AP42 Section:	9.11.1
Title:	Emission Factor Documentation for AP-42 Section 9.11.1 Vegetable Oil Processing Final Report APPENDICES ONLY The report is available electronically but not with the appendices (test reports).

Emission Factor Documentation for AP-42
Section 9.11.1

Vegetable Oil Processing

Final Report

For U. S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emission Factor and Inventory Group
Research Triangle Park, NC 27711

Attn: Mr. Dallas Safriet (MD-14)

Appendices a-f

EPA Contract No. 68-D2-0159
Work Assignment No. 2-03 and 3-01

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4603-01-03

November 1995

NOTICE

The information in this document has been funded wholly or in part by the United States Environmental Protection Agency under Contract No. 68-D2-0159 to Midwest Research Institute. It has been subjected to the Agency's peer and administrative review, and it has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

APPENDIX

CALCULATIONS AND SOURCE TEST DATA

This Appendix presents data from references 4 to 9, 11 to 14, 16, 17, and 18. With the exception of reference 16, which is a journal article, each reference begins with a copy of the reference cover page with the reference number indicated on the bottom, and is followed by a computer spread sheet prepared by MRI showing the conversion of data to emission factors and copies of the data tables from each reference.

United States
Environmental Protection
Agency

Office of Air Quality
Planning and Standards
Research Triangle Park NC 27711

October 1979

1175

Air

EPA

Vegetable Oil Production (Meal Processing)

Emission Test Report Cargill, Incorporated (East Plant) Cedar Rapids, Iowa

REFERENCE 4

REFERENCE 4 CALCULATIONS FOR HEXANE CONCENTRATION IN SOYBEAN MEAL

COL 1 SOURCE/ RUN NO.	COL 2 HEXANE CONCENTRATION IN PPM	COL 3 GALLONS OF HEXANE PER TON OF RAW SOYBEAN PROCESSED (COL 2 x 0.0003)	COL 4 LITERS OF HEXANE PER METRIC TON RAW SOYBEAN PROCESSED (COL 3 x 3.725)
DT			
1	290	0.087	0.3241
2	580	0.174	0.6482
3	340	0.102	0.3800
4	34	0.0102	0.0380
5	310	0.093	0.3464
6	500	0.15	0.5588
7	460	0.138	0.5141
8	420	0.126	0.4694
9	390	0.117	0.4358
10	170	0.051	0.1900
11	260	0.078	0.2906
12	230	0.069	0.2570
13	130	0.039	0.1453
14	130	0.039	0.1453
15	100	0.03	0.1118
16	51	0.0153	0.0570
17	52	0.0156	0.0581
18	87	0.0261	0.0972
19	78	0.0234	0.0872
20	49	0.0147	0.0548
21	86	0.0258	0.0961
ARITHMETIC MEAN	226	0.0678	0.2526
STANDARD DEVIATION	165	0.0495	0.1845
GEOMETRIC MEAN		0.0490	0.1825
STANDARD GEOMETRIC DEVIATION		0.8583	0.8583
COOLER			
1	91	0.0273	0.1017
2	73	0.0219	0.0816
3	110	0.033	0.1229
4	73	0.0219	0.0816
5	110	0.033	0.1229
6	110	0.033	0.1229
7	92	0.0276	0.1028
8	120	0.036	0.1341
9	100	0.03	0.1118
10	120	0.036	0.1341
11	100	0.03	0.1118
12	100	0.03	0.1118
13	170	0.051	0.1900
14	130	0.039	0.1453
15	100	0.03	0.1118
16	140	0.042	0.1565
17	91	0.0273	0.1017
18	150	0.045	0.1676
19	79	0.0237	0.0883
20	150	0.045	0.1676
21	79	0.0237	0.0883
ARITHMETIC MEAN	109	0.0327	0.1218
STANDARD DEVIATION	26	0.0079	0.0292
GEOMETRIC MEAN		0.0318	0.1184
STANDARD GEOMETRIC DEVIATION		0.2340	0.2340

0.0003 = CONVERSION FACTOR TO CONVERT HEXANE PPM IN MEAL TO GALLONS OF HEXANE/TON OF RAW SOYBEANS.
3.725 = CONVERSION FACTOR TO CONVERT GAL/TON TO L/MT.

NOTES: This table presents the calculations for converting hexane concentrations in meal to gallons of hexane per ton of raw soybean processed. The data presented in Column 2 is obtained from the tables copied from the reference that follows this page.

DATA SHEET

lant: Cargill East, Cedar Rapids   Date: June 21, 1979

Date nalysis		Sample No.-Location		Sample Date	Time	Wet Wt. (g)	Wet (µg/g)	Dry (µg/g
7/25/79		133	D.T.	6/21/79	10:00 pm	2.71	290	380
6/29/79		134	D.T.	6/21/79	10:00 pm	3.20	580	750
7/25/79		135	D.T.	6/21/79	10:00 pm	2.72	340	410
6/29/79		136	Milling	6/21/79	10:00 pm	3.57	110	140
7/18/79		137	Milling	6/21/79	10:00 pm	3.10	90	100
7/25/79		138	Milling	6/21/79	10:00 pm	3.36	66	73
7/25/79	(B)	139	Cooling	6/21/79	10:08 pm	3.28	91	11
7/31/79		140	Cooling	6/21/79	10:08 pm	3.66	73	8
7/18/79		141	Cooling	6/21/79	10:08 pm	2.96	110	13
7/18/79		142	D.T.	6/21/79	11:05 pm	3.01	34	4
7/18/79		143	D.T.	6/21/79	11:05 pm	2.39	310	38
6/29/79		144	D.T.	6/21/79	11:05 pm	3.34	500	64
7/18/79		145	Milling	6/21/79	11:08 pm	2.49	91	11
7/18/79		146	Milling	6/21/79	11:08 pm	2.51	73	8
7/18/79		147	Milling	6/21/79	11:08 pm	2.68	77	9
7/25/79		148	Cooling	6/21/79	11:12 pm	1.85	73	8
6/29/79		149	Cooling	6/21/79	11:12 pm	2.35	110	13
7/18/79		150	Cooling	6/21/79	11:12 pm	2.23	110	12
7/25/79		151	D.T.	6/21/79	12:02 pm	2.15	460	62
7/25/79		152	D.T.	6/21/79	12:02 pm	1.71	420	57
7/25/79		153	D.T.	6/21/79	12:02 pm	2.00	390	4
7/25/79		154	Milling	6/21/79	12:06 pm	2.67	81	1
7/25/79		155	Milling	6/21/79	12:06 pm	2.65	70	[illegible]
7/18/79		156	Milling	6/21/79	12:06 pm	3.02	74	
7/31/79	(A)	157	Cooling	6/21/79	12:10 pm	1.96	92	1
7/18/79		158	Cooling	6/21/79	12:10 pm	2.20	120	1
7/25/79		159	Cooling	6/21/79	12:10 pm	1.71	100	1
7/25/79		160	D.T.	6/21/79	1:04 pm	3.12	170	2
6/29/79		161	D.T.	6/21/79	1:04 pm	1.54	260	3
7/18/79		162	D.T.	6/21/79	1:04 pm	2.06	230	2

(A) Duplicate injection of this sample produced a 5 to 10% difference.

(B) Duplicate injection of this sample produced a difference greater than 10%.

DATA SHEET

nt: Cargill East, Cedar Rapids   Date: June 21, 1979

ate lysis		Sample No.	Location	Sample Date	Time	Wet Wt. (g)	Wet (µg/g)	Dry (µg/g)
29/79		163	Milling	6/21/79	1:08 pm	2.77	130	160
18/79	(A)	164	Milling	6/21/79	1:08 pm	2.62	84	95
25/79	(A)	165	Milling	6/21/79	1:08 pm	2.44	83	97
25/79		166	Cooling	6/21/79	1:13 pm	2.89	120	170
25/79	(A)	167	Cooling	6/21/79	1:13 pm	2.83	100	110
25/79		168	Cooling	6/21/79	1:13 pm	3.34	100	118
18/79		169	D.T.	6/21/79	2:00 pm	1.89	130	170
29/79		170	D.T.	6/21/79	2:00 pm	1.86	130	170
18/79		171	D.T.	6/21/79	2:00 pm	1.86	100	120
25/79		172	Milling	6/21/79	2:03 pm	2.11	67	77
18/79	(A)	173	Milling	6/21/79	2:03 pm	2.67	75	88
25/79		174	Milling	6/21/79	2:03 pm	1.95	76	87
31/79		175	Cooling	6/21/79	2:07 pm	1.54	170	240
18/79		176	Cooling	6/21/79	2:07 pm	2.11	130	150
31/79		177	Cooling	6/21/79	2:07 pm	2.09	100	130
18/79		178	D.T.	6/21/79	3 ~~2~~:07 pm	1.97	51	64
25/79		179	D.T.	6/21/79	3 ~~2~~:07 pm	2.18	52	71
29/79		180	D.T.	6/21/79	3 ~~2~~:07 pm	1.94	87	120
31/79		181	Milling	6/21/79	3:04 pm	2.78	62	78
31/79		182	Milling	6/21/79	3:04 pm	2.50	60	74
25/79		183	Milling	6/21/79	3:04 pm	2.43	60	76
29/79		184	Cooling	6/21/79	3:00 pm	2.90	140	170
25/79		185	Cooling	6/21/79	3:00 pm	3.11	91	110
29/79		186	Cooling	6/21/79	3:00 pm	3.02	150	170
29/79		187	D.T.	6/21/79	4:00 pm	2.74	78	110
25/79		188	D.T.	6/21/79	4:00 pm	3.79	49	65
29/79		189	D.T.	6/21/79	4:00 pm	1.97	86	110
29/79		190	Milling	6/21/79	4:05 pm	2.69	110	140
25/79		191	Milling	6/21/79	4:05 pm	2.14	64	71
25/79		192	Milling	6/21/79	4:05 pm	2.51	61	67
25/79		193	Cooling	6/21/79	4:08 pm	3.32	79	87
29/79		194	Cooling	6/21/79	4:08 pm	2.74	150	170
31/79		195	Cooling	6/21/79	4:08 pm	3.51	79	100

) Duplicate injection of this sample produced a 5 to 10% difference.

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Planning and Standards
Research Triangle Park NC 27711

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Air

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Vegetable Oil Production (Meal Processing)

Emission Test Report Cargill, Incorporated (West Plant) Cedar Rapids, Iowa

REFERENCE 5

REFERENCE 5 CALCULATIONS FOR HEXANE CONCENTRATION IN SOYBEAN MEAL

COL 1 SOURCE/ RUN NO.	COL 2 HEXANE CONCENTRATION IN PPM	COL 3 GALLONS OF HEXANE PER TON OF RAW SOYBEAN PROCESSED (COL 2 x 0.0003)	COL 4 LITERS OF HEXANE PER METRIC TON RAW SOYBEAN PROCESSED (COL 3 x 3.725)
DT			
1	2700	0.8100	3.0173
2	2800	0.8400	3.1290
3	2500	0.7500	2.7938
4	100	0.0300	0.1118
5	100	0.0300	0.1118
6	78	0.0234	0.0872
ARITHMETIC MEAN	1380	0.4139	1.5418
STANDARD DEVIATION	1290	0.3870	1.4416
GEOMETRIC MEAN		0.1486	0.5534
STANDARD GEOMETRIC DEVIATION		1.6849	1.6849
COOLER			
1	400	0.1200	0.4470
2	880	0.2640	0.9834
3	290	0.0870	0.3241
4	500	0.1500	0.5588
5	170	0.0510	0.1900
6	420	0.1260	0.4694
7	380	0.1140	0.4247
8	670	0.2010	0.7487
9	420	0.1260	0.4694
10	430	0.1290	0.4805
11	250	0.0750	0.2794
12	390	0.1170	0.4358
13	440	0.1320	0.4917
14	400	0.1200	0.4470
15	440	0.1320	0.4917
16	490	0.1470	0.5476
17	580	0.1740	0.6482
18	370	0.1110	0.4135
ARITHMETIC MEAN	440	0.1320	0.4917
STANDARD DEVIATION	153	0.0458	0.1705
GEOMETRIC MEAN		0.1245	0.4637
STANDARD GEOMETRIC DEVIATION		0.3485	0.3485

0.0003 = CONVERSION FACTOR TO CONVERT HEXANE PPM IN MEAL TO GALLONS OF HEXANE/TON OF RAW SOYBEANS.
3.725 = CONVERSION FACTOR TO CONVERT GAL/TON TO L/MT.

NOTES: This table presents the calculations for converting hexane concentrations in meal to gallons of hexane per ton of raw soybean processed. The data presented in Column 2 is obtained from the tables copied from the reference that follows this page.

TABLE 1. HEXANE CONCENTRATION IN MEAL SAMPLES
AT CARGILL WEST, CEDAR RAPIDS, IOWA

(Highest measured value only)

Sample site	Hexane concentration wet µg/g	Hexane concentration dry µg/g	Date of analysis
DT	2,800	3,000	7/24/79
Cooler	880	960	6/29/79
Flour Mill	89	200	6/29/79
Flash DT	6,100	6,700	6/29/79
Meal Post Grinding	150	180	7/12/79
Flash - After Schneckens	780	880	7/12/79

United States
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Office of Air Quality
Planning and Standards
Research Triangle Park NC 27711

EMB Report 79-VEG-6b
October 1979

1153.

Air

EPA

Vegetable Oil Production (Meal Processing)

Emission Test Report
AGRI Industries
Mason City, Iowa

REFERENCE 6

REFERENCE 6 CALCULATIONS FOR HEXANE CONCENTRATION IN SOYBEAN MEAL

COL 1 SOURCE/ RUN NO.	COL 2 HEXANE CONCENTRATION IN PPM	COL 3 GALLONS OF HEXANE PER TON OF RAW SOYBEAN PROCESSED (COL 2 x 0.0003)	COL 4 LITERS OF HEXANE PER TON OF RAW SOYBEAN PROCESSED (COL 3 x 3.725)
DT			
1	160	0.0480	0.1788
2	280	0.0840	0.3129
3	263	0.0789	0.2939
4	247	0.0741	0.2760
5	273	0.0819	0.3051
6	157	0.0471	0.1754
7	183	0.0549	0.2045
ARITHMETIC MEAN	223	0.0670	0.2495
STANDARD DEVIATION	47	0.0142	0.0528
GEOMETRIC MEAN		0.0652	0.2428
STANDARD GEOMETRIC DEVIATION		0.2231	0.2231
COOLER			
1	95	0.0285	0.1062
2	107	0.0321	0.1196
3	112	0.0336	0.1252
4	134	0.0402	0.1497
5	105	0.0315	0.1173
6	122	0.0366	0.1363
7	112	0.0336	0.1252
ARITHMETIC MEAN	112	0.0337	0.1256
STANDARD DEVIATION	11	0.0033	0.0122
GEOMETRIC MEAN		0.0336	0.1250
STANDARD GEOMETRIC DEVIATION		0.0954	0.0954

0.0003 = CONVERSION FACTOR TO CONVERT HEXANE PPM IN MEAL TO GALLONS OF HEXANE/TON OF RAW SOYBEANS.
3.725 = CONVERSION FACTOR TO CONVERT GAL/TON TO L/MT.

NOTES: This table presents the calculations for converting hexane concentrations in meal to gallons of hexane per ton of raw soybean processed. The data presented in Column 2 is obtained from the tables copied from the reference that follows this page.

TABLE 1. HEXANE CONCENTRATION[a] IN MEAL

AGRI - Mason City, Iowa
Sample date - June 18, 1979

Approximate sample time (p.m.)	Hexane concentration DT Wet meal µg/g	DT Dry meal µg/g	Cooler Wet meal µg/g	Cooler Dry meal µg/g	Milling Wet meal µg/g	Milling Dry meal µg/g
1:00	160	200	95	119	90	130
2:00	280	450	107	130	84	101
3:00	263	393	112	133	100	121
4:00	247	363	134	157	97	118
5:00	273	435	105	124	97	121
6:00	157	177	122	136	95	111
7:00	183	230	112	136	84	100
Average	223	321	112	134	92	115

[a]Concentration listed is the mean value of triplicate samples.

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Office of Air Quality
Planning and Standards
Research Triangle Park NC 27711

EMB Report 79-VEG-6h
October 1979

Air

1176

EPA

Vegetable Oil Production (Meal Processing)

Emission Test Report Cargill, Incorporated Fayetteville, NC

REFERENCE 7

REFERENCE 7 CALCULATIONS FOR HEXANE CONCENTRATION IN SOYBEAN MEAL

COL 1 SOURCE/ RUN NO.	COL 2 HEXANE CONCENTRATION IN PPM	COL 3 GALLONS OF HEXANE PER TON OF RAW SOYBEAN PROCESSED (COL 2 x 0.0003)	COL 4 LITERS OF HEXANE PER METRIC TON RAW SOYBEAN PROCESSED (COL 3 x 3.725)
DT			
1	1100	0.3300	1.2293
2	1100	0.3300	1.2293
3	910	0.2730	1.0169
4	830	0.2490	0.9275
5	600	0.1800	0.6705
6	560	0.1680	0.6258
7	100	0.0300	0.1118
8	940	0.2820	1.0505
9	910	0.2730	1.0169
10	960	0.2880	1.0728
11	453	0.1359	0.5062
12	520	0.1560	0.5811
13	200	0.0600	0.2235
14	970	0.2910	1.0840
15	590	0.1770	0.6593
16	930	0.2790	1.0393
17	870	0.2610	0.9722
18	880	0.2640	0.9834
19	600	0.1800	0.6705
20	620	0.1860	0.6929
21	730	0.2190	0.8158
ARITHMETIC MEAN	732	0.2196	0.8181
STANDARD DEVIATION	265	0.0796	0.2965
GEOMETRIC MEAN		0.1960	0.7302
STANDARD GEOMETRIC DEVIATION		0.5659	0.5659
DRYER			
1	880	0.2640	0.9834
2	730	0.2190	0.8158
3	890	0.2670	0.9946
4	730	0.2190	0.8158
5	870	0.2610	0.9722
6	880	0.2640	0.9834
7	750	0.2250	0.8381
8	660	0.1980	0.7376
9	620	0.1860	0.6929
10	260	0.0780	0.2906
11	300	0.0900	0.3353
12	330	0.0990	0.3688
13	440	0.1320	0.4917
14	530	0.1590	0.5923
15	470	0.1410	0.5252
16	470	0.1410	0.5252
17	530	0.1590	0.5923
18	510	0.1530	0.5699
19	550	0.1650	0.6146
20	650	0.1950	0.7264
21	510	0.1530	0.5699
ARITHMETIC MEAN	598	0.1794	0.6684
STANDARD DEVIATION	188	0.0564	0.2102
GEOMETRIC MEAN		0.1698	0.6323
STANDARD GEOMETRIC DEVIATION		0.3452	0.3452
COOLER			
1	980	0.2940	1.0952
2	1300	0.3900	1.4528
3	100	0.0300	0.1118
4	820	0.2460	0.9164
5	780	0.2340	0.8717
6	730	0.2190	0.8158
7	760	0.2280	0.8493
8	990	0.2970	1.1063
9	810	0.2430	0.9052
10	390	0.1170	0.4358
11	520	0.1560	0.5811
12	370	0.1110	0.4135
13	630	0.1890	0.7040
14	480	0.1440	0.5364
15	500	0.1500	0.5588
16	480	0.1440	0.5364
17	580	0.1740	0.6482
18	650	0.1950	0.7264
19	700	0.2100	0.7823
20	610	0.1830	0.6817
21	560	0.1680	0.6258
ARITHMETIC MEAN	654	0.1963	0.7312
STANDARD DEVIATION	249	0.0746	0.2780
GEOMETRIC MEAN		0.1782	0.6639
STANDARD GEOMETRIC DEVIATION		0.5005	0.5005

0.0003 = RATIO OF WEIGHT OF 1 GALLON HEXANE TO WEIGHT OF SOYBEAN MEAL FROM 1 TON OF RAW SOYBEANS
3.725 = RATIO OF GALLON TO LITER CONVERSION FACTOR (3.785) TO TON TO METRIC TON CONVERSION FACTOR (1.016)

TABLE 2-1. HEXANE CONCENTRATION IN MEAL VS. TIME
CARGILL, INC. - FAYETTEVILLE, N.C.

JULY 12 AND 13, 1979

Sample date/time	Average hexane concentration[a]							
	D T[b]		Dryer		Cooler		Grinder	
	Wet µg/g	Dry µg/g	Wet µg/g	Dry µg/g	Wet µg/g	Dry µg/g	Wet µg/g	Dry µg/g
7/12/79								
10:20	1037	1267	833	1030	1093	1233	793	-[c]
11:20	633	873	827	1097	777	943	420	477
12:20	950	1300	677	840	853	1043	453	573
1:20	740	1400	297	370	427	500	343	413
2:20	780*	1155*	480	580	537	657	373	453
7/13/79								
9:50	893	1200	503	623	570	660	333	393
10:55	650	837	570	700	623	737	393	467
Average	812	1147	598	749	697	825	444	463

[a] Average of triplicate samples.

[b] D T - Desolventizer-toaster.

[c] Dry weight not recorded.

* Avg of 2 samples in replicate, 3rd sample value was extremely high + not used

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Planning and Standards
Research Triangle Park NC 27711

EMB Report 78-VEG-4
July 1979

Air

EPA

Vegetable Oil Manufacturing

Emission Test Report Central Soya, Incorporated Delphos, Ohio

11602

REFERENCE 8

REFERENCE 8 VENT GAS CONCENTRATION CALCULATIONS

COL. 1 SOURCE/RUN NUMBER	COL. 2 HEXANE CONCENTRATION IN SOURCE (ppm)	COL. 3 HEXANE MASS FLOW RATE (LB/HR)	COL. 4 HEXANE MASS FLOW RATE (GAL/HR) (COL 3/5.34)	COL. 5 THROUGHPUT OF RAW SOYBEANS (TONS/HR)	COL. 6 GALLONS SOLVENT EMITTED PER TON OF RAW SOYBEAN (COL. 4/COL. 5)
MOS OUTLET TO ATMOSPHERE					
MOS-2-OUT-1	1877.000	5.000	0.936	50	0.0187
MOS-2-OUT-2	2270.000	6.700	1.255	50	0.0251
MOS-2-OUT-3	5150.000	12.300	2.303	50	0.0461
MOS-2-OUT-4	3885.000	10.600	1.985	50	0.0397
AVERAGE	3295.500	8.650	1.620	50	0.0324
STANDARD DEVIATION	1308.670	2.926	0.548		0.0110
DRYER VENT TO ATMOSPHERE					
DV-1	81.000	9.200	1.723	50	0.0345
DV-2	59.000	6.400	1.199	50	0.0240
DV-3	70.000	7.700	1.442	50	0.0288
DV-4	45.000	4.600	0.861	50	0.0172
DV-5	39.000	4.000	0.749	50	0.0150
AVERAGE	58.800	6.380	1.195	50	0.024
STANDARD DEVIATION	15.497	1.925	0.360		0.007
MEAL COOLER EXHAUST TO ATMOSPHERE					
CV-1	75	5.900	1.105	50	0.022
CV-2	7	0.200	0.037	50	0.001
CV-3	10	0.400	0.075	50	0.001
CV-4	--	--	0.000	50	0.000
CV-5	--	--			
AVERAGE	30.67	2.167	0.304	50	0.008
STANDARD DEVIATION	31.37	2.641	0.463		0.010

WEIGHT OF ONE GALLON HEXANE IN POUNDS = 5.34

NOTES: This table presents the calculations for converting vent gas hexane concentrations to gallons of hexane per ton of raw soybean processed.
The data presented in Column 2 is obtained from the tables copied from the reference that follows the calculations.
Runs CV-4 and CV-5 produced uncertain results and were not used in the average.

REFERENCE 8 SOYBEAN MEAL HEXANE CONCENTRATION CALCULATIONS

COL. 1 SOURCE/RUN NUMBER	COL. 2 HEXANE CONCENTRATION IN MEAL (ppm)	COL. 3 GALLONS OF HEXANE PER TON OF RAW SOYBEAN (COL. 2 x 0.0003)	COL. 4 LITERS OF HEXANE PER TON RAW SOYBEAN PROCESSED (COL. 3 X 3.725)
DESOLVENTIZER-TOASTER EXIT			
001	783	0.2349	0.8750
002	1047	0.3141	1.1700
003	1189	0.3567	1.3287
004	282	0.0846	0.3151
005	1399	0.4197	1.5634
006	1489	0.4467	1.6640
007	--	0.0000	0.0000
008	--	0.0000	0.0000
013	861	0.2583	0.9622
014	863	0.2589	0.9644
019	267	0.0801	0.2984
020	726	0.2178	0.8113
AVERAGE	742.17	0.2227	0.8294
STANDARD DEVIATION	487.48	0.1462	0.5448
DRYER EXIT			
009	1010	0.3030	1.1287
010	1560	0.4680	1.7433
015	80	0.0240	0.0894
016	664	0.1992	0.7420
AVERAGE	828.5	0.2486	0.9258
STANDARD DEVIATION	537.44	0.1612	0.6006
COOLER EXIT			
011	1257	0.3771	1.4047
012	1125	0.3375	1.2572
017	515	0.1545	0.5755
018	310	0.0930	0.3464
023	30	0.0090	0.0335
024	286	0.0858	0.3196
AVERAGE	587.17	0.1762	0.6562
STANDARD DEVIATION	451.13	0.1353	0.5041

0.0003 = CONVERSION FACTOR TO CONVERT HEXANE PPM IN MEAL TO GALLONS OF HEXANE/TON OF RAW SOYBEANS.
3.725 = CONVERSION FACTOR TO CONVERT GAL/TON TO L/MT.

NOTES: This table presents the calculations for converting hexane concentrations in meal to gallons of hexane per ton of raw soybean processed. The data presented in Column 2 is obtained from the tables copied from the reference that follows this page.

TABLE 4. MIDGET BUBBLER TRAIN TEST RESULTS

Test Site	Run Number	Hexane Concentration In Source g/m^3	Hexane Concentration In Source ppm[a]	Vent Gas Flow Rate m^3/min.	Vent Gas Flow Rate dscfm[b]	Hexane Mass Flow Rate kg/h	Hexane Mass Flow Rate lb/h
Inlet to First MOS	MOS-1-IN-1	343.14	95,730	5.90	208.4	121.5	267.3
	MOS-1-IN-2	290.44	81,030	6.45	227.9	112.4	247.3
	MOS-1-IN-3	280.17	78,200	5.20	183.7	87.4	192.3
	MOS-1-IN-4	240.88	67,200	5.97	210.7	86.3	189.9
	Average	288.66	80,540	5.88	207.7	101.9	224.2
Inlet to Second MOS	MOS-2-IN-1	27.27	7,610	5.63	198.6	9.2	20.2
	MOS-2-IN-2	46.21	12,900	6.20	219.0	17.2	37.8
	MOS-2-IN-3	51.22	14,300	5.11	180.4	15.7	34.5
	MOS-2-IN-4	64.98	18,130	5.87	207.2	22.9	50.4
	Average	47.42	13,235	5.70	201.3	16.25	35.73
Outlet of Second MOS To ATM	MOS-2-OUT-1	6.73	1,877	5.62	198.4	2.3	5.0
	MOS-2-OUT-2	8.13	2,270	6.21	219.3	3.0	6.7
	MOS-2-OUT-3	18.46	5,150	5.08	179.4	5.6	12.3
	MOS-2-OUT-4	13.92	3,885	5.80	204.7	4.8	10.6
	Average	11.81	3,296	5.68	200.5	3.9	8.7
Dryer Vent To ATM	DV-1	0.29	81	242.24	8555	4.2	9.2
	DV-2	0.21	59	233.30	8239	2.9	6.4
	DV-3	0.25	70	234.46	8280	3.5	7.7
	DV-4	0.16	45	217.13	7668	2.1	4.6
	DV-5	0.14	39	217.13	7668	1.8	4.0
	Average	0.21	59	228.85	8082	2.9	6.4
Meal Cooler Exhaust (Inlet air to dryer)	CV-1	0.27	75	167.52	5916	2.7	5.9
	CV-2	0.026	7	89.45	3159	0.1	0.2
	CV-3	0.037	10	74.00	26.13	0.2	0.4
	CV-4	<0.15	<42	167.52	5916	<1.5	<3.3
	CV-5	<0.014	<4	167.52	5916	<0.1	<0.2
	Average[c]						

[a] ppm - part per million by volume

[b] dscfm - dry standard cubic feet per minute - Std conditions - 20°C, 760 mm Hg.

[c] Average values not reported - CV-2 and CV-3 run during non representative conditions; i.e., cyclone plugged. CV-4 and CV-5 - uncertainty in analysis.

TABLE 6. HEXANE ANALYSIS OF MEAL SAMPLES COLLECTED AT CENTRAL SOYA, DELPHOS, OHIO

Test site	Sample No.	Sample taken Date/Time	Sample weight/g	Hexane[a] conentration µg/g
DT[b]-1	001	1-9-79/17:35	1.5225	783
DT-2	002	1-9-79/17:30	3.3094	1047
DT-1	003	1-10-79/ 9:30	1.6836	1189
DT-2	004	1-10-79/ 9:30	1.6005	282
DT-1	005	1-10-79/11:15	1.8572	1399
DT-2	006	1-10-79/11:15	1.3956	1489 – High
DT-1	007	1-11-79/11:05	2.2523	<10 – low
DT-2	008	1-11-79/11:05	1.6147	<10
Dryer	009	1-11-79/11:05	1.9814	1010
Dryer	010	1-11-79/11:05	2.0210	1560
Cooler	011	1-11-79/11:05	2.2906	1257
Cooler	012	1-11-79/11:05	2.1682	1125
DT-1	013	1-11-79/14:55	1.4245	861
DT-2	014	1-11-79/14:55	1.5648	863
Dryer	015	1-11-79/14:55	2.3091	80
Dryer	016	1-11-79/14:55	1.8955	664
Cooler	017	1-11-79/14:55	2.3983	515
Cooler	018	1-11-79/14:55	2.3486	310
DT-1	019	1-12-79/12:45	1.1614	267
DT-2	020	1-12-79/12:45	1.5363	726
Dryer	021	1-12-79/12:45	2.3088	10
Cooler	023	1-12-79/12:45	2.7055	30
Cooler	024	1-12-79/12:45	1.8404	286

[a] Reported as n-Hexane

[b] Desolventizer toaster

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United States Environmental Protection Agency

Office of Air Quality Planning and Standards
Research Triangle Park NC 27711

EMB Report 78-VEG-3
July 1979

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Air

EPA

Vegetable Oil Manufacturing

Emission Test Report
A. E. Staley Manufacturing Company
Des Moines, Iowa

REFERENCE 9

REFERENCE 9 VENT GAS CONCENTRATION CALCULATIONS

COL. 1 SOURCE/RUN NUMBER	COL. 2 HEXANE CONCENTRATION IN SOURCE (ppm)	COL. 3 HEXANE MASS FLOW RATE (LB/HR)	COL. 4 HEXANE MASS FLOW RATE (GAL/HR) (COL 3/5.34)	COL. 5 THROUGHPUT OF RAW SOYBEANS (TONS/HR)	COL. 6 GALLONS SOLVENT EMITTED PER TON OF RAW SOYBEAN (COL. 4/COL. 5)
MOS INLET–TO SCRUBBER					
1 A	211000	170.2400	31.8801	130	0.2452
1 B	201984	152.2700	28.5150	130	0.2193
2 A	179177	184.3500	34.5225	130	0.2656
3	187756	194.8400	36.4869	130	0.2807
AVERAGE	194979.25	175.4250	32.8511	130	0.2527
STANDARD DEVIATION	12324.85	15.9659	2.9899		0.0230
MOS OUTLET TO ATMOSPHERE					
1 A	10713	8.0900	1.5150	130	0.0117
1 B	10071	7.5800	1.4195	130	0.0109
2 A	10155	8.9700	1.6798	130	0.0129
2 B	15010	13.2500	2.4813	130	0.0191
AVERAGE	11487	9.4700	1.7734	130	0.0136
STANDARD DEVIATION	2048.77	2.2369	0.4189		0.0032
DRYER VENT TO ATMOSPHERE					
D-1	3348	191.7300	35.9045	130	0.2762
D-2 A	8835	341.5400	63.9588	130	0.4920
D-2 B	7478	288.9100	54.1030	130	0.4162
D-3 A	5545	249.5800	46.7341	130	0.3595
AVERAGE	6302	267.9400	50.1760	130	0.3860
STANDARD DEVIATION	2067.50	54.7779	10.2580		0.0789
MEAL COOLER EXHAUST TO ATMOSPHERE					
C-1	380	226.3900	42.3951	130	0.3261
C-2 A	37	21.2100	3.9719	130	0.0306
C-2 B	19	11.4200	2.1386	130	0.0165
C-3 A	45	26.1000	4.8876	130	0.0376
C-3 B	14	8.1600	1.5281	130	0.0118
AVERAGE	99.00	58.6560	10.9843	130	0.0845
STANDARD DEVIATION	140.96	84.1164	18.5601		0.1428

WEIGHT OF ONE GALLON HEXANE IN POUNDS = 5.34

NOTES: This table presents the calculations for converting vent gas hexane concentrations to gallons of hexane per ton of raw soybean processed. The data presented in Column 2 is obtained from the tables copied from the reference that follows the calculations.

REFERENCE 9 SOYBEAN MEAL HEXANE CONCENTRATION CALCULATIONS

COL. 1 SOURCE/RUN NUMBER	COL. 2 HEXANE CONCENTRATION IN MEAL (ppm)	COL. 3 GALLONS OF HEXANE PER TON OF RAW SOYBEAN (COL. 2 x 0.0003)	COL. 4 LITERS OF HEXANE PER METRIC TON RAW SOYBEAN PROCESSED (COL. 3 x 3.725)
DESOLVENTIZER-TOASTER EXIT			
01	3695.5	1.1087	4.1297
02	2725.8	0.8177	3.0461
03	2581.7	0.7745	2.8850
13	3559.9	1.0680	3.9782
14	2788.2	0.8365	3.1158
15	3120.3	0.9361	3.4869
25	5940.2	1.7821	6.6382
26	4015.3	1.2046	4.4871
27	3782.5	1.1348	4.2269
37	4627.8	1.3883	5.1716
38	3568.8	1.0706	3.9881
39	2378.2	0.7135	2.6576
49	3106.9	0.9321	3.4720
50	1827.6	0.5483	2.0423
51	1278.9	0.3837	1.4292
AVERAGE	3266.51	0.9800	3.6503
STANDARD DEVIATION	1096.58	0.2862	1.0660
DRYER EXIT			
04	1592.4	0.4777	1.7795
05	--	0.0000	0.0000
06	1396.3	0.4189	1.5604
16	1469	0.4407	1.6416
17	1294.5	0.3884	1.4466
18	1826.8	0.5480	2.0414
28	1664.8	0.4994	1.8604
29	2799.5	0.8399	3.1284
30	1925.3	0.5776	2.1515
40	1557.9	0.4674	1.7410
41	1636	0.4908	1.8282
42	1833.5	0.5501	2.0489
52	1432.3	0.4297	1.6006
53	1548.2	0.4645	1.7301
54	--	0.0000	0.0000
AVERAGE	1465.1	0.4395	1.6372
STANDARD DEVIATION	667.72	0.2003	0.7462
COOLER EXIT			
07	1407.8	0.4223	1.5732
08	1347.2	0.4042	1.5055
09	1373.7	0.4121	1.5351
19	829	0.2487	0.9264
20	965.9	0.2898	1.0794
21	841	0.2523	0.9398
31	1552.7	0.4658	1.7351
32	1397.6	0.4193	1.5618
33	1448.6	0.4346	1.6188
43	1571	0.4713	1.7556
44	1835.8	0.5507	2.0515
45	2009.5	0.6029	2.2456
55	29809.2	8.9428	33.3118
56	1369.2	0.4108	1.5301
57	1681.1	0.5043	1.8786
AVERAGE	3295.95	0.9888	3.6832
STANDARD DEVIATION	7093.14	2.1279	7.9266

0.0003 = CONVERSION FACTOR TO CONVERT HEXANE PPM IN MEAL TO GALLONS OF HEXANE/TON OF RAW SOYBEANS.
3.725 = CONVERSION FACTOR TO CONVERT GAL/TON TO L/MT.

NOTES: This table presents the calculations for converting hexane concentrations in meal to gallons of hexane per ton of raw soybean processed. The data presented in Column 2 is obtained from the tables copied from the reference that follows the calculations.

TABLE 3. CS_2 IMPINGER TRAIN - TEST RESULTS

Test Site	Run #	Hexane Concentration in Source		Gas Flow Rate		Hexane Mass Flow Rate	
		g/m^3	ppm[a]	m^3/min[b]	dscfm[b]	kg/h	lb/h
Mineral Oil Scrubber Inlet	1 A	756.34	211000	1.59	56.2	72.22	170.24
	1 B	723.96	201984	1.59	56.2	69.07	152.27
	2 A	642.25	179177	2.17	76.8	83.62	184.35
	3	672.61	187756	2.19	77.3	88.38	194.84
	Average	698.79	194979	1.98	70.1	78.32	175.43
Mineral Oil Scrubber Outlet	1 A	38.45	10713	1.59	56.2	3.67	8.09
	1 B	36.10	10071	1.59	56.2	3.44	7.58
	2 A	36.43	10155	1.86	65.7	4.07	8.97
	2 B	53.84	15010	1.86	65.7	6.01	13.25
	Average	41.20	11487	1.73	61.0	4.30	9.47
Meal Cooler Exhaust	C-1	1.36	380	1258.4	44441	102.69	226.39
	C-2 A	0.13	37	1233.7	43566	9.62	21.21
	C-2 B	0.07	19	1233.7	43566	5.18	11.42
	C-3 A	0.16	45	1233.7	43566	11.84	26.10
	C-3 B	0.05	14	1233.7	43566	3.70	8.16
	Average[c]			1246.1	44003		
Meal Dryer Exhaust	D-1	12.11	3348	119.7	4227	86.97	191.73
	D-2 A	31.68	8835	81.5	2879	154.92	341.54
	D-2 B	26.80	7478	81.5	2879	131.05	288.91
	D-3 A	19.88	5545	94.9	3350	113.20	249.56
	Average	22.62	6302	98.7	3485	121.53	267.94

[a] ppm - part per million by volume

[b] dscfm - dry standard cubic feet per minute, 68°F, 29.92 in. Hg.

[c] average conc. not reported due to wide variance in data.

TABLE 8.
Hexane Analysis of Meal Samples
Collected at A. E. Staley Co., Des Moines, Iowa

Sample #	Lab #	Test Site	Date	Time	Hexane Conc. (1) (µg/g)
01	AK181	DT Exit (2)	3/15/79	9:10 am	3695.5
02	AK182	DT Exit	3/15/79	9:10 am	2725.8
03	AK183	DT Exit	3/15/79	9:10 am	2581.7
04	AK184	Dryer Exit	3/15/79	9:10 am	1592.4
05	AK185	Dryer Exit	3/15/79	9:10 am	Broken Bottl
06	AK186	Dryer Exit	3/15/79	9:10 am	1396.3
07	AK187	Cooler Exit	3/15/79	9:10 am	1407.8
08	AK188	Cooler Exit	3/15/79	9:10 am	1347.2
09	AK189	Cooler Exit	3/15/79	9:10 am	1373.7
10	AK190	Milling Exit	3/15/79	9:10 am	736.1
11	AK191	Milling Exit	3/15/79	9:10 am	832.1
12	AK192	Milling Exit	3/15/79	9:10 am	699.1
13	AK193	DT Exit (2)	3/15/79	2:25 pm	3559.9
14	AK194	DT Exit	3/15/79	2:25 pm	2788.2
15	AK195	DT Exit	3/15/79	2:25 pm	3120.3
16	AK196	Dryer Exit	3/15/79	2:25 pm	1469.0
17	AK197	Dryer Exit	3/15/79	2:25 pm	1294.5
18	AK198	Dryer Exit	3/15/79	2:25 pm	1826.8
19	AK199	Cooler Exit	3/15/79	2:25 pm	829.0
20	AK200	Cooler Exit	3/15/79	2:25 pm	965.9
21	AK201	Cooler Exit	3/15/79	2:25 pm	841.0
22	AK202	Milling Exit	3/15/79	2:25 pm	667.8
23	AK203	Milling Exit	3/15/79	2:25 pm	493.4
24	AK204	Milling Exit	3/15/79	2:25 pm	728.9
25	AK205	DT Exit (2)	3/15/79	3:10 pm	5940.2
26	AK206	DT Exit	3/15/79	3:10 pm	4015.3
27	AK207	DT Exit	3/15/79	3:10 pm	3782.5
28	AK208	Dryer Exit	3/15/79	3:10 pm	1664.8
29	AK209	Dryer Exit	3/15/79	3:10 pm	2799.5
30	AK210	Dryer Exit	3/15/79	3:10 pm	1925.3
31	AK211	Cooler Exit	3/15/79	3:10 pm	1552.7
32	AK212	Cooler Exit	3/15/79	3:10 pm	1397.6
33	AK213	Cooler Exit	3/15/79	3:10 pm	1448.6

Continued

TABLE 8. (Continued)
Hexane Analysis of Meal Samples
Collected at A. E. Staley Co., Des Moines, Iowa

Sample #	Lab #	Test Site	Date	Time	Hexane Conc. (1) (µg/g)
34	AK214	Milling Exit	3/15/79	3:10 pm	921.1
35	AK215	Milling Exit	3/15/79	3:10 pm	834.3
36	AK216	Milling Exit	3/15/79	3:10 pm	933.9
37	AK217	DT Exit (2)	3/15/79	5:05 pm	4627.8
38	AK218	DT Exit	3/15/79	5:05 pm	3568.8
39	AK219	DT Exit	3/15/79	5:05 pm	2378.2
40	AK220	Dryer Exit	3/15/79	5:05 pm	1557.9
41	AK221	Dryer Exit	3/15/79	5:05 pm	1636.0
42	AK222	Dryer Exit	3/15/79	5:05 pm	1833.5
43	AK223	Cooler Exit	3/15/79	5:05 pm	1571.0
44	AK224	Cooler Exit	3/15/79	5:05 pm	1835.8
45	AK225	Cooler Exit	3/15/79	5:05 pm	2009.5
46	AK226	Milling Exit	3/15/79	5:05 pm	1062.5
47	AK227	Milling Exit	3/15/79	5:05 pm	1188.6
48	AK228	Milling Exit	3/15/79	5:05 pm	1009.3
49	AK229	DT Exit (2)	3/15/79	5:50 pm	3106.9
50	AK230	DT Exit	3/15/79	5:50 pm	1827.6
51	AK231	DT Exit	3/15/79	5:50 pm	1278.9
52	AK232	Dryer Exit	3/15/79	5:50 pm	1432.3
53	AK233	Dryer Exit	3/15/79	5:50 pm	1548.2
54	AK234	Dryer Exit	3/15/79	5:50 pm	Sample Discar
55	AK235	Cooler Exit	3/15/79	5:50 pm	2909.2
56	AK236	Cooler Exit	3/15/79	5:50 pm	1369.2
57	AK237	Cooler Exit	3/15/79	5:50 pm	1681.1
58	AK238	Milling Exit	3/15/79	5:50 pm	1595.4
59	AK239	Milling Exit	3/15/79	5:50 pm	Sample Discar
60	AK240	Milling Exit	3/15/79	5:50 pm	941.5

(1) Reported as n-Hexane

(2) Desolvatizer Toaster

United States Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park NC 27711
EMB Report 79-VEG-6c
October 1979

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Air

EPA

Vegetable Oil Production (Meal Processing)

Emission Test Report MFA Soybeans Mexico, Missouri

REFERENCE 11

REFERENCE 11 CALCULATIONS FOR HEXANE CONCENTRATION IN SOYBEAN MEAL

COLUMN 1 SOURCE/ RUN NO.	COLUMN 2 HEXANE CONCENTRATION IN PPM	COLUMN 3 GALLONS OF HEXANE PER TON OF RAW SOYBEAN PROCESSED (COL 2 x 0.0003)	COLUMN 4 LITERS OF HEXANE PER METRIC TON OF RAW SOYBEAN PROCESSED (COL 3 x 3.725)
DT			
1	297	0.0891	0.3319
2	220	0.0660	0.2459
3	320	0.0960	0.3576
4	277	0.0831	0.3095
5	236	0.0708	0.2637
6	290	0.0870	0.3241
7	227	0.0681	0.2537
ARITHMETIC MEAN	267	0.0800	0.2981
STANDARD DEVIATION	34	0.0101	0.0377
GEOMETRIC MEAN		0.0793	0.2953
STANDARD GEOMETRIC DEVIATION		0.1278	0.1278
COOLER			
1	265	0.0795	0.2961
2	117	0.0351	0.1307
3	190	0.0570	0.2123
4	203	0.0609	0.2269
5	150	0.0450	0.1676
6	260	0.0780	0.2906
7	287	0.0861	0.3207
ARITHMETIC MEAN	210	0.0631	0.2350
STANDARD DEVIATION	55	0.0165	0.0614
GEOMETRIC MEAN		0.0604	0.2249
STANDARD GEOMETRIC DEVIATION		0.2853	0.2853

0.0003 = CONVERSION FACTOR TO CONVERT HEXANE PPM IN MEAL TO GALLONS OF HEXANE/TON OF RAW SOYBEANS.
3.725 = CONVERSION FACTOR TO CONVERT GAL/TON TO L/MT.

NOTES: This table presents the calculations for converting hexane concentrations in meal to gallons of hexane per ton of raw soybean processed. The data presented in Column 2 is obtained from the tables copied from the reference that follows this page.

TABLE 2-1. AVERAGE HEXANE CONCENTRATION IN MEAL
MFA - MEXICO, MISSOURI

JULY 6, 1979

Approximate sample time	Hexane concentration[a]					
	D T[b]		Grinder		Cooler	
	Wet µg/g	Dry µg/g	Wet µg/g	Dry µg/g	Wet µg/g	Dry µg/g
10:20	297	-[c]	153	193	265	405
11:20	220	303	148	-[c]	117	153
12:20	320	457	123	160	190	257
1:20	277	383	143	180	203	253
2:20	236	300	150	187	150	173
3:20	290	360	153	210	260	310
4:15	227	320	206	-[c]	287	-[c]
Average	267	354	154	186	210	259

[a] Average of triplicate samples.

[b] D T - Desolventizer-Toaster.

[c] Dry weight not recorded.

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United States
Environmental Protection
Agency

Planning and Standards
Research Triangle Park NC 27711

Air

11754

EPA

Vegetable Oil Production

Emission Test Report
Cargill, Incorporated
Sidney, Ohio

REFERENCE 12

REFERENCE 12 VENT GAS CONCENTRATION CALCULATIONS

COL. 1 SOURCE/RUN NUMBER	COL. 2 HEXANE CONCENTRATION IN SOURCE (ppm)	COL. 3 HEXANE MASS FLOW RATE (LB/HR)	COL. 4 HEXANE MASS FLOW RATE (GAL/HR) (COL 3/5.34)	COL. 5 THROUGHPUT OF RAW SOYBEANS (TONS/HR)	COL. 6 GALLONS SOLVENT EMITTED PER TON OF RAW SOYBEAN (COL. 4/COL. 5)
MOS OUTLET TO ATMOSPHERE					
1A	17	0.0400	0.0075	70	0.0001
1B	2091	4.7000	0.8801	70	0.0126
2A	35196	81.2000	15.2060	70	0.2172
3A	57	0.1300	0.0243	70	0.0003
3B	16000	37.4000	7.0037	70	0.1001
4A	12	0.0300	0.0056	70	0.0001
4B	2520	6.1000	1.1423	70	0.0163
AVERAGE	7984.71	18.5143	3.4671	70	0.0495
STANDARD DEVIATION	12300.96	28.4155	5.3212		0.0760
MEAL COOLER EXHAUST TO ATMOSPHERE					
1A	6	1.5000	0.2809	70	0.0040
1B	7	1.8000	0.3371	70	0.0048
2A	7	1.8000	0.3371	70	0.0048
2B	8	2.1000	0.3933	70	0.0056
AVERAGE	7.00	1.8000	0.3371	70	0.0048
STANDARD DEVIATION	0.71	0.2121	0.0397		0.0006

WEIGHT OF ONE GALLON HEXANE IN POUNDS = 5.34

NOTES: This table presents the calculations for converting vent gas hexane concentrations to gallons of hexane per ton of raw soybean processed.
The data presented in Column 2 is obtained from the tables copied from the reference that follows the calculations.

REFERENCE 12 SOYBEAN MEAL HEXANE CONCENTRATION CALCULATIONS

COL. 1 SOURCE/RUN NUMBER	COL. 2 HEXANE CONCENTRATION IN MEAL (ppm)	COL. 3 GALLONS OF HEXANE PER TON OF RAW SOYBEAN (COL. 2 x 0.0003)	COL. 4 LITERS OF HEXANE PER METRIC TON RAW SOYBEAN PROCESSED (COL. 3 x 3.725)
DESOLVENTIZER-TOASTER EXIT			
360	210	0.0630	0.2347
361	220	0.0660	0.2459
362	200	0.0600	0.2235
372	220	0.0660	0.2459
373	220	0.0660	0.2459
374	210	0.0630	0.2347
379	210	0.0630	0.2347
380	220	0.0630	0.2347
381	260	0.0660	0.2459
384	180	0.0780	0.2906
385	180	0.0540	0.2012
386	190	0.0540	0.2012
396	170	0.0570	0.2123
397	190	0.0510	0.1900
398	170	0.0570	0.2123
402	200	0.0510	0.1900
403	170	0.0600	0.2235
404	180	0.0510	0.1900
408	130	0.0540	0.2012
409	170	0.0390	0.1453
410	190	0.0510	0.1900
420	130	0.0570	0.2123
421	120	0.0390	0.1453
422	160	0.0360	0.1341
426	160	0.0480	0.1788
427	170	0.0480	0.1788
428	160	0.0510	0.1900
432	180	0.0480	0.1788
433	140	0.0540	0.2012
434	170	0.0420	0.1565
444	180	0.0510	0.1900
445	200	0.0540	0.2012
446	160	0.0600	0.2235
450	160	0.0480	0.1788
451	160	0.0480	0.1788
452	170	0.0480	0.1788
462	140	0.0510	0.1900
463	170	0.0420	0.1565
464	150	0.0510	0.1900
468	150	0.0450	0.1676
469	200	0.0450	0.1676
470	140	0.0600	0.2235
474	190	0.0420	0.1565
475	190	0.0570	0.2123
476	170	0.0570	0.2123
486	180	0.0510	0.1900
487	170	0.0540	0.2012
488	170	0.0510	0.1900
492	180	0.0510	0.1900
493	180	0.0540	0.2012
494	140	0.0540	0.2012
498	180	0.0420	0.1565
499	180	0.0540	0.2012
500	180	0.0540	0.2012
510	140	0.0540	0.2012
511	170	0.0420	0.1565
512	150	0.0510	0.1900
516	160	0.0450	0.1676
517	84	0.0480	0.1788
518	150	0.0252	0.0939
522	160	0.0450	0.1676
523	170	0.0480	0.1788
524	140	0.0510	0.1900
AVERAGE		0.0522	0.1945
STANDARD DEVIATION		0.0085	0.0315

0.0003 = CONVERSION FACTOR TO CONVERT HEXANE PPM IN MEAL TO GALLONS OF HEXANE/TON OF RAW SOYBEANS.
3.725 = CONVERSION FACTOR TO CONVERT GAL/TON TO L/MT.

NOTES: This table presents the calculations for converting soybean meal hexane concentrations to gallons of hexane per ton of raw soybean processed. The data presented in Column 2 is obtained from the tables copied from the reference that follows the calculations.

REFERENCE 12 SOYBEAN MEAL HEXANE CONCENTRATION CALCULATIONS

COL. 1 SOURCE/RUN NUMBER	COL. 2 HEXANE CONCENTRATION IN MEAL (ppm)	COL. 3 GALLONS OF HEXANE PER TON OF RAW SOYBEAN (COL. 2 x 0.0003)	COL. 4 LITERS OF HEXANE PER METRIC TON RAW SOYBEAN PROCESSED (COL. 3 x 3.725)
DRYER EXIT			
363	170	0.0510	0.1900
364	120	0.0360	0.1341
365	140	0.0420	0.1565
375	130	0.0390	0.1453
376	120	0.0360	0.1341
377	140	0.0420	0.1565
378	130	0.0390	0.1453
382	130	0.0390	0.1453
383	120	0.0360	0.1341
387	150	0.0450	0.1676
388	100	0.0300	0.1118
389	130	0.0390	0.1453
399	120	0.0360	0.1341
400	120	0.0360	0.1341
401	92	0.0276	0.1028
405	110	0.0330	0.1229
406	75	0.0225	0.0838
407	110	0.0330	0.1229
411	120	0.0360	0.1341
412	100	0.0300	0.1118
413	130	0.0390	0.1453
423	87	0.0261	0.0972
424	120	0.0360	0.1341
425	110	0.0330	0.1229
429	84	0.0252	0.0939
430	99	0.0297	0.1106
431	91	0.0273	0.1017
435	94	0.0282	0.1050
436	100	0.0300	0.1118
437	96	0.0288	0.1073
447	110	0.0330	0.1229
448	98	0.0294	0.1095
449	110	0.0330	0.1229
453	73	0.0219	0.0816
454	100	0.0300	0.1118
455	91	0.0273	0.1017
465	110	0.0330	0.1229
466	83	0.0249	0.0928
467	84	0.0252	0.0939
471	94	0.0282	0.1050
472	110	0.0330	0.1229
473	100	0.0300	0.1118
477	84	0.0252	0.0939
478	84	0.0252	0.0939
479	60	0.0180	0.0671
489	62	0.0186	0.0693
490	75	0.0225	0.0838
491	100	0.0300	0.1118
495	160	0.0480	0.1788
496	100	0.0300	0.1118
497	120	0.0360	0.1341
501	85	0.0255	0.0950
502	98	0.0294	0.1095
503	130	0.0390	0.1453
513	47	0.0141	0.0525
514	200	0.0600	0.2235
515	100	0.0300	0.1118
519	100	0.0300	0.1118
520	46	0.0138	0.0514
521	78	0.0234	0.0872
525	90	0.0270	0.1006
526	72	0.0216	0.0805
AVERAGE	104.7097	0.0314	0.1170
STANDARD DEVIATION	27.3185	0.0082	0.0305
COOLER EXIT			
366	120	0.0360	0.1341
367	110	0.0330	0.1229
368	120	0.0360	0.1341
390	87	0.0261	0.0972
391	130	0.0390	0.1453
392	100	0.0300	0.1118
414	110	0.0330	0.1229
415	130	0.0390	0.1453
416	110	0.0330	0.1229
438	100	0.0300	0.1118
439	97	0.0291	0.1084
440	95	0.0285	0.1062
456	110	0.0330	0.1229
457	100	0.0300	0.1118
458	100	0.0300	0.1118
480	100	0.0300	0.1118
481	110	0.0330	0.1229
482	110	0.0330	0.1229
504	140	0.0420	0.1565
505	99	0.0297	0.1106
506	110	0.0330	0.1229
527	91	0.0273	0.1017
528	71	0.0213	0.0793
AVERAGE	106.5217	0.0320	0.1190
STANDARD DEVIATION	14.8144	0.0044	0.0166

0.0003 = CONVERSION FACTOR TO CONVERT HEXANE PPM IN MEAL TO GALLONS OF HEXANE/TON OF RAW SOYBEANS.
3.725 = CONVERSION FACTOR TO CONVERT GAL/TON TO L/MT.

NOTES: This table presents the calculations for converting soybean meal hexane concentrations to gallons of hexane per ton of raw soybean processed.
The data presented in Column 2 is obtained from the tables copied from the reference that follows the calculations.

TABLE 3. CS_2 IMPINGER TEST RESULTS

Test site	Run No.	Date (1979)	Clock time	Hexane conc., ppm[a]	Gas flow rate m^3/min[b]	Gas flow rate scfm[b]	Hexane mass flow rate Kg/h	Hexane mass flow rate lb/h
MOS inlet	1A	7/23	15:53	307658	6.2	220	412.9	908.3
	1B	7/23	15:53	90537	6.2	220	121.5	267.3
	2A	7/25	9:30	194123	5.8	206	243.9	536.6
	3A	7/25	12:23	187949	6.0	211	241.9	532.2
	3B	7/25	12:23	239460	6.0	211	308.2	678.0
	4A[c]							
	4B	7/25	15:10	280054	6.6	232	396.3	871.9
	Average			216630				
MOS outlet	1A	7/23	15:53	17	4.8	168	0.02	0.04
	1B	7/23	15:53	2091	4.8	168	2.1	4.7
	2A	7/25	9:30	35196	4.9	172	36.9	81.2
	3A	7/25	12:23	57	4.9	174	0.06	0.13
	3B	7/25	12:23	16000	4.9	174	17.0	37.4
	4A	7/25	15:10	12	5.1	181	0.01	0.03
	4B	7/25	15:10	2520	5.1	181	2.8	6.1
Cooler outlet	1A	7/26	10:00	6	537	18950	0.69	1.5
	1B	7/26	10:00	7	537	18950	0.81	1.8
	2A	7/26	14:17	7	541	19100	0.82	1.8
	2B	7/26	14:17	8	541	19100	0.93	2.1
	Average			7				

[a] Parts per million by volume.

[b] scfm - Standard cubic feet per minute 29.92 in. Hg., 58°F.

[c] Sample lost.

DATA SHEET

Plant: Sidney, Ohio Date: July 26, 1979

Date Analysis	Sample No.	Location	Sample Date	Time	Wet Wt. (g)	Wet (μg/g)	Dry (μg/g)
9/13/79	393	Finish	7/26/79	10:10	2.38	100	300
9/13/79	394	Finish	7/26/79	10:10	2.97	100	240
9/13/79	395	Finish	7/26/79	10:10	2.23	110	310
9/13/79	396	D.T.	7/26/79	10:20	1.75	170	300
9/13/79	397	D.T.	7/26/79	10:20	2.52	190	470
9/13/79	398	D.T.	7/26/79	10:20	2.28	170	400
9/13/79	399	Dry	7/26/79	10:25	1.81	120	250
9/13/79	400	Dry	7/26/79	10:25	1.39	120	220
9/13/79	401	Dry	7/26/79	10:25	2.73	92	260
9/13/79	402	D.T.	7/26/79	10:42	1.48	200	310
9/13/79	403	D.T.	7/26/79	10:42	1.27	170	270
9/13/79	404	D.T.	7/26/79	10:42	1.44	180	300
9/13/79	405	Dry	7/26/79	10:44	1.57	110	220
9/13/79	406	Dry	7/26/79	10:44	2.13	75	200
9/14/79	407	Dry	7/26/79	10:44	2.08	110	260
9/19/79	408	D.T.	7/26/79	11:00	1.56	130	230
9/19/79	409	D.T.	7/26/79	11:00	1.61	170	320
9/14/79	410	D.T.	7/26/79	11:00	1.20	190	290
9/14/79	411	Dry	7/26/79	11:05	1.57	120	280
9/14/79	412	Dry	7/26/79	11:05	1.65	100	210
9/14/79	413	Dry	7/26/79	11:05	1.52	130	220
9/14/79	414	Cool	7/26/79	11:09	2.40	110	310
9/14/79	415	Cool	7/26/79	11:09	2.49	130	380
9/14/79	416	Cool	7/26/79	11:09	2.29	110	340
9/14/79	417	Finish	7/26/79	11:10	2.19	89	230
9/14/79	418	Finish	7/26/79	11:10	1.93	93	220
9/14/79	419	Finish	7/26/79	11:10	1.90	110	220
9/14/79	420	D.T.	7/26/79	11:23	1.11	130	190
9/14/79	421	D.T.	7/26/79	11:23	1.97	120	260
9/14/79	422	D.T.	7/26/79	11:23	1.54	160	280
9/14/79	423	Dry	7/26/79	11:26	1.58	87	160
9/14/79	424	Dry	7/26/79	11:26	1.16	120	230
9/14/79	425	Dry	7/26/79	11:26	1.72	110	240

DATA SHEET

Plant: - Sidney, Ohio

Date: July 26, 1979

Date Analysis	Sample No.	-Location	Sample Date	Time	Wet Wt. (g)	Wet (μg/g)	Dry (μg/g)
9/14/79	426	D.T.	7/26/79	11:41	1.78	160	340
9/14/79	427	D.T.	7/26/79	11:41	1.43	170	290
9/14/79	428	D.T.	7/26/79	11:41	1.21	160	240
9/14/79	429	Dry	7/26/79	11:48	1.87	84	160
9/14/79	430	Dry	7/26/79	11:48	1.97	99	220
9/14/79	431	Dry	7/26/79	11:48	2.30	91	220
9/14/79	432	D.T.	7/26/79	12:00	1.52	180	360
9/14/79	433	D.T.	7/26/79	12:00	1.53	140	240
9/14/79	434	D.T.	7/26/79	12:00	1.79	170	340
9/17/79	435	Dry	7/26/79	12:05	1.56	94	200
9/17/79	436	Dry	7/26/79	12:05	1.57	100	200
9/17/79	437	Dry	7/26/79	12:05	1.38	96	160
9/17/79	438	Cool	7/26/79	12:07	2.27	100	310
9/17/79	439	Cool	7/26/79	12:07	2.07	97	250
9/17/79	440	Cool	7/26/79	12:07	1.89	95	210
9/17/79	441	Finish	7/26/79	12:09	2.23	78	210
9/17/79	442	Finish	7/26/79	12:09	1.95	78	180
9/17/79	443	Finish	7/26/79	12:09	2.36	79	220
9/17/79	444	D.T.	7/26/79	1:40	1.45	180	300
9/17/79	445	D.T.	7/26/79	1:40	1.36	200	330
9/17/79	446	D.T.	7/26/79	1:40	1.46	160	260
9/17/79	447	Dry	7/26/79	1:43	1.96	110	260
9/17/79	448	Dry	7/26/79	1:43	1.71	98	200
9/17/79	449	Dry	7/26/79	1:43	1.72	110	250
9/17/79	450	D.T.	7/26/79	2:00	1.71	160	320
9/17/79	451	D.T.	7/26/79	2:00	1.37	160	260
9/17/79	452	D.T.	7/26/79	2:00	1.74	170	330
9/17/79	453	Dry	7/26/79	2:05	1.32	73	110
9/17/79	454	Dry	7/26/79	2:05	1.74	100	200
9/17/79	455	Dry	7/26/79	2:05	1.77	91	180
9/17/79	456	Cool	7/26/79	2:08	1.90	110	290
9/17/79	457	Cool	7/26/79	2:08	1.94	100	230
9/17/79	458	Cool	7/26/79	2:08	2.12	100	260

DATA SHEET

Plant: Sidney, Ohio Date: July 26, 1979

Date Analysis	Sample No.-Location		Sample Date	Time	Wet Wt. (g)	Wet (μg/g)	Dry (μg/g)
9/18/79	459	Finish	7/26/79	2:10	2.17	110	300
9/18/79	460	Finish	7/26/79	2:10	1.85	100	250
9/18/79	461	Finish	7/26/79	2:10	1.84	99	220
9/18/79	462	D.T.	7/26/79	2:21	1.37	140	250
9/18/79	463	D.T.	7/26/79	2:21	1.52	170	310
9/18/79	464	D.T.	7/26/79	2:21	1.35	150	260
9/18/79	465	Dry	7/26/79	2:24	1.56	110	220
9/18/79	466	Dry	7/26/79	2:24	1.57	83	170
9/18/79	467	Dry	7/26/79	2:24	1.97	84	210
9/18/79	468	D.T.	7/26/79	2:42	1.29	150	230
9/18/79	469	D.T.	7/26/79	2:42	1.45	200	400
9/18/79	470	D.T.	7/26/79	2:42	1.67	140	250
9/18/79	471	Dry	7/26/79	2:45	1.68	94	170
9/18/79	472	Dry	7/26/79	2:45	1.87	110	220
9/18/79	473	Dry	7/26/79	2:45	1.61	100	190
9/18/79	474	D.T.	7/26/79	3:00	2.29	190	450
9/18/79	475	D.T.	7/26/79	3:00	1.74	190	380
9/18/79	476	D.T.	7/26/79	3:00	1.78	170	- (1)
9/18/79	477	Dry	7/26/79	3:08	1.62	84	190
9/18/79	478	Dry	7/26/79	3:08	1.94	84	200
9/18/79	479	Dry	7/26/79	3:08	1.27	60	96
9/18/79	480	Cool	7/26/79	3:12	1.49	100	210
9/18/79	481	Cool	7/26/79	3:12	1.71	110	250
9/18/79	482	Cool	7/26/79	3:12	1.48	110	210
9/18/79	483	Finish	7/26/79	3:14	1.50	94	180
9/18/79	484	Finish	7/26/79	3:14	1.14	96	160
9/18/79	485	Finish	7/26/79	3:14	1.28	100	170
9/18/79	486	D.T.	7/26/79	3:20	1.49	180	330
9/18/79	487	D.T.	7/26/79	3:20	1.56	170	310
9/18/79	488	D.T.	7/26/79	3:20	1.53	170	310
9/19/79	489	Dry	7/26/79	3:22	1.47	62	110
9/19/79	490	Dry	7/26/79	3:22	1.51	75	140
9/19/79	491	Dry	7/26/79	3:22	1.64	100	210

(1) Dry weight not recorded.

DATA SHEET

Plant: Sidney, Ohio Date: July 26, 1979

Date Analysis	Sample No.	Location	Sample Date	Time	Wet Wt. (g)	Wet (μg/g)	Dry (μg/g)
9/19/79	492	D.T.	7/26/79	3:40	1.51	140	210
9/19/79	493	D.T.	7/26/79	3:40	1.30	180	290
9/19/79	494	D.T.	7/26/79	3:40	1.34	140	250
9/19/79	495	Dry	7/26/79	3:42	1.90	160	450
9/19/79	496	Dry	7/26/79	3:42	1.69	100	200
9/19/79	497	Dry	7/26/79	3:42	1.64	120	270
9/19/79	498	D.T.	7/26/79	4:03	1.45	180	320
9/19/79	499	D.T.	7/26/79	4:03	1.43	180	330
9/19/79	500	D.T.	7/26/79	4:03	1.97	180	370
9/19/79	501	Dry	7/26/79	4:05	2.19	85	220
9/19/79	502	Dry	7/26/79	4:05	2.08	98	230
9/19/79	503	Dry	7/26/79	4:05	1.92	130	320
9/19/79	504	Cool	7/26/79	4:08	1.66	140	271
9/19/79	505	Cool	7/26/79	4:08	1.76	99	200
9/19/79	506	Cool	7/26/79	4:08	1.59	110	240
9/19/79	507	Finish	7/26/79	4:10	1.90	80	200
9/19/79	508	Finish	7/26/79	4:10	1.99	80	180
9/19/79	509	Finish	7/26/79	4:10	1.93	100	240
9/19/79	510	D.T.	7/26/79	4:21	1.44	140	240
9/19/79	511	D.T.	7/26/79	4:21	1.86	170	340
9/19/79	512	D.T.	7/26/79	4:21	1.46	150	270
9/19/79	513[2]	Dry	7/26/79	4:24	2.20	47	120
9/19/79	514[2]	Dry	7/26/79	4:24	2.02	200	460
9/19/79	515	Dry	7/26/79	4:24	2.29	100	280
9/19/79	516	D.T.	7/26/79	4:40	1.21	160	280
9/19/79	517[2]	D.T.	7/26/79	4:40	2.45	84	110
9/19/79	518	D.T.	7/26/79	4:40	1.34	150	250
9/19/79	519	Dry	7/26/79	4:42	1.70	100	230
9/19/79	520	Dry	7/26/79	4:42	1.54	46	93
9/19/79	521	Dry	7/26/79	4:42	2.45	78	120
9/19/79	522	D.T.	7/26/79	4:55	1.30	160	270
9/19/79	523	D.T.	7/26/79	4:55	1.22	170	270
9/19/79	524	D.T.	7/26/79	4:55	1.49	140	270

[2] Reanalysis of sample yielded same results.

DATA SHEET

Plant: Sidney, Ohio Date: July 26, 1979

Date Analysis	Sample No.	Location	Sample Date	Time	Wet Wt. (g)	Wet (μg/g)	Dry (μg/g)
9/11/79	360	D.T.	7/26/79	9:00	1.84	210	440
9/11/79	361	D.T.	7/26/79	9:00	2.00	220	470
9/11/79	362	D.T.	7/26/79	9:00	2.03	200	470
9/11/79	363	Dry	7/26/79	9:17	2.21	170	440
9/11/79	364	Dry	7/26/79	9:17	2.75	120	370
9/11/79	365	Dry	7/26/79	9:17	2.94	140	410
9/11/79	366	Cool	7/26/79	9:20	2.72	120	420
9/11/79	367	Cool	7/26/79	9:20	2.69	110	350
9/11/79	368	Cool	7/26/79	9:20	2.63	120	390
9/11/79	369	Finish	7/26/79	9:22	2.25	120	330
9/11/79	370	Finish	7/26/79	9:22	2.44	130	430
9/11/79	371	Finish	7/26/79	9:22	2.72	120	370
9/10/79	372	D.T.	7/26/79	9:35	2.31	220	510
9/10/79	373	D.T.	7/26/79	9:35	1.90	220	500
9/10/79	374	D.T.	7/26/79	9:35	2.58	210	530
9/10/79	375	Dry	7/26/79	9:38	2.35	130	350
9/11/79	376	Dry	7/26/79	9:38	1.95	120	290
9/11/79	377	Dry	7/26/79	9:38	1.52	140	260
9/11/79	379	D.T.	7/26/79	9:40	2.03	210	460
9/11/79	380	D.T.	7/26/79	9:40	2.41	220	510
9/11/79	381	D.T.	7/26/79	9:40	1.87	260	580
9/11/79	378	Dry	7/26/79	9:48	4.32	130	490
9/11/79	382	Dry	7/26/79	9:48	3.66	130	430
9/11/79	383	Dry	7/26/79	9:48	3.68	120	410
9/12/79	384	D.T.	7/26/79	10:00	1.48	180	310
9/12/79	385	D.T.	7/26/79	10:00	1.92	180	290
9/12/79	386	D.T.	7/26/79	10:00	1.44	190	340
9/12/79	387	Dry	7/26/79	10:05	1.59	150	420
9/12/79	388	Dry	7/26/79	10:05	1.72	100	470
9/12/79	389	Dry	7/26/79	10:05	2.04	130	290
9/13/79	390	Cool	7/26/79	10:08	2.39	87	240
9/13/79	391	Cool	7/26/79	10:08	2.19	130	420
9/13/79	392	Cool	7/26/79	10:08	2.22	100	320

DATA SHEET

Plant: - Sidney, Ohio

Date: July 26, 1979

Date Analysis	Sample No.-Location		Sample Date	Time	Wet Wt. (g)	Wet (μg/g)	Dry (μg/g)
9/19/79	525	Dry	7/26/79	4:57	2.11	90	240
9/19/79	526	Dry	7/26/79	4:57	1.61	72	140
9/19/79	527	Cool	7/26/79	4:59	1.98	91	200
9/19/79	528	Cool	7/26/79	4:59	1.52	71	150
9/19/79	529	Finish	7/26/79	5:01	1.88	68	210
9/19/79	530	Finish	7/26/79	5:01	1.79	95	220

United States Environmental Protection Agency

Office of Air Quality Planning and Standards Research Triangle Park NC 27711

EMB Report 79-VEG-6d
October 1979

11556

Air

EPA

Vegetable Oil Production (Meal Processing)

Emission Test Report Ralston Purina Company Memphis, Tennessee

REFERENCE 13

REFERENCE 13 CALCULATIONS FOR HEXANE CONCENTRATION IN SOYBEAN MEAL

COL 1 SOURCE/ RUN NO.	COL 2 HEXANE CONCENTRATION IN PPM	COL 3 GALLONS OF HEXANE PER TON OF RAW SOYBEAN PROCESSED (COL 2 x 0.0003)	COL 4 LITERS OF HEXANE PER METRIC TON RAW SOYBEAN PROCESSED (COL 3 x 3.725)
DT			
1	560	0.168	0.6258
2	500	0.15	0.5588
3	500	0.15	0.5588
4	300	0.09	0.3353
5	390	0.117	0.4358
6	390	0.117	0.4358
7	350	0.105	0.3911
8	320	0.096	0.3576
9	320	0.096	0.3576
10	400	0.12	0.4470
11	440	0.132	0.4917
12	440	0.132	0.4917
13	420	0.126	0.4694
14	460	0.138	0.5141
15	410	0.123	0.4582
16	380	0.114	0.4247
17	460	0.138	0.5141
18	370	0.111	0.4135
19	430	0.129	0.4805
20	480	0.144	0.5364
21	380	0.114	0.4247
ARITHMETIC MEAN	414	0.1243	0.4630
STANDARD DEVIATION	64	0.0193	0.0718
GEOMETRIC MEAN		0.1228	0.4574
STANDARD GEOMETRIC DEVIATION		0.1563	0.1563
DRYER			
1	350	0.105	0.3911
2	150	0.045	0.1676
3	370	0.111	0.4135
4	230	0.069	0.2570
5	220	0.066	0.2459
6	200	0.06	0.2235
7	230	0.069	0.2570
8	170	0.051	0.1900
9	220	0.066	0.2459
10	250	0.075	0.2794
11	180	0.054	0.2012
12	230	0.069	0.2570
13	240	0.072	0.2682
14	280	0.084	0.3129
15	230	0.069	0.2570
16	270	0.081	0.3017
17	270	0.081	0.3017
18	240	0.072	0.2682
19	350	0.105	0.3911
20	250	0.075	0.2794
21	280	0.084	0.3129
ARITHMETIC MEAN	248	0.0744	0.2772
STANDARD DEVIATION	55	0.0166	0.0618
GEOMETRIC MEAN		0.0726	0.2706
STANDARD GEOMETRIC DEVIATION		0.2212	0.2212

0.0003 = CONVERSION FACTOR TO CONVERT HEXANE PPM IN MEAL TO GALLONS OF HEXANE/TON OF RAW SOYBEANS.
3.725 = CONVERSION FACTOR TO CONVERT GAL/TON TO L/MT.

NOTES: This table presents the calculations for converting hexane concentrations in meal to gallons of hexane per ton of raw soybean processed. The data presented in Column 2 is obtained from the tables copied from the reference that follows this page.

*Table 3

*check calculations (both wet + Dry)

?

TABLE 1. AVERAGE[a] HEXANE CONTENT OF MEAL

Sample type		Hexane concentration	
		Wet meal µg/g	Dry meal µg/g
D T[b]	(21)	416 414	557 ✓
Dryer	(21)	248 ✓	292 273
Stripper	(21)	502 492	566 570
Final Edible	(20)	240 226	271 256
Final meal	(21)	177 178	212 ✓

[a] Average of all samples taken.

[b] D T - Desolventizer-Toaster.

Air

11663

EPA

Vegetable Oil Production (Meal Processing)

Emission Test Report Ralston Purina Company Bloomington, Illinois

REFERENCE 14

REFERENCE 14 CALCULATIONS FOR HEXANE CONCENTRATION IN SOYBEAN MEAL

COL 1 SOURCE/ RUN NO.	COL 2 HEXANE CONCENTRATION IN PPM	COL 3 GALLONS OF HEXANE PER TON OF RAW SOYBEAN PROCESSED (COL 2 x 0.0003)	COL 4 LITERS OF HEXANE PER TON RAW SOYBEAN PROCESSED (COL 3 x 3.725)
DT			
1	310	0.093	0.3464
2	260	0.078	0.2906
3	310	0.093	0.3464
4	240	0.072	0.2682
5	240	0.072	0.2682
6	630	0.189	0.7040
7	720	0.216	0.8046
ARITHMETIC MEAN	387	0.1161	0.4326
STANDARD DEVIATION	174	0.0521	0.1940
GEOMETRIC MEAN		0.1052	0.3919
STANDARD GEOMETRIC DEVIATION		0.3982	0.3982
COOLER			
1	190	0.057	0.2123
2	170	0.051	0.1900
3	200	0.06	0.2235
4	190	0.057	0.2123
5	170	0.051	0.1900
6	190	0.057	0.2123
7	1370	0.411	1.5310
ARITHMETIC MEAN	354	0.1063	0.3959
STANDARD DEVIATION	388	0.1164	0.4336
GEOMETRIC MEAN		0.0738	0.2748
STANDARD GEOMETRIC DEVIATION		0.6581	0.6581
DRYER			
1	220	0.066	0.2459
2	220	0.066	0.2459
3	230	0.069	0.2570
4	210	0.063	0.2347
5	180	0.054	0.2012
6	180	0.054	0.2012
7	1300	0.39	1.4528
ARITHMETIC MEAN	363	0.1089	0.4055
STANDARD DEVIATION	358	0.1075	0.4004
GEOMETRIC MEAN		0.0803	0.2991
STANDARD GEOMETRIC DEVIATION		0.6094	0.6094

0.0003 = CONVERSION FACTOR TO CONVERT HEXANE PPM IN MEAL TO GALLONS OF HEXANE/TON OF RAW SOYBEANS.
3.725 = CONVERSION FACTOR TO CONVERT GAL/TON TO L/MT.

NOTES: This table presents the calculations for converting hexane concentrations in meal to gallons of hexane per ton of raw soybean processed.
The data presented in Column 2 is obtained from the tables copied from the reference that follows this page.

TABLE 2-1. HEXANE CONCENTRATION IN MEAL VS. TIME
RALSTON PURINA - BLOOMINGTON

AUGUST 10, 1979

Sample time	Hexane concentration[a] μg/g of wet meal					
	Edible cooler	Edible stripper	D.T.[b]	Dryer	Cooler	Final meal
9:00	1170	1470	310	220	190	140
10:00	1270	1370	260	220	170	140 (130)
11:00	1370 (1330)	1670	310	230	200	150
12:00	1270 (1230)	1470	240	210	190	110
1:00	1070	1100	240	180	170	120
2:00	2800	4130	630	180	190	130
3:00	1060	1130	720	1300	1370	1000

[a] Average of triplicate samples.
[b] D.T. - Desolventizer-Toaster.

Most [illegible] here [illegible]
[illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
that [illegible]

Investigating Sources Of Hexane Emissions

By
ROBERT L. CHESSIN, Environmental Health Specialist
Research Triangle Institute, Research Triangle Park, North Carolina

THE SUBJECT OF this paper is, I'm sure, of as much interest to oil mill superintendents and operators, as it was to the Environmental Protection Agency. I hope that our research will be of some use to the vegetable oil industry. We understand that one company is making plans for recovering solvent where presently no attempt is being made, possibly due, in part, to our efforts.

Let me say just one thing about who we are and what we were doing. The Research Triangle Institute is a not-for-profit research group that was contracted with the U.S. EPA from approximately December 1978 through May 1980 to develop new source performance standards for volatile organic compounds (in this case hexane) and particulate emissions for the vegetable oil industry. Work was terminated in May of 1980 and no standards were developed or recommended. These standards were to affect only new plants or plants that underwent major reconstruction, but such a standard could have provided guidance to individual states in regulating both new and existing vegetable oil plants. This paper does not, however, represent EPA policy and the author is fully responsible for the presentation and interpretation of the data.

Testing Program Design

Early in the contract soybean mills were selected as the target industry. No testing was performed at other oilseed mills. However, those of you working with cottonseed, sunflower seed, or peanuts should find our results of interest, too.

The EPA testing program was designed to find out how much hexane was being lost at various points in the process. A meal sampling program was undertaken with the idea that a standard might be developed that would place a limit on the hexane content of the meal exiting the desolventizer-toaster (DT). As will be discussed in a moment, the meal sampling program did not provide data that accurately reflected solvent losses. It did, however, provide useful information on where hexane is being lost. Noel Myers (see report, July issue) visited most of these plants while we were collecting meal samples and should provide an idea in his paper of what can and is being done by companies to minimize solvent losses.

Meal Sampling and Analysis

EPA's Emission Measurement Branch (EMB), within the Office of Air Quality Planning and Standards (OAQPS), developed both a meal sampling routine and an analytical procedure based upon the work of Dupuy (1,2) and Wan et al. (3), the latter here at Texas A&M University. From June 18 through August 10, 1979, RTI and another EPA contractor visited eight soybean plants to collect meal samples. These eight soybean plants were sampled, each for seven hours, with triplicate samples taken hourly at each sampling point. The sampling points of interest were the meal discharges from the DT, meal dryer, meal cooler, and milling, plus appropriate points in the edible flour systems.

Earlier, solvent emissions tests had been performed at two plants: one during December 1978 and another during March 1979, when meal samples were also collected. The December 1978 meal sampling was neither as extensive nor as systematic as that described above, and the results are not considered to be valid, partly due to it being the first test and bugs needed to be worked out of the system.

Table I summarizes the testing program. A range of plant sizes and ages was selected. Three of the plants produced edible flour in addition to soybean meal. All but two plants are located in the Midwest, and all process only soybeans.

Table II summarizes the results of the meal sampling and analysis program. There is a weak statistical association between the overall reported losses of solvent and the measured solvent residue in the meal following the DT. This is believed to be more a reflection of the difference between reported loss and actual loss during sampling than a lack of association between meal residual

REFERENCE 16

and overall plant solvent loss. The soybean companies provided solvent loss records that were based on a two-week to one-month average. Daily hexane inventories typically do not reflect usage. The two plants with the largest reported hexane losses are plants that produce edible soy flour. Plant D stands out from the others. This plant must not have been operating normally at the time of sampling. The hexane residual in the DT meal itself equals a solvent loss of nearly one gallon per ton of soybeans.

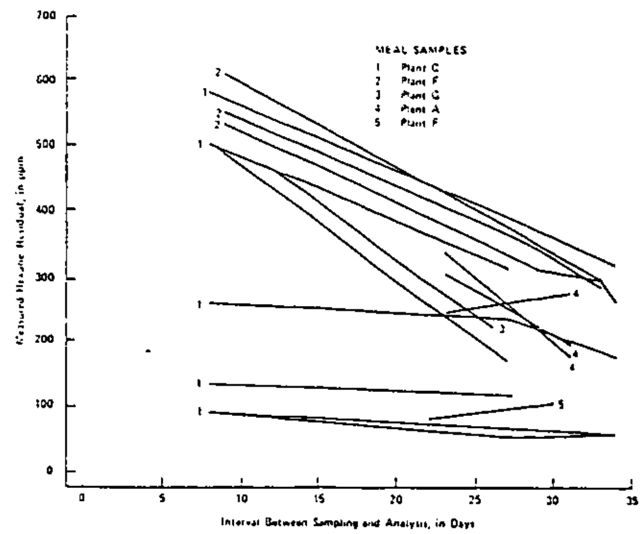
Before making any further judgement about these results one important fact must be mentioned. After the meal samples were collected they were then chilled and stored until analysis would be performed. The problem is that most samples were not analyzed for a month or more. We may have lost some valuable data because of the delay. However, I think we can salvage some information from these meal samples.

Fifteen triplicate samples were analyzed at different times. For example, there were a few DT samples analyzed about eight or nine days after the samples were collected. Other samples taken at the same time and place were analyzed three to four weeks later and almost without exception those analyzed later showed lower hexane residuals. As you can see in Figure 1 there appears to be a definite trend downwards with time. Another interesting observation is those samples with higher initial residuals showed a more dramatic loss, or reduced detection, of hexane after additional storage.

EPA and another contractor investigated this apparent degradation of hexane in soybean meal and found under laboratory conditions that the hexane was not lost after storage periods of a month or more. There was not a problem of leaking bottles. They concluded that something about the solvent extraction and desolventizing process itself created certain conditions where the hexane was modified or bound to the meal so that it was not detected under analysis.

This discussion about analysis and sampling is meant to support the idea that the residuals reported in Table 2 are probably lower than the actual levels. How much below the actual levels

FIGURE 1:
Effect Of Storage On Measured Hexane Residual
(triplicate samples analyzed after different storage periods)



we cannot say. However, we should be able to make some reasonable judgements about what the test results mean. Additional information that we should look at, along with the meal residuals data, are the hexane emission results. The vents sampled were the 1) main vent following a mineral oil scrubber, 2) the dryer exhaust stack, and 3) the cooler exhaust stack. We are fairly confident that the results reflect the actual levels found at the time of testing.

Table 3 does show a few things, I believe. First of all, the main vent when properly sized and controlled by a mineral oil system does not contribute greatly to the overall solvent losses. Unfortunately, there were some sampling equipment problems with

TABLE I — Summary Of Soybean Plant Tests

Plant	Approximate Size Tons/Day	Time of Visit	Meal Samples	Stack Sampling, Hexane	Waste Water Samples	Oil Samples
A	<1,000	Summer 1979	X			
B	<1,000	Summer 1979	X			
C	1,500-2,000	Summer 1979	X			
D	>2,500	Spring 1979	X	X	X	X
E	>1,000	Summer 1979	X			
F	>1,000	Summer 1979	X			
G	1,500-2,000	Summer 1979	X			
H	1,500-2,000	Summer 1979	X	X		X
I	1,500-2,000	Summer 1979	X			
J	>1,000	Winter (1978-79)	X	X	X	

TABLE II — Meal Sampling Results

Plant	Reported Hexane Loss (gallons/ton seed)*	Total Number of Samples Per Site	Average Measured Hexane Levels, PPM In Soybean Meal: DT	Dryer	Cooler	Milling	Flash Desolventizing	Cooling	Final Edible
A	0.5	21	220		110	95			
B	1.75	21	390	360	345	55	1,760	1,365	
C	0.1	21	265		110	80			
D	0.85	15	3,265	1,665	1,500	930			
E	2.2	21	415	240		165	495		225
F	0.9	21	95a			105a	3,300b/575c	495	55
G	0.9	21	265		235	155			
H	0.3	21	170	105	105	95			
I	0.5	21	880	600	695	445			
Jd	0.75	6	890	665	585				

a Only 3 samples collected. b Post flash tube, 15 samples. c Post full desolventization, 6 samples. d Many fewer samples, great variation in duplicate samples.

*Provided by soybean plant representative.

NOTE: Conversion Factor—100 ppm = 0.03 gallons of hexane residual/ton of soybean processed. 6.5/0.93= .16/1,000 =0.0001 x 1,000,000 testing the main vent at Plant H and the resulting data for the main vent are not presented for they are invalid.

The dryer vent data are critical to understanding where hexane is lost. Again the testing program had shortcomings in that one plant could not be tested for dryer hexane emissions due to operating and design features. Looking at the results from Plants J and D we see greatly different estimates of hexane emissions. I believe these emission are in proportion to the amount of hexane that is being carried out of the DT. Plant D had high levels of hexane in DT meal. This implies that the DT was not effectively removing the hexane and would also explain why so little hexane was found in the main vent, given that the two solvent recovery systems at Plants J and D are designed for equal efficiencies. All cooler vents showed little hexane being driven off the meal in the cooler.

TABLE III — Vent Stream Test Results
(Gallons Solvent Emitted/Ton Soybean)

MAIN VENT (following mineral oil scrubber)		
Plant J	Plant H	Plant D
0.02	Sample problems	0.01
0.03	No reportable data.	0.01
0.05		0.01
0.05		0.02
0.04 avg		0.01 avg
DRYER		
Plant J	Plant H	Plant D
0.04		
0.03		
0.04	NOT	0.28
0.02	TESTED	0.50
0.02		0.36
0.03 avg		0.38 avg
COOLER		
Plant J	Plant H	Plant D
0.03		0.03
>0.01	0.004	0.02
>0.01	0.005	0.004
0.01	0.005	0.001
>0.01	0.006	0.002
>.01 avg	0.005 avg	0.03 avg

Interpretation

Returning to the meal sampling results and in light of the vent results I will attempt to make some judgements as to their meaning. The meal collected from the discharge end of the DT shows hexane contents ranging from 0.03 to nearly one gallon per ton. If we look just at those plants that appear to have been operating normally, i.e., throw out Plant D for the reasons mentioned earlier, and exclude plants that produce flour, the range is from .05 gallons to .25 gallons per ton. In other words, from 15 per cent to 50 per cent of the total reported loss was found in the meal exiting the DT. These estimates are probably low because of the storage problem already discussed. Thus, under steady state conditions, the meal is carrying away a sizeable portion of the total hexane loss, but probably not a great majority of the loss.

Another interesting point is the average percentage loss of hexane across the dryer. On the average, approximately one-third of the hexane residual was lost after passing through the dryer. This may not be too significant in terms of total solvent loss, but in the case of Plant D it was over four-tenths of a gallon, and this is confirmed by the nearly four-tenths of a gallon that was found at its dryer vent. So under conditions where the DT is not efficiently desolventizing, a large amount of hexane apparently will be driven off in the dryer. Not having studied the stacked cooker or even Schnecken tubes, as found in many cottonseed oil mills, I cannot say if this is likely to happen in these types of dryers, but I would assume hexane would continue to be driven off in significant amounts if DT's are not efficiently desolventizing.

Where is the remainder of the solvent going? If we can account for only 50 per cent of the hexane in the meal exiting the DT and another five per cent, let's say, coming from the vent system, there need to be other places where the hexane is lost. Some is not recovered from the oil, but our tests found only trace amounts in the crude oil. Likewise, wastewater was tested at two plants and only traces were detected. There appears to be no reason for hexane to be lost via oil or wastewater under normal conditions in a well designed plant.

What remains is the contribution of fugitive emissions and shutdown or breakdown losses to overall plant losses. In our attempts to add up the admittedly crude estimates of hexane losses via meal, main vent oil, and wastewater, we assigned additional hexane losses of 20 to 25 per cent for fugitives and shutdown and breakdowns. It could be even higher, for all these assigned estimates should reflect well designed and operated solvent extraction mill.

A plant that is losing more than one gallon of hexane per ton of seed is definitely open for improvements in one or more of the following areas:

1) desolventizing,
2) vent system,
3) oil desolventizing,
4) maintenance of seals, gaskets, valve stems, etc.,
5) purging systems with solvent recovery.

I will leave to the engineers and plant managers the task of improving solvent recovery with plenty of help from escalating prices for solvent. I hope the information presented here will prove to be valuable.

REFERENCES

1. Dupuy, H.P., and S.P. Fore, JAOCS 47:231 (1970).
2. Fore, S.P. and H.P. Dupuy, Ibid. 49:129 (1972).
3. Wan, P. J. et al, Ibid. 54:542 (1977).

Presented to the Short Course for Oil Mill Operators, Texas A&M University, College Station, April 1981.

Billy R. Lester Joins IMPCO

Effective July 1, Billy Lester joined the engineering staff of Industrial Metal Products of Phoenix, Arizona. Billy is the son of past IOMSA President Bill and Lela Lester.

Billy and his wife Beth along with their four children have resided in Phoenix for the past five years. Billy is a 1975 graduate of Texas Tech University in Lubbock and at the time of his graduation was employed by Plains Cooperative Oil Mill.

He first joined IMPCO in 1976 working on dust control system design. In 1978 Billy joined the engineering staff of Anderson Clayton Co., Oilseed Processing Division, in Phoenix. For the past three years, his responsibility has been in the area of air and water pollution control and was also involved with new project construction at the various ACCO mills.

In making this announcement Boyce Davis, president of IMPCO, said that he is very pleased to have Mr. Lester back with their company and that he will play a vital role in the company's growing involvement in the oilseed processing industry.

Secretary of Agriculture John R. Block has announced that the **Food Safety and Quality Service** will be transferred to the jurisdiction of **Assistant Secretary C.W. McMillan.** FSQS and the Agricultural Marketing Service will then be reorganized to emphasize the department's marketing functions. Under the reorganization, the commodity services program will move from FSQS to AMS, where it was located prior to 1977.

RANCHER COTTON OIL
P.O. BOX 2596
Fresno, Ca. 93745

PARTICULATE & METALS
POOLED SOURCE TESTS
WESTERN COTTON SERVICES CORPORATION
Chowchilla, Calif.

April 30-May 1, 1990

Prepared By:

BTC ENVIRONMENTAL, INC.
1536 EASTMAN AVENUE
Ventura, CA 93003

Job Number
18010

Laboratory Report Number
A0-074

Test Team Leader
Tom Porter

Results Verified By:
Tom Porter - Field Operations Manager

BTC ENVIRONMENTAL INCORPORATED REFERENCE 17

EMISSION SUMMARY

Seed Cleaner #1

CONSTITUENT	RUN #1	RUN #2	RUN #3	AVERAGE
Total Particulate				
gr/DSCF	0.0061	0.0049	0.0066	*0.0059*
lbs/hr	0.10	0.08	0.10	*0.09*
Metals (lb/hr)				
Arsenic	<0.00001	<0.00001	<0.00001	*<0.00001*
Beryllium	<0.00002	<0.00001	<0.00001	*<0.00001*
Cadmium	0.00003	0.00004	0.00001	*0.00003*
Chromium	0.00007	0.00004	0.00006	*0.00006*
Hex Chromium	<0.00001	<0.00001	<0.00001	*<0.00001*
Copper	0.00008	0.00012	0.00010	*0.00010*
Lead	0.00004	0.00004	0.00006	*0.00005*
Manganese	0.00005	0.00003	0.00006	*0.00005*
Nickel	0.00016	0.00014	0.00020	*0.00017*
Zinc	0.00032	0.00025	0.00077	*0.00045*
Mercury	0.00006	0.00003	0.00004	*0.00004*
Selenium	<0.00001	<0.00001	<0.00001	*<0.00001*
Crystalline Silica				
Alpha Quartz, %	4.5-5.0	3.5-4.3	8.0-9.2	*6.0-6.2*
lb/hr	0.0047	0.0031	0.0086	*0.0055*

EMISSION SUMMARY

Linter cyclone #2

CONSTITUENT	RUN #1	RUN #2	RUN #3	AVERAGE
Total Particulate				
gr/DSCF	0.0423	0.0404	0.0508	*0.0445*
lbs/hr	3.20	3.05	3.83	*3.36*
Metals (lb/hr)				
Arsenic	0.00001	0.00002	<0.00001	*0.00001*
Beryllium	<0.00004	<0.00004	<0.00004	*<0.00004*
Cadmium	0.00029	0.00036	0.00012	*0.00026*
Chromium	0.00157	0.00064	0.00063	*0.00095*
Hex Chromium	0.00001	0.00001	0.00001	*0.00001*
Copper	0.00060	0.00058	0.00034	*0.00051*
Lead	0.00052	0.00039	0.00020	*0.00037*
Manganese	0.00062	0.00033	0.00044	*0.00046*
Nickel	0.00211	0.00111	0.00134	*0.00152*
Zinc	0.00285	0.00201	0.00162	*0.00216*
Mercury	0.00604	0.03289	0.00053	*0.01315*
Selenium	<0.00001	<0.00001	<0.00001	*<0.00001*
Crystalline Silica				
Alpha Quartz, %	0.5-0.7	0.7-1.1	0.2-0.5	*0.4-0.8*
lb/hr	0.0192	0.0274	0.0134	*0.0200*

EPA-450/3-73-003a

EMISSIONS CONTROL IN THE GRAIN AND FEED INDUSTRY VOLUME I - ENGINEERING AND COST STUDY

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Water Programs
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

REFERENCE 18

Table 142. MEASURED EMISSION RATES FROM TRUCK DUMP PIT ASPIRATION SYSTEM AT A SOYBEAN PLANT[a/]

Source	Control Equipment	Process Rate (tons/hr)	Dust Loading Leaving Control Equipment (gr/scf)	Emission Factor (lb/ton processed)
Truck dump pit aspiration system	Fabric filter reverse jet cleaning 30 hp fan, 11,250 cfm	73	0.009	0.0119
		54	0.0247	0.04
		84	0.0032	0.0032

a/ EPA Method 5 sampling procedures were used to obtain data.

Table 143. MEASURED EMISSION RATES FROM SELECTED SOURCES AT A SOYBEAN PROCESSING PLANT

Source	Control Equipment	Gas Volume (cfm)	Process Rate (lb/hr)	Emission Rate (lb/hr)	Emission Factor (lb/ton processed)
Forsberg screen system	Cyclone	2,680	10,500	0.11	0.021
White flakes cooling system	Cyclone	12,500	12,000	5.7	0.95

Table 144. MEASURED EMISSION RATES FROM SELECTED SOURCES AT A SOYBEAN PROCESSING PLANT

Source	Control Equipment	Gas Volume (cfm)	Plant Process Rate (bu/day)	Emission Rate (lb/day)	Emission Factor (lb/bu)
Hull toaster	Cyclone	8,629	37,500	92.4	0.0025
Flake roll aspiration	Cyclone	12,204	37,500	144.2	0.0038
Primary dehulling	Cyclone	19,646	37,500	351.5	0.0095
Hull screens and conveyor	Cyclone	6,506	37,500	23.6	0.00063
Meal cooler	Cyclone (2)	22,608	37,500	209.5	0.0056
Meal dryer	Cyclone	9,050	37,500	11.7	0.00031

Convert to lb/ton by assuming soybean weight of 60 lb/bushel

Table 147. ESTIMATED DUST EMISSION RATES FROM PROCESSING EQUIPMENT AT VARIOUS SOYBEAN PROCESSING PLANTS

Source	Control Device	Gas Volume (cfm)	Dust Load to Control Device (gr/scf)	Dust Load to Control Device (lb/hr)	Emission Rate From Dust Control Device (gr/scf)	Emission Rate From Dust Control Device (lb/hr)	Processing Rate (bu/day)	Emission Factor (lb/bu processed)
Cracking rolls	Cyclone	5,330	1.31	60	0.4	1.8	36,630	0.0012
Primary dehulling aspirator	Cyclone	13,000	134.6	15,000	0.09	10	37,500	0.0064
	Cyclone	16,000	60	8,230	0.25	34	60,000	0.014
Secondary dehulling aspirator	Cyclone	6,500	125.6	7,000	0.017	1	37,500	0.0006
	Cyclone	7,000	125	7,500	0.033	2	37,500	0.0012
Bean conditioner	Settling chamber	3,000	0.39	10	0.16	4	38,500	0.0024
	Cyclone	3,000	0.78	20	0.019	0.5	36,630	0.0003
Hull grinder	Cyclone	5,780	40	2,000	0.16	8	36,630	0.0052
	Cyclone	7,500	104	6,690	0.093	6	60,000	0.0024
	Cyclone	6,000	152	7,800	0.31	16	37,500	0.01
Flaking rolls	Cyclone	5,000	0.38	16.2	0.047	2	38,500	0.0012
	Cyclone	6,800	0.68	40	0.021	1.2	36,630	0.0007
	Cyclone	3,550	0.98	30	0.0135	2	37,500	0.0013
Meal dryer	Cyclone	6,200	0.56	30	0.056	3	38,500	0.0018
	Cyclone	13,500	0.96	112	0.06	7	38,500	0.0043
	Cyclone	12,500	5.6	600	0.11	12	36,630	0.0078
	Cyclone	9,000	2.6	200	0.26	20	37,500	0.0128
	Cyclone	9,000	0.26	20	0.0064	0.5	37,500	0.0003
	Settling chamber	2,000	5.1	87.3	0.12	2	60,000	0.0008
Meal grinder	Cyclone	6,600	10.6	600	0.32	18	36,630	0.012
	Cyclone	10,200	5.15	450	0.15	13.5	36,630	0.0088

Convert to lb/ton by assuming soybean weight of 60 lb/bushel