AIR EMISSIONS FROM LWDF FACILITY AND CKD OPERATIONS

ESSROC CEMENT CORP.
LOGANSPORT, IN

SCI-TECH
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Engineering and Environmental Services

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FOR

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LOGANSPORT, IN

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1.0 INTRODUCTION

SCI-TECH was contracted to assist Essroc in the preparation of a Risk Assessment for the waste derived fuel operations at the Essroc Cement Corp. plant in Logansport, Indiana. Specifically, SCI-TECH was engaged to prepare estimates of the organic air emissions from the liquid waste derived fuel (LWDF) storage facility and the fugitive particulate matter emissions from the handling and disposal of waste cement kiln dust (CKD). The results of the project are summarized in the following sections of this report.

2.0 LWDF FACILITY EMISSIONS

Essroc provided SCI-TECH with the basic information necessary to develop the proposed LWDF facility emission estimates. The information included the most recent detailed LWDF analyses and operating information about the LWDF storage facility. Based on this information and a site visit conducted by SCI-TECH, 15 sources of emissions from the LWDF facility were identified. The sources are as follows.

- Storage Tank Vent Emissions
- Emissions from Fugitive Equipment Leaks
- Truck Unloading/Sampling
- Rail Car Unloading/Sampling
- Heel Reduction System Hook Up
- Heel Reduction System Clean Up
- Burner Lance Cleaning
- Recirculation Pump Repair
- Unloading Pump Repair
- Vent System Repair
- Filter Pot Cleaning
- Valve or Flange Repair
- CWDF Solid Sampling
- Rail Car Entry and Clean Up
- Storage Tank Entry And Clean Up

The estimation of the various emissions is described in the following subsections.

2.1 Breathing and Working Loss Emissions from LWDF Tanks

The most recent detailed LWDF fuel analysis shown in Table 2-1 was used to determine the emission characteristics of the LWDF mixture. The uncontrolled breathing and working losses were estimated by using the LWDF fuel composition and Version 3.1 of the USEPA Tanks Program. The storage tank emission summary is shown in Table 2-2. In order to perform the calculations on a worst case basis, it was assumed that the maximum annual amount of LWDF was utilized, 42,356,000 gallons. This maximum amount was determined by assuming that each kiln was fired at the maximum allowable rate, 330 lb/min, for each of the 8,760 hours in a year. The output from the tanks program is contained in Appendix A.

The estimated total uncontrolled breathing and working losses from the ten LWDF tanks is 13,356 lb. However, due to the control systems maintained by Essroc at the LWDF facility, the estimated controlled emissions are dramatically less, 677 lb/yr.

2.2 Fugitive Emissions from LWDF Process Equipment

Since the facility is required to have formal process equipment leak inspection and repair program, stratified emission factors were used to develop equivalent fugitive emission factors. In order to estimate the emissions on a worst case basis it was assumed that each piece of equipment emitted at the screening value, <10,000 PPM for the entire year. The summary of fugitive equipment leak emissions by source is shown in Table 2-3. The total fugitive emissions from all process equipment were estimated to be 3,347 lb/yr. Emissions caused by the leaking and subsequent repair of equipment were estimated separately as shown below.

2.3 Miscellaneous LWDF Facility Emissions

Based on the site visit and discussions with Essroc staff, the list of miscellaneous LWDF facility sources shown in Table 2-4 was developed. For each source a typical and maximum frequency was determined. The maximum frequency was determined by scaling up the typical frequency based on the ratio of the maximum possible LWDF facility throughput, 42,356,00 gallons to the typical throughput, 21,589,00 gallons. For each miscellaneous source an emission factor was chosen as shown in Table 2-4. Two sources, rail car cleaning and storage tank cleaning account for most of the emissions.

2.4 Summary of Results

The emissions from the 15 identified LWDF facility sources are summarized by organic chemical in Table 2-5. The total estimated emissions were apportioned to each identified chemical in the LWDF based on the vapor fractions determined by Tanks 3.1. Since two of the largest sources of emissions, rail car cleaning and storage tank cleaning, occur at frequencies that cannot be approximated by steady state average emission rates, maximum short term emission rates were estimated for all sources and chemicals.

TABLE 2-1
1998 LWDF ANALYSIS

Chemical	Normalized Liquid Fraction (%)
1,1,2-Trichloroethane	0.03
1,2,4-Trichlorobenzene	0.02
1,2-Dichlorobenzene	0.03
Acetone	1.89
Benzene	0.03
bis(2-Ethylhexyl)phthalate	0.04
Chlorobenzene	0.53
Chloroform	0.02
Cresols (mixed isomers)	0.02
Cumene	0.01
Cyclohexane	0.18
Dimethyphthalate	0.01
Di-n-butylphthalate	0.01
Ethyl Acetate	0.73
Ethyl acrylate	0.01
Ethyl Benzene	1.39
High MW Aliphatics (as decane)	48.72
Isobutyl Alcohol	0.31
Isopropyl Acetate	0.04
Isopropyl Alcohol	0.16
Methyl alcohol	2.30
Methyl chloroform	0.11
Methyl ethyl ketone	2.10
Methyl isobutyl ketone	1.16
Methylene chloride	1.21
Naphthalene	0.30
n-Butyl Acetate	1.02
n-Butyl alcohol	0.13
n-Hexane	0.02
Phenol	0.07
Propyl Acetate	0.09
Styrene	0.33
Tetrachloroethylene	0.63
Toluene	7.03
Toluene diisocyanate	1.34
trans-1,3-Dichloropropene	0.01
Trichloroethylene	0.15
Trichloromonofluoromethane	0.12
Vinyl acetate	0.02
Xylene	5.69
Total Organics	78.00
Water	22.00
Total	100

The above includes:
all reportable TRI organic chemicals
any other liquids with concentrations >100 PPM.

TABLE 2-2
STORAGE TANK EMISSION SUMMARY

TANK TYPE	TANK ID	TANK WORKING VOLUME gal	MAXIMUM TANK THROUGHPUT gal	MAXIMUM TANK TURNOVERS	MAXIMUM TANKS 3.1 UNCONTROLLED STANDING LOSSES lb/yr	MAXIMUM TANKS 3.1 UNCONTROLLED WORKING LOSSES lb/yr	MAXIMUM TANKS 3.1 UNCONTROLLED TOTAL LOSSES lb/yr	MAXIMUM TANKS 3.1 CONTROLLED TOTAL LOSSES lb/yr
Receiving	1	33,400	7,059,341		148.80	879.34	1028.14	51.4
Receiving	2	33,400	7,059,341		148.80	879.34	1028.14	51.4
Receiving	3	35,200	7,059,341		148.80	879.34	1028.14	51.4
Receiving	4	35,200	7,059,341		148.80	879.34	1028.14	51.4
Receiving	5	19,300	7,059,341		148.80	879.34	1028.14	51.4
Receiving	6	27,300	7,059,341		148.80	879.34	1028.14	51.4
Receiving	Total	183,800	42,356,044					
	Typical Tank	33,400		211.4				
Blend	7	27,300	21,178,022		133.14	1708.76	1841.90	92.1
Blend	8	30,500	21,178,022		133.14	1708.76	1841.90	92.1
Blend	Total	57,800	42,356,044					
	Typical Tank	27,300		775.8				
Burn	9	27,300	21,178,022		133.14	1708.76	1841.90	92.1
Burn	10	27,300	21,178,022		133.14	1708.76	1841.90	92.1
Burn	Total	54,600	42,356,044					
	Typical Tank	27,300		775.8				
Grand	Total	296,200			1,425	12,111	13,536	676.8

Typical annual facility throughput, Lb	176,815,106
Average density, Lb/gal	8.19
Typical annual facility throughput, gal	21,589,146
Maximum throughput per kiln, Lb/min	330
Maximum annual facility throughput, Lb	346,896,000
Maximum annual facility throughput, gal	42,356,044
Tank vent control system efficiency, %	95
Vapor molecular weight, lb/lb mole	45.813

TABLE 2-3
FUGITIVE EQUIPMENT LEAK SUMMARY

EQUIPMENT TYPE	LDAR EQUIPMENT ID	LDAR MAX SCREENING VALUE PPM	EMISSION ESTIMATE KG/HR/SOURCE	SOURCES TOTAL NO.	ESTIMATED TOTAL ANNUAL EMISSIONS LB/YR
LIGHT LIQUID PUMPS	VARIOUS	< 10,000	1.87E-03	16	577
LIGHT LIQUID VALVES & AWFCO	VARIOUS	< 10,000	1.65E-04	356	1,132
LIGHT LIQUID VALVE FLANGES (AS CONNECTORS)	VARIOUS	< 10,000	8.10E-05	712	1,111
LIGHT LIQUID PIPE FLANGES (AS CONNECTORS)	VARIOUS	< 10,000	8.10E-05	71	111
MANWAYS (AS CONNECTORS)	VARIOUS	< 10,000	8.10E-05	21	33
CAPPED OPEN ENDS (AS CONNECTORS)	VARIOUS	< 10,000	8.10E-05	6	9
FLOWMETERS & PRESSURE TAPS (AS CONNECTORS)	VARIOUS	< 10,000	8.10E-05	32	50
FILTER POT FLANGES (AS PUMPS)	VARIOUS	< 10,000	1.87E-03	6	216
MISC VAPOR SERVICE FITTINGS (AS CONNECTORS)	VARIOUS	< 10,000	8.10E-05	69	108
TOTAL				1289	3,347
				TOTAL (LB/HR)	0.38

Protocol for Equipment Leak Emission Rates, EPA-453/R-95-017, Table 2-5.

Light liquid valves leak rate @ < 10,000 ppmv (kg/hr/source) = 0.000165
Light liquid pumps leak rate @ < 10,000 ppmv (kg/hr/source) = 0.00187
Connector leak rate @ < 10,000 ppmv (kg/hr/source) = 0.0000810

TABLE 2-4
SUMMARY OF LWDF FACILITY EMISSION SOURCES

Source Description	Typical Annual Throughput (gal/yr)	Maximum Annual Throughput (gal/yr)	Approximate Source Volume (gal)	Typical Annual Sources (sources/yr)	Maximum Annual Sources (sources/yr)	Emission Period (hr/source)	Emission Factor	Units	Emission Factor Ref.	Maximum Long Term Emissions (lb/yr)	Maximum Short Term Emissions (lb/hr)
Miscellaneous Emission Sources											
Truck Unloading/Sampling	19,089,146	37,356,044	5,000	3,818	7,471	0.50	0.01195	kg/hr-source	1	98.2	0.0
Rail Car Unloading/Sampling	2,500,000	5,000,000	20,000	125	250	0.50	0.01195	kg/hr-source	1	3.3	0.0
Heel Reduction System Hook Up	NA	NA	NA	400	785	0.50	0.01195	kg/hr-source	1	10.3	0.0
Heel Reduction System Clean Up	NA	NA	NA	400	785	0.02	0.01195	kg/hr-source	1	0.4	0.0
Burner Lance Cleaning	NA	NA	NA	260	510	0.17	0.01195	kg/hr-source	1	2.3	0.0
Recirculation Pump Repair	NA	NA	NA	104	204	2.00	0.24300	kg/hr-source	2	218.2	0.5
Unloading Pump Repair	NA	NA	NA	10	20	12.00	0.24300	kg/hr-source	2	125.9	0.5
Vent System Repair	NA	NA	NA	2	4.0	12.00	74.2	lb/yr	3	74.2	1.5
Filter Pot Cleaning	NA	NA	NA	100	196	0.25	0.01195	kg/hr-source	1	1.3	0.0
Valve or Flange Repair	NA	NA	NA	10	20	0.50	0.11300	kg/hr-source	4	2.4	0.2
CWDF Solid Sampling	NA	NA	NA	365	716	0.08	0.01195	kg/hr-source	1	1.5	0.0
Rail Car Entry and Clean Up	NA	NA	20,000	60	118	10.00	318	lb/source	5	37,544	31.8
Storage Tank Entry And Clean Up	NA	NA	33,400	2	4.0	72.00	531	lb/source	5	2,125	7.4
Storage Tank Vent Emissions	Various	Various	Various	10	10	8,760	676.8	lb/yr	6	676.8	0.1
Emissions from Fugitive Equipment Leaks	NA	NA	NA	1,289	1,289	8,760	3,347	lb/yr	7	3,347	0.4
Total	21,589,146	42,356,044								44,231	42.7

Emission Factor References:

1. Protocol for Equipment Leak Emission Estimates, EPA-453/R-95-017.
   SOCMI Screening Range Emission Factor for leaks (Table 2-5 >10,000 ppm) from open ended lines applied to each operation for the time required.

2. Protocol for Equipment Leak Emission Estimates, EPA-453/R-95-017.
   SOCMI Screening Range Emission Factor for leaks (Table 2-5 >10,000 ppm) from pump seals applied to each operation for the time required.

3. Estimated by apportioning the total annual uncontrolled emission from all tanks based on the hours required for repair.
   (4 sources)(12 hr/source)(13,536 lb/yr)/(8760 hr/yr)

4. Protocol for Equipment Leak Emission Estimates, EPA-453/R-95-017.
   SOCMI Screening Range Emission Factor for leaks (Table 2-5 >10,000 ppm) from connectors applied to each operation for the time required.

5. Estimated by assuming one vessel volume of saturated vapors is emitted during each cleaning operation.
   (20,000 gal)(45.813 lb/lb mole)/(7.48 gal/cf)(385 cf/lb mole)
   (33,400 gal)(45.813 lb/lb mole)/(7.48 gal/cf)(385 cf/lb mole)

6. From Table 2-2, Storage Tank Emission Summary

7. From Table 2-3, Fugitive Equipment Leak Summary

TABLE 2-5
LWDF FACILITY EMISSION SUMMARY

Chemical	Normalized Liquid Fraction (%)	Estimated Tanks 3.1 Vapor Fraction (%)	Maximum Long Term Emission Rate (lb/yr)	Maximum Short Term Emission Rate (lb/hr)
1,1,2-Trichloroethane	0.03	0.02	9	0.01
1,2,4-Trichlorobenzene	0.02	0.00	0	0.00
1,2-Dichlorobenzene	0.03	0.00	0	0.00
Acetone	1.89	17.20	7,608	7.34
Benzene	0.03	0.11	49	0.05
bis(2-Ethylhexyl)phthalate	0.04	0.00	0	0.00
Chlorobenzene	0.53	0.22	97	0.09
Chloroform	0.02	0.15	66	0.06
Cresols (mixed isomers)	0.02	0.00	0	0.00
Cumene	0.01	0.00	0	0.00
Cyclohexane	0.18	0.68	301	0.29
Dimethyphthalate	0.01	0.00	0	0.00
Di-n-butylphthalate	0.01	0.00	0	0.00
Ethyl Acetate	0.73	2.56	1,132	1.09
Ethyl acrylate	0.01	0.01	4	0.00
Ethyl Benzene	1.39	0.46	203	0.20
High MW Aliphatics (as decane)	48.72	2.13	942	0.91
Isobutyl Alcohol	0.31	0.17	75	0.07
Isopropyl Acetate	0.04	0.09	40	0.04
Isopropyl Alcohol	0.16	0.23	102	0.10
Methyl alcohol	2.30	10.21	4,516	4.36
Methyl chloroform	0.11	0.56	248	0.24
Methyl ethyl ketone	2.10	7.07	3,127	3.02
Methyl isobutyl ketone	1.16	0.75	332	0.32
Methylene chloride	1.21	21.26	9,403	9.08
Naphthalene	0.30	0.00	0	0.00
n-Butyl Acetate	1.02	3.57	1,579	1.52
n-Butyl alcohol	0.13	0.02	9	0.01
n-Hexane	0.02	0.12	53	0.05
Phenol	0.07	0.00	0	0.00
Propyl Acetate	0.09	0.20	88	0.09
Styrene	0.33	0.07	31	0.03
Tetrachloroethylene	0.63	0.40	177	0.17
Toluene	7.03	7.15	3,163	3.05
Toluene diisocyanate	1.34	0.00	0	0.00
trans-1,3-Dichloropropene	0.01	0.35	155	0.15
Trichloroethylene	0.15	0.38	168	0.16
Trichloromonofluoromethane	0.12	4.14	1,831	1.77
Vinyl acetate	0.02	0.09	40	0.04
Xylene	5.69	2.26	1,000	0.97
Total Organics	78.00	82.63	36,548	35.3
Water	22.00	17.36	7,678	7.41
Total	100	100	44,226	42.7

The above includes all reportable TRI organic chemicals and any other liquids with concentrations >100 PPM.

Maximum long term emissions, lb/yr 44,231

Maximum short term emissions, lb/hr 42.7

3.0 WASTE CKD PARTICULATE EMISSIONS

The particulate matter emissions generated by the kilns at the Essroc facility in Logansport, Indiana are controlled by electrostatic precipitators (ESPs). The cement kiln dust (CKD) that is collected by the ESPs falls into a hopper. At periodic intervals (approximately 10-18 times per day), the collected CKD is mixed with water in a conveyor and loaded into haul trucks through a loading spout at the base of the hopper. Water sprays are utilized during the truck loading process to minimize dust emissions. The waste CKD is hauled to a disposal area on the plant property where it is placed on top of a storage pile. There are two routes that can be taken from the ESP to the CKD storage pile. The average distance to the pile is 0.85 miles. The storage pile is approximately 65 feet tall with a maximum operating face dimension of 800 feet. Approximately every two weeks, a front-end loader pushes the deposited material over the edge of the pile and regrades the storage pile area. The handling of the waste CKD results in the emission of particulate matter to the ambient air.

3.1 CKD Characteristics

The daily waste CKD generation characteristic for a typical year, 1998, is shown in Table 3-1. A total of 60,936 tons of CKD were place on the CKD storage pile in 1998. The waste CKD generation rate ranged from 1,635 to 6,173 tons per month in 1998. In order to insure that the CKD fugitive emission calculations were performed on a worst case basis, the 1998 data was used to estimate the maximum amount of CKD that could be wasted in a given year. The maximum annual CKD waste amount was estimated to be 80,556 tons by assuming that the maximum 1998 monthly amount, 6,173 tons, could be wasted for 12 consecutive months.

Essroc performs daily sampling and analysis on waste CKD for several inorganic constituents. A summary of these analyses for 1998 is shown in Table 3-2.

3.2 Dust Generating Sources

Based on a site visit conducted by SCI-TECH, in conjunction with site maps provided by Essroc, 15 specific dust generating sources were identified that are associated with the waste dust handling process. These sources are as follows:

- Unloading of waste dust from ESP to haul trucks.
- Haul truck travel on road segments from ESP loadout to waste pile.
- Wind erosion of waste dust in haul trucks during travel.
- Loaded haul truck travel on surface of waste pile.
- Unloading of waste dust from haul trucks to waste pile.
- Empty haul truck travel on surface of waste pile.
- Haul truck travel on road segments from waste pile to ESP loadout.
- Front-end loader travel on road segments to and from waste pile.
- Front-end loader travels on surface of waste pile.
- Front-end loader pushing of waste dust over edge of waste pile.
- Wind erosion of exposed face and top of waste pile.
- Wind erosion of road segments between waste pile and ESP.
- Loading of waste dust from ESP area to accumulation bin.
- Unloading of waste dust from accumulation bin.
- Wind erosion of exposed face and top of accumulation bin.

3.3 Emission Calculations

To estimate the emissions from the dust generating sources, predictive emission factor equations and techniques were used in conjunction with site specific data, local meteorological data, engineering calculations, and engineering assumptions. Site specific data were obtained from a variety of sources, such as plant layout drawings, direct observation, waste dust sample field and laboratory analyses, and discussions with Essroc staff. The local meteorological data were obtained from the monthly Local Climatological Data summaries compiled for the Indianapolis airport.

The waste dust sampling and analysis entailed obtaining samples of the waste dust in three different exposure modes: as generated, weathered and undisturbed for one week, and weathered and undisturbed for two weeks. These three modes address the range of conditions of the waste dust between periods of front-end loader activity. The analyses included silt content, free moisture content, and mode of aggregate size distribution.

The predictive emission factor equations and techniques were obtained from USEPA's Compilation of Air Pollution Emission Factors (AP-42). Each of the factors and techniques used included particle size multipliers that allowed for the estimation of emissions in various particle size ranges. The size ranges selected for use with this project included total material less than 30 microns (total suspended particulate), material less than 10 microns (inhalable particulate), and material less than 2.5 microns (respirable particulate). In some cases, the equations were modified by SCI-TECH to account for the chemical changes that occur in cement dust during exposure to moisture.

3.4 Summary of Results

The annual emissions for the 15 dust generating sources are summarized in Table 3-3. Based on SCI-TECH's experience with the estimation of fugitive dust emissions from industrial sources, as supported by information presented in the literature, it was assumed that the emissions from wind erosion of plant roadways and wind erosion of the waste dust in the haul trucks are negligible in comparison with the emissions from the other 13 sources. A calculation sheet for each of these sources is included in Appendix B. These calculation sheets present the emission factors used, the values selected for the input variables, and the calculation results. The exception to this back-up documentation is the wind erosion of the exposed surfaces of the waste dust pile. The technique used to estimate the emissions for this source is very complex and so only the data summary is provided in the Appendix. The reader is referred to AP-41 Section 13.2.5 for further details on this procedure.

The average 1998 CKD metals analyses shown in Table 3-2 were used to prepare Table 3-4, which is an estimate of the worst case air emissions of the metals from the handling and disposal of waste CKD at the facility. The range of emissions is from <0.1 to <4.0 lb/yr depending upon the metal. Thus, the fugitive air emissions of metals from the handling and disposal of CKD appear to be insignificant for all the reported metals.

TABLE 3-1
1998 CKD SUMMARY

Wasted CKD - 1998 (tons/day)												
Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	174	116	198	182	130	286	174	200	123	273	164	205
2	184	94	192	172	150	274	133	190	115	244	194	203
3	192	72	194	178	143	290	177	187	105	252	190	203
4	196	96	224	164	155	288	166	187	124	255	180	190
5	198	104	230	176	152	280	185	190	129	231	192	174
6	198	134	216	174	170	266	153	166	156	208	242	164
7	190	158	198	174	178	264	151	151	195	208	234	161
8	178	178	202	174	140	230	140	146	187	195	226	172
9	186	182	194	170	180	210	148	143	226	205	211	156
10	192	208	180	71	90	188	172	185	268	203	195	156
11	184	226	178	0	110	184	153	191	278	192	182	146
12	156	230	174	0	108	184	159	176	276	169	198	140
13	140	236	156	0	122	166	153	165	268	161	221	122
14	102	222	148	0	118	156	133	160	263	166	221	120
15	94	204	146	0	144	164	114	131	244	161	221	107
16	84	178	150	0	154	164	130	122	226	187	234	101
17	98	112	144	0	174	152	151	117	221	208	213	94
18	84	106	154	0	200	158	148	96	226	205	208	94
19	98	106	160	0	190	150	161	70	226	213	187	101
20	106	128	160	0	182	140	140	94	234	234	172	91
21	120	142	166	0	188	140	122	130	260	208	169	143
22	150	140	174	0	198	134	125	161	242	211	172	208
23	158	134	188	0	206	118	135	185	250	130	190	208
24	180	124	180	0	216	104	140	195	250	130	198	156
25	218	138	180	0	222	88	164	211	255	130	211	156
26	248	142	180	0	232	106	166	192	257	138	203	156
27	214	158	184	0	240	110	177	192	299	153	187	169
28	202	172	180	0	244	104	185	182	278	208	174	247
29	208		182	0	244	124	177	216	263	208	190	234
30	180		194	0	264	112	182	208	270	239	198	104
31	146		186		274		198	190		244		78
Total	5,058	4,240	5,592	1,635	5,518	5,334	4,813	5,129	6,713	6,172	5,974	4,758

1998 Total, Tons	60,936
Maximum 1998 Month, Tons	6,713
Maximum Potential Year Based on Maximum 1998 Month, Tons	80,556

TABLE 3-2
1998 CKD ANALYSIS

CKD Component	Average Concentration PPM	Amount Wasted Tons
Chlorides	23,965.64	1,460.37
Aluminum	9,743.18	593.71
Antimony	11.28	0.69
Arsenic	6.49	0.40
Barium	254.90	15.53
Beryllium	1.52	0.09
Cadmium	15.83	0.96
Calcium	294,347.10	17,936.33
Chromium	56.66	3.45
Cobalt	7.81	0.48
Copper	113.12	6.89
Iron	9,470.58	577.10
Lead	579.58	35.32
Magnesium	6,917.26	421.51
Manganese	229.43	13.98
Mercury	2.13	0.13
Nickel	36.39	2.22
Phosphorus	260.07	15.85
Potassium	31,762.78	1,935.50
Selenium	15.51	0.95
Silver	11.48	0.70
Sodium	6,379.38	388.73
Strontium	137.36	8.37
Thallium	15.42	0.94
Vanadium	68.06	4.15
Zinc	1,166.12	71.06
Sulfur	20,643.33	1,257.92
Total CKD Wasted	NA	60,936.00

TABLE 3-3
CKD FUGITIVE AIR EMISSION SUMMARY

ID	Fugitive Dust Generating Activity	CKD Fugitive Emissions		
		< 30 um lb/yr	< 10 um lb/yr	< 2.5 um lb/yr
1	Unloading of waste dust from ESP to haul trucks	134.3	63.5	20.0
2	Haul truck travel on road segments from ESP loadout to waste pile	392.8	175.5	46.8
3	Wind erosion of waste dust in haul trucks during travel	Included in item 2 above		
4	Loaded haul truck travel on surface of waste pile	462.2	206.5	55.1
5	Unloading of waste dust from haul trucks to waste pile	134.3	63.5	20.0
6	Empty haul truck travel on surface of waste pile	586.7	262.1	69.9
7	Haul truck travel on road segments from waste pile to ESP loadout	498.7	222.8	59.4
8	Frontend loader travel on road segments to and from waste pile	4.8	2.1	0.6
9	Frontend loader travel on surface of waste pile	59.9	26.8	7.1
10	Frontend loader pushing of waste dust over edge of waste pile	555.9	171.6	24.0
11	Wind erosion of exposed face and top of waste pile	3715.5	1857.8	743.1
12	Wind erosion of road segments between waste pile and ESP	Included in items 2, 7, and 8 above		
13	Loading of waste dust from ESP area to accumulation bin	2.8	1.3	0.4
14	Unloading of waste dust from accumulation bin	2.8	1.3	0.4
15	Wind erosion of exposed face and top of accumulation bin (a)	250.8	125.4	50.2
Total		6,801	3,180	1,097

(a) Item 15 was estimated from the waste pile wind erosion estimate using the following ratios.

Bin Face Area/Pile Face Area: 33.59 m^2/6986 m^2 = 0.00481

Annual Bin Disturbace Frequency/Annual Pile Disturbance Frequency: 365/26 = 14.04

TABLE 3-4
CKD METALS FUGITIVE EMISSION SUMMARY

Metal	Average Concentration PPM	CKD Fugitive Emissions <30 um lb/yr	CKD Fugitive Emissions <10 um lb/yr	CKD Fugitive Emissions <2.5 um lb/yr
Antimony	11.28	0.077	0.036	0.012
Arsenic	6.49	0.044	0.021	0.007
Barium	254.90	1.734	0.811	0.280
Beryllium	1.52	0.010	0.005	0.002
Cadmium	15.83	0.108	0.050	0.017
Chromium	56.66	0.385	0.180	0.062
Lead	579.58	3.942	1.843	0.636
Mercury	2.13	0.014	0.007	0.002
Nickel	36.39	0.248	0.116	0.040
Selenium	15.51	0.105	0.049	0.017
Silver	11.48	0.078	0.037	0.013
Thallium	15.42	0.105	0.049	0.017
Total Metals	NA	6.850	3.203	1.105
Total PM	NA	6,801	3,180	1,097

APPENDIX A
USEPA TANKS 3.1 OUTPUTS

TANK IDENTIFICATION AND PHYSICAL CHARACTERISTICS

Identification

Identification No.:	Essroc98RC
City:	Logansport
State:	IN
Company:	Essroc
Type of Tank:	Vertical Fixed Roof
Description:	98 Typical Receiving Tank

Tank Dimensions

Shell Height (ft):	46.0
Diameter (ft):	12.0
Liquid Height (ft):	44.5
Avg. Liquid Height (ft):	22.2
Volume (gallons):	33400
Turnovers:	211.4
Net Throughput (gal/yr):	7060760

Paint Characteristics

Shell Color/Shade:	Gray/Light
Shell Condition:	Good
Roof Color/Shade:	Gray/Light
Roof Condition:	Good

Roof Characteristics

Type:	Dome
Height (ft):	3.50
Radius (ft) (Dome Roof):	12.00
Slope (ft/ft) (Cone Roof):	0.0000

Breather Vent Settings

Vacuum Setting (psig):	0.00
Pressure Setting (psig):	0.00

Meteorological Data Used in Emission Calculations: Indianapolis, Indiana (Avg Atmospheric Pressure = 14.7 psia)

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Essroc 98 WDF	All	58.32	50.35	66.29	54.34	0.3495	0.2700	0.4490	45.813				
Toluene						0.3132	0.2428	0.4004		0.0703	0.0715	92.13	Option 2: A=6.9540, B=1344.800, C=219.480
Xylene (-m)						0.1222	0.0923	0.1601		0.0569	0.0226	106.17	Option 2: A=7.0090, B=1426.266, C=215.110
Methyl alcohol						1.3675	1.0570	1.7531		0.0230	0.1021	32.04	Option 2: A=7.8970, B=1474.080, C=229.130
Ethylbenzene						0.1023	0.0769	0.1346		0.0139	0.0046	106.17	Option 2: A=6.9750, B=1424.255, C=213.210
Toluene Diisocyanate						0.0001	0.0001	0.0001		0.0134	0.0000	174.16	Option 1
Methyl ethyl ketone						1.0367	0.8185	1.3014		0.0210	0.0707	72.10	Option 2: A=6.9742, B=1209.600, C=216.000
Methylene chloride						5.4150	4.4671	6.5230		0.0121	0.2126	84.94	Option 2: A=7.4090, B=1325.900, C=252.600
Methyl isobutyl ketone						0.1999	0.1503	0.2628		0.0116	0.0075	100.20	Option 2: A=6.6720, B=1168.400, C=191.900
Tetrachloroethylene						0.1960	0.1500	0.2535		0.0063	0.0040	165.83	Option 2: A=6.9800, B=1386.920, C=217.530
Chlorobenzene						0.1261	0.0957	0.1644		0.0053	0.0022	112.60	Option 2: A=6.9780, B=1431.050, C=217.550
Styrene						0.0677	0.0508	0.0893		0.0033	0.0007	104.15	Option 2: A=7.1400, B=1574.510, C=224.090
napthalene						0.0019	0.0013	0.0028		0.0030	0.0000	128.00	Option 2: A=7.0100, B=1733.710, C=201.860
Cyclohexane						1.1573	0.9272	1.4328		0.0018	0.0068	84.16	Option 2: A=6.8410, B=1201.530, C=222.650
Trichloroethylene						0.7785	0.6082	0.9862		0.0015	0.0038	131.40	Option 2: A=6.5180, B=1018.600, C=192.700
Butanol-(1)						0.0523	0.0358	0.0752		0.0013	0.0002	74.12	Option 2: A=7.4768, B=1362.390, C=178.770
Trichlorofluoromethane(freon 1						10.6318	8.9330	12.5720		0.0012	0.0414	137.37	Option 1
Trichloroethane (1,1,1)						1.5787	1.2679	1.9537		0.0011	0.0056	133.42	Option 2: A=8.6430, B=2136.600, C=302.800
Phenol						0.0026	0.0017	0.0040		0.0007	0.0000	94.00	Option 2: A=7.1330, B=1516.790, C=174.950
Diethylhexylphthalate (as DBP)										0.0004	0.0000	390.00	Option 2: A=6.6398, B=1744.200, C=113.690
Trichloroethane (1,1,2)						0.2316	0.1763	0.3011		0.0003	0.0002	133.40	Option 2: A=6.9510, B=1314.410, C=209.200
Benzene						1.1145	0.8882	1.3868		0.0003	0.0011	78.11	Option 2: A=6.9050, B=1211.033, C=220.790
1,2-Dichlorobenzene (o)						0.0129	0.0093	0.0178		0.0003	0.0000	147.00	Option 1
Chloroform						2.3291	1.8727	2.8707		0.0002	0.0015	119.39	Option 2: A=6.4930, B=929.440, C=196.030
Hexane (-n)						1.8313	1.4802	2.2482		0.0002	0.0012	86.17	Option 2: A=6.8760, B=1171.170, C=224.410
1,2,4-Trichlorobenzene						0.0049	0.0049	0.0058		0.0002	0.0000	181.45	Option 1
Cresol (-o)						0.0016	0.0010	0.0025		0.0002	0.0000	108.14	Option 2: A=6.9110, B=1435.500, C=165.160
Vinyl acetate						1.3321	1.0572	1.6646		0.0002	0.0009	86.09	Option 2: A=7.2100, B=1296.130, C=226.660
Cumene						0.0447	0.0326	0.0604		0.0001	0.0000	120.19	Option 1
Di-n-butyl phthalate										0.0001	0.0000	278.00	Option 2: A=6.6398, B=1744.200, C=113.690
Ethyl acrylate						0.4561	0.3598	0.5740		0.0001	0.0001	100.11	Option 2: A=7.9645, B=1897.011, C=273.160
Dimethyl phthalate										0.0001	0.0000	194.20	Option 2: A=4.5220, B=700.310, C=51.420
1,3-Dichloropropene(as C3H5Cl						10.9162	9.2006	12.8732		0.0001	0.0035	76.52	Option 1
aliphatics (as n-Decane)						0.0135	0.0097	0.0186		0.4872	0.0213	142.00	Option 1
Water						0.2432	0.1808	0.3236		0.2200	0.1736	18.00	Option 1
Acetone						2.8038	2.2714	3.4351		0.0189	0.1720	58.08	Option 2: A=7.1170, B=1210.595, C=229.664
butyl acetate						1.0785	0.8490	1.3579		0.0102	0.0357	116.00	Option 2: A=7.1010, B=1244.950, C=217.880
Ethyl acetate						1.0785	0.8490	1.3579		0.0073	0.0256	88.10	Option 2: A=7.1010, B=1244.950, C=217.880
Iso-butyl alcohol						0.1691	0.1205	0.2337		0.0031	0.0017	74.12	Option 2: A=7.4743, B=1314.190, C=186.550
Isopropyl alcohol						0.4516	0.3347	0.6024		0.0016	0.0023	60.09	Option 2: A=8.1177, B=1580.920, C=219.610
Propyl Acetate(i-Propyl Acetat						0.6876	0.5382	0.8707		0.0009	0.0020	102.10	Option 1

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Isopropyl Acetate						0.6876	0.5382	0.8707		0.0004	0.0009	102.13	Option 1

Annual Emission Calculations

Standing Losses (lb):	148.7974
Vapor Space Volume (cu ft):	2784.81
Vapor Density (lb/cu ft):	0.0029
Vapor Space Expansion Factor:	0.073994
Vented Vapor Saturation Factor:	0.686741
Tank Vapor Space Volume	
Vapor Space Volume (cu ft):	2784.81
Tank Diameter (ft):	12.0
Vapor Space Outage (ft):	24.62
Tank Shell Height (ft):	46.0
Average Liquid Height (ft):	22.2
Roof Outage (ft):	0.82
Roof Outage (Dome Roof)	
Roof Outage (ft):	0.82
Dome Radius (ft):	12
Shell Radius (ft):	6.0
Vapor Density	
Vapor Density (lb/cu ft):	0.0029
Vapor Molecular Weight (lb/lb-mole):	45.812906
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.349537
Daily Avg. Liquid Surface Temp.(deg. R):	517.99
Daily Average Ambient Temp. (deg. R):	511.77
Ideal Gas Constant R (psia cuft /(lb-mole-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	514.01
Tank Paint Solar Absorptance (Shell):	0.54
Tank Paint Solar Absorptance (Roof):	0.54
Daily Total Solar Insolation Factor (Btu/sqftday):	1165.00
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.073994
Daily Vapor Temperature Range (deg.R):	31.87
Daily Vapor Pressure Range (psia):	0.178915
Breather Vent Press. Setting Range(psia):	0.00
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.349537
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.270046
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.448962
Daily Avg. Liquid Surface Temp. (deg R):	517.99
Daily Min. Liquid Surface Temp. (deg R):	510.02
Daily Max. Liquid Surface Temp. (deg R):	525.96
Daily Ambient Temp. Range (deg.R):	19.80

Annual Emission Calculations
Vented Vapor Saturation Factor

Vented Vapor Saturation Factor:	0.686741
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.349537
Vapor Space Outage (ft):	24.62
Working Losses (lb):	879.3424
Vapor Molecular Weight (lb/lb-mole):	45.812906
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.349537
Annual Net Throughput (gal/yr):	7060760
Turnover Factor:	0.3266
Maximum Liquid Volume (cuft):	5033
Maximum Liquid Height (ft):	44.5
Tank Diameter (ft):	12.0
Working Loss Product Factor:	1.00
Total Losses (lb):	1028.14

Annual Emissions Report

Liquid Contents	Losses (lbs.): Standing	Working	Total
Essroc 98 WDF	148.80	879.34	1028.14
Toluene	10.63	62.84	73.48
Xylene (-m)	3.36	19.84	23.20
Methyl alcohol	15.19	89.76	104.95
Ethylbenzene	0.69	4.06	4.75
Toluene Diisocyanate	0.00	0.00	0.00
Methyl ethyl ketone	10.51	62.13	72.64
Methylene chloride	31.64	186.98	218.63
Methyl isobutyl ketone	1.12	6.62	7.74
Tetrachloroethylene	0.60	3.52	4.12
Chlorobenzene	0.32	1.91	2.23
Styrene	0.11	0.64	0.75
napthalene	0.00	0.02	0.02
Cyclohexane	1.01	5.95	6.95
Trichloroethylene	0.56	3.33	3.90
Butanol-(1)	0.03	0.19	0.23
Trichlorofluoromethane(freon 1	6.16	36.41	42.57
Trichloroethane (1,1,1)	0.84	4.96	5.79
Phenol	0.00	0.01	0.01
Diethylhexylphthalate (as DBP)	0.00	0.00	0.00
Trichloroethane (1,1,2)	0.03	0.20	0.23
Benzene	0.16	0.95	1.12
1,2-Dichlorobenzene (o)	0.00	0.01	0.01
Chloroform	0.22	1.33	1.55
Hexane (-n)	0.18	1.05	1.22
1,2,4-Trichlorobenzene	0.00	0.00	0.00
Cresol (-o)	0.00	0.00	0.00
Vinyl acetate	0.13	0.76	0.89
Cumene	0.00	0.01	0.02
Di-n-butyl phthalate	0.00	0.00	0.00
Ethyl acrylate	0.02	0.13	0.15
Dimethyl phthalate	0.00	0.00	0.00
1,3-Dichloropropene(as C3H5Cl	0.53	3.12	3.64
aliphatics (as n-Decane)	3.17	18.74	21.91
Water	25.84	152.68	178.51
Acetone	25.59	151.23	176.82
butyl acetate	5.31	31.39	36.71
Ethyl acetate	3.80	22.47	26.27
Iso-butyl alcohol	0.25	1.50	1.75
Isopropyl alcohol	0.35	2.06	2.41
Propyl Acetate(i-Propyl Acetat	0.30	1.77	2.06
Isopropyl Acetate	0.13	0.78	0.92
Total:	148.80	879.34	1028.14

TANK IDENTIFICATION AND PHYSICAL CHARACTERISTICS

Identification

Identification No.:	Essroc98BL
City:	Logansport
State:	IN
Company:	Essroc
Type of Tank:	Vertical Fixed Roof
Description:	98 Typical Blend Tank

Tank Dimensions

Shell Height (ft):	39.0
Diameter (ft):	12.0
Liquid Height (ft):	37.5
Avg. Liquid Height (ft):	18.8
Volume (gallons):	27300
Turnovers:	775.8
Net Throughput (gal/yr):	21179340

Paint Characteristics

Shell Color/Shade:	Gray/Light
Shell Condition:	Good
Roof Color/Shade:	Gray/Light
Roof Condition:	Good

Roof Characteristics

Type:	Dome
Height (ft):	3.50
Radius (ft) (Dome Roof):	12.00
Slope (ft/ft) (Cone Roof):	0.0000

Breather Vent Settings

Vacuum Setting (psig):	0.00
Pressure Setting (psig):	0.00

Meteorological Data Used in Emission Calculations: Indianapolis, Indiana (Avg Atmospheric Pressure = 14.7 psia)

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Essroc 98 WDF	All	58.32	50.35	66.29	54.34	0.3495	0.2700	0.4490	45.813				
Toluene						0.3132	0.2428	0.4004		0.0703	0.0715	92.13	Option 2: A=6.9540, B=1344.800, C=219.480
Xylene (-m)						0.1222	0.0923	0.1601		0.0569	0.0226	106.17	Option 2: A=7.0090, B=1426.266, C=215.110
Methyl alcohol						1.3675	1.0570	1.7531		0.0230	0.1021	32.04	Option 2: A=7.8970, B=1474.080, C=229.130
Ethylbenzene						0.1023	0.0769	0.1346		0.0139	0.0046	106.17	Option 2: A=6.9750, B=1424.255, C=213.210
Toluene Diisocyanate						0.0001	0.0001	0.0001		0.0134	0.0000	174.16	Option 1
Methyl ethyl ketone						1.0367	0.8185	1.3014		0.0210	0.0707	72.10	Option 2: A=6.9742, B=1209.600, C=216.000
Methylene chloride						5.4150	4.4671	6.5230		0.0121	0.2126	84.94	Option 2: A=7.4090, B=1325.900, C=252.600
Methyl isobutyl ketone						0.1999	0.1503	0.2628		0.0116	0.0075	100.20	Option 2: A=6.6720, B=1168.400, C=191.900
Tetrachloroethylene						0.1960	0.1500	0.2535		0.0063	0.0040	165.83	Option 2: A=6.9800, B=1386.920, C=217.530
Chlorobenzene						0.1261	0.0957	0.1644		0.0053	0.0022	112.60	Option 2: A=6.9780, B=1431.050, C=217.550
Styrene						0.0677	0.0508	0.0893		0.0033	0.0007	104.15	Option 2: A=7.1400, B=1574.510, C=224.090
napthalene						0.0019	0.0013	0.0028		0.0030	0.0000	128.00	Option 2: A=7.0100, B=1733.710, C=201.860
Cyclohexane						1.1573	0.9272	1.4328		0.0018	0.0068	84.16	Option 2: A=6.8410, B=1201.530, C=222.650
Trichloroethylene						0.7785	0.6082	0.9862		0.0015	0.0038	131.40	Option 2: A=6.5180, B=1018.600, C=192.700
Butanol-(1)						0.0523	0.0358	0.0752		0.0013	0.0002	74.12	Option 2: A=7.4768, B=1362.390, C=178.770
Trichlorofluoromethane(freon 1						10.6318	8.9330	12.5720		0.0012	0.0414	137.37	Option 1
Trichloroethane (1,1,1)						1.5787	1.2679	1.9537		0.0011	0.0056	133.42	Option 2: A=8.6430, B=2136.600, C=302.800
Phenol						0.0026	0.0017	0.0040		0.0007	0.0000	94.00	Option 2: A=7.1330, B=1516.790, C=174.950
Diethylhexylphthalate (as DBP)										0.0004	0.0000	390.00	Option 2: A=6.6398, B=1744.200, C=113.690
Trichloroethane (1,1,2)						0.2316	0.1763	0.3011		0.0003	0.0002	133.40	Option 2: A=6.9510, B=1314.410, C=209.200
Benzene						1.1145	0.8882	1.3868		0.0003	0.0011	78.11	Option 2: A=6.9050, B=1211.033, C=220.790
1,2-Dichlorobenzene (o)						0.0129	0.0093	0.0178		0.0003	0.0000	147.00	Option 1
Chloroform						2.3291	1.8727	2.8707		0.0002	0.0015	119.39	Option 2: A=6.4930, B=929.440, C=196.030
Hexane (-n)						1.8313	1.4802	2.2482		0.0002	0.0012	86.17	Option 2: A=6.8760, B=1171.170, C=224.410
1,2,4-Trichlorobenzene						0.0049	0.0049	0.0058		0.0002	0.0000	181.45	Option 1
Cresol (-o)						0.0016	0.0010	0.0025		0.0002	0.0000	108.14	Option 2: A=6.9110, B=1435.500, C=165.160
Vinyl acetate						1.3321	1.0572	1.6646		0.0002	0.0009	86.09	Option 2: A=7.2100, B=1296.130, C=226.660
Cumene						0.0447	0.0326	0.0604		0.0001	0.0000	120.19	Option 1
Di-n-butyl phthalate										0.0001	0.0000	278.00	Option 2: A=6.6398, B=1744.200, C=113.690
Ethyl acrylate						0.4561	0.3598	0.5740		0.0001	0.0001	100.11	Option 2: A=7.9645, B=1897.011, C=273.160
Dimethyl phthalate										0.0001	0.0000	194.20	Option 2: A=4.5220, B=700.310, C=51.420
1,3-Dichloropropene(as C3H5Cl						10.9162	9.2006	12.8732		0.0001	0.0035	76.52	Option 1
aliphatics (as n-Decane)						0.0135	0.0097	0.0186		0.4872	0.0213	142.00	Option 1
Water						0.2432	0.1808	0.3236		0.2200	0.1736	18.00	Option 1
Acetone						2.8038	2.2714	3.4351		0.0189	0.1720	58.08	Option 2: A=7.1170, B=1210.595, C=229.664
butyl acetate						1.0785	0.8490	1.3579		0.0102	0.0357	116.00	Option 2: A=7.1010, B=1244.950, C=217.880
Ethyl acetate						1.0785	0.8490	1.3579		0.0073	0.0256	88.10	Option 2: A=7.1010, B=1244.950, C=217.880
Iso-butyl alcohol						0.1691	0.1205	0.2337		0.0031	0.0017	74.12	Option 2: A=7.4743, B=1314.190, C=186.550
Isopropyl alcohol						0.4516	0.3347	0.6024		0.0016	0.0023	60.09	Option 2: A=8.1177, B=1580.920, C=219.610
Propyl Acetate(i-Propyl Acetat						0.6876	0.5382	0.8707		0.0009	0.0020	102.10	Option 1

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Isopropyl Acetate						0.6876	0.5382	0.8707		0.0004	0.0009	102.13	Option 1

Annual Emission Calculations

Standing Losses (lb):	133.1404
Vapor Space Volume (cu ft):	2377.65
Vapor Density (lb/cu ft):	0.0029
Vapor Space Expansion Factor:	0.073994
Vented Vapor Saturation Factor:	0.719703

Tank Vapor Space Volume

Vapor Space Volume (cu ft):	2377.65
Tank Diameter (ft):	12.0
Vapor Space Outage (ft):	21.02
Tank Shell Height (ft):	39.0
Average Liquid Height (ft):	16.8
Roof Outage (ft):	0.82

Roof Outage (Dome Roof)

Roof Outage (ft):	0.82
Dome Radius (ft):	12
Shell Radius (ft):	6.0

Vapor Density

Vapor Density (lb/cu ft):	0.0029
Vapor Molecular Weight (lb/lb-mole):	45.812906
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.349537
Daily Avg. Liquid Surface Temp.(deg. R):	517.99
Daily Average Ambient Temp. (deg. R):	511.77
Ideal Gas Constant R (psia cuft /(lb-mole-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	514.01
Tank Paint Solar Absorptance (Shell):	0.54
Tank Paint Solar Absorptance (Roof):	0.54
Daily Total Solar Insolation Factor (Btu/sqftday):	1165.00

Vapor Space Expansion Factor

Vapor Space Expansion Factor:	0.073994
Daily Vapor Temperature Range (deg.R):	31.87
Daily Vapor Pressure Range (psia):	0.178915
Breather Vent Press. Setting Range(psia):	0.00
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.349537
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.270046
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.448962
Daily Avg. Liquid Surface Temp. (deg R):	517.99
Daily Min. Liquid Surface Temp. (deg R):	510.02
Daily Max. Liquid Surface Temp. (deg R):	525.96
Daily Ambient Temp. Range (deg.R):	19.80

Annual Emission Calculations
Vented Vapor Saturation Factor

Vented Vapor Saturation Factor:	0.719703
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.349537
Vapor Space Outage (ft):	21.02
Working Losses (lb):	1708.7598
Vapor Molecular Weight (lb/lb-mole):	45.812906
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.349537
Annual Net Throughput (gal/yr):	21179340
Turnover Factor:	0.2116
Maximum Liquid Volume (cuft):	4241
Maximum Liquid Height (ft):	37.5
Tank Diameter (ft):	12.0
Working Loss Product Factor:	1.00
Total Losses (lb):	1841.90

Annual Emissions Report

Liquid Contents	Losses (lbs.): Standing	Working	Total
Essroc 98 WDP	133.14	1708.76	1841.90
Toluene	9.52	122.12	131.64
Xylene (-m)	3.00	38.55	41.56
Methyl alcohol	13.59	174.42	188.01
Ethylbenzene	0.61	7.89	8.50
Toluene Diisocyanate	0.00	0.01	0.01
Methyl ethyl ketone	9.41	120.73	130.14
Methylene chloride	28.31	363.35	391.66
Methyl isobutyl ketone	1.00	12.86	13.86
Tetrachloroethylene	0.53	6.85	7.38
Chlorobenzene	0.29	3.71	3.99
Styrene	0.10	1.24	1.34
napthalene	0.00	0.03	0.03
Cyclohexane	0.90	11.55	12.45
Trichloroethylene	0.50	6.48	6.98
Butanol-(1)	0.03	0.38	0.41
Trichlorofluoromethane(freon 1	5.51	70.75	76.26
Trichloroethane (1,1,1)	0.75	9.63	10.38
Phenol	0.00	0.01	0.01
Diethylhexylphthalate (as DBP)	0.00	0.00	0.00
Trichloroethane (1,1,2)	0.03	0.39	0.42
Benzene	0.14	1.85	2.00
1,2-Dichlorobenzene (o)	0.00	0.02	0.02
Chloroform	0.20	2.58	2.78
Hexane (-n)	0.16	2.03	2.19
1,2,4-Trichlorobenzene	0.00	0.01	0.01
Cresol (-o)	0.00	0.00	0.00
Vinyl acetate	0.12	1.48	1.59
Cumene	0.00	0.02	0.03
Di-n-butyl phthalate	0.00	0.00	0.00
Ethyl acrylate	0.02	0.25	0.27
Dimethyl phthalate	0.00	0.00	0.00
1,3-Dichloropropene(as C3H5Cl	0.47	6.05	6.53
aliphatics (as n-Decane)	2.84	36.42	39.26
Water	23.12	296.69	319.81
Acetone	22.90	293.87	316.76
butyl acetate	4.75	61.00	65.76
Ethyl acetate	3.40	43.66	47.06
Iso-butyl alcohol	0.23	2.91	3.13
Isopropyl alcohol	0.31	4.01	4.32
Propyl Acetate(i-Propyl Acetat	0.27	3.43	3.70
Isopropyl Acetate	0.12	1.53	1.64
Total:	133.14	1708.76	1841.90

TANK IDENTIFICATION AND PHYSICAL CHARACTERISTICS

Identification

Identification No.:	Essroc98BU
City:	Logansport
State:	IN
Company:	Essroc
Type of Tank:	Vertical Fixed Roof
Description:	98 Typical Burn Tank

Tank Dimensions

Shell Height (ft):	39.0
Diameter (ft):	12.0
Liquid Height (ft):	37.5
Avg. Liquid Height (ft):	18.8
Volume (gallons):	27300
Turnovers:	775.8
Net Throughput (gal/yr):	21179340

Paint Characteristics

Shell Color/Shade:	Gray/Light
Shell Condition:	Good
Roof Color/Shade:	Gray/Light
Roof Condition:	Good

Roof Characteristics

Type:	Dome
Height (ft):	3.50
Radius (ft) (Dome Roof):	12.00
Slope (ft/ft) (Cone Roof):	0.0000

Breather Vent Settings

Vacuum Setting (psig):	0.00
Pressure Setting (psig):	0.00

Meteorological Data Used in Emission Calculations: Indianapolis, Indiana (Avg Atmospheric Pressure = 14.7 psia)

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Essroc 98 WDF	All	58.32	50.35	66.29	54.34	0.3495	0.2700	0.4490	45.813				
Toluene						0.3132	0.2428	0.4004		0.0703	0.0715	92.13	Option 2: A=6.9540, B=1344.800, C=219.480
Xylene (-m)						0.1222	0.0923	0.1601		0.0569	0.0226	106.17	Option 2: A=7.0090, B=1426.266, C=215.110
Methyl alcohol						1.3675	1.0570	1.7531		0.0230	0.1021	32.04	Option 2: A=7.8970, B=1474.080, C=229.130
Ethylbenzene						0.1023	0.0769	0.1346		0.0139	0.0046	106.17	Option 2: A=6.9750, B=1424.255, C=213.210
Toluene Diisocyanate						0.0001	0.0001	0.0001		0.0134	0.0000	174.16	Option 1
Methyl ethyl ketone						1.0367	0.8185	1.3014		0.0210	0.0707	72.10	Option 2: A=6.9742, B=1209.600, C=216.000
Methylene chloride						5.4150	4.4671	6.5230		0.0121	0.2126	84.94	Option 2: A=7.4090, B=1325.900, C=252.600
Methyl isobutyl ketone						0.1999	0.1503	0.2628		0.0116	0.0075	100.20	Option 2: A=6.6720, B=1168.400, C=191.900
Tetrachloroethylene						0.1960	0.1500	0.2535		0.0063	0.0040	165.83	Option 2: A=6.9800, B=1386.920, C=217.530
Chlorobenzene						0.1261	0.0957	0.1644		0.0053	0.0022	112.60	Option 2: A=6.9780, B=1431.050, C=217.550
Styrene						0.0677	0.0508	0.0893		0.0033	0.0007	104.15	Option 2: A=7.1400, B=1574.510, C=224.090
napthalene						0.0019	0.0013	0.0028		0.0030	0.0000	128.00	Option 2: A=7.0100, B=1733.710, C=201.860
Cyclohexane						1.1573	0.9272	1.4328		0.0018	0.0068	84.16	Option 2: A=6.8410, B=1201.530, C=222.650
Trichloroethylene						0.7785	0.6082	0.9862		0.0015	0.0038	131.40	Option 2: A=6.5180, B=1018.600, C=192.700
Butanol-(1)						0.0523	0.0358	0.0752		0.0013	0.0002	74.12	Option 2: A=7.4768, B=1362.390, C=178.770
Trichlorofluoromethane(freon 1						10.6318	8.9330	12.5720		0.0012	0.0414	137.37	Option 1
Trichloroethane (1,1,1)						1.5787	1.2679	1.9537		0.0011	0.0056	133.42	Option 2: A=8.6430, B=2136.600, C=302.800
Phenol						0.0026	0.0017	0.0040		0.0007	0.0000	94.00	Option 2: A=7.1330, B=1516.790, C=174.950
Diethylhexylphthalate (as DBP)										0.0004	0.0000	390.00	Option 2: A=6.6398, B=1744.200, C=113.690
Trichloroethane (1,1,2)						0.2316	0.1763	0.3011		0.0003	0.0002	133.40	Option 2: A=6.9510, B=1314.410, C=209.200
Benzene						1.1145	0.8882	1.3868		0.0003	0.0011	78.11	Option 2: A=6.9050, B=1211.033, C=220.790
1,2-Dichlorobenzene (o)						0.0129	0.0093	0.0178		0.0003	0.0000	147.00	Option 1
Chloroform						2.3291	1.8727	2.8707		0.0002	0.0015	119.39	Option 2: A=6.4930, B=929.440, C=196.030
Hexane (-n)						1.8313	1.4802	2.2482		0.0002	0.0012	86.17	Option 2: A=6.8760, B=1171.170, C=224.410
1,2,4-Trichlorobenzene						0.0049	0.0049	0.0058		0.0002	0.0000	181.45	Option 1
Cresol (-o)						0.0016	0.0010	0.0025		0.0002	0.0000	108.14	Option 2: A=6.9110, B=1435.500, C=165.160
Vinyl acetate						1.3321	1.0572	1.6646		0.0002	0.0009	86.09	Option 2: A=7.2100, B=1296.130, C=226.660
Cumene						0.0447	0.0326	0.0604		0.0001	0.0000	120.19	Option 1
Di-n-butyl phthalate										0.0001	0.0000	278.00	Option 2: A=6.6398, B=1744.200, C=113.690
Ethyl acrylate						0.4561	0.3598	0.5740		0.0001	0.0001	100.11	Option 2: A=7.9645, B=1897.011, C=273.160
Dimethyl phthalate										0.0001	0.0000	194.20	Option 2: A=4.5220, B=700.310, C=51.420
1,3-Dichloropropene(as C3H5Cl						10.9162	9.2006	12.8732		0.0001	0.0035	76.52	Option 1
aliphatics (as n-Decane)						0.0135	0.0097	0.0186		0.4872	0.0213	142.00	Option 1
Water						0.2432	0.1808	0.3236		0.2200	0.1736	18.00	Option 1
Acetone						2.8038	2.2714	3.4351		0.0189	0.1720	58.08	Option 2: A=7.1170, B=1210.595, C=229.664
butyl acetate						1.0785	0.8490	1.3579		0.0102	0.0357	116.00	Option 2: A=7.1010, B=1244.950, C=217.880
Ethyl acetate						1.0785	0.8490	1.3579		0.0073	0.0256	88.10	Option 2: A=7.1010, B=1244.950, C=217.880
Iso-butyl alcohol						0.1691	0.1205	0.2337		0.0031	0.0017	74.12	Option 2: A=7.4743, B=1314.190, C=186.550
Isopropyl alcohol						0.4516	0.3347	0.6024		0.0016	0.0023	60.09	Option 2: A=8.1177, B=1580.920, C=219.610
Propyl Acetate(i-Propyl Acetat						0.6876	0.5382	0.8707		0.0009	0.0020	102.10	Option 1

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Isopropyl Acetate						0.6876	0.5382	0.8707		0.0004	0.0009	102.13	Option 1

Annual Emission Calculations

Standing Losses (lb):	133.1404
Vapor Space Volume (cu ft):	2377.65
Vapor Density (lb/cu ft):	0.0029
Vapor Space Expansion Factor:	0.073994
Vented Vapor Saturation Factor:	0.719703
Tank Vapor Space Volume	
Vapor Space Volume (cu ft):	2377.65
Tank Diameter (ft):	12.0
Vapor Space Outage (ft):	21.02
Tank Shell Height (ft):	39.0
Average Liquid Height (ft):	18.8
Roof Outage (ft):	0.82
Roof Outage (Dome Roof)	
Roof Outage (ft):	0.82
Dome Radius (ft):	12
Shell Radius (ft):	6.0
Vapor Density	
Vapor Density (lb/cu ft):	0.0029
Vapor Molecular Weight (lb/lb-mole):	45.812906
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.349537
Daily Avg. Liquid Surface Temp. (deg. R):	517.99
Daily Average Ambient Temp. (deg. R):	511.77
Ideal Gas Constant R (psia cuft /(lb-mole-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	514.01
Tank Paint Solar Absorptance (Shell):	0.54
Tank Paint Solar Absorptance (Roof):	0.54
Daily Total Solar Insolation Factor (Btu/sqftday):	1165.00
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.073994
Daily Vapor Temperature Range (deg.R):	31.87
Daily Vapor Pressure Range (psia):	0.178915
Breather Vent Press. Setting Range(psia):	0.00
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.349537
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.270046
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.448962
Daily Avg. Liquid Surface Temp. (deg R):	517.99
Daily Min. Liquid Surface Temp. (deg R):	510.02
Daily Max. Liquid Surface Temp. (deg R):	525.96
Daily Ambient Temp. Range (deg.R):	19.80

Annual Emission Calculations
Vented Vapor Saturation Factor

Vented Vapor Saturation Factor:	0.719703
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.349537
Vapor Space Outage (ft):	21.02
Working Losses (lb):	1708.7598
Vapor Molecular Weight (lb/lb-mole):	45.812906
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.349537
Annual Net Throughput (gal/yr):	21179340
Turnover Factor:	0.2116
Maximum Liquid Volume (cuft):	4241
Maximum Liquid Height (ft):	37.5
Tank Diameter (ft):	12.0
Working Loss Product Factor:	1.00
Total Losses (lb):	1841.90

Annual Emissions Report

Liquid Contents	Losses (lbs.): Standing	Working	Total
Essroc 98 WDF	133.14	1708.76	1841.90
Toluene	9.52	122.12	131.64
Xylene (-m)	3.00	38.55	41.56
Methyl alcohol	13.59	174.42	188.01
Ethylbenzene	0.61	7.89	8.50
Toluene Diisocyanate	0.00	0.01	0.01
Methyl ethyl ketone	9.41	120.73	130.14
Methylene chloride	28.31	363.35	391.66
Methyl isobutyl ketone	1.00	12.86	13.86
Tetrachloroethylene	0.53	6.85	7.38
Chlorobenzene	0.29	3.71	3.99
Styrene	0.10	1.24	1.34
napthalene	0.00	0.03	0.03
Cyclohexane	0.90	11.55	12.45
Trichloroethylene	0.50	6.48	6.98
Butanol-(1)	0.03	0.38	0.41
Trichlorofluoromethane(freon 1	5.51	70.75	76.26
Trichloroethane (1,1,1)	0.75	9.63	10.38
Phenol	0.00	0.01	0.01
Diethylhexylphthalate (as DBP)	0.00	0.00	0.00
Trichloroethane (1,1,2)	0.03	0.39	0.42
Benzene	0.14	1.85	2.00
1,2-Dichlorobenzene (o)	0.00	0.02	0.02
Chloroform	0.20	2.58	2.78
Hexane (-n)	0.16	2.03	2.19
1,2,4-Trichlorobenzene	0.00	0.01	0.01
Cresol (-o)	0.00	0.00	0.00
Vinyl acetate	0.12	1.48	1.59
Cumene	0.00	0.02	0.03
Di-n-butyl phthalate	0.00	0.00	0.00
Ethyl acrylate	0.02	0.25	0.27
Dimethyl phthalate	0.00	0.00	0.00
1,3-Dichloropropene(as C3H5Cl	0.47	6.05	6.53
aliphatics (as n-Decane)	2.84	36.42	39.26
Water	23.12	296.69	319.81
Acetone	22.90	293.87	316.76
butyl acetate	4.75	61.00	65.76
Ethyl acetate	3.40	43.66	47.06
Iso-butyl alcohol	0.23	2.91	3.13
Isopropyl alcohol	0.31	4.01	4.32
Propyl Acetate(i-Propyl Acetat	0.27	3.43	3.70
Isopropyl Acetate	0.12	1.53	1.64
Total:	133.14	1708.76	1841.90

APPENDIX B

CKD FUGITIVE EMISSION CALCULATIONS