by 20%

FIGURE 6

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

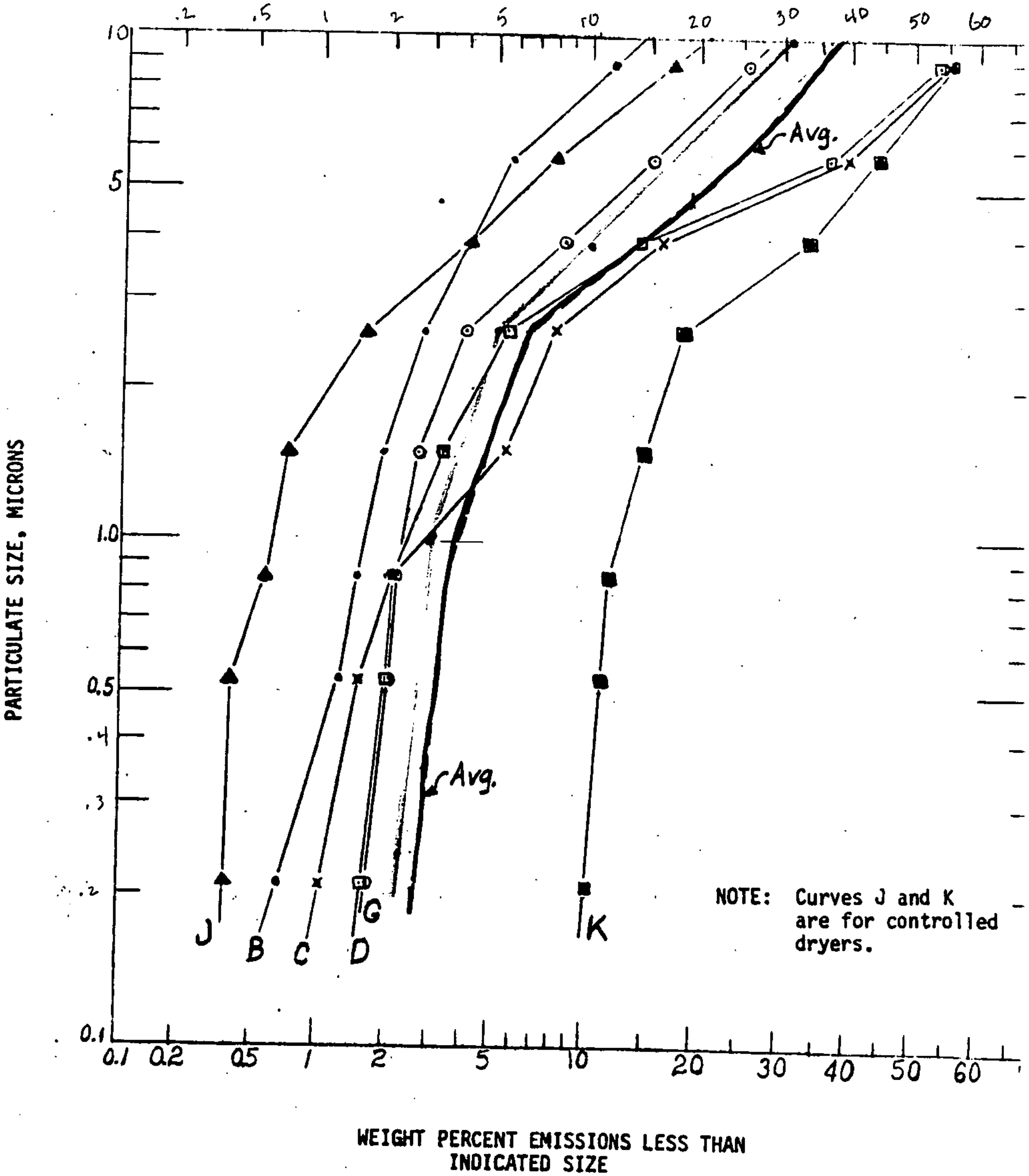


FIGURE 7

BAFFLE DRYERS

WEIGHT PERCENT PARTICULATE EMISSIONS IN A SIZE RANGE VERSUS PARTICLE SIZE

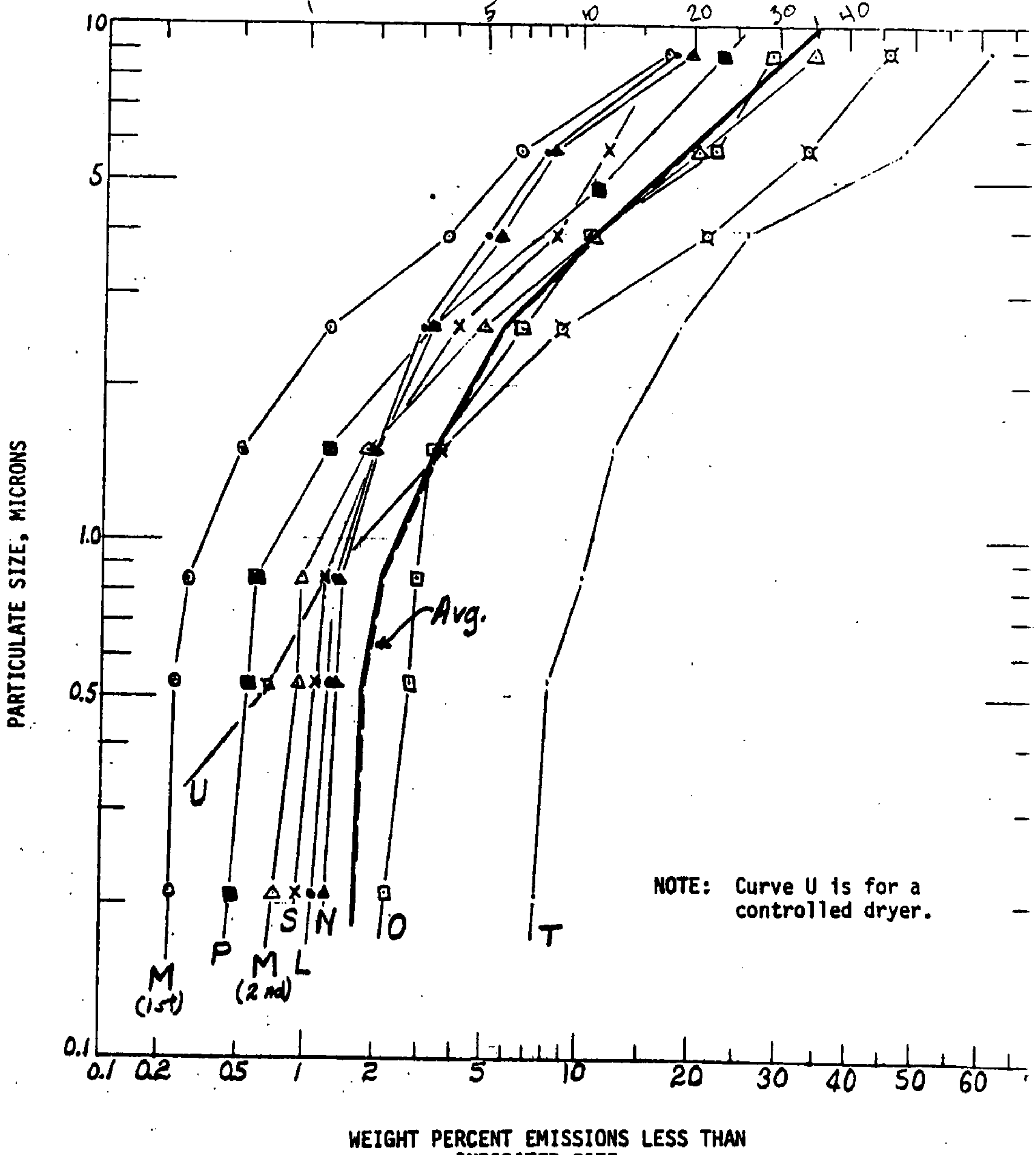


FIGURE 8

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

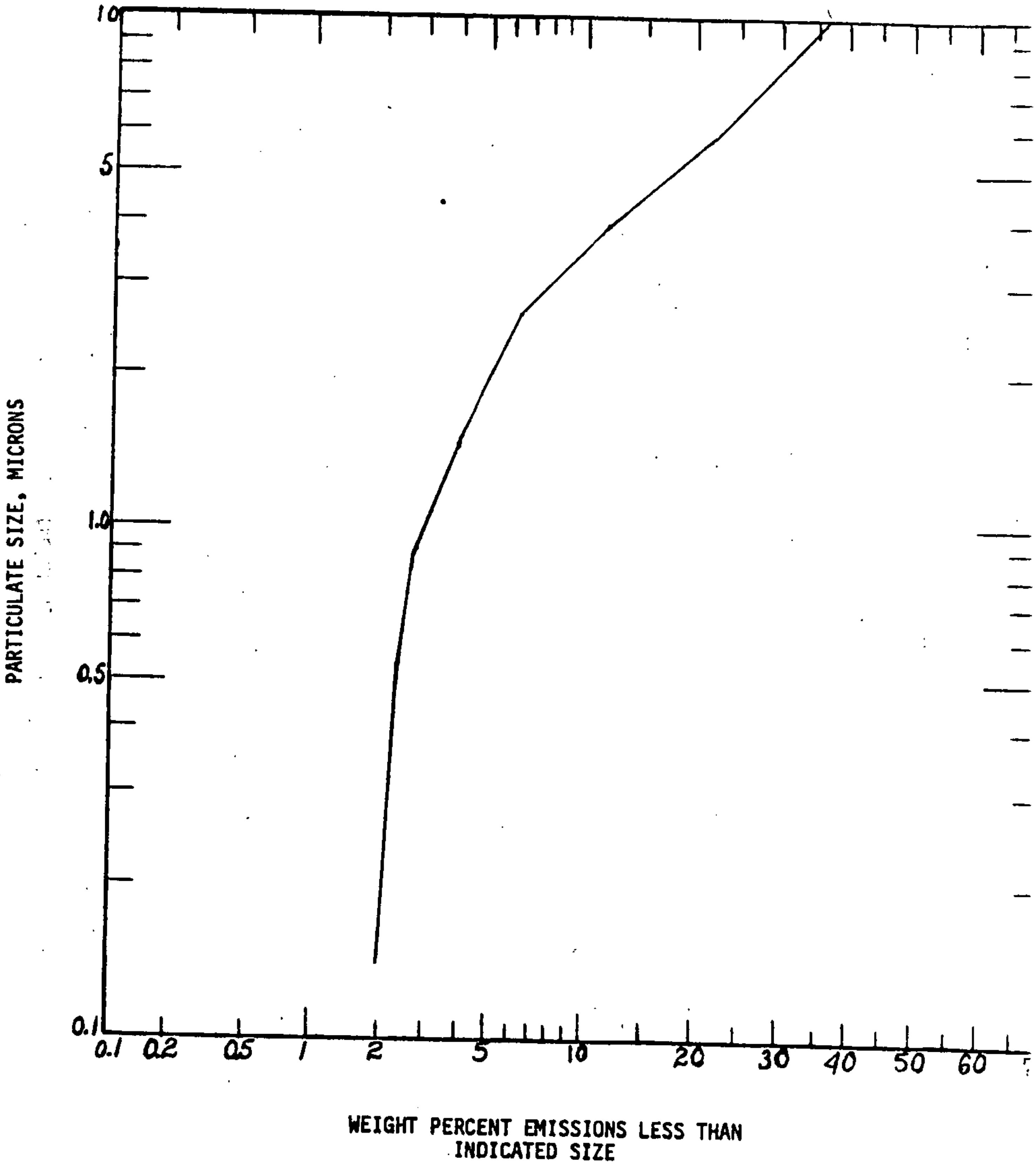


FIGURE 9

PARTICULATE SIZE EMISSIONS FROM VARIOUS DRYER CATEGORIES

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

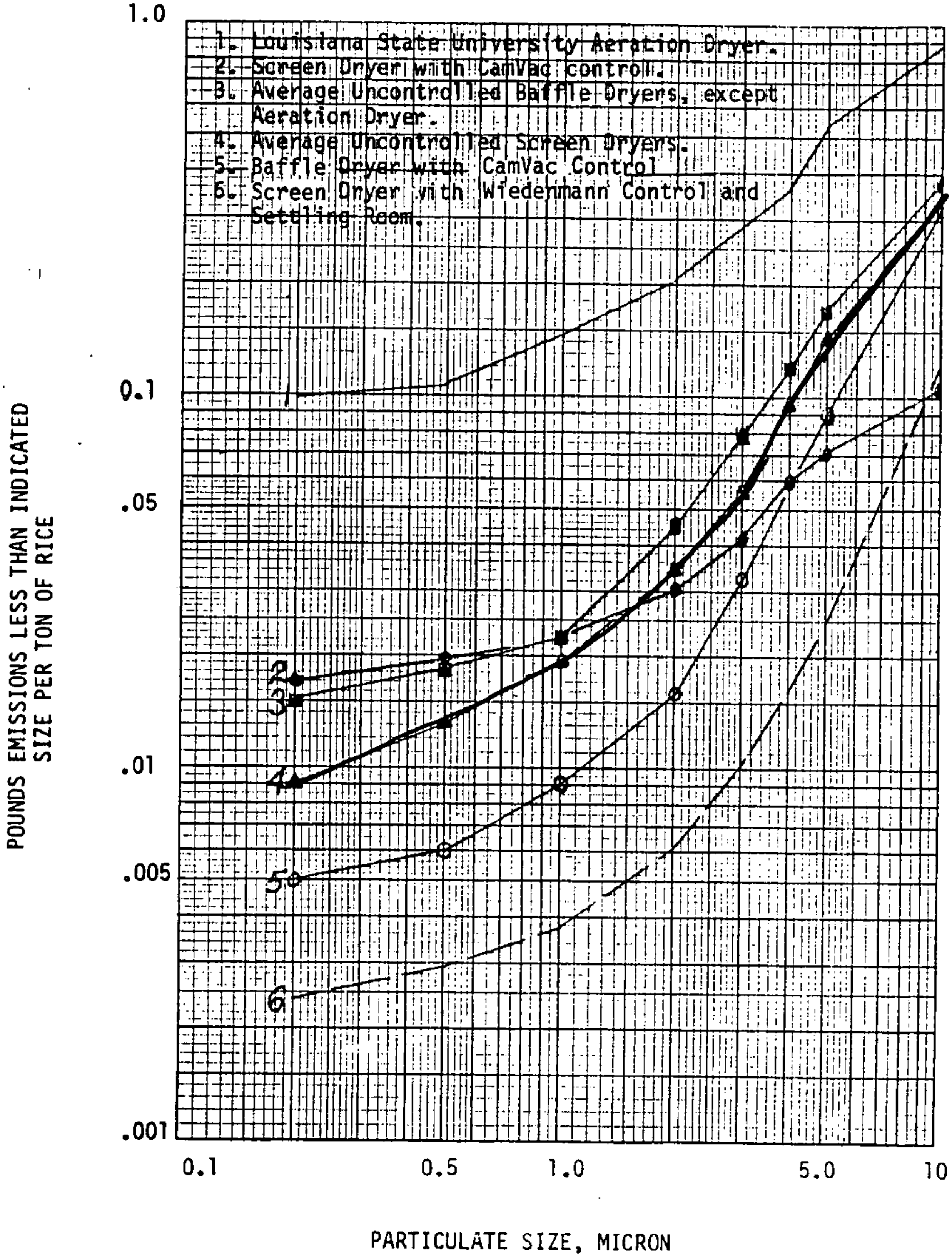


TABLE I

SCREEN DRYERS
DATA AND TEST RESULTS FOR CONTROLLED AND UNCONTROLLED DRYERS

DRYER	UNITS	SIZE OF DRYER LENGTH, FT.	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/SDCF**	EMISSIONS LBS/HR	EMISSIONS RATE LBS/T	EMISSIONS ALLOWABLE
[redacted]												
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 8.96/10 = .90 AVERAGE	40.0
WITH CONTROLS												
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

(AIRFLOW [X], PROCESS [Y]) ⇒ $Y = .2498X + 9.875$

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											16.94 / 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

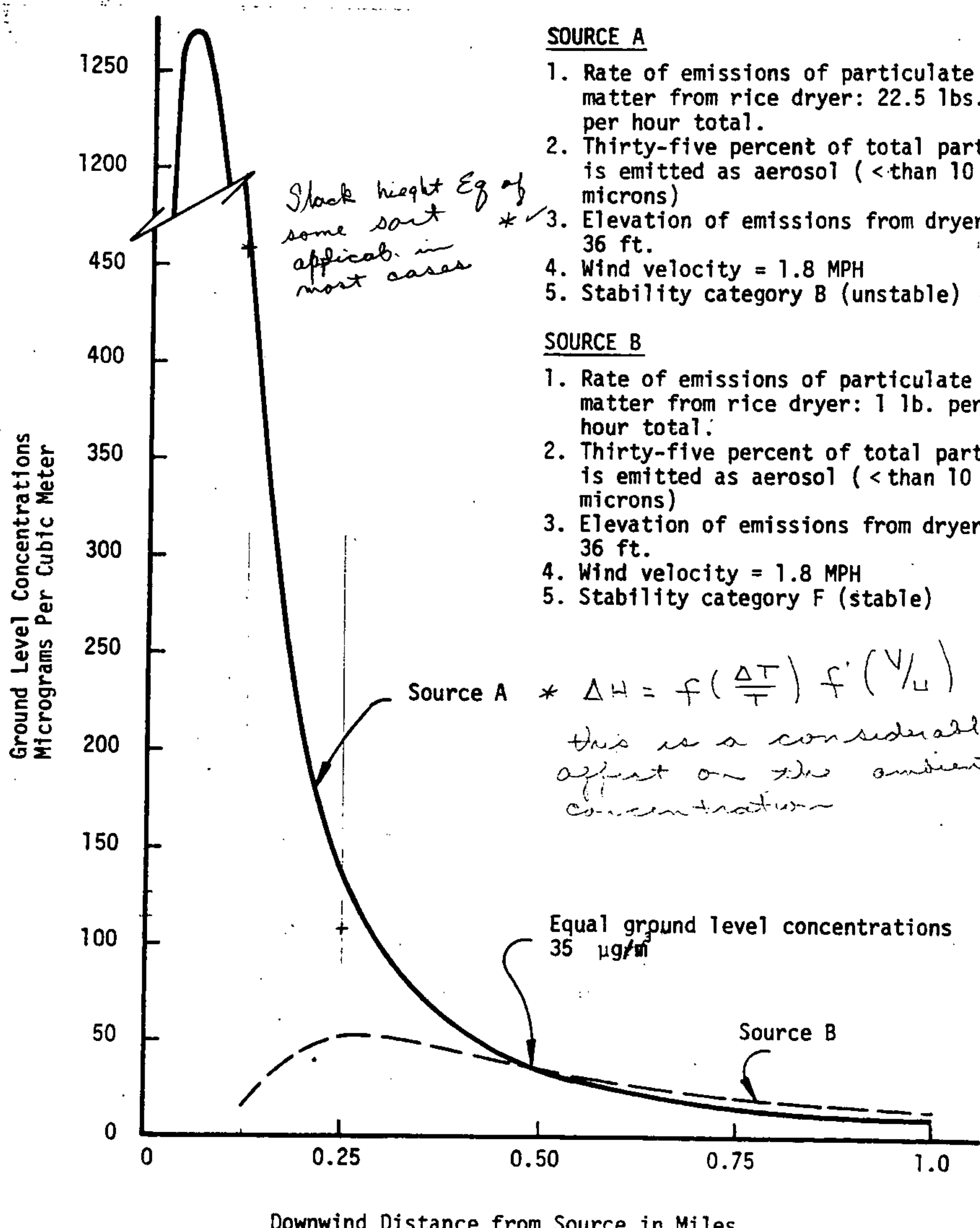
*All tabulated emission rates would produce equal ground level concentrations (35 micrograms per cubic meter) on the plume axis, one half mile downwind from the source, assuming 35% by weight of emissions less than 10 microns.

**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



SOURCE A

1. Rate of emissions of particulate matter from rice dryer: 22.5 lbs. per hour total.
2. Thirty-five percent of total particula[te] is emitted as aerosol (< than 10 microns)
3. Elevation of emissions from dryer = 36 ft. *
4. Wind velocity = 1.8 MPH
5. Stability category B (unstable)

SOURCE B

1. Rate of emissions of particulate matter from rice dryer: 1 lb. per hour total.
2. Thirty-five percent of total particulat[e] is emitted as aerosol (< than 10 microns)
3. Elevation of emissions from dryer = 36 ft.
4. Wind velocity = 1.8 MPH
5. Stability category F (stable)

* $\Delta H = f\left(\frac{\Delta T}{T}\right) f'\left(V/u\right)$

this is a considerable affect on the ambient concentration

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.