AP42 Section:	9.10.1.2
Background Chapter	4
Reference:	25
Title:	Particulate Emission Study--Michigan Sugar Company, Croswell, Michigan, Swanson Environmental, Inc., Farmington Hills, MI, November 19, 1990.

APPENDIX X

REPORT EXCERPTS FROM REFERENCE 25

(Michigan Sugar Company, November 19, 1990)

PARTICULATE EMISSION STUDY

MICHIGAN SUGAR COMPANY
CROSWELL, MICHIGAN

Report Prepared For:

Michigan Sugar Company
P. O. Box 1348
Saginaw, Michigan 48605

November 19, 1990
MA-6482

SWANSON ENVIRONMENTAL INC.

24156 Haggerty Road • Farmington Hills, Michigan 48335
(313) 478-2700 Fax: (313) 478-3819

PARTICULATE EMISSION STUDY
MICHIGAN SUGAR COMPANY
CROSWELL, MICHIGAN
NOVEMBER 19, 1990
MA-6482

EXECUTIVE SUMMARY

Swanson Environmental, Inc. (SEI) was retained by Michigan Sugar Company to perform a particulate emissions study on the exhaust gases discharged from the Pulp Drier at their Croswell, Michigan facility.

The study took place on November 13, 1990 and was conducted in accordance with U.S. EPA Methods 1, 2, 3, 4 and MDNR Method 5B for the purpose of fulfilling compliance requirements. The results of the study are as follows:

Drier Exhaust

Test No.	Test Date	Stack Gas Flow Rate (DSCFM)	Lbs/1000 Lbs EG @ (Dry)	Lbs/1000 Lbs dry 50%E A*	Lbs/1000 Lbs EG @	Lbs/ Hour
P-1	11-13-90	32426	0.110	0.262	0.078	16.175
P-2	11-13-90	34044	0.102	0.263	0.072	15.819
P-3	11-13-90	33804	0.099	0.275	0.070	15.152
Average		33425	0.104	0.267	0.073	15.715

EA * = Excess Air

EG @ = Exhaust Gas

SWANSON ENVIRONMENTAL, INC.
PARTICULATE SAMPLING DATA AND CALCULATIONS

PLANT: MI SUGAR SOURCE: DRYER EXH.
DATE: 11-13-90

	CLOCK TIME:	60.00	60.00	60.00
	1.00 NUMBER	P-1	P-2	P-3
B.	STACK DIAMETER, In	72.000	72.000	72.000
C.	STACK AREA, Sq.Ft	28.27	28.27	28.27
D.	No. SAMPLE POINTS	24.00	24.00	24.00
E.	TOTAL SAMPLE TIME, MIN.	60.00	60.00	60.00
F.	NOZZLE DIAMETER, In.	0.357	0.357	0.357
G.	NOZZLE AREA, Sq.Ft.	0.00070	0.00070	0.00070
H.	CALIBRATION FACTORS:			
	PITOT TUBE, Cp	0.8090	0.8090	0.8090
	GAS METER, y	0.970	0.970	0.970
I.	BAROMETRIC PRESSURE, In.Hg.	30.49	30.52	30.54
J.	STACK STATIC PRESSURE In.H2O	0.32	0.32	0.32
K.	STACK GAS TEMP.	279.54	270.79	276.96
L.	AVG. Sq. Rt. VEL. HEAD	0.64	0.67	0.67
M.	AVG. METER TEMP.	76.75	77.50	77.38
N.	AVG. METER PRESS., H2O	2.16	2.43	2.36
O.	METER VOL., ACTUAL Cu. Ft.	47.29	50.51	46.81
P.	METER VOL., @STP	46.41	49.59	45.99
Q.	LIQUID VOL., H20 COND., Ml.	646.10	714.90	651.20
R.	VAPOR VOL., H20 COND., @STP, Cu.Ft.	30.63	33.89	30.87
S.	TOTAL GAS SAMPLED, @ STP, Cu.Ft.	77.04	83.47	76.85
T.	%MOISTURE IN EXHAUST GAS			
	1) AT TEST LOCATION	39.75	40.60	40.16
	2) BEFORE COLLECTOR	0.00	0.00	0.00
U.	DRY GAS COMP. %O2	15.4	15.8	16.2
	%CO2	4.0	4.2	3.8
	%CO	0.0	0.0	0.0
	%N2	80.6	80.0	80.0
V.	DENSITY & MOL. Wt. -STACK GAS			
	1)DRY, @ STP,Lbs/Cu.Ft.	0.0756	0.0758	0.0756
	2)WET, @ STP,Lbs/Cu.Ft.	0.0641	0.0639	0.0639
	3)WET @ STACK,Lbs/Cu.Ft.	0.0468	0.0473	0.0469
	4)MOL.Wt., @ STP,Lb/MOLE	29.26	29.31	29.26
W.	WEIGHT OF GAS SAMPLED:			
	1)DRY GAS,Lbs	3.51	3.76	3.48
	2)WET GAS,Lbs	4.93	5.33	4.91
X.	TOTAL PARTICULATE COLLECTED (GRAMS)	0.1752	0.1743	0.1560

Y. AVERAGE GAS VELOCITY, FPM	2607	2740	2722
Z. STACK GAS FLOW RATE			
1)AT STACK, Qa, ACFM	73698	77469	76959
2)AT Std.,Qstd, SCFM	53822	57310	56494
3)Std. DRY,Qdg, SCFM	32426	34044	33804
AA. PERCENT EXCESS AIR	262	297	329
BB. CONCENTRATION CONVERSION FACTORS:			
1)50% E.A.,AFTER COLLECTOR	1.70	1.76	1.83
2)50% E.A.,BEFORE COLLECTOR	3.35	3.66	3.93
3)MOISTURE BEFORE COLLECTOR	1.41	1.42	1.41
CC. PARTICULATE CONCENTRATION:			
1)Lbs/1000 Lbs., ACTUAL	0.078	0.072	0.070
2)Lbs/1000 Lbs., DRY	0.110	0.102	0.099
3)Lbs/1000 Lbs., WET @ 50%E.A	0.133	0.127	0.128
4)Lbs/1000 Lbs., DRY @ 50%E.A	0.262	0.263	0.275
5)GRAINS / DSCF	0.058	0.054	0.052
6)POUNDS / HOUR	16.175	15.819	15.152
DD. PERCENT ISOKINETIC	96.9	98.6	92.1

++

Michigan Sugar Company

Pulp Drier Data

Date: 11-13-90

Operator:

Location: Crowell

Equip. No.:

Fuel Type: #6 oil

*Gallons on Oil, SCFH on Natural Gas
**If Applicable

Time	Slice Rate (Tons/Hr)	Totalizer Fuel Reading (Gallons)*	% Fuel Rate (GPH)*	Furnace Temp. (°F)	Exit Temp. (°F)	Pressure Differential Across The Drum (In. Of Water)	Pressure Differential Across The Collector (In. Of Water)	Flue gas recirculation FGR Flow Rate (ACFM)	Pressed Pulp Moisture (Feed) (% Water)	Dried Pulp Moisture (Product) % Water	**Feed Screw Speed Drier #1 (RPM)	Drier #2 (RPM)
600	168	60503	7.9	1590	266	1.03	8.1	11770	74.1	8.1	2530	.15
6:15	163	60630	8.5	1620	280	.80	7.7	11360	74.9	11.1	2410	.14
6:30	157	60726	6.5	1720	271	.60	5.2	12160	75.1	10.1	2010	.16
6:45	152	60838	7.3	1530	271	1.19	8.0	11930	73.8	3.7	2550	.16
7:00	156	60970	8.8	1530	250	1.25	8.2	11700	76.4	5.2	2560	.15
7:15	150	61083	7.5	1530	253	.93	7.9	11490	77.5	13.3	2510	.14
7:30	150	61224	9.4	1610	279	.80	8.3	11700	78.3	16.5	2560	.15
7:45	145	61332	7.2	1610	284	.92	8.2	11750	75.9	12.9	2550	.16
8:00	150	61447	7.7	1620	285	.94	8.2	11510	75.6	8.9	2570	.15
8:15	140	61590	9.5	1670	285	.95	8.2	11550	72.8	7.1	2600	.15
8:30	140	61690	6.7	1670	285	.95	8.2	11550	73.9	8.4	2600	.15
8:45	147	61862	11.5	1640	284	.89	7.6	12570	73.7	6.5	2510	.13
9:00	146	61990	8.5	1580	274	.95	7.4	12760	74.4	3.5	2470	.13
9:15	140	62128	9.2	1630	266	1.20	7.8	12600	74.5	6.9	2510	.15
9:30	143	62216	5.9	1670	269	.95	7.9	12510	77.2	8.9	2520	.15
9:45	150	62350	8.9	1540	266	.97	7.7	12760	75.9	11.2	2500	.14
10:00	145	62514	10.9	1590	276	.96	7.6	12560	74.0	11.1	2480	.15
10:15	153	62617	6.9	1620	274	.81	6.1	12850	74.0	3.4	2200	.14
10:30	153	62714	6.5	1560	271	.77	6.3	12480	68.1	2.8	2260	.14
10:45	149	62826	7.6	1540	267	1.03	6.8	12840	69.3	3.2	2:	.13
11:00	141	62942	7.6	1690	273	.90	7.0	12720	68.2			

FORM HRS 9-24-90

Michigan Sugar Company

Pulp Drier Data

Date: 11-13-90

Operator:

Location: Carrollton

Equip. No.:

Fuel Type: #6 Oil

*Gallons on Oil, SCFH on Natural Gas
**If Applicable

Time	Slice Rate (Tons/Hr)	Totalizer Fuel Reading (Gallons)*	Fuel Rate (GPH)*	Furnace Temp. (°F)	Exit Temp. (°F)	Pressure Differential Across The Drum (In. Of Water)	Pressure Differential Across The Collector (In. Of Water)	FGR Flow Rate (ACFM)	Pressed Pulp Moisture (Feed) (% Water)	Dried Pulp Moisture (Product) % Water	Drier Speed Drier #1 (RPM)	Drier Speed Drier #2 (RPM)
AM 11:15	139	63057	7.7	1810	272	.72	5.1	12590	68.1	4.1	2010	.14
11:30	147	63153	6.4	1780	268	9.0	5.5	12590	72.1	3.3	2090	.14
11:45	140	63263	7.3	1770	269	.79	5.4	12550	73.3	2.2	2080	.15
12:00	142	63378	7.7	1760	259	.94	5.7	12570	75.6	2.2	2160	.14
12:15	136	63505	8.5	1750	265	.94	7.5	13200	73.9	4.8	2450	.16
12:30	145	63608	6.9	1720	260	.78	4.8	13270	73.7	6.3	1950	.16
12:45	138	63710	6.8	1630	259	.90	6.6	13310	69.0	3.2	2320	.14
PM 1:00	130	63835	8.3	1650	267	.73	5.7	13260	75.2	2.6	2130	.15
1:15	144	63944	7.3	1630	262	.78	6.2	13620	69.1	3.3	2220	.14
1:30	140	64061	7.8	1550	262	.85	6.2	13200	74.1	2.5	2230	.14
1:45	140	64177	7.7	1630	263	.76	6.2	13500	73.5	2.5	2210	.14
2:00	140	64280	6.9	1690	264	.89	5.9	13590	74.1	2.5	2190	.15
2:15	147	64390	7.3	1680	264	.82	6.0	13840	73.2	2.5	2200	.14
2:30	151	64504	7.6	1710	265	.88	6.1	13700	73.4	2.2	2200	.14
2:45	146	64610	7.1	1670	264	.80	6.0	13720	72.4	2.2	2100	.14
3:00	142	64748	9.2	1650	262	.96	6.2	13600	72.7	2.2	2280	.14
3:15	147	64832	5.6	1630	259	.82	6.6	13640	73.3	2.5	2260	.14
3:30	133	64953	8.1	1650	260	.91	6.4	13470	72.0	3.3	2250	.14
4:00	138	40277		1370	260	.94	6.3	1400	OFF		2240	.18
5:00	160	40337		1530	270	.73	6.2	1411			2230	.15
6:00	142	40408		1520	263	.77	6.3	1370			2210	.15

FORM .HRS 9-24-90

12 PAGE LAB REPORT MICHIGAN SUGAR COMPANY PLANT: CROSWELL PAGE: 5 [illegible] 1991

			PULP PRODUCED				PRESSED PULP			DRY PULP			PELLET PULP			% SUGAR IN PRESSED PULP			
		---TONS---		% ON BEETS			-----% MOISTURE-----			-----% MOISTURE-----			-----% MOISTURE-----			-% SUGAR-		---TONS---	
DATE	DAY	DAY	TODATE	DAY	TD	AVE	DAY	TOTAL	TODATE	DAY	TOTAL	TODATE	DAY	TOTAL	TODATE	DAY	TD	DAY	TD
10/26	32	122	4279	3.99	4.58	134	74.48	2210.24	73.67	11.35	291.30	9.71	11.56	328.86	10.96	.30	.36	9.17	334.80
10/27	33	180	4459	5.00	4.59	135	73.26	2283.50	73.66	9.15	300.45	9.69	12.24	341.10	11.00	.31	.36	11.16	345.96
10/28	34	150	4609	4.50	4.59	136	73.85	2357.35	73.67	9.75	310.20	9.69	11.32	352.42	11.01	.37	.36	12.35	358.31
10/29	35	178	4787	4.99	4.60	137	75.93	2433.28	73.74	9.83	320.03	9.70	12.18	364.60	11.05	.43	.36	15.33	373.64
10/30	36	152	4939	4.49	4.60	137	76.85	2510.13	73.83	11.23	331.26	9.74	11.78	376.38	11.07	.40	.36	13.55	387.19
10/31	37	146	5085	4.50	4.60	137	73.16	2583.29	73.81	10.05	341.31	9.75	10.19	386.57	11.04	.33	.36	10.71	397.90
11/01	38	92	5177	4.00	4.58	136	71.66	2654.95	73.75	9.50	350.81	9.74	11.14	397.71	11.05	.40	.36	9.21	407.11
WK 5		1020		4.53			74.17			10.12			11.49			.36		81.48	
TD			5177		4.58				73.75			9.74			11.05		.36		407.11
11/02	39	158	5335	5.01	4.60	137	73.90	2728.85	73.75	10.22	361.03	9.76	11.26	408.97	11.05	.42	.36	13.24	420.35
11/03	40	163	5498	4.99	4.61	137	75.24	2804.09	73.79	9.53	370.56	9.75	11.39	420.36	11.06	.43	.36	14.04	434.39
11/04	41	145	5643	5.01	4.62	138	74.23	2878.32	73.80	10.10	380.66	9.76	11.65	432.01	11.08	.35	.36	10.13	444.52
11/05	42	88	5731	4.95	4.62	136	76.60	2954.92	73.87	8.43	389.09	9.73	10.96	442.97	11.07	.42	.36	7.46	451.98
11/06	43	93	5824	5.00	4.63	135	74.98	3029.90	73.90	9.09	398.18	9.71	11.06	454.03	11.07	.37	.36	6.89	458.87
11/07	44	111	5935	4.99	4.63	135	69.55	3099.45	73.80	8.12	406.30	9.67	11.38	465.41	11.08	.30	.36	6.67	465.54
11/08	45	85	6020	2.97	4.60	134	67.55	3167.00	73.65	7.26	413.56	9.62	10.96	476.37	11.08	.35	.36	10.02	475.56
WK 6		843		4.67			73.15			8.96			11.24			.38		68.45	
TD			6020		4.60				73.65			9.62			11.08		.36		475.56
11/09	46	168	6188	5.01	4.61	135	70.48	3237.48	73.58	9.03	422.59	9.60	10.58	486.95	11.07	.31	.36	10.40	485.96
11/10	47	159	6347	4.99	4.62	135	73.86	3311.34	73.59	10.15	432.74	9.62	11.34	498.29	11.07	.37	.36	11.79	497.75
11/11	48	132	6479	4.49	4.61	135	74.74	3386.08	73.61	9.17	441.91	9.61	10.51	508.80	11.06	.45	.36	13.23	510.98
11/12	49	144	6623	4.50	4.61	135	74.81	3460.89	73.64	9.93	451.84	9.61	10.86	519.66	11.06	.44	.37	14.07	525.05
→11/13	50	165	6788	5.00	4.62	136	73.70	3534.59	73.64	9.94	461.78	9.62	10.74	530.40	11.05	.34	.36	11.22	536.27
11/14	51	155	6943	4.98	4.63	136	72.92	3607.51	73.62	9.87	471.65	9.63	11.62	542.02	11.06	.37	.37	11.51	547.78
11/15	52	171	7114	4.99	4.63	137	73.72	3681.23	73.62	9.97	481.62	9.63	11.48	553.50	11.07	.48	.37	16.46	564.24
WK 7		1094		4.86			73.46			9.72			11.02			.39		88.68	
TD			7114		4.63				73.62			9.63			11.07		.37		564.24
11/16	53	144	7258	4.98	4.64	137	75.05	3756.28	73.65	10.11	491.73	9.64	10.32	563.82	11.06	.47	.37	13.60	577.84
11/17	54	151	7409	5.00	4.65	137	70.40	3826.68	73.59	8.13	499.86	9.61	10.96	574.78	11.05	.38	.37	11.48	589.32
11/18	55	151	7560	5.00	4.65	137	75.36	3902.04	73.62	9.31	509.17	9.61	11.22	586.00	11.06	.37	.37	11.17	600.49
11/19	56	152	7712	4.97	4.66	138	74.39	3976.43	73.64	9.84	519.01	9.61	11.81	597.81	11.07	.40	.37	12.23	612.72
11/20	57	145	7857	4.98	4.67	138	73.27	4049.70	73.63	8.41	527.42	9.59	10.56	608.37	11.06	.54	.37	15.71	628.43
11/21	58	160	8017	4.94	4.67	138	72.94	4122.64	73.62	7.81	535.23	9.56	11.16	619.53	11.06	.43	.37	13.94	642.37
11/22	59	90	8107	4.93	4.67	137	74.23	4196.87	73.63	6.66	541.89	9.51	10.59	630.12	11.05	.54	.38	9.86	652.23
WK 8		993		4.97			73.66			8.61			10.95			.44		87.99	
TD			8107		4.67				73.63			9.51			11.05		.38		652.23

Filename: BEET25.WQ1
Date: 19-Jan-95
Facility: Michigan Sugar Company
Location: Croswell, Michigan
Source: Pulp dryer with multiclones (fuel-oil fired)
Test date: November 19, 1990

D. Emission Data/Mass Flux Rates/Emission Factors

Test ID	Parameter	Units	Values reported			
			Run 1	Run 2	Run 3	Average
1	Stack temperature	Deg F	279.54	270.79	276.96	
	Pressure	in. HG	30.49	30.52	30.54	
	Moisture	%	39.75	40.6	40.16	
	Oxygen	%	15.4	15.8	16.2	
	Volumetric flow, actual	acfm	73698	77469	76959	
	Volumetric flow, standard*	dscfm	32428	34042	33806	
	Isokinetic variation	%	96.9	98.6	92.1	
	Wet pulp feed rate	TPH	24.1	23.7	24.9	
	Pollutant concentrations:					
	Filterable PM	G/dscf	0.058	0.054	0.052	
	CO2	% dv	4	4.2	3.8	
	Pollutant mass flux rates:					
	Filterable PM	lb/hr	16.2	15.8	15.2	
	CO2	lb/hr	8890	9799	8804	
	Emission factors (ENGLISH UNITS):					AVERAGE
	Filterable PM	lb/ton	0.67	0.67	0.61	0.65
	CO2	lb/ton	369	413	354	379
	Emission factors (METRIC UNITS):					AVERAGE
	Filterable PM	kg/Mg	0.34	0.33	0.30	0.32
	CO2	kg/Mg	184	207	177	189

*DSCFM BASED ON A STANDARD TEMPERATURE OF 70 DEGREES FAHRENHEIT

MIDWEST RESEARCH INSTITUTE

Project/Acct. No. 4602-03 Date/Time 12/9/94

Project Title SUGAR BEET PROCESSING AP-42

Signature [signature] Verified by _____ (signature/date)

Phone Contact ☐ Meeting Notes ☐ Work Sheet ☒

CROSWELL, MICHIGAN FACILITY

TEST DATE: 11/13/90

Test No.	Time (estimated)*
P-1	11:00 - 12:00
P-2	12:15 - 1:15
P-3	2:00 - 3:00

* ESTIMATED BASED ON 60 MINUTES PER TEST RUN AND INDICATED TIMES ON PULP DRIER DATA SHEETS FOR 11-13-90

TOTAL DRY PULP PRODUCED ON 11/13/90 = 165 TONS = 6.9 TONS/HR. AVERAGE

AVERAGE OVER 60 MINUTE TEST RUN

Test No.	Slice Rate (Tons/Hr)	Pressed Pulp Moisture (%)	Dried Pulp Moisture (%)
P-1	142	72.3	3.0
P-2	139	71.8	3.9
P-3	147	72.9	2.3

$$\% \text{ Solids} = \frac{\text{Dry Pulp Produced} - \text{Dry Pulp Moisture} * \text{Pulp Produced}}{\text{Beets Sliced}}$$

P-1: $\% \text{ Solids} = \frac{6.9 - (0.03 * 6.9)}{142} = \frac{6.69}{142} \times 100 = 4.7\%$

P-2: $\% \text{ Solids} = \frac{6.9 - (0.039 * 6.9)}{139} = \frac{6.63}{139} \times 100 = 4.8\%$

P-3: $\% \text{ Solids} = \frac{6.9 - (0.023 * 6.9)}{147} = \frac{6.74}{147} \times 100 = 4.6\%$

MIDWEST RESEARCH INSTITUTE

Project/Acct. No. 4602-03 Date/Time 12/9/94

Project Title Sugar Beet Processing AP-42

Signature _____ Verified by _____ (signature/date)

Phone Contact ☐
Meeting Notes ☐
Work Sheet ☒

$$\text{Process Rate (tons/hr)} = \frac{\text{Beets Sliced} * \%\ \text{Solids}}{1 - \left(\frac{\text{(wet pulp moisture (\%))}}{100}\right)}$$

P-1: Rate = $\frac{142 * 0.047}{1 - \left(\frac{72.3}{100}\right)} = \frac{6.67}{0.277} = 24.1$ tons/hr.

P-2: Rate = $\frac{139 * 0.048}{1 - \left(\frac{71.8}{100}\right)} = \frac{6.67}{0.282} = 23.7$ tons/hr.

P-3: Rate = $\frac{147 * 0.046}{1 - \left(\frac{72.9}{100}\right)} = \frac{6.76}{0.271} = 24.9$ tons/hr.

PARTICULATE EMISSION STUDY
MICHIGAN SUGAR COMPANY
CROSWELL, MICHIGAN
NOVEMBER 19, 1990
MA-6482

1.0 INTRODUCTION

Swanson Environmental, Inc. (SEI) was retained by Michigan Sugar Company to conduct a total particulate emissions study on the exhaust gases discharged from the Pulp Drier at their Croswell, Michigan facility.

The purpose of the study was to determine the total particulate emissions, as required by the Michigan Department of Natural Resources (MDNR), in accordance with Michigan Sugar's permit conditions. The testing procedures used for the study were conducted in accordance with those outlined in U.S. EPA Methods 1, 2, 3, 4 and MDNR Method 5B.

The emission tests were conducted on November 13, 1990 by Mr. Bruce Montagne, Mr. Doug Groves and Mr. Tom Wilk of Swanson Environmental, Inc.

2.0 PRELIMINARY TESTS AND CALCULATIONS

Prior to testing, the emission stack was measured for stack length and inner diameter. The number of traverse points was determined in accordance with U.S. EPA Method 1-Sample and Velocity Traverse for Stationary Sources. A total of twenty-four (24) sampling points were selected.

SWANSON ENVIRONMENTAL, INC.

TABLE 1
PLANT: MICHIGAN SUGAR
LOCATION: CROSWELL

DATE: NOVEMBER 19, 1990

TEST NO.	TEST DATE	STACK GAS FLOW RATE (DSCFM)	EMISSION CONC. RATE GRAIN PER DSCF	EMISSION CONC. RATE LBS/1000 LBS DRY-GAS	EMISSION CONC. RATE LBS/1000 LBS DRY 50%E A*	EMISSION RATE LBS/ HOUR
P-1	11-13-90	32426	0.058	0.110	0.262	16.175
P-2	11-13-90	34044	0.054	0.102	0.263	15.819
P-3	11-13-90	33804	0.052	0.099	0.275	15.152

* EA = Excess Air

TABLE 2

PLANT: MICHIGAN SUGAR
LOCATION: CROSWELL
DATE: 10-20-90

EXHAUST GAS COMPOSITION (PERCENT)

TEST NO	%O2	%CO2	%N2
P-1	15.4	4.0	80.6
P-2	15.8	4.2	80.0
P-3	16.2	3.8	80.0