EPA-450/3-77-007

BACKGROUND DOCUMENT: BAGASSE COMBUSTION IN SUGAR MILLS

by

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SUGAR CANE PROCESSING - BAGASSE COMBUSTION

I. General Information

Bagasse is a waste product of the sugar cane extraction process and has a heating value of up to 4,000 BTU per pound (wet).[1] Figure 1 shows typical sugar cane wash and mill operations generating juice and bagasse. The bagasse represents about 30% of the weight of the raw sugar cane.[2] In order for the sugar cane mill to avoid a large solid waste disposal problem and to minimize the cost of power requirements, the bagasse is used as the primary fuel for on-site steam production. In at least one mill, it is sent to an adjacent chemical production plant for use in making furfural and the bagasse residue is returned as fuel for generating process steam for both facilities.[3]

No. 6 fuel oil is fired as an auxiliary fuel to increase the steam production per boiler when firing wet bagasse (>50% moisture content) or when the steam load can not be met by burning only bagasse. Several mills incorporate a bagasse dryer or air pre-heater system to reduce the quantity of fuel oil used, however this practice is not in common use in the industry.[4,5,6]

The United States sugar cane industry is located in Florida, Louisiana, Hawaii, Texas, and Puerto Rico. Except in Hawaii, where raw sugar production takes place year around, the industry is seasonal ranging from two to five months per year.

Table 1 shows a typical bagasse composition; the low sulfur and high

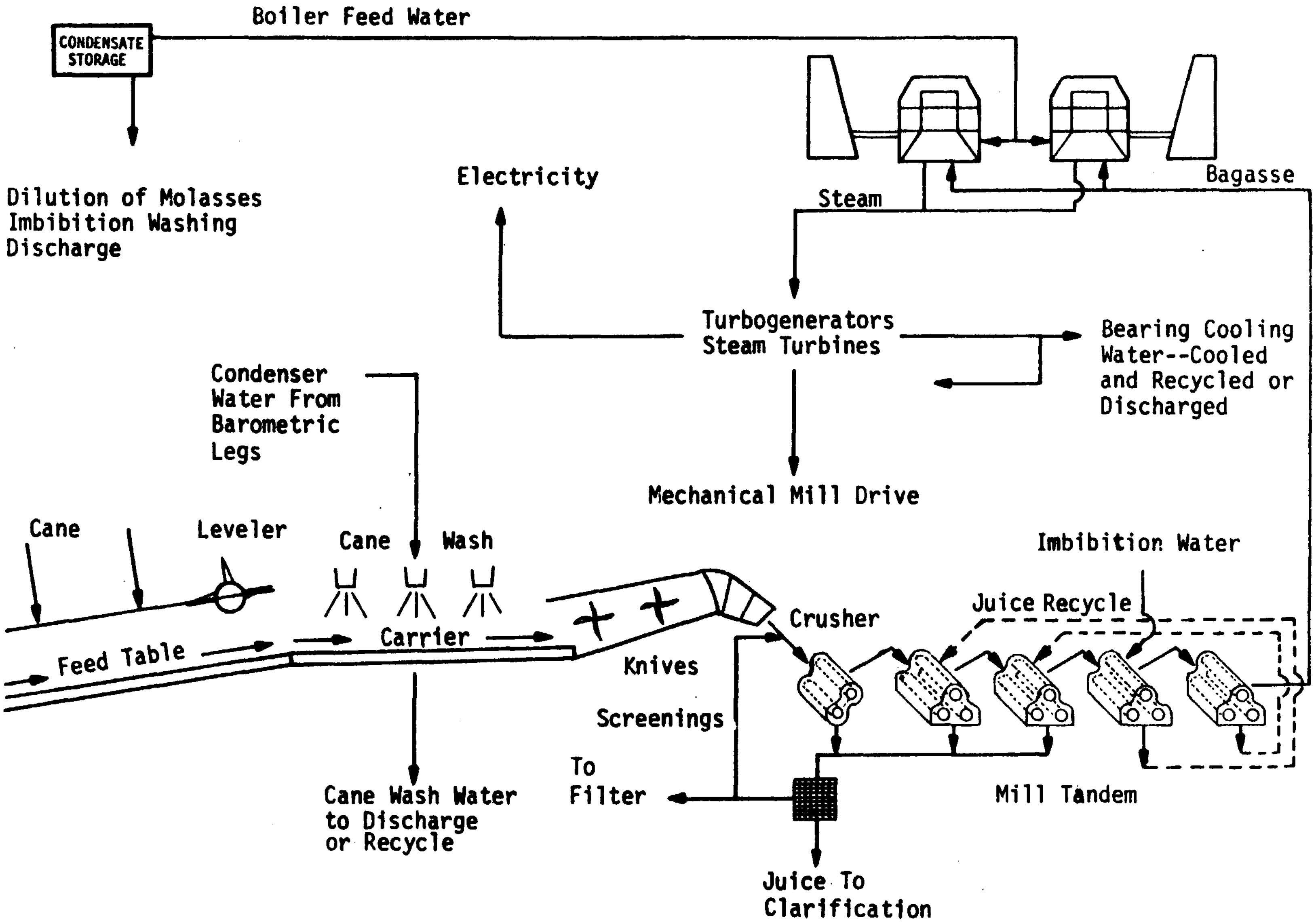


FIGURE 1

TYPICAL SUGAR FACTORY WITH CANE WASH

moisture contents are of interest. The size of a bagasse fiber is dependent upon the mill requirements for shredding and can range from fine particles to 1/4 inch.

Table I Typical Bagasse Composition.[1]

		Percent by Weight as Fired
H_2	Hydrogen	2.8
C	Carbon	23.4
S	Sulfur	<.1
N_2	Nitrogen	0.1
O_2	Oxygen	20.0
H_2O	Moisture	52.0
A	Ash	1.7
	Heating Value	4,000 BTU/pound

II. Operations

Bagasse boilers function to incinerate the bagasse and recover the available heat in the form of steam. The overall thermal efficiency for a typical unit is 55% (ranging from 50-70%). In comparison with large fossil fuel fired steam generators this efficiency range is rather low. However, since bagasse is a plentiful by-product fuel with a potential for a large solid waste problem, thermal efficiencies have been of secondary importance.

A bagasse boiler has a furnace chamber similar to an incinerator; it can be either a solid hearth or a grate type. The solid hearth design employs a horseshoe or equivalent furnace configuration. Bagasse is gravity fed through chutes and forms a pile of burning fibers. The burning occurs on the surface of the pile and receives combustion air through primary and overfired air ports located in the furnace walls. The fire bed is occasionally manually stoked and raked. Pile burning is common in most older mills in the sugar cane industry.

Another type of combustion chamber uses a traveling grate which carries the bagasse into the combustion zone. Underfired air is used to suspend the bagasse and overfired air is supplied to complete the combustion. This method of burning requires bagasse with a high percentage of fines, a moisture content not over 50%, and more experienced operating personnel. The Hawaiian mills reported in the reviewed emission tests generally use this type of furnace design.

III. Emissions

Two reports performed by EPA contractors[7] show the emissions from bagasse boilers to be particulates, sulfur dioxide, and nitrogen oxides. All other test reports gave data concerning only particulate emissions.

Figures 5, 6, and 7 show photomicrographs of the particulate matter emitted from a bagasse fired boiler.[8] As can be noticed, the shapes of the particles are elongated and fiberous. A size distribution for these

FIGURE 2 PHOTOMICROGRAPH
Sample F117, 1260X

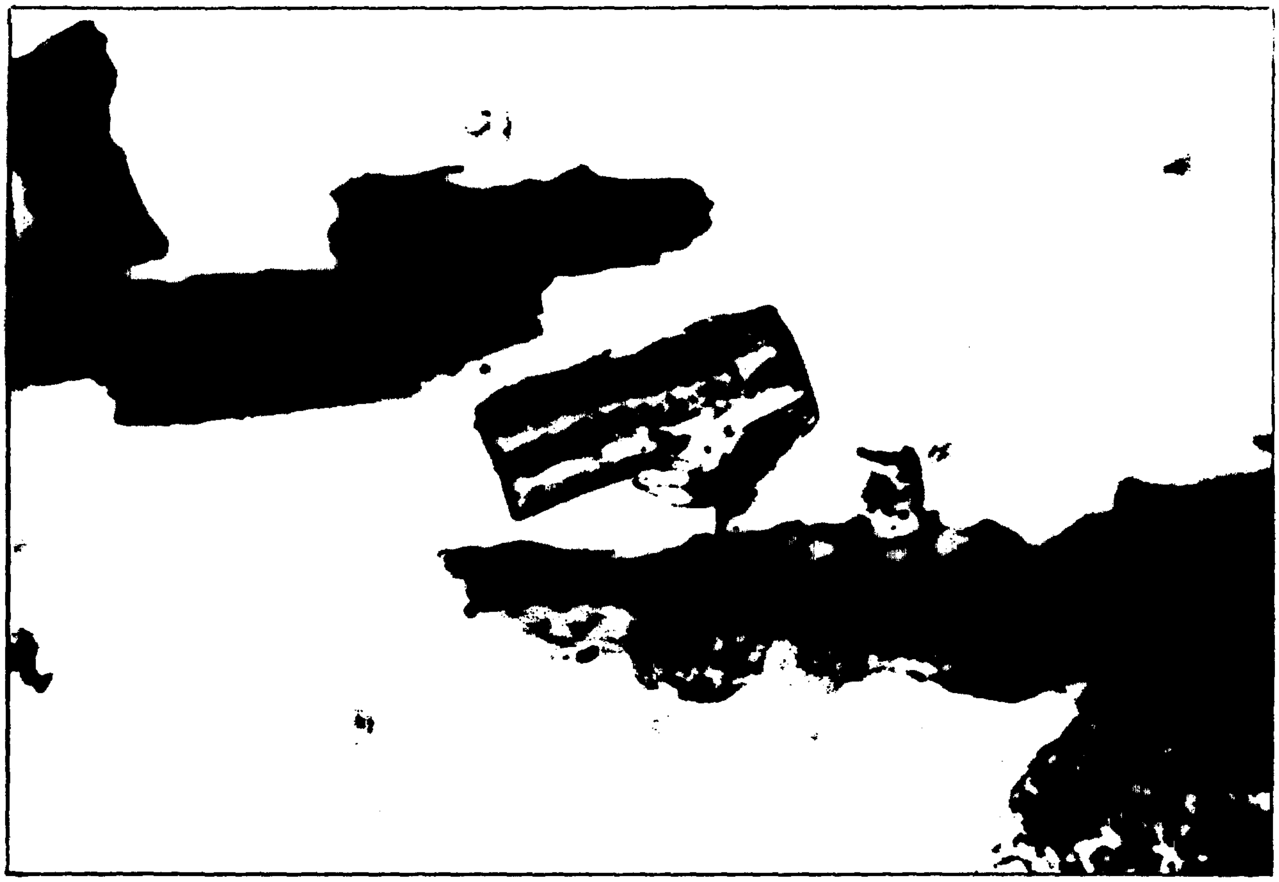


FIGURE 3 PHOTOMICROGRAPH
Sample F126, 1260X

FIGURE 4 PHOTOMICROGRAPH
Sample F208, 1260X

photomicrographs is presented in Table II. These studies were performed by microscopy analysis. However, using other sizing techniques at other mills, size distributions were obtained of approximately 20% (by Coulter Counter)[9] and approximately 85% (by in-stack impactor)[10] being smaller than 10 microns.[11,12]

All of the above size distribution data were obtained from either uncontrolled or multi-cyclone controlled bagasse boilers. Variability of the size distribution may be due to technical methods (sample sized in-stack versus collection on a filter prior to sizing) or due to process differences (boiler type, variety of sugar cane, size of bagasse, auxilliary fuel used, etc.).

IV. Factors Affecting Emissions

Since bagasse boilers are more closely related to incinerators rather than process boilers, the primary combustion factors that influence emission rates are the same as incinerators, such as:

1. Specific design of the combustion chamber (solid hearth, grates, primary and secondary air port locations, geometrics of furnace)
2. Variability of fuel (specific variety of sugar cane, age, soil and rainfall, growing conditions, moisture content, degree of fineness in milling, use of auxiliary fuel)
3. Firing characteristics (feed rate per furnace volume, excess air, reinjection of fly ash)
4. Good operating techniques and proper equipment maintenance.

TABLE II

Particle Size Distributions, Martin's Diameter

Size, μm	Sample F117 No. %	Sample F117 Wt. %	Sample F126 No. %	Sample F126 Wt. %	Sample F208 No. %	Sample F208 Wt. %
< 2.2	9.02	0	16.0	0	7.40	0
2.2 - 4.4	17.0	0	20.6	0	18.5	0
4.4 - 8.8	24.5	0.06	25.5	0.05	27.2	0.08
8.8 - 17.6	24.5	0.55	15.4	0.24	22.2	0.54
17.6 - 35.2	17.0	3.08	13.5	1.71	15.1	2.96
35.2 - 70.4	5.41	7.88	5.53	5.62	6.34	9.97
70.4 - 140.8	1.80	21.0	1.84	15.0	2.64	33.2
140.8 - 220.0	0.36	20.9	1.23	49.8	0.26	16.6
> 220.0	0.36	46.4	0.30	27.5	0.26	36.6

V. Controls

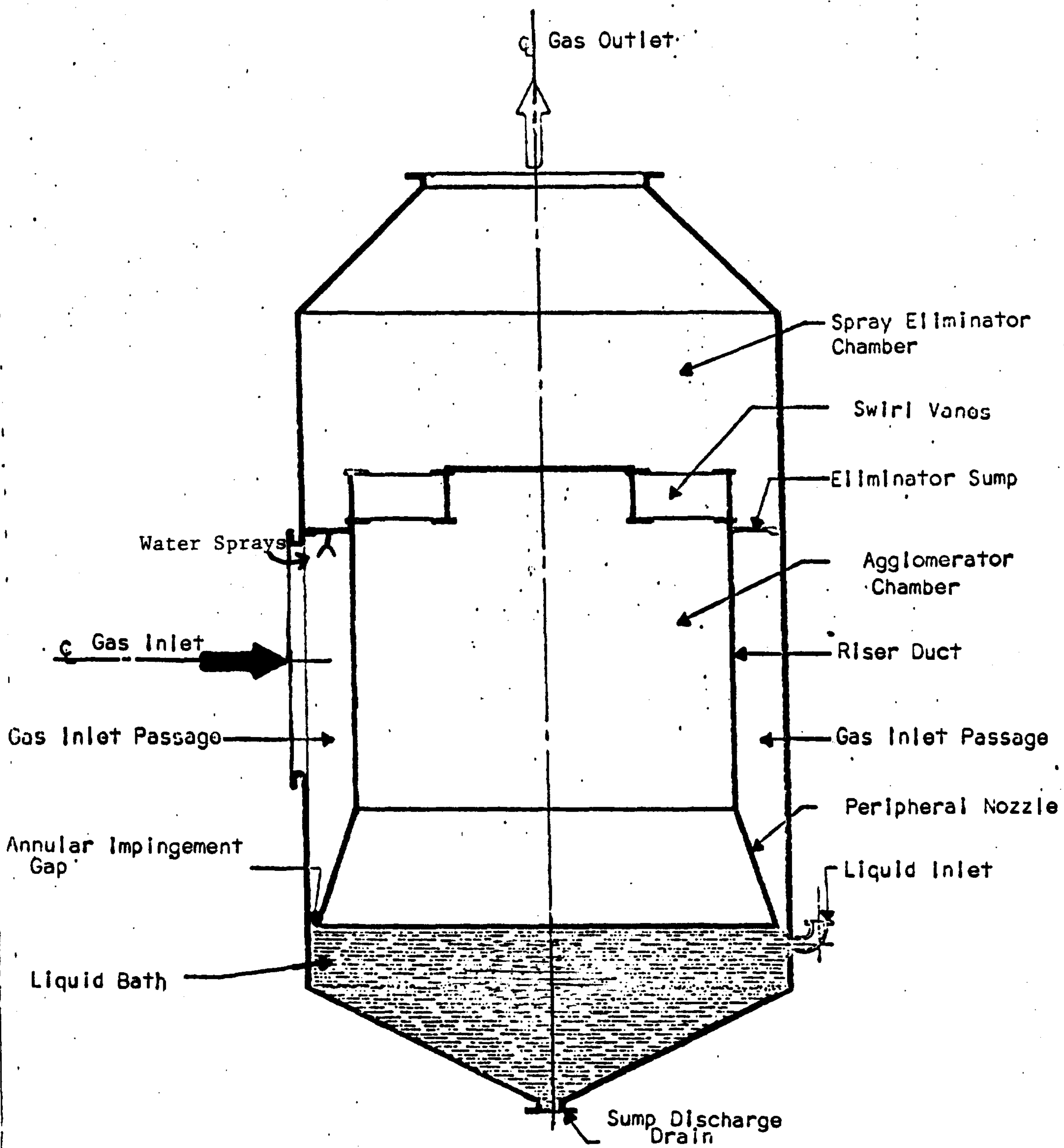
Particulate emissions are reduced by use of either multi-cyclones or water scrubbers. Other types of control equipment have been investigated but have not been found to be practical. Baghouses have a fire potential from carry-over of burning particles. Electrostatic precipitators have been used, but with little success.

Multi-cyclones have been reported to have collection efficiencies of 20-60%.[13] However, the particulate emissions are abrasive and severe erosion problems can be associated with mechanical collectors.

Scrubbers have collection efficiencies of approximately 90% and are of two basic types; venturi and spray impingement. The venturi scrubber requires a medium to high pressure drop of about 10-15 inches of water which produces collection efficiencies of 90%+. The spray impingement scrubber (see Figure 4) operates at from 4-6 inches of water and has efficiencies up to 90%. Operational problems occur with scrubbers due to clogged spray nozzles, sludge deposits in hopper, dirty recirculation water, improper water levels and too low pressure drops. Based on the reported test data, the use of both types of scrubbers is generally limited to the Florida mills in order to comply with the more stringent control regulations. The spray impingement scrubber is in greater use due to lower energy requirements and less operating and maintenance problems.

In the review of the reported emission tests, it was found that the controls in use on most bagasse boilers reflect the existing state regulations

Figure 5 Spray Impingement Scrubber.



SECTION THROUGH SCRUBBER
(Weir Box not shown)

rather than the state-of-the art. Presently, federal new source performance standards have not been promulgated for bagasse boilers.

VI. Development of Emission Factors

Most bagasse boilers have limited monitoring of operating parameters. The steam production will be measured and recorded and the fuel oil may be metered, but the amount of bagasse fired is not directly measured. Therefore, when source sampling a bagasse boiler, the field data obtained are generally steam production (at a specific pressure and temperature) and fuel oil consumption. The heat input from the burning of the bagasse is based upon calculations using percent boiler efficiency, BTU content of the bagasse, and the steam load corrected for that amount coming from the fuel oil.

$$\underset{\text{(BTU/hour)}}{\text{Bagasse Input}} = \frac{\text{Steam(BTU/hr)}}{\text{Boiler Efficiency (\%)}} - \text{Oil Input (BTU/hr)}$$

In developing our methodology for this project, it was decided that since steam production was the only directly measurable parameter, it should be the basis for an emission factor. The contribution of particulates from the fuel oil could be determined from Section 1.3 Fuel Oil Combustion of AP-42, added to that from bagasse and a total potential emissions estimated.

In order to develop the emission factors, test data were obtained from 3 mills in Puerto Rico, 7 mills in Florida, and 6 mills in Hawaii. Data was not received from the mills in Louisiana and Texas nor from the remaining mills in Hawaii and Puerto Rico. (A complete inventory of sugar cane processors is in Appendix A.

It was decided to have emission factors for each type of control device generally used (none/multi-cyclone/scrubber) and for fuel used (bagasse versus bagasse and oil).

Initially, the data for each test run reported were inventoried for the following information:

1. Steam Load
2. Fuel Oil Used
3. Type of Furnace
4. Flue Gas Composition
5. Emission Rate - lbs/hour
6. Air Pollution Controls

If not given, values of total heat input from bagasse were calculated by dividing the steam load by 60% boiler efficiency, minus the portion generated from fuel oil. The heat inputs were used to obtain estimates of the pounds emissions per million BTU's. These figures could be readily compared to most state standards based on the same units. Factors of pounds emissions per 1,000 pounds of steam produced from firing bagasse alone were calculated for each test series.

Based on past engineering experience with bagasse boilers, test results were classified as acceptable or questionable. The latter were either too high or low for the level of control equipment used and were not used in developing the final emission factors.

Table III presents a summary of all test data and calculated factors. It should be noted that the spread of the factors within each control group is large. A linear regression analysis of emission rate to steam loading was performed for each control category and the calculated correlation coefficients were found to be low in each case.

The summary of the nitrogen dioxide emission data is presented in Table IV. All data points were taken from three tests conducted by EPA contractors; other tests reviewed did not include NO_x in their sampling program.

The particulate emission factors from the acceptable test series were to have been averaged per control type and further divided per fuel used. The latter could not be done for the first two control groups due to lack of sufficient data. Table V shows the factors calculated for each group.

It should be noted that Table V shows multi-cyclones and scrubbers to be 29% and 90% efficient respectively. These efficiencies seem to be low for the multi-cyclones and about as expected for the scrubbers.

The lower emission factor for boilers fired with bagasse rather than bagasse and oil, is most probably the result of the wide data spread and round-off errors. These fuel category emission factors are not presented in the draft of Section 1.8.

The emission factors should be used to estimate the portion of the par-

TABLE III. Summary of Particulate Emission Data for Bagasse Boilers.

Facility-Boiler #	Test Date	Emission Rate lbs/hr	Heat Input* 10^6 BTU/hr	Steam Load*** 10^3 lbs	Emission Factors		Fuel B-Bagasse O-Oil	Data Evaluation A-Acceptable Q-Questionable
					lbs/10^6BTU	lbs/10^3lbs Steam***		
NO CONTROLS								
Central Mercedita Co. Units 3,4,5, 6,7	1975	1150	N.A.	240	N.A.	4.8	B,O**	A
Central Mercedita Co. Units 1,8,9	1975	2066	540	270	3.8	7.7	B	A
Osceola Farms Unit 1	1969	192	60	30	3.2	6.4	B	A
Osceola Farms Unit 2	1969	228	250	125	.9	1.8	B	A
Osceola Farms Unit 3	1969	152	380	190	.4	0.8	B	Q
Osceola Farms Unit 4	1969	92	120	60	.8	1.5	B	A
Osceola Farms Unit 5	1969	222	200	100	1.1	2.2	B	A
Talisman Sugar Co. Unit 4	1975	54	111	72	.5	.7	B,O	Q
Talisman Sugar Co. Unit 5	1975	209	140	84	1.5	2.4	B,O	A

Average: 3.14 lbs/10^3 lbs steam - All data points
3.83 lbs/10^3 lbs steam - Only acceptable data points

TABLE III. Summary of Particulate Emission Data for Bagasse Boilers, continued.

Facility-Unit #	Test Date	Emission Rate lbs/hr	Heat Input* 10^6BTU/hr	Steam Load*** 10^3 lbs	Emission Factors lbs/10^6 BTU	Emission Factors lbs/10^3 lbs Steam***		Fuel B-Bagasse O-Oil	Data Evaluation A-Acceptable Q-Questionable
MULTI CYCLONES									
Central Aguirre Co. Units 19,20	1975	686	140	70	4.9	9.8	4.6*	B	Q
Central Aguirre Co. Units 17, 18, 21	1975	1653	290	172	5.7	9.6	3.2*	B,O	Q
Central Fajardo Co. Units 1, 2	1975	112	N.A.	180	N.A.	0.6	.3*	B,O**	Q
Central Fajardo Co. Units 3, 4, 5, 6	1975	968	360	180	2.7	5.4	2.7*	B	A
Hawaiian Commercial Sugar Co., Paia Mill Unit - Unknown	1975	206	400	185	.5	1.1		B	A
Hawaiian Commercial Sugar Co. Puunene Mill, Unit 3	1975	361	379	233	1.0	1.6		B	A
Hawaiian Commercial Sugar Co. Puunene Mill, Units 1, 2	1975	538	313	191	2.1	3.4		B	A

* 1976 source tests conducted [illegible] Technical [illegible]

TABLE III. Summary of Particulate Emission Data for Bagasse Boilers, continued.

Facility-Unit #	Test Date	Emission Rate lbs/hr	Heat Input* 10^6BTU/hr	Steam Load*** 10^3 lbs	Emission Factors		Fuel B-Bagasse O-Oil	Data Evaluation A-Acceptable Q-Questionable
					lbs/10^6 BTU	lbs/10^3 lbs Steam***		
MULTI CYCLONES								
Laupahoehoe Co. Unit Not Specified	1975	2649	634	273	4.2	9.7	B	Q
Honokaa Company Unit Not Specified	1975	321	312	152	1.0	2.1	B	A
Glades County Coop, Unit 1	1975	53	205	102	.3	.5	B	Q
Talisman Sugar Co., Unit 4	1975	58	205	105	.3	.6	B	Q
Talisman Sugar Co., Unit 5	1975	57	212	106	.3	.5	B	Q

Average: 3.74 lbs/10^3 lbs steam - All data points
2.72 lbs/10^3 lbs steam - Only acceptable data points

TABLE III. Summary of Particulate Emission Data for Bagasse Boilers, continued

Facility-Unit #	Test Date	Emission Rate lbs/hr	Heat Input* 10^6BTU/hr	Steam Load*** 10^3 lbs	Emission Factors lbs/10^6 BTU	Emission Factors lbs/10^3 lbs Stream***	Fuel B-Bagasse O-Oil	Data Evaluation A-Acceptable Q-questionable
SCRUBBERS								
Oahu Company Unit Not Specified	1975	302	460	303	.7	1.0	B	Q
Oahu Company Unit Not Specified	1975	185	424	212	.4	.9	B,O	A
Gulf & Western Foods, Unit 4	1975	38	132	69	.3	.6	B	A
Gulf & Western Foods, Unit 5	1975	31	128	65	.2	.5	B	A
Gulf & Western Foods, Unit 6	1975	29	139	73	.2	.4	B	A
Gulf & Western Foods, Unit 10	1975	42	228	114	.2	.4	B,O	A
Gulf & Western Foods, Unit 11	1975	32	215	107	.2	.3	B	A
Glades County Coop, Unit 2	1975	41	251	125	.2	.3	B	A
Talisman Sugar Co. Unit 6	1975	32	367	201	.1	.2	B	A

TABLE III. Summary of Particulate Emission Data for Bagasse Boilers, continued

Facility-Unit #	Test Date	Emission Rate lbs/hr	Heat Input* 10^6BTU/hr	Steam Load*** 10^3 lbs	Emission Factors lbs/10^6 BTU	Emission Factors lbs/10^3 lbs Steam***	Fuel B-Bagasse O-Oil	Data Evaluation A-Acceptable Q-Questionable
S C R U B B E R S								
Osceola Farms Unit 1	1975	9.8	90	48	.1	.2	B	A
Osceola Farms Unit 2	1975	19	257	125	.1	.2	B	A
Osceola Farms Unit 3	1975	19	132	71	.1	.3	B	A
Osceola Farms Unit 4	1975	30	127	68	.2	.4	B	A
Sugar Cane Growers Coop, Unit 1	1975	39	200	123	.2	.3	B	A
Sugar Cane Growers Coop, Unit 2	1975	31	175	107	.2	.3	B	A
Sugar Cane Growers Coop, Unit 3	1975	29	157	97	.2	.3	B	A
Sugar Cane Growers Coop, Unit 4	1975	58	391	240	.2	.2	B	A
Sugar Cane Growers Coop, Unit 5	1975	25	245	150	.1	.2	B	A

TABLE III. Summarv of Particulate Emission Data for Bagasse Boilers, continued.

Facility-Unit #	Test Date	Emission Rate lbs/hr	Heat Input* 10^6BTU/hr	Steam Load*** 10^3 lbs	Emission Factors lbs/10^6 BTU	lbs/10^3 lbs Steam***	Fuel B-Bagasse O-Oil	Data Evaluation A-Acceptable Q-Questionable
SCRUBBERS								
U.S. Sugar Corp. Clewiston-Unit 1	1975	34	287	149	.1	.2	B	A
U.S. Sugar Corp. Clewiston-Unit 2	1975	56	315	158	.2	.4	B,O	A
U.S. Sugar Corp. Clewiston-Unit 3	1975	36	134	67	.3	.5	B,O	A
U.S. Sugar Corp. Clewiston-Unit 6	1975	19	129	58	.2	.3	B	A
U.S. Sugar Corp. Bryant-Unit 3	1975	23	276	137	.1	.2	B	A
U.S. Sugar Corp. Bryant-Unit 2	1975	33	290	149	.1	.2	B	A
U.S. Sugar Corp. Clewiston-Unit 1	1974	70	289	145	.2	.5	B,O	A
U.S. Sugar Corp. Clewiston-Unit 2	1974	176	232	116	.8	1.5	B,O	Q
U.S. Sugar Corp. Bryant-Unit 3	1974	25	274	137	.1	.2	B	A

TABLE III. Summary of Particulate Emission Data for Bagasse Boilers, continued.

Facility-Unit #	Test Date	Emission Rate lbs/hr	Heat Input* 10^6BTU/hr	Steam Load*** 10^3 lbs	Emission Factors		Fuel B-Bagasse O-Oil	Data Evaluation A-Acceptable Q-Questionable
					lbs/10^6 BTU	lbs/10^3 lbs Steam***		
SCRUBBERS								
Atlantic Sugar Assn. Unit 1	1975	43	154	77	.3	.6	B,O	A
Atlantic Sugar Assn. Unit 2	1975	37	125	63	.3	.6	B,O	A
Atlantic Sugar Assn. Unit 3	1975	62	227	115	.3	.5	B	A
Atlantic Sugar Assn. Unit 4	1975	66	222	112	.3	.6	B	A

*Values calculated from steam loads

**Not corrected for fuel oil heat input - no fuel data given

***Based on bagasse portion of fuel

Average: .43 lbs/10^3 lbs Steam - all data points
.37 lbs/10^3 lbs Steam - only acceptable data points

TABLE IV. Summary of Nitrogen Oxides (as NO_2) Emission Data for Bagasse Boilers.

Mill - Unit - Date	Emission lbs/hour	Emission ppm	Emission Factors lbs/10^6 BTU	Emission Factors lbs/10^3lbs steam	Fuel B-Bagasse O-Oil	Data Evaluation
Talisman Sugar Corp. Unit 5 - 1975	27.02	88	.19	.32	B,O	Acceptable
Hawaiian Commercial Sugar Co., Puunene Mill, Units 1 & 2	79.50	98.8	.6	.44	B	Acceptable
Hawaiian Commercial Sugar Co., Puunene Mill, Unit 3	26.98	42.2	.7	.12	B	Acceptable

Average: .29 lbs/10^3 lbs steam

TABLE V. Particulate Emission Factors for Bagasse Boilers.

Control Type	lbs/1000 lbs steam
None	3.83
Multi-cyclones	2.72
Scrubbers	0.37 (0.31 bagasse only, 0.56 bagasse and oil)

TABLE VI. Nitrogen Oxide (as NO_2) Emission Factor for Bagasse Boilers

Emission Factor: .3 lbs/10^3 lbs steam ticulate and NO_x emission rates from the firing of only the bagasse. If significant amounts of auxiliary fuel is to be used, its portion of the particulate and NO_2 emission rates can be estimated from Table 1.3-1 of AP-42.

The NO_2 emission factor for bagasse firing (.3 lbs/10^3 lbs steam) is much lower than if 100% fuel oil was burning in the same units (~1.1 lbs/10^3lbs steam based on Table 3.1-1 of AP-42).

VII. Reliability of Emission Factors

The methodology used in the development of the bagasse boiler emission factors was based upon source emission data and engineering review of the data. A summary of the ranking procedures is shown in Table VII. The overall ranking is 21 points for particulate and 24 points for nitrogen oxides which gives an average letter grade of "C". The reliability of the emission factors in Tables V and VI are felt to be such that they will yield a fair estimate of the potential emissions from bagasse fired boilers.

Table VII. Ranking of Bagasse Boiler Particulate Emission Factors.

	Emission Data	Process Data	Engineering Analysis	Total
Particulates	0-20 pts.	0-10 pts.	0-10 pts.	
No controls	12	0	5	17
Cyclones	15	0	7	22
Scrubbers	18	0	7	25
Nitrogen oxides	20	0	5	25
		AVERAGE		21

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2. Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Raw Cane Sugar, Processing Segment of the Cane Sugar Processing Point Source Category, Environmental Science and Engineering, Inc. Gainesville, Florida. July, 1974.

3. Telephone conversation with Mr. Enrique Arias of Sugar Cane Growers Cooperative, Belle Glade, Florida.

4. Bailliet, V.J. Bagasse Drying Versus Air Pre-heating, The Sugar Journal, March, 1976.

5. Kerr, E.W. condensed by W.P. Boulet. Waste Fuel Drying and the Energy Crisis. The Sugar Journal, March, 1975.

6. Boulet, W.P. Waste Fuel Drying and the Energy Crisis. The Sugar Journal, November, 1975.

7. See "General References" 1c and 1d

8. See "General References" 2

9. See "General References" 1d

10. See "General References" 1c

11. Hendrickson, E.R. Investigation of Ambient Air Quality. Florida Sugar Cane League, Inc. September 1, 1970.

12. Background Information for Establishment of National Standards of Performance for New Sources. Raw Cane Sugar Industry. Environmental Science and Engineering, Inc. Gainesville, Florida. Prepared for the Environmental Protection Agency, Research Triangle Park, N.C. under Contract No. CPA 70-142, Task Order 9c. July 15, 1971.

13. Hendrickson, E.R. and F.A. Grillot, Jr. Raw Sugar Factor Wastes and their Control.

General References

1. Source Emission Test Data

a. Galso Technical Services, Inc. - Central Aguirre, P.R. - Boilers 19 & 20
17, 18 & 19

Central Fojardo, P.R. - Boilers 1 & 2;
3, 4, 5, & 6

Central Mercedita, P.R. - Boilers 3, 4, 5,
6 & 7; 1, 8 & 9

b. Ecology Audits Inc. - Oahu Co. Ha. - Boiler Not Specified

Hawaiian Commercial Sugar Co. Ha. -
Paia Mill - Boiler Not Specified
Puunene Mill - Boilers 1 & 2; 3

Laupahoehoe Co. Ha. - Boiler Not Specified

Honokaa Co. Ha. - Boiler Not Specified

c. Midwest Research Institute - Hawaiian Sugar Co. Ha. - Boilers 1 & 2; 3
Puunene Mill - Boilers 1 & 2; 3

d. Engineering Science Inc. - Talisman Sugar Co. - Boilers 4 & 5

e. Florida Sugar Cane League Inc. - Gulf & Western Foods, Fla. - Boilers
4, 5, 6, 11

Osceola Farms, Florida - Boilers 1, 2, 3, 4,

U. S. Sugar Corp., Florida -
Clewiston Mill - Boilers 1, 2, 3, 6
Bryant Mill - Boilers 2, 3

f. Sholtes & Koolger Inc. - Glades County Coop., Fla. - Boilers 1, 2

Talisman Sugar Corp., Fla. - Boilers 4, 5, 6

Environmental Science & Engineering Inc. - Atlantic Sugar Association, Fla.
Boilers 1, 2, 3, 4

Sugar Cane Growers Coop, Fla.
Boilers 1, 2, 3, 4 & 5

Gulf & Western Foods, Fla.
Boiler 10

Osceola Farms, Fla.
Boilers 1, 2, 3, 4, 5

U.S. Sugar Corp., Fla.
Boilers 1, 2, 3

Duhe-Bourgeois Sugar Co., La.
Boiler Unknown

2. Scrubber Efficiency Data

Environmental Science & Engineering, Inc. - Pilot Plant Tests

APPENDIX A

INVENTORY OF SUGAR CANE INDUSTRY

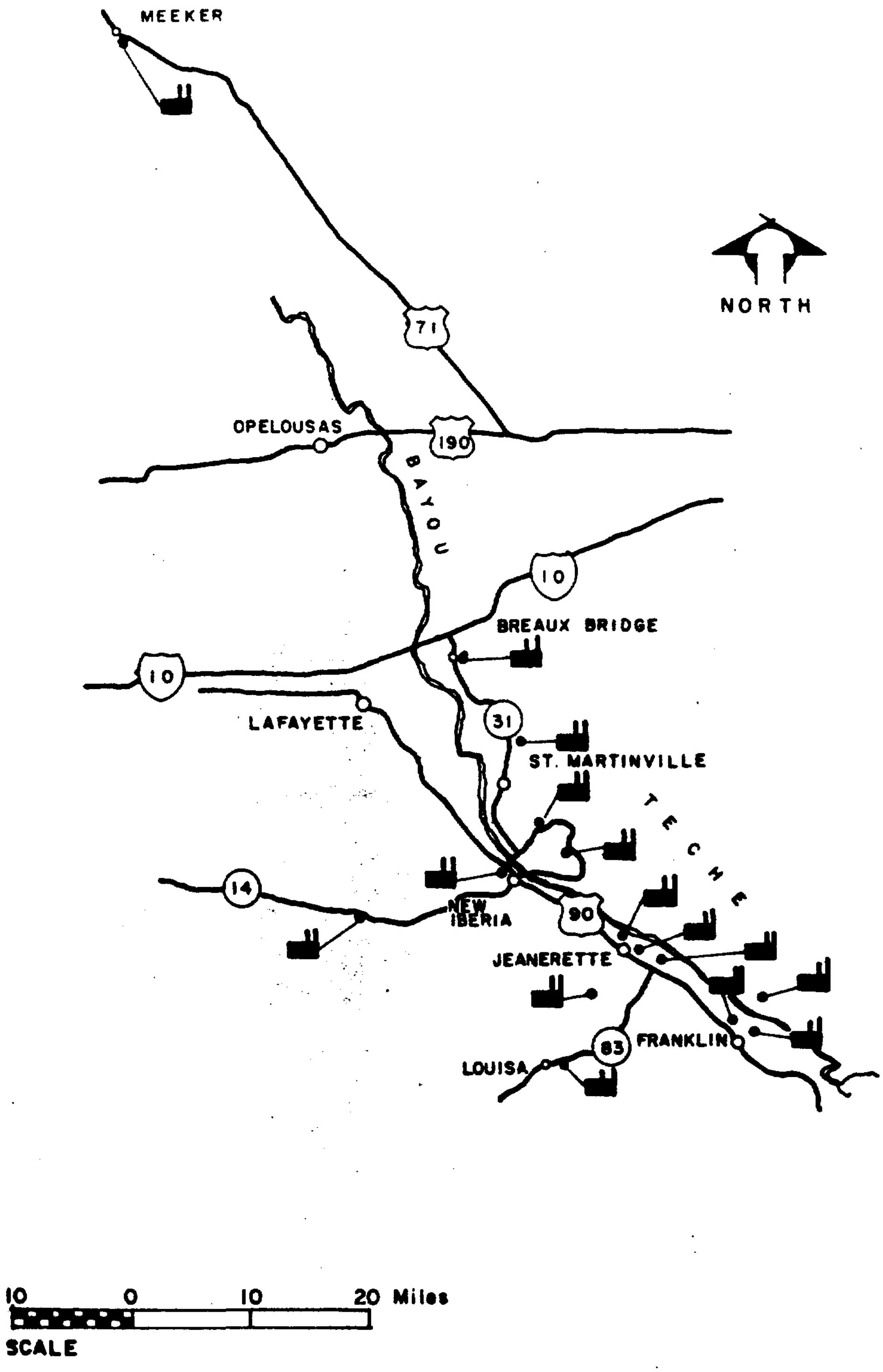

FIGURE A-1 LOUISIANA SUGAR FACTORIES (BAYOU TECHE) OPERATING 1973

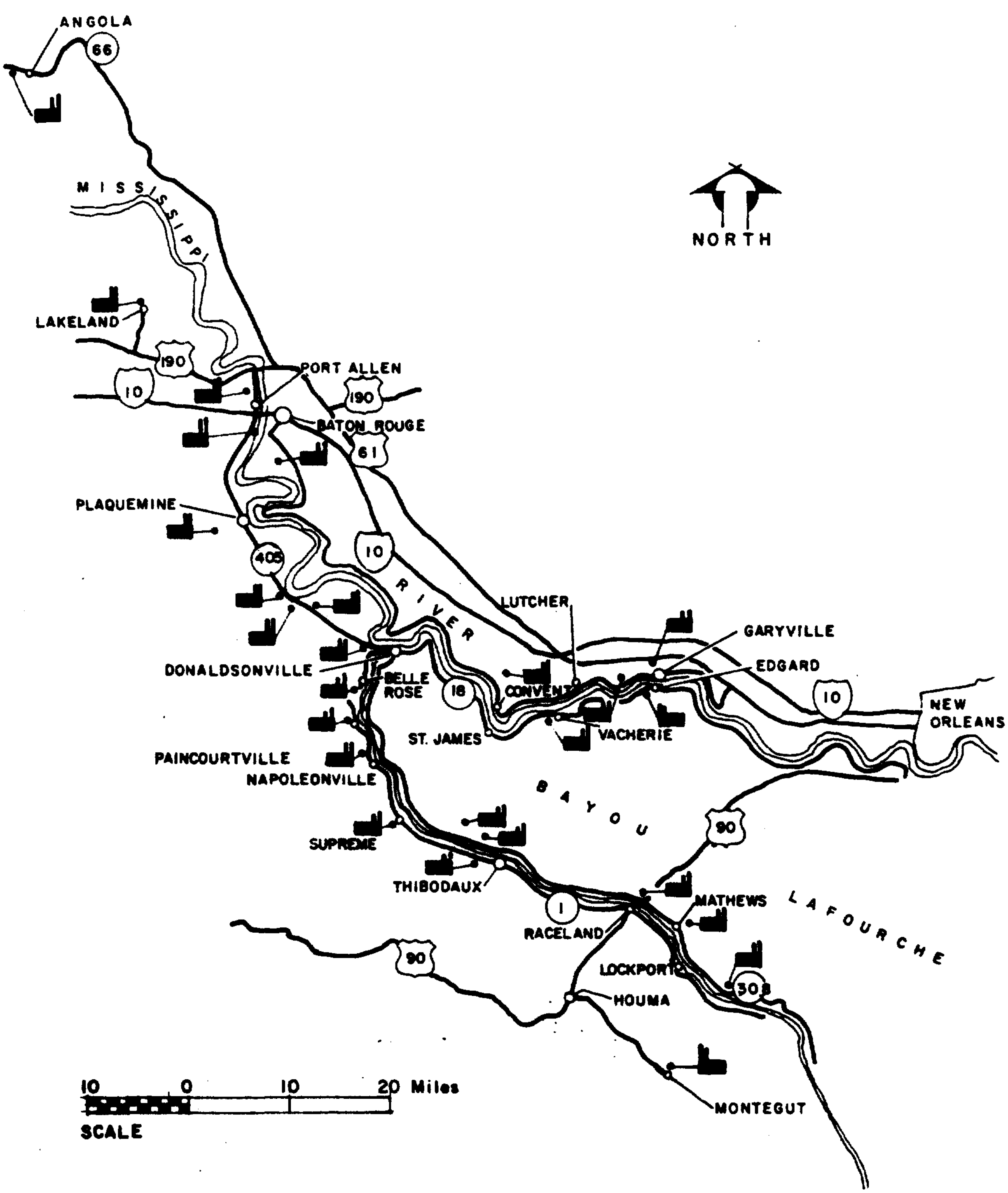

FIGURE A-2 LOUISIANA SUGAR FACTORIES (MISSISSIPPI RIVER VALLEY) OPERATING 1973

TABLE A-1
LOUISIANA SUGAR FACTORIES OPERATING 1972-1973

Factory Name	Location	Normal Grind (Metric Tons/Day)
Alma	Lakeland	1,814
Angola	Angola State Prison	778
Armant	Vacherie	2,392
Audubon	Baton Rouge	326*
Billeaud	Brossard	2,267
Breaux Bridge	Breaux Bridge	1,807
Cajun	New Iberia	4,017
Caldwell	Thibodaux	3,159
Catherine	Bayou Goula	68
Cedar Grove	White Castle	1,730
Cinclare	Brusly	2,535
Columbia	Edgard	1,146
Columbia	Franklin	1,360
Cora-Texas	White Castle	2,425
Delgado-Albania	Jeanerette	1,601
Duhe & Bourgeois	Jeanerette	1,270
Enterprise	Jeanerette	3,379
Evan Hall	McCall	4,330
Georgia	Mathews	1,938
Glenwood	Napoleonville	3,083
Greenwood	Thibadoux	2,774

*24 Hour Capacity

TABLE A- 1 (Continued)

LOUISIANA SUGAR FACTORIES OPERATING 1972-1973

Factory Name	Location	Normal Grind (Metric Tons/Day)
Helvetia	Convent	2,133
Iberia	New Iberia	3,193
Leighton	Thibadoux	4,177
Louisa	Louisa	1,906
Lula	Belle Rose	2,797
Meeker	Meeker	2,052
Myrtle Grove	Plaquemine	1,852
Oaklawn	Franklin	3,558
Poplar Grove	Port Allen	1,779
Raceland	Raceland	4,258
St. James	St. James	3,367
St. John	St. Martinville	2,409
St. Mary	Jeanerette	3,174
San Francisco	Reserve	832
Smithfield	Port Allen	1,833
Southdown	Houma	3,174
Sterling	Franklin	4,331
Supreme	Supreme	2,868
Terrebonne	Montegut	2,079
Valentine	Lockport	2,411
Vida	Loreauville	866
Westfield	Paincourtville	3,294

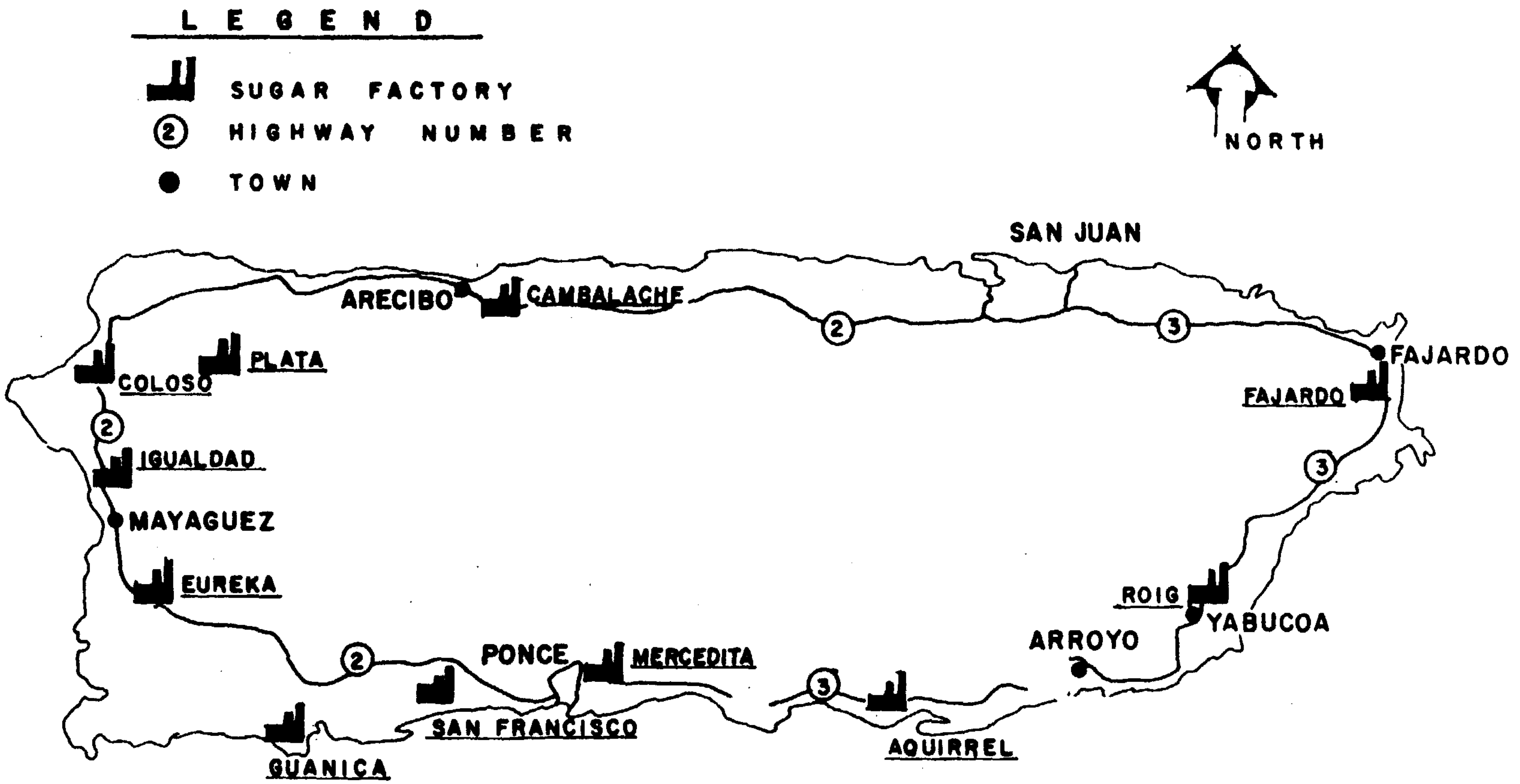

FIGURE A-3

OPERATING SUGAR FACTORIES IN PUERTO RICO (1974)

0 2 4 6 8 10 12 14 16

APPROXIMATE SCALE IN MILES

TABLE A-2

PUERTO RICO FACTORIES OPERATING 1974

Factory Name	Location	Normal Grind (Metric Tons/Day)
Central Aguirre	Salinas	4,988
Central Cambalache	Arecibo	3,991
Central Coloso	Coloso	2,932
Central Eureka	Hormiqueros	1,360
Central Fajardo	Fajardo	1,841
Central Guanica	Ensenada	3,628
Central Igualdad	Mayaguez	1,542
Central Mercedita	Mercedita	453
Central Roig	Yabacoa	3,084
Central Plata	San Sebastian	4,535

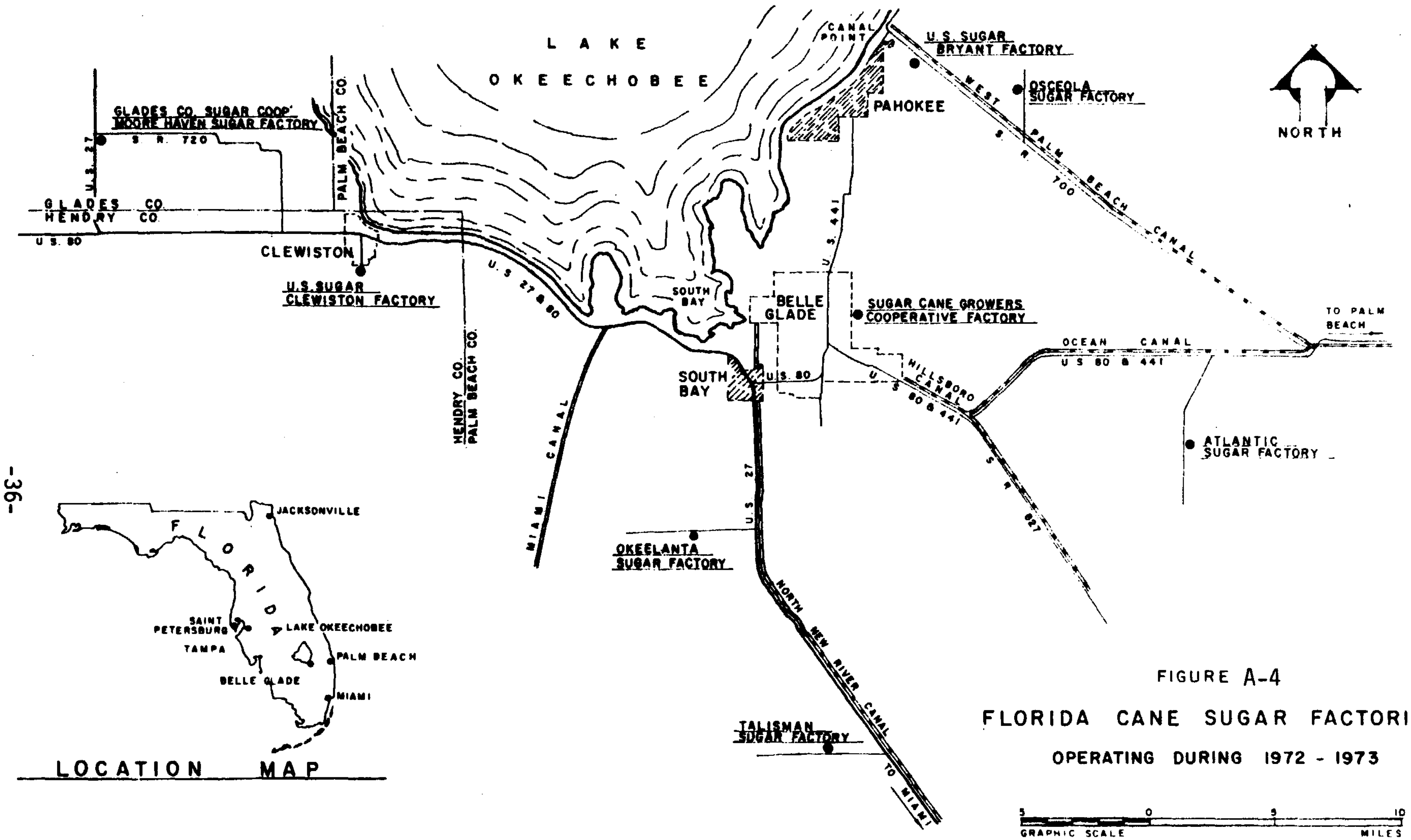

FIGURE A-4

FLORIDA CANE SUGAR FACTORIES

OPERATING DURING 1972 - 1973

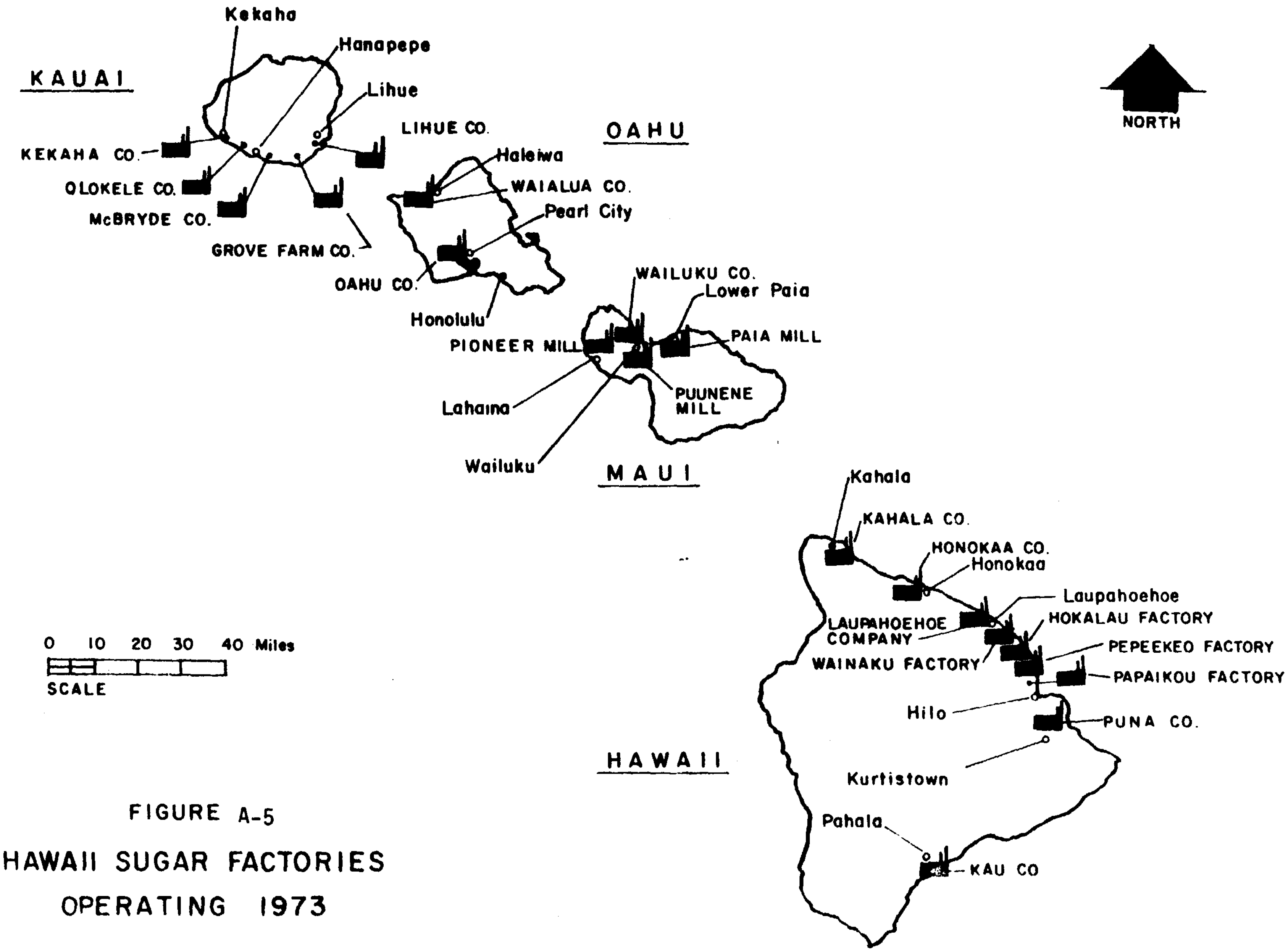

FIGURE A-5

HAWAII SUGAR FACTORIES
OPERATING 1973

TABLE A-3

FLORIDA SUGAR FACTORIES OPERATING 1973

Factory Name	Location	Normal Grind (Metric tons/Day)
Atlantic Sugar Association	Belle Glade	5,200
Glades County Sugar Growers Coop.	Moore Haven	4,100
Gulf Western Food Okeelanta Sugar Div.	South Bay	11,000
Osceola Farms	Pahokee	5,000
Sugar Cane Growers Coop. of Florida	Belle Glade	9,100
Talisman Sugar Corporation	Belle Glade	9,100
U.S. Sugar Corporation	Bryant	10,000
U.S. Sugar Corporation	Clewiston	10,000

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16. ABSTRACT

This is a background document in support of the contents of Section 1.8 of AP-2, Compilation of Air Pollutant Emission Factors, Second Edition. It concerns the major criteria pollutants emitted during the combustion of bagasse (a fiberous waste product in a sugar cane mill) in steam boilers. The general aspects of mill operations, physical characteristics of the bagasse and its combustion, furnace designs, air pollution control devices and factors affecting emissions are described. Stack emission tests are reviewed and analyzed for inclusion in the data base for developing factors for particulate and NO_x emission while firing bagasse or bagasse and fuel oil. The reliability of these factors is evaluated and presented.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

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