3.0 AIR EMISSIONS

3.1 SELECTION OF CHEMICALS OF CONCERN

The purpose of this section is to identify a list of chemicals of potential concern that are components of the cement kiln emissions and other RCRA-regulated operations at the ESSROC facility. The goal in selecting chemicals of concern is to identify a subset of all emitted chemicals that represent the majority of potential risks from facility emissions. It is this subset that is then carried through the remainder of the risk assessment.

3.1.1 IDENTIFICATION OF CANDIDATE CHEMICALS OF CONCERN

Candidate chemicals of concern were identified from the lists of chemicals known or suspected to be emitted from the facility as a result of the use of liquid and solid waste materials as auxiliary fuels. The candidate chemicals from which the list of chemicals of concern are selected includes: 1) the specific chemical analytes identified in the RCRA stack emission testing at the site; 2) those chemicals analyzed for but not detected in stack emissions during the RCRA testing; and 3) chemicals estimated to be emitted from non-stack RCRA regulated sources (e.g., fugitive volatile emissions from storage tanks and distribution piping, and fugitive kiln dust emissions at the facility).

Separate lists of candidate chemicals of concern were developed for the direct and the indirect exposure pathways. The chemicals of concern selected for indirect exposure pathways focus on those chemicals that are known to be persistent in the environment and those chemicals that may demonstrate potentially significant bioaccumulation. The selection process for chemicals of concern for both direct and indirect exposures was further narrowed to those chemicals for which U.S. EPA approved toxicological data is available. This latter subdivision relies on data presented in Section 7.0, which discusses the available toxicity information for the chemicals at the site.

In general, the chemicals of concern selected for the direct exposure pathway were all chemicals identified in stack and fugitive emissions for which U.S. EPA-approved toxicological data is available.

3.1.1.1 Cement Kiln Stack Emissions

RCRA trial burn tests were conducted at the ESSROC facility in October 1998. The results of the RCRA trial burn tests, including the measurement of both organic and inorganic constituents in stack gas emissions, is presented in the report entitled, *RCRA Trial Burn for the Burning of Waste-Derived Fuels for Energy Recovery at ESSROC Cement Corp. Logansport, IN* (ESSROC trial burn report) (APCC, 1999). As described in the ESSROC trial burn report, the following parameters were subject to chemical analyses during the stack gas emissions testing:

1) the metals antimony, arsenic, barium, beryllium, cadmium, total and hexavalent chromium, lead, mercury, nickel, selenium, silver, and thallium;
2) a list of 47 volatile organic chemicals;
3) a list of 55 semi-volatile organic chemicals;
4) Dioxins (PCDD)/Furans (PCDF) (total of 11 congeners);
5) Polychorinated biphenyls (PCBs) (total of 13 individual congeners (collectively termed the coplanar PCBs) and total concentrations for each of ten classes of PCB congeners (i.e., total mono PCB through total deca PCB)).

These chemical classes represent over 140 specific chemical analytes. A listing of all inorganic and organic chemicals analyzed for during the RCRA trial burn testing is presented on Table 3-1. A listing of those chemicals detected during the RCRA trial burn tests is included as Table 3-2, and Table 3-3 presents a list of the remaining chemicals analyzed for but not detected in any of the emissions test runs.

All chemicals analyzed for and detected during the RCRA trial burn tests were retained for further consideration as candidate chemicals of concern for both the direct and indirect pathways of exposure.

3.1.1.2 Chemicals That May Be Emitted From Other RCRA Regulated Operations

Several specific volatile organic chemicals are contained in the LWDF stored at the facility. While not necessarily detected in kiln stack emissions, these chemicals may be released from the site through fugitive emissions that arise during the storage and handling of the LWDF. The list of candidate chemicals of concern was expanded to include volatile chemicals present in LWDF not already identified in the stack emissions. The list of additional volatile chemicals was based on an evaluation of the typical composition of the LWDF managed and stored at the facility (see Section 3.3.1). A listing of the chemicals that may be subject to potential fugitive emissions is included on Table 3-4. Each of these chemicals is retained as a candidate chemical of potential concern for both the direct and indirect pathways of exposure.

3.1.2 SELECTION OF CHEMICALS OF CONCERN FROM CANDIDATE CHEMICALS

In this section, the lists of candidate chemicals of concern determined in Section 3.1.1 are narrowed down to specific lists of chemicals of concern for both the direct and indirect chemical exposure pathways. The selection process for both lists is based on the availability of toxicological data for specific chemicals. In addition, the selection of chemicals of concern for the indirect exposure pathways is further narrowed based on the chemical properties of the candidate chemicals, and a quantitative ranking scheme that takes into account both the relative toxicity and concentration of the emitted chemicals.

3.1.2.1 Elimination of Chemicals Based on Available Toxicological Data

As recommended by U.S. EPA, risk assessments cannot be completed for chemicals that lack dose-response relationships for specific health endpoints. Accordingly, chemicals without toxicological data were eliminated from the list of potential chemicals of concern. The list of chemicals for which no toxicological data is available include the following:

Volatile Organic Compounds

1,2-Dibromomethane	trans-1,4-Dichloro-2-butene
1,3-Dichlorobenzene	4-Methyl-2-pentanone

Semi-Volatile Organic Compounds

Acenaphthylene
4-Chloro-3-methylphenol
Dibenzofuran
4,6-Dinitro-2-methylphenol
2,2-Oxybis(1-chloropropane)

The list of the candidate chemicals of concern that have quantitative dose-response information suitable for use in this risk assessment is presented on Table 3-5. A more in depth discussion of available dose-response information for those chemicals detected in the ESSROC emissions is presented in Section 7.0.

For the evaluation of direct exposures (inhalation), each of the detected and non-detected analytes for which inhalation toxicological data is available is considered a chemical of concern.

For the indirect exposure pathways, the chemicals in Table 3-5 are further narrowed down according to the steps described below.

3.1.2.2 Bioaccumulation, Bioconcentration and Persistence

The U.S. EPA recommends that the list of chemicals of concern for the indirect exposure pathway analyses be selected from those chemicals that have "a definite propensity for bioaccumulating or bioconcentration in the human food chain" (U.S. EPA, 1993a). Chemical classes specifically recommended for evaluation of the indirect pathways of exposure include chlorinated dioxins and dibenzofurans, PCBs, polycyclic aromatic hydrocarbons (PAHs), and heavy metals. Volatile organic chemicals are not included as chemicals of concern for the indirect pathways of exposure because, relative to the heavy metals and non-volatile chemicals detected in the chemical emissions, the VOCs are not expected to be significantly bioaccumulated.

In addition to their relatively low potential for bioaccumulation, the atmospheric, soil and aquatic half-life of most VOCs are generally lower than the larger organic and inorganic chemicals. These shorter half-lives indicate that long term buildup of VOCs in soils and other environmental media is not likely to occur.

3.1.2.3 Quantitative Ranking

As a final screening measure, the candidate chemicals of concern for the indirect exposure pathway were ranked according to their estimated emission rates and relative toxicity's in order to arrive at a subset of chemicals that would be expected to produce the majority of potential health effects through the indirect exposure routes. As recommended by U.S. EPA, a scoring system that combines the calculated emission rates for each chemical with chemical specific oral toxicity data was employed.

It should be noted that several chemicals were reported as non-detect during the emissions testing. For purposes of this quantitative scoring, chemicals reported as non-detect were assigned an emission equal to one half of the sample quantitation limit.

Oral toxicity data was selected for use in this scoring system because it is through the ingestion pathway that the majority of indirect exposures of concern would occur. Furthermore, dermal exposures to soil and water (also considered in this risk assessment) utilize the oral toxicity information. Inhalation toxicity information is relevant only to the direct exposure routes, in which all chemicals with verified dose response information were retained.

The emission rates used in the scoring system were the two-kiln emission rates presented in Section 3.2. Kiln emissions were selected because they represent the only available data for the non-volatile organic chemicals. Kiln emissions were also selected over fugitive cement kiln dust emissions for the inorganic chemicals because, as will be discussed, the kiln emissions and associated chemical deposition rates and risks are estimated to be greater than the fugitive dust emission rates estimated for specific compounds.

Separate scoring was conducted for both carcinogenic effects and noncarcinogenic effects. The carcinogenic scores represent the product of the estimated average long term kiln emission rate (presented in Section 3.2) and the oral slope factors (discussed in Section 7.0).

The scoring information for carcinogenic effects is provided in Table 3-6. As seen on this table, 55 chemicals for which verified oral carcinogenic slope factors are available were scored. This list of 55 chemicals also includes the ten individual classes of PCB congeners. The scoring system indicates that the majority of the carcinogenic score is attributable to PCDFs and PCDDs. Therefore, all eleven PCDD and PCDF congeners were retained as chemicals of potential concern.

The polychlorinated biphenyls (PCBs) were scored based on the emission rates for each of the ten classes of congeners and for each of the 13 individual coplanar congeners. Recent information suggests that the coplanar PCBs may exhibit carcinogenic properties similar to dioxins and furans. For this reason, scoring of PCBs was conducted for both the congener classes and the individual coplanar congeners. As shown on Table 3-6, the PCBs ranked relatively low in the overall carcinogenic scoring. However, since PCBs are known to bioaccumulate to a significant degree in environmental media, the 13 coplanar congeners were retained as carcinogenic chemicals of potential concern.

Of the carcinogenic polynuclear aromatic hydrocarbons (PAHs), benzo(a)pyrene, benzo(b)fluoranthene, benzo(a)anthracene, and dibenz(a,h)anthracene scored the highest in the quantitative ranking. These compounds, therefore, were retained as chemicals of potential concern. It is also noted that dibenz(a,h) anthracene was not detected in stack emissions during any of the trial burn tests. The remaining carcinogenic chemicals retained as chemicals of concern were chosen to represent the various classes of chemicals (i.e., phthalates, phenols and substituted phenols, substituted amines and benzenes) identified during the emissions testing. These compounds include bis(2-ethylhexyl)phthalate, 2,6-dinitrotoluene, 1,4-dichlorobenzene, hexachlorobenzene, n-nitroso-di-n-propylamine, and pentachlorophenol. It is also noted that hexachlorobenzene, 2,6-dinitrotoluene, and petachlorophenol were not detected in stack emissions during any of the trial burn tests.

With respect to the metals, arsenic and beryllium were retained as chemicals of potential concern based on their carcinogenic properties.

The noncarcinogenic scores were calculated as the estimated long term emission rate divided by the oral reference dose. The scoring information for the noncarcinogenic effects is presented on Table 3-7. As seen on this table, 61 chemicals were scored for these effects. The majority of the noncarcinogenic score is attributable to eight chemicals (mercury, 2-nitroaniline, thallium, cadmium, naphthalene, hexachlorobutadiene, arsenic and bis(2-ethylhexyl)phthalate). These chemicals were retained as chemicals of potential concern. It is noted that hexachlorobutadiene was not detected during any of the stack emissions tests. The remaining noncarcinogenic chemicals retained as chemicals of potential concern include those chemicals that scored in the top 31 in the quantitative ranking with the exception of acenaphthylene. Acenaphthylene was not included on the list since other PNAs have already been included on the list. The top 31 chemicals represent approximately 99.99% of the total noncarcinogenic score for all chemicals. With regard to the PCBs, eight of the ten classes of total congeners scored in the top 31 on the noncarcinogenic scoring list. Therefore, all ten individual classes of total congeners were included on the list of noncarcinogenic chemicals of potential concern. Additionally, so that the phenolic and chlorobenzene classes are represented, phenol, 2,4-dimethylphenol, 1,4-dichlorobenzene and 1,2,4-trichlorobenzene were also included on the list of chemicals of potential concern.

3.1.3 FINAL LIST OF CHEMICALS OF CONCERN

The final list of chemicals of concern for direct exposures consists of all analytes detected in kiln stack emission testing for which inhalation toxicity data is available (see Table 3-5), as well as those analytes which were not detected and for which inhalation toxicity data is available.

The final list of chemicals of concern for the indirect exposure pathway is presented in Table 3-8.

3.2 ESTIMATION OF KILN STACK EMISSIONS

The kiln stack emissions estimates used in this risk assessment were based on data presented in the March 1999 RCRA trial burn report. RCRA trial burn testing at the

ESSROC facility was conducted under three phases of work. During the first phase of work, triplicate measurements of various stack gas parameters including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), dioxins and furans, and PCBs were collected. During the Phase I testing, the kiln was operated at maximum CO concentration, minimum combustion chamber temperature, and maximum chlorine feed and production rate. The liquid waste derived fuels were fed at a fixed rate equivalent to achieve minimum kiln temperatures.

During the Phase 2 work, triplicate measurements of stack gas parameters including metals and dioxin/furans were collected. The kiln and the electrostatic precipitator were operated at maximum temperature during the Phase 2 testing.

During the Phase 3 work, triplicate measurements of stack gas parameters were collected for VOCs, SVOCs, dioxins/furans, and PCBs. Both kilns were operated under normal operating conditions during the Phase 3 work.

The U.S. EPA states in its addendum guidance that average emissions are most representative of the expected long term emissions over the life of the facility. As a result, emission rates for each chemical of concern identified at the ESSROC facility were determined by averaging the available emission rates from multiple test runs.

The results of the emissions tests for all three Phases are presented in Appendix A. The typical emission rates used in this risk assessment for VOCs represent the average of the emissions for the Phase I test runs (i.e., samples 01-VO-01, 01-VO-02, and 01-VO-03) performed on October 13 and 14, 1998. The typical emission rates used in this risk assessment for SVOCs represent the average of the emissions for the Phase I test runs (i.e., samples 01-SV-01, 01-SV-02, and 01-SV-03 performed on October 13 and 14, 1998. These emission test runs were completed under lower than normal kiln temperature operating conditions in order to provide an upper bound estimate of the kiln destruction of VOCs. As such, the emission of these particular compounds under the Phase I conditions are likely greater than emissions under the standard operation conditions at this facility. Use of this data for estimating long term VOC and SVOC emissions provides an additional measure of conservatism to the risk assessment.

Dioxins/furans emission rate estimates used in this risk assessment were based on the average of the emissions for the Phase I test runs (i.e., samples 01-SV-01, 01-SV-02, and 01-SV-03) performed on October 13 and 14, 1998 and the emissions for the Phase II test runs (i.e., samples 02-DF-04, 02-DF-05, and 02-DF-06 performed on October 15, 1998. These tests were conducted under minimum and maximum kiln temperatures. As such, the emission rates for the dioxins and furans under the Phase I and Phase II conditions provide an upper bound worst case estimate of actual dioxin/furan emissions when compared to emissions under normal kiln operating conditions.

The emission rate estimates used in this risk assessment for metals were based on the average of the emissions during the Phase 2 testing and the emission rate estimates for PCBs were based on the average of the emissions during the Phase 1 testing. The average emission rate worksheets are included as Appendix A to this document.

Several chemicals were reported as non-detect in one or more of the emission tests. For the purpose of determining an average emission rate, a value equal to one-half the sample quantitation limit was assigned to the data.

It should be noted that each of the trial burn tests present emission rates for single kiln operations. Because both kilns at the ESSROC facility could operate under normal site conditions, the one kiln emission rates were multiplied by two to determine a final two kiln emission rate for use in the risk assessment. Two kiln emission rates for each of the chemicals of concern are also presented on Table 3-9. The two-kiln emission rates are used as the inputs into the air modeling and other media modeling included in the remainder of this risk assessment.

3.3 ESTIMATION OF NON-KILN RCRA EMISSIONS

SCI-TECH, Inc. was contracted by ESSROC to prepare estimates of the fugitive volatile organic emissions from LWDF storage and handling operations and the fugitive particulate matter emissions from the handling of cement kiln dust at the facility. The results of their evaluation are presented in the report *Air Emissions From LWDF Facility and CKD Operations ESSROC Cement Corp. Logansport, Indiana* (SCI-TECH report) (SCI-Tech, January 2000). The report is included as Appendix B to this risk assessment.

A summary of the calculated chemical emission estimates for the fugitive volatile and particulate emissions from the ESSROC facility are presented below.

3.3.1 LWDF Facility Emissions

A total of 15 sources of fugitive emissions associated with the liquid waste derived fuel (LWDF) operations were identified in the SCI-TECH report. These 15 sources of LWDF fugitive emissions can be segregated into the following three broad source area categories:

- Breathing and working losses from LWDF tanks;
- Fugitive emissions for LWDF process equipment;
- Miscellaneous LWDF facility emissions.

As described in the SCI-TECH report (Appendix B), the most recent detailed LWDF fuel analysis profile for liquid hazardous wastes received by ESSROC was used to determine the waste composition profile for the LWDF fugitive emissions. The total uncontrolled and controlled breathing and working losses from the LWDF tanks were estimated using the LWDF fuel composition profile and Version 3.1 of the U.S. EPA Tanks Program, as described in the SCI-Tech Report. However, for purposes of this risk assessment, the controlled emissions are considered most representative of the long term future emissions from the facility and are used to determine exposure concentrations. The total controlled and uncontrolled emissions from tank breathing and working losses is presented on Table 2-2 of the SCI-TECH report (Appendix B).

Since ESSROC is required to have formal process equipment leak inspection and repair programs, stratified emission factors were used to develop equivalent fugitive emission factors for LWDF process equipment. The estimated emissions from process equipment leaks were estimated on a worst case basis by assuming that each piece of equipment emitted at the screening value of <10,000 ppm. The summary of fugitive emissions from all process equipment is presented on Table 2-3 of the SCI-TECH report (Appendix B).

Emission rates associated with several miscellaneous LWDF sources were also estimated in the SCI-TECH report. Two activities, rail car cleaning and storage tank cleaning account for most of the emissions associated with these miscellaneous activities. The estimated emissions for these miscellaneous LWDF emission sources are presented on Table 2-4 of the SCI-TECH report (Appendix B).

The combined estimated maximum long term and short term emission rates for all of these LWDF sources are presented in Table 3-10. For the fugitive LWDF dispersion modeling described in Section 4.0, each of the LWDF sources was combined and treated as one source area. It is noted that the fugitive emission rates presented on Table 3-10 are estimated uncontrolled emissions. The ESSROC facility has emissions control systems in place that prevent the release of fugitive emissions. As such, the emission rates presented on Table 3-10 are considered conservative values that significantly overestimate the true fugitive emissions at the ESSROC facility.

3.3.2 CEMENT KILN DUST PARTICULATE EMISSIONS

Particulate matter emissions from the kilns at the ESSROC facility are controlled by electrostatic precipitators (ESPs). Cement kiln dust (CKD) collected by the ESPs is mixed with water and loaded into haul trucks approximately 10 to 18 times per day. Water sprays are utilized during the loading process to minimize fugitive emissions. Waste CKD is hauled to a disposal area on-site where it is dumped on top of a storage pile. 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 regrades the storage pile area.

As discussed in Appendix B, 15 discrete dust generating sources were identified and evaluated. These were:

- Unloading the waste dust from the ESP to the haul trucks
- Haul truck travel on road segments from the ESP load out to the waste pile;
- Wind erosion of the waste dust in the haul trucks during travel;
- Loaded haul truck travel on the surface of the waste pile;
- Unloading of the waste dust from the haul trucks to the waste pile;
- Empty haul truck travel on the surface of the waste pile;
- Haul truck travel on the road segments from the waste pile to the ESP load out;

- Front-end loader travel on road segments to and from the waste pile;
- Front-end loader travel on the surface of the waste pile;
- Front-end loader pushing the waste dust over the edge of the waste pile;
- Wind erosion of the exposed face and top of the waste pile;
- Wind erosion of the road segments between the waste pile and the ESP;
- Loading of waste dust from ESP area to accumulation bin;
- Unloading of waste dust from accumulation bin; and
- Wind erosion of exposed face and top of accumulation bin.

The specific methodologies utilized for calculating emissions from the above identified dust sources are presented in Appendix B. Predictive emission factor equations and techniques were obtained from *U.S. EPA's Compilation of Air Pollution Emission Factors* (AP-42, U.S. EPA 1988). The techniques used require particle size multipliers. 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).

ESSROC performs daily sampling and analyses for the 12 metals identified as chemicals of potential concern. CKD metal analyses for 1998 were used to calculate chemical specific particulate emission rates. The CKD metal concentrations and calculated annual emissions for all three categories of CKD activities combined are summarized in Table 3-11.

In order to model fugitive CKD dispersion and deposition rates (described in Section 4.3), the 15 individual sources were combined into the following three area sources: electrostatic precipitator ESP hopper activities; haul truck travel on on-site roads to the CKD storage pile; and CKD storage pile activities. Table 3-12 presents the estimated fugitive emissions for each of these three source areas. As shown on Table 3-12, the percent relative contribution to total CKD fugitive emissions for each of the three source areas is as follows: ESP hopper activities, 6%; haul truck travel activities, 13%; and CKD storage pile activities, 81%. As shown on Table 3-12, the CKD storage pile related activities contribute approximately 81% of the total CKD fugitive emissions. Therefore, since almost all of the CKD fugitive emissions are attributed to the CKD waste pile activities, for purposes of modeling CKD fugitive emission impacts, the CKD storage pile source area was modeled in the dispersion and deposition air modeling presented in Section 4.0

Table 3-1

Chemicals Analyzed for During RCRA Emissions Testing
ESSROC
Logansport, IN

Inorganics

Antimony	Lead
Arsenic	Mercury
Barium	Nickel
Beryllium	Selenium
Cadmium	Silver
Chromium (VI)	Thallium
Chromium, total	

Volatile Organic Compounds

Acetone	1,2-Dichloroethane
Acrylonitrile	1,1-Dichloroethene
Allyl Chloride	cis 1,2-Dichloroethene
Benzene	trans 1,2-Dichloroethene
Bromodichloromethane	cis 1,3-Dichloropropene
Bromomethane	trans 1,3-Dichloropropene
Bromoform	trans-1,4-Dichloro-2-butene
1,3-Butadiene	Dichlorodifluoromethane
2-Butanone	Ethylbenzene
Carbon disulfide	Methylene Chloride
Carbon tetrachloride	4-Methyl-2-Pentanone
Chlorobenzene	n-Hexane
Chloroethane	Styrene
Chloroform	1,1,2,2-Tetrachloroethane
Chloromethane	Tetrachloroethylene
Cumene (isopropylbenzene)	1,1,1-Trichloroethane
1,2-Dichloropropane	Trichloroethene
Dibromochloromethane	Trichlorofluoromethane
Dibromomethane	Toluene
1,2-Dibromomethane	Xylene (m/p)
1,2-Dichlorobenzene	o-Xylene
1,3-Dichlorobenzene	Vinyl acetate
1,4-Dichlorobenzene	Vinyl chloride
1,1-Dichloroethane	

Table 3-1

Chemicals Analyzed for During RCRA Emissions Testing
ESSROC
Logansport, IN

Semi-Volatile Organic Compounds

Acenaphthene	4,6-Dinitro-2-methylphenol
Acenaphthylene	2,4-Dinitrophenol
Anthracene	2,4-Dinitrotoluene
Benzoic Acid	2,6-Dinitrotoluene
Benzo(a)pyrene	Fluoranthene
Benzo(a)anthracene	Fluorene
Benzo(b)fluoranthene	Hexachlorobenzene
Benzo(k)fluoranthene	Hexachlorobutadiene
Benzo(g,h,i)perylene	Hexachlorocyclopentadiene
Benzyl Alcohol	Hexachloroethane
Bis(2-ethyl hexyl)phthalate	Indeno(1,2,3-cd)pyrene
Butyl benzyl phthalate	2-Methylphenol
4-Chloroaniline	4-Methylphenol
2-Chloronaphthalene	2-Methylnaphthalene
4-Chloro-3-methylphenol	Naphthalene
2-Chlorophenol	2-Nitroaniline
Chrysene	Nitrobenzene
Dibenzo(a,h)anthracene	n-Nitrosodiphenylamine
Dibenzofuran	n-Nitroso-di-n-propylamine
1,2-dichlorobenzene	2,2-oxybis(1-Chloropropane)
1,3-dichlorobenzene	Pentachlorophenol
1,4-dichlorobenzene	Phenanthrene
3,3-Dichlorobenzidine	Phenol
Di-n-octyl phthalate	Pyrene
Dimethylphthalate	1,2,4-Trichlorobenzene
Diethyl phthalate	2,4,5-Trichlorophenol
2,4-Dimethylphenol	2,4,6-Trichlorophenol
di-n-butylphthalate	

Table 3-1

Chemicals Analyzed for During RCRA Emissions Testing
ESSROC
Logansport, IN

Chlorinated dibenzo-p-dioxins (CDDs) and dibenzofurans (CDFs)

2,3,7,8-TCDD	2,3,7,8-TCDF
2,3,7,8-PeCDD	1,2,3,7,8-PeCDF
2,3,7,8-HxCDD	2,3,4,7,8-PeCDF
2,3,7,8-HpCDD	2,3,7,8-HxCDF
OCDD	2,3,7,8-HpCDF
	OCDF

Polychlorinated Biphenyls

3,3'-Tetra CB (#77)	Total Mono CB
2,3,4,4',5-Penta CB (#114)	Total Di CB
2,3',4,4',5-Penta CB (#118)	Total Tri CB
2',3,3',4,4'-Penta CB (#123)	Total Tetra CB
2,3,3',4,4'-Penta CB (#105)	Total Penta CB
3,3',4,4',5-Penta CB (#126)	Total Hexa CB
2,3'4,4',5,5'-Hexa CB (#167)	Total Hepta CB
2,3,3',4,4',5-Hexa CB (#156)	Total Octa CB
2,3,3',4,4',5-Hexa CB (#157)	Total Nona CB
3,3',4,4',5,5'-Hexa CB (#169)	Deca CB
2,2',3,4,4',5,5'-Hepta CB (#180)	
2,2',3,4,4',5,5'-Hepta CB (#170)	
2,3,3',4,4',5,5'-Hepta CB (#189)	

Table 3-2

Chemicals Detected During Kiln Stack Emission Testing
ESSROC
Logansport, Indiana

Inorganics

Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium (VI)
Chromium, total
Lead
Mercury
Nickel
Selenium
Silver
Thallium

Volatile Organic Compounds

Acetone
Acrylonitrile
Allyl Chloride
Benzene
Bromomethane
1,3-Butadiene
2-Butanone
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
Cumene (isopropylbenzene)
Dichlorodifluoromethane
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Ethylbenzene
Methylene chloride
n-Hexane
Styrene
Tetrachloroethylene
1,1,1-Trichloroethane
Trichlorofluoromethane
Toluene
Xylene (m/p)
Xylene (o)
Vinyl Chloride

Semi-Volatile Organic Compounds

Acenaphthylene
Anthracene
Benzoic Acid
Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Bis(2-ethyl hexyl)phthalate
2-Chlorophenol
Chrysene
2-Chloronaphthalene
Dibenzofuran
1,4-Dichlorobenzene
Diethyl phthalate
di-n-butylphthalate
Di-n-octyl phthalate
Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene
2-methylphenol
4-methylphenol
2-Methylnaphthalene
Naphthalene
Phenanthrene
Phenol
Pyrene

Table 3-2

Chemicals Detected During Kiln Stack Emission Testing
ESSROC
Logansport, Indiana

Chlorinated dibenzo-p-dioxins (CDDs) and dibenzofurans (CDFs)

2,3,7,8-TCDD (equivalent)	2,3,7,8-TCDF
2,3,7,8-TCDD	1,2,3,7,8-PeCDF
2,3,7,8-PeCDD	2,3,4,7,8-PeCDF
2,3,7,8-HxCDD	2,3,7,8-HxCDF
2,3,7,8-HpCDD	2,3,7,8-HpCDF
OCDD	OCDF

Polychlorinated Biphenyls

3,3'-Tetra CB (#77)	Total Mono CB
2,3,4,4',5-Penta CB (#114)	Total Di CB
2,3',4,4',5-Penta CB (#118)	Total Tri CB
2',3,3',4,4'-Penta CB (#123)	Total Tetra CB
2,3,3',4,4'-Penta CB (#105)	Total Penta CB
2,3'4,4',5,5'-Hexa CB (#167)	Total Hexa CB
2,3,3',4,4',5-Hexa CB (#156)	Total Hepta CB
2,3,3',4,4',5-Hexa CB (#157)	Total Octa CB
3,3',4,4',5,5'-Hexa CB (#169)	Total Nona CB
2,2',3,4,4',5,5'-Hepta CB (#180)	
2,2',3,4,4',5,5'-Hepta CB (#170)	
2,3,3',4,4',5,5'-Hepta CB (#189)	

Table 3-3

Analytes Reported as Nondetect During Kiln Stack Emission Testing
ESSROC
Logansport, Indiana

Volatile Organic Compounds

Bromodichloromethane	Bromoform
Dibromochloromethane	Dibromomethane
1,2-Dibromomethane	1,2-Dichloroethane
1,1-Dichloroethane	cis-1,2-Dichloroethene
1,1-Dichloroethene	cis-1,3-Dichloropropene
trans-1,2-Dichloroethene	1,2-Dichloropropane
trans-1,3-Dichloropropene	trans-1,4-Dichloro-2-butene
4-Methyl-2-pentanone	1,1,2,2-Tetrachloroethane
Trichloroethylene	Vinyl acetate

Semi-Volatile Organic Compounds

Acenaphthene	1,3-Dichlorobenzene
Benzo(g,h,i)perylene	4-Chloro-3-methylphenol
Benzyl Alcohol	1,2-Dichlorbenzene
2,2-oxybis(1-chloropropane)	Dibenzo(a,h)anthracene
4-chloroaniline	Dimethylphthalate
3,3-Dichlorobenzidine	2,4-Dinitrophenol
2,4-Dimethylphenol	2-6-Dinitrotoluene
4,6-Dinitro-2-methylphenol	Hexachlorobutadiene
2,4-Dinitrotoluene	Hexachloroethane
Hexachlorobenzene	n-Nitrosodiphenylamine
Hexachlorocyclopentadiene	Nitrobenzene
Butylbenzyl phthalate	1,2,4-Trichlorobenzene
Pentachlorophenol	2,4,6-Trichlorophenol
n-Nitroso-di-n-propylamine	2,4,5-Trichlorophenol
2-Nitroaniline	

Polychlorinated Biphenyls

3,3',4,4',5-Penta CB (#126)	Deca CB

Table 3-4

Potential Components of Fugitive Emissions
Not Analyzed for During Stack Testing
ESSROC
Logansport, Indiana

1,1,2-Trichloroethane
Methyl Alcohol
n-Butyl Alcohol
Methyl Ethyl Ketone
Isopropyl Acetate
Ethyl Acetate
Butyl Acetate
Ethylacrylate
Methyl Chloroform
Isopropyl Alcohol
Isobutyl alcohol
Methyl Isobutyl Ketone
Propyle Acetate
Cyclohexane
Cresols

Table 3-5

Summary of Available Toxicological Data
ESSROC
Logansport, Indiana

Chemical	Oral Toxicity Data Available	Inhalation Toxicity Data Available
Inorganics		
Antimony	X	
Arsenic	X	X
Barium	X	
Beryllium	X	X
Cadmium	X	X
Chromium (VI)	X	X
Chromium, total	X	
Lead		
Mercury		X
Methyl Mercury	X	
Nickel	X	
Selenium	X	
Silver	X	
Thallium	X	
Volatile Organic Compounds		
Acetone	X	
Acrylonitrile		X
Allyl Chloride		X
Benzene	X	X
Bromodichloromethane	X	
Bromomethane	X	X
Bromoform	X	X
1,3-Butadiene		X
2-Butanone	X	X
Carbon disulfide	X	X
Carbon tetrachloride	X	
Chlorobenzene	X	
Chloroethane	X	
Chloroform		X
Chloromethane	X	X
Cumene (isopropylbenzene)	X	X
Dibromochloromethane	X	
1,2-Dichlorobenzene		X
1,4-Dichlorobenzene	X	X
1,1-Dichloroethane	X	X
1,2-Dichloroethane	X	X
1,1-Dichloroethene	X	X
cis 1,2-Dichloroethene	X	

Table 3-5

Summary of Available Toxicological Data
ESSROC
Logansport, Indiana

Chemical	Oral Toxicity Data Available	Inhalation Toxicity Data Available
trans 1,2-Dichloroethene	X	
1,2-Dichloropropane	X	X
cis 1,3-Dichloropropene	X	X
trans 1,3-Dichloropropene	X	X
Dichlorodifluoromethane	X	
Ethylbenzene	X	X
Methylene Chloride		
n-Hexane		X
Styrene	X	X
1,1,2,2-Tetrachloroethane	X	
Tetrachloroethylene	X	
1,1,1-Trichloroethane		X
Trichloroethene	X	X
Trichlorofluoromethane		X
Toluene	X	X
Xylene (m/p)	X	
o-Xylene	X	
Vinyl acetate		X
Vinyl chloride	X	
Semi-Volatiles		
Acenaphthene	X	
Anthracene	X	
Benzoic Acid	X	
Benzo(a)pyrene	X	X
Benzo(a)anthracene	X	X
Benzo(b)fluoranthene	X	X
Benzo(k)fluoranthene	X	X
Benzo(g,h,i)perylene	X	
Benzyl Alcohol	X	
Bis(2-ethyl hexyl)phthalate		
Butyl benzyl phthalate	X	
4-Chloroaniline	X	
2-Chloronaphthalene	X	
2-Chlorophenol	X	
Chrysene	X	X
Dibenz(a,h)anthracene	X	X
3,3-Dichlorobenzidine	X	
Dimethylphthalate	X	
Diethyl phthalate	X	
2,4-Dimethylphenol	X	

Table 3-5

Summary of Available Toxicological Data
ESSROC
Logansport, Indiana

Chemical	Oral Toxicity Data Available	Inhalation Toxicity Data Available
di-n-butylphthalate	X	X
Di-n-octyl phthalate	X	X
2,4-Dinitrophenol	X	X
2,4-Dinitrotoluene	X	X
2,6-Dinitrotoluene	X	X
Fluoranthene	X	X
Fluorene	X	X
Hexachlorobenzene	X	X
Hexachlorobutadiene	X	X
Hexachlorocyclopentadiene	X	X
Hexachloroethane	X	X
Indeno(1,2,3-cd)pyrene	X	X
2-Methylphenol	X	
4-Methylphenol	X	
2-Methylnaphthalene		
Naphthalene	X	X
2-Nitroaniline	X	X
Nitrobenzene	X	X
n-Nitrosodiphenylamine	X	X
n-Nitroso-di-n-propylamine	X	X
Pentachlorophenol	X	X
Phenanthrene	X	
Phenol	X	X
Pyrene	X	X
1,2,4-Trichlorobenzene	X	X
2,4,5-Trichlorophenol	X	X
2,4,6-Trichlorophenol	X	
Chlorinated dibenzo-p-dioxins (CDDs) and dibenzofurans (CDFs)		
2,3,7,8-TCDD	X	X
2,3,7,8-PeCDD	X	X
2,3,7,8-HxCDD	X	X
2,3,7,8-HpCDD	X	X
OCDD	X	X
2,3,7,8-TCDF	X	X
1,2,3,7,8-PeCDF	X	X
2,3,4,7,8-PeCDF	X	X
2,3,7,8-HxCDF	X	X
2,3,7,8-HpCDF	X	X
OCDF	X	X

Table 3-5

Summary of Available Toxicological Data
ESSROC
Logansport, Indiana

Chemical	Oral Toxicity Data Available	Inhalation Toxicity Data Available
Polychlorinated Biphenyls		
3,3'-Tetra CB	X	X
2,3,4,4','5-Penta CB	X	X
2,3',4,4',5-Penta CB	X	X
2',3,3',4,4'-Penta CB	X	X
2,3,3',4,4'-Penta CB	X	X
3,3',4,4',5-Penta CB	X	X
2,3',4,4',5,5'-Hexa CB	X	X
2,3,3'4,4',5-Hexa CB	X	X
2,3,3',4,4',5'_Hexa CB	X	X
3.3',4,4',5,5'-Hexa CB	X	X
2,2',3,4,4',5,5'-Hepta CB	X	X
2,2'3,3'4,4',5-Hepta CB	X	X
2,3,3',4,4',5,5'-Hepta CB	X	X
Total Mono CB	X	X
Total Di CB	X	X
Total Tri CB	X	X
Total Tetra CB	X	X
Total Penta CB	X	X
Total Hex CB	X	X
Total Hepta CB	X	X
Total Octa CB	X	X
Total Nona CB	X	X
Total Deca CB	X	X

Table 3-6

Potential Chemicals of Concern - Indirect Exposures
Carcinogenic Scores
ESSROC
Logansport, Indiana

Chemical	Average Two-Kiln Emission (g/sec)	Oral CSF (mg/kg/day)-1	Carcinogenic Score
2,3,4,7,8-PeCDF	7.12E-08	75000	5.34E-03
2,3,7,8-HxCDF	1.20E-07	15000	1.80E-03
n-Nitroso-di-n-propylamine	2.32E-04	7	1.62E-03
Benzo(a)pyrene	1.85E-04	7.30E+00	1.35E-03
2,3,7,8-TCDF	7.12E-08	15000	1.07E-03
2,3,7,8-HxCDD	6.08E-08	15000	9.12E-04
2,3,7,8-PeCDD	8.20E-09	75000	6.15E-04
Arsenic	3.26E-04	1.5	4.89E-04
Dibenz(a,h)anthracene *	6.02E-05	7.3	4.39E-04
2,3,7,8-TCDD	2.32E-09	1.50E+05	3.48E-04
Hexachlorobenzene *	2.17E-04	1.6	3.47E-04
1,2,3,7,8-PeCDF	4.24E-08	7500	3.18E-04
Bis(2-ethyl hexyl)phthalate	2.06E-02	1.40E-02	2.88E-04
2,3,7,8-HpCDD	1.76E-07	1500	2.64E-04
Benzo(b)fluoranthene	3.23E-04	7.30E-01	2.36E-04
2,6-Dinitrotoluene *	3.34E-04	6.80E-01	2.27E-04
2,4-Dinitrotoluene *	2.63E-04	6.80E-01	1.79E-04
Benzo(a)anthracene	2.23E-04	7.30E-01	1.63E-04
2,3,7,8-HpCDF	4.32E-08	1500	6.48E-05
Indeno(1,2,3-cd)pyrene	8.07E-05	7.30E-01	5.89E-05
Beryllium	1.18E-05	4.3	5.07E-05
Benzo(ghi)perylene	6.86E-05	0.73	5.01E-05
Pentachlorophenol *	3.27E-04	1.20E-01	3.93E-05
1,4-dichlorobenzene	8.91E-04	2.40E-02	2.14E-05
Hexachlorobutadiene *	2.63E-04	7.80E-02	2.05E-05
3,3',4,4',5-Penta CB	1.07E-09	1.50E+04	1.61E-05
OCDD	9.12E-08	150	1.37E-05
Total Hepta CB	3.44E-06	2	6.88E-06
Benzo(k)fluoranthene	8.54E-05	7.30E-02	6.23E-06
Total Hex CB	2.24E-06	2	4.48E-06
2,3,3'4,4',5-Hexa CB	2.76E-08	75	2.07E-06
2,2'3,3'4,4',5-Hepta CB	2.62E-07	15	3.93E-06
Hexachloroethane *	2.77E-04	1.40E-02	3.88E-06
3.3',4,4',5,5'-Hexa CB	2.20E-09	1.50E+03	3.30E-06
Chrysene	4.00E-04	7.30E-03	2.92E-06
2,4,6-Trichlorophenol	2.05E-04	1.10E-02	2.25E-06

Table 3-6

Potential Chemicals of Concern - Indirect Exposures
Carcinogenic Scores
ESSROC
Logansport, Indiana

Chemical	Average Two-Kiln Emission (g/sec)	Oral CSF (mg/kg/day)-1	Carcinogenic Score
Total Mono CB	9.80E-07	2	1.96E-06
OCDF	1.21E-08	1.50E+02	1.82E-06
Total Tri CB	8.94E-07	2	1.79E-06
2,3,4,4,'5-Penta CB	2.36E-08	75	1.77E-06
Total Octa CB	7.80E-07	2	1.56E-06
Total Di CB	6.94E-07	2	1.39E-06
Total Tetra CB	6.60E-07	2	1.32E-06
Total Penta CB	6.20E-07	2	1.24E-06
2,2',3,4,4',5,5'-Hepta CB	7.18E-07	1.5	1.08E-06
2,3,3',4,4',5'_Hexa CB	8.40E-09	75	6.30E-07
3,3'-Tetra CB	7.80E-09	75	5.85E-07
n-Nitrosodiphenylamine *	1.11E-04	4.90E-03	5.44E-07
2,3',4,4',5-Penta CB	2.70E-08	15	4.05E-07
Total Nona CB	3.98E-08	2	7.96E-08
2,3,3',4,4',5,5'-Hepta CB	3.00E-09	15	4.50E-08
2,3',4,4',5,5'-Hexa CB	1.38E-08	1.5	2.07E-08
2,3,3',4,4'-Penta CB	1.07E-09	15	1.61E-08
2',3,3',4,4'-Penta CB	9.74E-10	15	1.46E-08
Total Deca CB *	6.58E-09	2	1.32E-08

* Analyte reported as non-detect during kiln stack emission testing.

Table 3-7
Potential Chemicals of Concern - Indirect Exposures
Noncarcinogenic Scores
ESSROC
Logansport, Indiana

Chemical	Average Two-Kiln Emission (g/sec)	Oral Rfd (mg/kg/day)	Noncarcinogenic Score
Mercury	6.16E-03	1.00E-04	6.16E+01
2-Nitroaniline	2.89E-04	6.00E-05	4.82E+00
Thallium	3.84E-04	8.00E-05	4.80E+00
Cadmium	4.36E-03	1.00E-03	4.36E+00
Naphthalene	3.74E-02	2.00E-02	1.87E+00
Hexachlorobutadiene*	2.63E-04	2.00E-04	1.31E+00
Arsenic	3.26E-04	3.00E-04	1.09E+00
bis(2-ethylhexyl)phthalate	2.06E-02	2.00E-02	1.03E+00
Antimony	2.80E-04	4.00E-04	7.00E-01
2,6-Dinitrotoluene	3.34E-04	1.00E-03	3.34E-01
Nitrobenzene *	1.56E-04	5.00E-04	3.12E-01
2,4-Dinitrophenol *	5.62E-04	2.00E-03	2.81E-01
Hexachloroethane	2.77E-04	1.00E-03	2.77E-01
Hexachlorobenzene	2.17E-04	8.00E-04	2.71E-01
Acenaphthylene	6.86E-03	3.00E-02	2.29E-01
Selenium	1.07E-03	5.00E-03	2.14E-01
Total Hepta CB	3.44E-06	2.00E-05	1.72E-01
Pyrene *	4.00E-03	3.00E-02	1.33E-01
2,4-Dinitrotoluene	2.63E-04	2.00E-03	1.31E-01
Total Hex CB	2.24E-06	2.00E-05	1.12E-01
Fluoranthene	3.82E-03	4.00E-02	9.55E-02
2-Chlorophenol	4.46E-04	5.00E-03	8.92E-02
Total Mono CB	9.74E-07	2.00E-05	4.87E-02
Total Tri CB	8.94E-07	2.00E-05	4.47E-02
Barium	3.04E-03	7.00E-02	4.34E-02
Nickel	8.28E-04	2.00E-02	4.14E-02
Total Octa CB	7.82E-07	2.00E-05	3.91E-02
Hexachlorocyclopentadiene	2.46E-04	7.00E-03	3.51E-02
Total Di CB	6.95E-07	2.00E-05	3.48E-02
Total Tetra CB	6.60E-07	2.00E-05	3.30E-02
Silver	1.59E-04	5.00E-03	3.18E-02
Total Penta CB	6.20E-07	2.00E-05	3.10E-02
4-Chloroaniline *	1.23E-04	4.00E-03	3.08E-02
2-Methylnaphthalene	7.97E-04	3.00E-02	2.66E-02
1,2,4-Trichlorobenzene *	1.64E-04	1.00E-02	1.64E-02
Phenol	9.70E-03	6.00E-01	1.62E-02
4-Methylphenol	6.72E-04	5.00E-02	1.34E-02
2-Methylphenol	5.81E-04	5.00E-02	1.16E-02
Fluorene	4.39E-04	4.00E-02	1.10E-02
Pentachlorophenol	3.27E-04	3.00E-02	1.09E-02

Table 3-7
Potential Chemicals of Concern - Indirect Exposures
Noncarcinogenic Scores
ESSROC
Logansport, Indiana

Chemical	Average Two-Kiln Emission (g/sec)	Oral Rfd (mg/kg/day)	Noncarcinogenic Score
Di-n-octyl phthalate	1.87E-04	2.00E-02	9.35E-03
2,4-Dimethylphenol *	1.54E-04	2.00E-02	7.72E-03
Beryllium	1.18E-05	2.00E-03	5.90E-03
Benzoic Acid	1.99E-03	4.00E-01	4.98E-03
Chromium (VI)	1.43E-05	3.00E-03	4.77E-03
1,4-Dichlorobenzene	8.98E-04	2.30E-01	3.90E-03
Di-n-butylphthalate	2.30E-04	1.00E-01	2.30E-03
2,4,5-Trichlorophenol	2.25E-04	1.00E-01	2.25E-03
Total Nona CB	3.98E-08	2.00E-05	1.99E-03
1,2-dichlorobenzene	1.54E-04	9.00E-02	1.71E-03
1,3-Dichlorobenzene	1.44E-04	8.90E-02	1.61E-03
Acenaphthene	8.95E-05	6.00E-02	1.49E-03
Anthracene	4.23E-04	3.00E-01	1.41E-03
Butyl benzyl phthalate *	2.70E-04	2.00E-01	1.35E-03
2-Chloronaphthalene	9.88E-05	8.00E-02	1.24E-03
Benzyl Alcohol *	2.38E-04	3.00E-01	7.94E-04
Chromium, total	8.08E-04	1.5	5.39E-04
Diethyl phthalate	3.24E-04	8.00E-01	4.05E-04
Deca CB	6.58E-09	2.00E-05	3.29E-04
3,3-Dichlorobenzidene	1.59E-04	4.50E-01	3.53E-04
Dimethylphthalate	7.00E-05	1.00E+01	7.00E-06

* Analyte reported as non-detect during kiln stack emission testing.

Table 3-8
Final List of Chemicals of Concern
Indirect Exposure Pathway
ESSROC
Logansport, Indiana

Chlorinated dibenzo-p-dioxins (CDDs) and dibenzofurans (CDFs)

2,3,7,8-TCDD
2,3,7,8-PECD
2,3,7,8-HxCDD
2,3,7,8-HpCDD
OCDD

2,3,7,8-TCDF
1,2,3,7,8-PeCDF
2,3,7,8-HxCDF
2,3,7,8-HpCDF
OCDF

Polychlorinated biphenyls

3,3'-Tetra CB
2,3,4,4',5-Penta CB
2,3',4,4',5-Penta CB
2',3,3',4,4'-Penta CB
2,3,3',4,4'-Penta CB
3,3',4,4',5-Penta CB
2,3',4,4'5,5'-Hexa CB

2,3,3',4,4',5-Hexa CB
2,3,3',4,4',5'_Hexa CB
3,3',4,4',5,5'-Hexa CB
2,2',3,4,4',5,5'-Hepta CB
2,2',3,3',4,4',5-Hepta CB
2,3,3',4,4',5,5'-Hepta CB

Total Mono CB
Total Di CB
Total Tri CB
Total Tetra CB
Total Penta CB

Total Hexa CB
Total Hepta CB
Total Octa CB
Total Nona CB
Total Deca CB

Metals

Antimony
Arsenic
Barium
Beryllium
Cadmium

Hexavalent Chromium
Total Chromium
Lead
Mercury
Nickel
Thallium

Semi-Volatile Organic Compounds

Acenaphthene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(a)anthracene
bis(2-ethylhexyl)phthalate
2-chlorophenol

2,6-Dinitrotoluene *
Hexachlorobenzene *
Hexchlorobutadiene *
Hexachlorocyclopentadiene
2-Nitroaniline
Naphthalene

Table 3-8
Final List of Chemicals of Concern
Indirect Exposure Pathway
ESSROC
Logansport, Indiana

Dibenz(a,h)anthracene *
Hexachloroethane
1,4-Dichlorobenzene
2,4-Dinitrophenol *
Fluoranthene
2,4-Dinitrotoluene *
2,4-Dimethylphenol *
n-Nitroso-di-n-propylamine
Nitrobenzene *
Pentachlorophenol *
Phenol
Pyrene *
1,2,4-Trichlorobenzene *

* analyted not detected during emissions testing

Table 3-9

Kiln Stack Emission Rates
ESSROC
Logansport, Indiana

Chemical	Average One-Kiln Emission (g/sec)	Average Two-Kiln Emission (g/sec)
Metals		
Antimony	1.40E-04	2.80E-04
Arsenic	1.63E-04	3.26E-04
Barium	1.52E-03	3.04E-03
Beryllium	5.89E-06	1.18E-05
Cadmium	2.18E-03	4.36E-03
Chromium (VI)	7.17E-06	1.43E-05
Chromium, total	4.04E-04	8.08E-04
Lead	3.07E-02	6.14E-02
Mercury	3.08E-03	6.16E-03
Nickel	4.14E-04	8.28E-04
Selenium	5.34E-04	1.07E-03
Silver	7.97E-05	1.59E-04
Thallium	1.92E-04	3.84E-04
Volatile Organic Compounds		
Acetone	8.61E-03	1.72E-02
Acrylonitrile	2.40E-03	4.79E-03
Allyl Chloride	3.69E-04	7.38E-04
Benzene	3.76E-02	7.52E-02
Bromodichloromethane *	7.47E-06	1.49E-05
Bromomethane	6.58E-04	1.32E-03
Bromoform *	1.38E-05	2.77E-05
1,3-Butadiene	6.91E-03	1.38E-02
2-Butanone	2.23E-04	4.46E-04
Carbon disulfide	2.64E-03	5.27E-03
Carbon tetrachloride	1.63E-04	3.27E-04
Chlorobenzene	4.74E-04	9.49E-04
Chloroethane	1.66E-04	3.32E-04
Chloroform	1.29E-04	2.58E-04
Chloromethane	8.34E-03	1.67E-02
Cumene (isopropylbenzene)	1.76E-05	3.52E-05
Dibromochloromethane *	8.53E-06	1.71E-05
Dibromomethane *	1.59E-05	3.17E-05
1,2-Dibromomethane *	1.14E-05	2.29E-05
1,2-Dichlorobenzene	1.74E-05	3.47E-05
1,3-Dichlorobenzene	5.00E-05	9.99E-05
1,4-Dichlorobenzene	9.04E-05	1.81E-04

0.05153 g/h

Table 3-9

Kiln Stack Emission Rates
ESSROC
Logansport, Indiana

Chemical	Average One-Kiln Emission (g/sec)	Average Two-Kiln Emission (g/sec)
1,1-Dichloroethane *	7.85E-06	1.57E-05
1,2-Dichloroethane *	1.26E-05	2.53E-05
1,1-Dichloroethene *	1.50E-05	2.99E-05
cis 1,2-Dichloroethene *	1.31E-05	2.62E-05
trans 1,2-Dichloroethene *	1.30E-05	2.61E-05
1,2-Dichloropropane *	1.26E-05	2.52E-05
cis 1,3-Dichloropropene *	7.63E-06	1.53E-05
trans 1,3-Dichloropropene *	9.30E-06	1.86E-05
trans-1,4-Dichloro-2-butene	2.23E-05	4.46E-05
Dichlorodifluoromethane	1.05E-04	2.09E-04
Ethylbenzene	4.32E-04	8.64E-04
Methylene Chloride	1.02E-02	2.04E-02
4-Methyl-2-Pentanone *	1.97E-05	3.93E-05
n-Hexane	4.61E-04	9.21E-04
Styrene	1.33E-03	2.65E-03
1,1,2,2-Tetrachloroethane *	1.40E-05	2.80E-05
Tetrachloroethylene	7.52E-05	1.50E-04
1,1,1-Trichloroethane	5.54E-05	1.11E-04
Trichloroethene *	3.05E-05	6.10E-05
Trichlorofluoromethane	1.52E-04	3.05E-04
Toluene	1.92E-02	3.84E-02
Xylene (m/p)	5.33E-04	1.07E-03
o-Xylene	1.62E-04	3.23E-04
Vinyl acetate *	1.20E-05	2.40E-05
Vinyl chloride	1.16E-03	2.32E-03

Kiln Stack Emission Rates
ESSROC
Logansport, Indiana

Chemical	Average One-Kiln Emission (g/sec)	Average Two-Kiln Emission (g/sec)
Semi-Volatile Compounds		
Acenaphthene *	4.48E-05	8.95E-05
Acenaphthylene	3.43E-03	6.86E-03
Anthracene	2.12E-04	4.23E-04
Benzoic Acid	9.93E-04	1.99E-03
Benzo(a)pyrene	9.25E-05	1.85E-04
Benzo(a)anthracene	1.12E-04	2.23E-04
Benzo(b)fluoranthene	1.61E-04	3.23E-04
Benzo(k)fluoranthene	4.27E-05	8.54E-05
Benzo(g,h,i)perylene *	3.43E-05	6.86E-05
Benzyl Alcohol *	1.19E-04	2.38E-04
Bis(2-ethyl hexyl)phthalate	1.03E-02	2.06E-02
Butyl benzyl phthalate *	1.35E-04	2.70E-04
4-Chloroaniline *	6.15E-05	1.23E-04
2-Chloronaphthalene	4.94E-05	9.88E-05
4-Chloro-3-methylphenol *	8.82E-05	1.76E-04
2-Chlorophenol	2.23E-04	4.46E-04
Chrysene	2.00E-04	4.00E-04
Dibenz(a,h)anthracene *	3.01E-05	6.02E-05
Dibenzofuran	1.24E-03	2.48E-03
1,2-dichlorobenzene *	7.72E-05	1.54E-04
1,3-dichlorobenzene *	7.25E-05	1.45E-04
1,4-dichlorobenzene	4.49E-04	8.98E-04
3,3-Dichlorobenzidine *	7.95E-05	1.59E-04
Dimethylphthalate *	3.50E-05	7.00E-05
Diethyl phthalate	1.62E-04	3.24E-04
2,4-Dimethylphenol *	7.78E-05	1.56E-04
di-n-butylphthalate	1.15E-04	2.30E-04
4,6-Dinitro-2-methylphenol *	2.06E-04	4.12E-04
2,4-Dinitrophenol *	2.81E-04	5.62E-04
2,4-Dinitrotoluene *	1.31E-04	2.63E-04
2,6-Dinitrotoluene *	1.67E-04	3.34E-04
Fluoranthene	1.91E-03	3.82E-03
Fluorene	2.20E-04	4.39E-04
Hexachlorobenzene *	1.08E-04	2.17E-04
Hexachlorobutadiene *	1.31E-04	2.63E-04
Hexachlorocyclopentadiene *	1.23E-04	2.46E-04
Hexachloroethane *	1.39E-04	2.77E-04

Kiln Stack Emission Rates
ESSROC
Logansport, Indiana

Chemical	Average One-Kiln Emission (g/sec)	Average Two-Kiln Emission (g/sec)
Indeno(1,2,3-cd)pyrene	4.04E-05	8.07E-05
2-Methylphenol	2.91E-04	5.81E-04
4-Methylphenol	3.36E-04	6.72E-04
2-Methylnaphthalene	3.99E-04	7.97E-04
Naphthalene	1.87E-02	3.74E-02
2-Nitroaniline *	1.45E-04	2.89E-04
Nitrobenzene *	7.80E-05	1.56E-04
n-Nitrosodiphenylamine *	5.55E-05	1.11E-04
n-Nitroso-di-n-propylamine *	1.16E-04	2.32E-04
2,2-oxybis(1-Chloropropane) *	7.18E-05	1.44E-04
Pentachlorophenol *	1.64E-04	3.27E-04
Phenanthrene	3.56E-03	7.11E-03
Phenol	4.85E-03	9.70E-03
Pyrene	2.00E-03	4.00E-03
1,2,4-Trichlorobenzene *	8.27E-05	1.65E-04
2,4,5-Trichlorophenol *	1.13E-04	2.25E-04
2,4,6-Trichlorophenol *	1.02E-04	2.05E-04
Di-n-octyl phthalate	9.35E-05	1.87E-04
Dioxins/Furans		
2,3,7,8-TCDD	1.16E-09	2.32E-09
2,3,7,8-PeCDD	4.10E-09	8.20E-09
2,3,7,8-HxCDD	3.04E-08	6.08E-08
2,3,7,8-HpCDD	8.79E-08	1.76E-07
OCDD	4.56E-08	9.12E-08
2,3,7,8-TCDF	3.56E-08	7.12E-08
1,2,3,7,8-PeCDF	2.12E-08	4.24E-08
2,3,4,7,8-PeCDF	3.56E-08	7.12E-08
2,3,7,8-HxCDF	6.00E-08	1.20E-07
2,3,7,8-HpCDF	2.16E-08	4.32E-08
OCDF	6.05E-09	1.21E-08
Polychlorinated Biphenyls		
3,3'-Tetra CB	3.90E-09	7.80E-09
2,3,4,4,'5-Penta CB	1.18E-08	2.36E-08
2,3',4,4',5-Penta CB	1.26E-08	2.52E-08
2',3,3',4,4'-Penta CB	4.87E-10	9.74E-10
2,3,3',4,4'-Penta CB	2.11E-09	4.22E-09
3,3',4,4',5-Penta CB *	5.34E-10	1.07E-09

Table 3-9

Kiln Stack Emission Rates
ESSROC
Logansport, Indiana

Chemical	Average One-Kiln Emission (g/sec)	Average Two-Kiln Emission (g/sec)
2,3',4,4',5,5'-Hexa CB	6.89E-09	1.38E-08
2,3,3'4,4',5-Hexa CB	1.38E-08	2.76E-08
2,3,3',4,4',5'_Hexa CB	4.22E-09	8.44E-09
3.3',4,4',5,5'-Hexa CB	1.10E-09	2.20E-09
2,2',3,4,4',5,5'-Hepta CB	3.59E-07	7.18E-07
2,2'3,3'4,4',5-Hepta CB	3.58E-07	7.16E-07
2,3,3',4,4',5,5'-Hepta CB	1.52E-09	3.04E-09
Total Mono CB	4.87E-07	9.74E-07
Total Di CB	3.47E-07	6.94E-07
Total Tri CB	4.47E-07	8.94E-07
Total Tetra CB	3.30E-07	6.60E-07
Total Penta CB	3.10E-07	6.20E-07
Total Hex CB	1.12E-06	2.24E-06
Total Hepta CB	1.72E-06	3.44E-06
Total Octa CB	3.91E-07	7.82E-07
Total Nona CB	1.98E-08	3.96E-08
Deca CB *	3.29E-09	6.58E-09

* Analyte reported as non-detect during emissions testing.

Table 3-10
Summary of LWDF Fugitive Emissions
ESSROC
Logansport, Indiana

Chemical	Maximum Long Term Emission Rate		Maximum Short Tem Emission Rate	
	(lb/yr)	(g/s)	(lb/hr)	(g/s)
1,1,2-Trichloroethane	9	1.29E-04	0.01	1.26E-03
1,2,4-Trichlorobenzene	0	0.00E+00	0	0.00E+00
1,2-Dichlorobenzene	0	0.00E+00	0	0.00E+00
Acetone	7,608	1.09E-01	7.34	9.25E-01
Benzene	49	7.05E-04	0.05	6.30E-03
bis(2-ethylhexl)phthalate	0	0.00E+00	0	0.00E+00
Chlorobenzene	97	1.40E-03	0.09	1.13E-02
Chloroform	66	9.49E-04	0.06	7.56E-03
Cresols	0	0.00E+00	0	0.00E+00
Cumene	0	0.00E+00	0	0.00E+00
Cyclohexane	301	4.33E-03	0.29	3.65E-02
Dimethylphthalate	0	0.00E+00	0	0.00E+00
Di-n-butyl phthalate	0	0.00E+00	0	0.00E+00
Ethyl Acetate	1,132	1.63E-02	1.09	1.37E-01
Ethyl Acrylate	4	5.75E-05	0	0.00E+00
Ethylbenzene	203	2.92E-03	0.2	2.52E-02
High MW Aliphatics	942	1.35E-02	0.91	1.15E-01
Isobutyl Alcohol	75	1.08E-03	0.07	8.82E-03
Isopropyl Acetate	40	5.75E-04	0.04	5.04E-03
Isopropyl Alcohol	102	1.47E-03	0.1	1.26E-02
Methyl Alcohol	4,516	6.50E-02	4.36	5.49E-01
Methyl Chloroform	248	3.57E-03	0.24	3.02E-02
Methyl Ethyl Ketone	3,127	4.50E-02	3.02	3.81E-01
Methyl Isobutyl Ketone	332	4.78E-03	0.32	4.03E-02
Methylene Chloride	9,403	1.35E-01	9.08	1.14E+00
Naphthalene	0	0.00E+00	0	0.00E+00
n-Butyl Acetate	1,579	2.27E-02	1.52	1.92E-01
n-Butyl Alcohol	9	1.29E-04	0.01	1.26E-03
n-Hexane	53	7.62E-04	0.05	6.30E-03
Phenol	0	0.00E+00	0	0.00E+00
Propyl Acetate	88	1.27E-03	0.09	1.13E-02
Styrene	31	4.46E-04	0.03	3.78E-03
Tetrachloroethylene	177	2.55E-03	0.17	2.14E-02
Toluene	3,163	4.55E-02	3.05	3.84E-01
Toluene Diisocynanate	0	0.00E+00	0	0.00E+00
trans 1,3-Dichloropropene	155	2.23E-03	0.15	1.89E-02
Trichloroethylene	168	2.42E-03	0.16	2.02E-02
Trichloromonofluoromethane	1,831	2.63E-02	1.77	2.23E-01
Vinyl Acetate	40	5.75E-04	0.04	5.04E-03
Xylene	1,000	1.44E-02	0.97	1.22E-01
Total Organics	36,548		35.3	
Water	7,678		7.41	
Total	44,226		42.7	

Table 3-11

Calculated Fugitive Dust Emissions
ESSROC
Logansport, Indiana

Chemical	Concentration in CKD	CKD Fugitive Emissions			CKD Fugitive Emissions		
	mg/kg	< 30 um lb/yr	< 10 um lb/yr	< 2.5 um lbyr	< 30 um g/sec	< 10 um g/sec	< 2.5 um g/sec
Antimony	11.28	7.70E-02	3.60E-02	1.20E-02	1.1E-06	5.2E-07	1.7E-07
Arsenic	6.49	4.40E-02	2.10E-02	7.00E-03	6.3E-07	3.0E-07	1.0E-07
Barium	254.9	1.73E+00	8.11E-01	2.80E-01	2.5E-05	1.2E-05	4.0E-06
Beryllium	1.52	1.00E-02	5.00E-03	2.00E-03	1.4E-07	7.2E-08	2.9E-08
Cadmium	15.83	1.08E-01	5.00E-02	1.70E-02	1.6E-06	7.2E-07	2.4E-07
Chromium	56.66	3.85E-01	1.80E-01	6.20E-02	5.5E-06	2.6E-06	8.9E-07
Lead	579.58	3.94E+00	1.84E+00	6.36E-01	5.7E-05	2.7E-05	9.1E-06
Mercury	2.13	1.40E-02	7.00E-03	2.00E-03	2.0E-07	1.0E-07	2.9E-08
Nickel	36.39	2.48E-01	1.16E-01	4.00E-02	3.6E-06	1.7E-06	5.8E-07
Selenium	15.51	1.05E-01	4.90E-02	1.70E-02	1.5E-06	7.0E-07	2.4E-07
Silver	4.78	7.80E-02	3.70E-02	1.30E-02	1.1E-06	5.3E-07	1.9E-07
Thallium	2.23	1.05E-01	4.90E-02	1.70E-02	1.5E-06	7.0E-07	2.4E-07

Table 3-12
CKD Fugitive Emission Summary
ESSROC
Logansport, Indiana

	CKD Fugitive Emissions		
	<30 um lb/yr	<10 um lb/yr	< 2.5 um lb/yr
ESP Hopper Activities			
1 Unloading the waste dust from the ESP to the haul trucks	134.3	63.5	20
2 Loading of waste dust from ESP area to accumulation bin	2.8	1.3	0.4
3 Wind erosion of exposed face and top of accumulation bin	250.8	125.4	50.2
4 Unloading of waste dust from accumulation bin	2.8	1.3	0.4
Total Emissions from ESP Hopper Activities	**390.7**	**191.5**	**71**
Haul Truck Travel			
5 Haul truck travel on road segments from the ESP load out to the waste pile	392.8	175.5	46.8
6 Wind erosion of the waste dust in the haul trucks during travel	Included in item 5 above		
7 Haul truck travel on the road segments from the waste pile to the ESP load out	498.7	222.8	59.4
8 Front-end loader travel on road segments to and from the waste pile	4.8	2.1	0.6
9 Wind erosion of the road segments between the waste pile and the ESP	Included in items 5, 7, and 8		
Total Emissions from haul truck travel	**896.3**	**400.4**	**106.8**
CKD Waste Pile Activities			
9 Loaded haul truck travel on the surface of the waste pile	462.2	206.5	55.1
10 Unloading of the waste dust from the haul trucks to the waste pile	134.3	63.5	20
11 Empty haul truck travel on the surface of the waste pile	586.7	262.1	69.9
12 Front-end loader travel on the surface of the waste pile	59.9	26.8	7.1
13 Front-end loader pushing the waste dust over the edge of the waste pile	555.9	171.6	24
14 Wind erosion of the exposed face and top of the waste pile	3715.5	1857.8	743.1
Total Emissions from CKD Waste Pile Activities	**5514.5**	**2588.3**	**919.2**
Total Emissions all activities	**6801**	**3180**	**1097**