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AIR EMISSIONS FROM THE TREATMENT OF SOILS CONTAMINATED WITH PETROLEUM FUELS AND OTHER SUBSTANCES

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ABSTRACT

This report updates a 1992 report that summarizes available information on air emissions from the treatment of soils contaminated with fuels. Soils contaminated by leaks or spills of fuel products, such as gasoline and jet fuel, are a nationwide concern. Air emissions during remediation are a potential problem because of the volatile nature of many of the fuel components and the remediation processes themselves, which may promote or result in contaminant transfer to the vapor phase. Limited information also is included on air emissions from the treatment of soils contaminated with hazardous wastes.

The report will allow staff from state and local regulatory agencies, as well as staff from EPA regional offices, to assess the different options for cleaning up soil contaminated with fuels. Seven general remediation approaches are addressed in this report. For each approach, information is presented about the remediation process, the typical air emission species of concern and their release points, and the available air emissions data. Control technologies for each remediation approach are identified and their reported efficiencies are summarized. Cost data are given for each remediation approach and for its associated control technologies. Emission estimation methods (EEMs) for each remediation approach are presented along with a brief case study. An uncertainty and sensitivity analysis was also prepared for each EEM.

A 1992 report was initially revised in 1995 in fulfillment of EPA Contract No. 68-D2-0160, Work Assignment 62, by Radian Corporation. The 1992 report also was prepared by Radian Corporation.

This second revision to the 1992 report was prepared in 1996 in fulfillment of EPA Contract No. 68-D3-0035, Work Assignment II-92, by E.H. Pechan & Associates, Inc., 2880 Sunrise Boulevard, Suite 220, Rancho Cordova, CA 95740.

EXECUTIVE SUMMARY

This document summarizes the available information on air emissions from the treatment of soils contaminated with fuels. It is intended to guide State and local air pollution control agencies in the evaluation of the air emission potential of treatment of contaminated soil and the cost-effectiveness of applicable emission control technologies. The scope was limited to the emissions of volatile organic compounds (VOCs); however, because of the limited data that were available, information was also included for the emissions of other organic compounds. This additional information is primarily from the treatment of soils contaminated with hazardous wastes.

Seven general approaches for the disposal or treatment of soils contaminated with gasoline, oil, or diesel fuel were identified:

- Excavation and removal;
- Thermal desorption;
- Soil vapor extraction (SVE);
- In-Situ biodegradation;
- Ex-Situ biodegradation;
- Incineration; and
- Soil washing/solvent extraction/soil flushing.

Each general approach may include several specific options. For example, thermal desorption may be performed in portable units designed specifically for soil treatment or in rotary drum aggregate dryers that are part of asphalt plants or other industrial facilities.

Literature pertaining to the emissions of volatile organic compounds (VOCs) for each remediation approach was identified and reviewed. The summarized information was organized into the same ten part format for each approach:

- Process description;
- Identification of air emission points;
- Identification of typical air emission species of concern;
- Summary of published air emissions data;
- Identification of applicable control technologies;
- Cost data for the overall remediation approach;
- Cost data for the emission controls;
- Equations and models for estimating VOC emissions;
- Case study of the use of the remediation approach; and
- References.

For most of the technologies examined, VOC emission estimates or measured data were found. Emission factors, in grams per hour, were identified or developed that are based on available data as well as assumed "typical" operating conditions for the remediation of relatively large sites. Cost data, in dollars per ton or cubic yard of soil treated, were obtained from a variety of sources, but data prior to 1986 were generally avoided because of the changes in remediation technology, standard operating practices, and regulations in recent years. All cost data for years prior to 1991 were converted to 1991 dollars using a 5% annual escalation factor. Cost data for years subsequent to 1991 are given on an as-is basis.

Certain limitations of the data presented in this document should be considered before extrapolations are made to a specific site under consideration. Any generalized guidance has inherent limitations due to the variety of site-specific and process-specific factors that may be encountered. Many of the cleanup processes are emerging technologies and have short operating histories. For these technologies, data on air emissions, treatment effectiveness, and costs are very limited. Furthermore, each site has its own unique obstacles to cleanup that may force modifications to the cleanup hardware or operating conditions. The development of typical air emission rates and emission factors applicable to the maximum number of site conditions and site locations required assumptions regarding the rate and scope of the cleanup effort, the type of fuel being treated, the number and nature of emission release points, and so on. The more a specific site differs from the assumed conditions, the less likely the generalized air emissions data will be applicable.

In general, only limited information was found for air emissions from the treatment of contaminated soil. The need for more data is greatest for emerging technologies and those that are area sources of VOC emissions. The general needs are for more emissions data, more control cost and effectiveness data, and data for the development of accurate emission estimation methods (EEMs). The most important research needs that were identified during this study were:

- VOC emission rate data for excavation;
- Improved EEMs to estimate VOC emissions from excavation; and
- Fate studies for VOCs in biotreatment systems.

METRIC CONVERSIONS

Non-metric	Multiplied by	Yields Metric
MMBtu/hr	1054.35	MJ/hr (megajoule per hour)
°F	0.555556 (°F - 32)	°C
ft	0.3048	m
acfm	0.028317	acmm
dscfm	0.028317	dscmm
gal	3.78541	L
hp	746	J/sec
in	2.54	cm
lb	0.453592	kg
mil	0.0254	mm
mile	1609.344	m
ton	0.907185	Mg (megagram), metric ton, or 1,000 kg
yd^3	0.76455	m^3
yd^2	0.8361	m^2

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AFB	Air Force Base
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
BTU	British Thermal Unit
BTX	Benzene, Toluene, and Xylenes
CO	Carbon Monoxide
CSTR	Continuously-Stirred Tank Reactor
CTC	Control Technology Center
DAVES	Desorption and Vapor Extraction System
DOD	Department of Defense
EEM	Emission Estimation Method
EPA	Environmental Protection Agency
FTIR	Fourier-Transform Infrared
GAC	Granular Activated Carbon
HCl	Hydrochloric acid
HEPA	High Efficiency Particulate Air
IC	Internal Combustion
ICE	Internal Combustion Engine
LEL	Lower Explosive Limit
LTTA	Low-Temperature Thermal Aeration
LTTD	Low-Temperature Thermal Desorption
LUST	Leaking Underground Storage Tank
NA	Not Applicable
ND	Not Determined
NOx	Nitrogen Oxides
OUST	Office of Underground Storage Tanks
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PCDD	Polychlorinated Dibenzodioxins
PCDF	Polychlorinated Dibenzofurans
PM	Particulate Matter
PNA	Polynuclear Aromatic
PVC	Polyvinyl Chloride
RCRA	Resource Conservation and Recovery Act
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compound
TCDD	Tetrachlorodibenzodioxin
TCE	Trichloroethylene
TEQ	Toxic Equivalent Quantity
THC	Total Hydrocarbons
TNMHC	Total Non-Methane Hydrocarbons
TPH	Total Petroleum Hydrocarbons
TTSD	Technology Transfer and Support Division (former CERI)

TVH	Total Volatile Hydrocarbons
UST	Underground Storage Tank
UV	Ultraviolet
VOC	Volatile Organic Compound