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Remediation of Petroleum Contaminated Soils Remediation of Petroleum-contaminated Soils Petroleum Contaminated Soils, Volume I Petroleum Contaminated Soils Principles and Practices for Petroleum Contaminated Soils Petroleum Contaminated Soils Assessments And Remediation Of Oil Contaminated Soils Contaminated Soils Guidelines for Assessment and Remediation of Petroleum Contaminated Soils Remediation of Petroleum-contaminated Soils Petroleum Contaminated Soils Petroleum-contaminated Soils Treatment Options Petroleum Contaminated Soils Use of Risk-Based Standards for Cleanup of Petroleum Contaminated Soil Petroleum Contaminated Soils Problems Problems Dealing with Petroleum Contaminated Soils Guidance for Remediation of Petroleum Contaminated Soils A Petroleum Contaminated Soil Bioremediation Facility Assessment and Remediation of Petroleum Contaminated Sites Petroleum Contaminated Soils Bioremediation of Petroleum Contaminated Soils Petroleum Contaminated Soils - Volume 2 : Remediation Techniques, Environmental Fate, Risk Assessment, Analytical Methodologies , Proceedings of the Third National Conference on Petroleum Contaminated Soils, Amherst, MA, September 19 - 21 1988

Petroleum Contaminated Soils Petroleum Contaminated Soils Remedial Technologies for Petroleum-contaminated Soils and Groundwater Bioremediation of Petroleum Contaminated Soils Use of Petroleum Contaminated Soils in Construction Material Production Petroleum-contaminated Soils Handling Options Rapid Hyperspectral Identification of Petroleum Contaminated Soils Engineering Solutions for Petroleum Contaminated Soils Bioremediation of Petroleum and Radiological Contaminated Soils at the Savannah River Site Influence of Soils, Plants and Microorganisms in Bioremediation of Petroleum-contaminated Soils Petroleum Contaminated Soils - Volume I : Remediation Techniques, Environmental Fate, Risk Assessment , Proceedings of the Second National Conference on the Environmental and Public Health Effects of Soils Contaminated with Petroleum Products, Amherst, MA, September 28 - 30 1987 Use of Petroleum Contaminated Soils in Construction Materials Production In Situ Bioremediation of Petroleum-contaminated Soils Model Remedies for Sites with Petroleum Contaminated Soils Applying Ozone to Accelerate Remediation of Petroleum-contaminated Soils Biological Treatment of Petroleum in Radiologically Contaminated Soil Petrodiesel Fuels Use of Surfactants in the Bioremediation of Petroleum-contaminated Soils

These three volumes provide valuable information to help bring rational and scientifically feasible solutions to petroleum contaminated soils. State-of-the-art information

on both technical and regulatory issues is covered, including environmental fate, health effects, risk assessment and remedial alternatives. They show why petroleum contaminated soils are a problem - and propose solutions for that problem. These books are an excellent reference for regulatory personnel and environmental consultants at all levels. This synthesis will be of interest to state transportation personnel involved with project planning and location (administrative and regulatory personnel), design staff (general civil, geotechnical, and environmental engineers), and project managers (construction and maintenance engineers and staff). It will also be of interest to federal and state environmental agencies and to environmental consultants and contractors as well as to trainers in the field of petroleum-contaminated soil remediation. This synthesis describes the remedial technologies that may be available to transportation agencies faced with the regulatory responsibility to clean or remediate petroleum-contaminated soils in the vadose zone (unsaturated soils above the groundwater table) at a particular site as well as the state of the practice within the agencies. This report of the Transportation Research Board describes the applicability and cost-effectiveness of alternate technologies to remediate petroleum-contaminated soil. Practices currently being used by state transportation agencies to remediate petroleum-contaminated soils, both on site and off site are also described. This summary of transportation agency practice complements the limited telephone survey of soil

remediation techniques that was performed in preparing NCHRP Report 351, Hazardous Wastes in Highway Rights-of-Way. The amount of petroleum contaminated soil (PCS) at the Savannah River site (SRS) that has been identified, excavated and is currently in storage has increased several fold during the last few years. Several factors have contributed to this problem: (1) South Carolina Department of Health ad Environmental control (SCDHEC) lowered the sanitary landfill maximum concentration for total petroleum hydrocarbons (TPH) in the soil from 500 to 100 parts per million (ppm), (2) removal and replacement of underground storage tanks at several sites, (3) most recently SCDHEC disallowed aeration for treatment of contaminated soil, and (4) discovery of several very large contaminated areas of soil associated with leaking underground storage tanks (LUST), leaking pipes, disposal areas, and spills. Thus, SRS has an urgent need to remediate large quantities of contaminated soil that are currently stockpiled and the anticipated contaminated soils to be generated from accidental spills. As long as we utilize petroleum based compounds at the site, we will continue to generate contaminated soil that will require remediation. SOILS CONTAMINATED BY MOTOR FUELS: RESEARCH ACTIVITIES AND PERSPECTIVES OF THE AMERICAN PETROLEUM INSTITUTE; A STATE'S PERSPECTIVE OF THE PROBLEMS ASSOCIATED WITH PETROLEUM CONTAMINATED SOILS; ELECTRIC UTILITY PERSPECTIVE OF THE CLEANUP OF PETROLEUM CONTAMINATED SOILS; PROBLEMS DEALING WITH

PETROLEUM CONTAMINATED SOILS: A NEW JERSEY PERSPECTIVE; FEDERAL UNDERGROUND STORAGE TANK REGULATIONS AND CONTAMINATED SOILS; MODELING PETROLEUM PRODUCTS IN SOILS; MOVEMENT AND RETENTION OF ORGANICS IN SOIL: A REVIEW AND A CRITIQUE OF MODELING; APPLICABILITY OF POSSM TO PETROLEUM PRODUCT SPILLS; THE UTILITY OF ENVIRONMENTAL FATE MODELS TO REGULATORY PROGRAMS; AVAILABLE REMEDIAL TECHNOLOGIES FOR PETROLEUM CONTAMINATED SOILS; AN EVALUATION OF ORGANIC MATERIALS THAT INTERFERE WITH STABILIZATION/SOLIDIFICATION PROCESSES; IN SITU VITRIFICATION PROCESSING OF SOILS CONTAMINATED WITH HAZARDOUS WASTES; FIELD STUDIES OF IN SITU SOIL WASHING; LAND TREATMENT OF HYDROCARBON CONTAMINATED SOILS; ASPHALT BATCHING OF PETROLEUM CONTAMINATED SOILS AS A VIABLE REMEDIAL OPTION; INCORPORATION OF CONTAMINATED SOILS INTO BITUMINOUS CONCRETE; LOW TEMPERATURE STRIPPING OF VOLATILE COMPOUNDS; RECOVERY TECHNIQUES AND TREATMENT TECHNOLOGIES FOR PETROLEUM AND PETROLEUM PRODUCTS IN SOIL AND GROUNDWATER; risk assessment for soils contaminated with petroleum products, an overview; a methodology for evaluating the environmental and public health risks of contaminated soil; review of present risk assessment models for petroleum contaminated soils;

determination of exposure of oral and dermal benzene from contaminated soils; epidemiological study to estimate how much soil children eat; a site specific approach for the development of soil cleanup guidelines for trace organic compounds. Principles and Practices for Petroleum Contaminated Soils includes some of the best research and practical work done by top researchers in the field-both in industry and academia. It covers fundamental and advanced topics, such as analysis and site assessment, techniques (e.g., vacuum extraction, asphalt incorporation), and case studies. The book will interest anyone working with contaminated soils, ground water, and underground storage tanks. It will also be a valuable reference for regulatory personnel and environmental consultants at all levels. Federal regulations have required thousands of underground storage tanks (USTs) to be dug up and removed or replaced. The contamination of soil and ground water from leaking USTs has become widespread and has produced an overwhelming number of sites that require remediation. Assessment and Remediation of Petroleum Contaminated Sites presents the broad scope of the remedial process from initial site assessment to closure in an integrated, understandable format. The book guides you effortlessly through regulatory requirements, site assessments and sampling, and remediation methods. RCRA and CERCLA federal regulations are addressed. The chemistry and toxicology of petroleum hydrocarbons in the remediation process are explained, and factors affecting soil remediation are discussed. Environmental

assessments, site characterizations, remediation planning, and remediation methods are all covered in detail. The book is an essential guide for environmental consultants, regulatory agency personnel, engineers, and environmental attorneys. This third volume of the handbook presents a representative sample of the population papers in the field of petrodiesel fuels. Following the substantial public concerns on the adverse impact of the emissions from petrodiesel fuels on the environment and human health, the research has intensified in the areas related to the reduction of these adverse effects. Thus, bioremediation of spills from crude oils and petrodiesel fuels at sea and soils as well as desulfurization of petrodiesel fuels have emerged as publicly important research areas. Similarly, the emissions from diesel fuel exhausts, due to their adverse effects on both human health and environment, have been researched more in recent years. These emissions cover particulate emissions, aerosol emissions, and NOx emissions. Research on the adverse impact of petrodiesel fuel exhaust emissions on human health has primarily progressed along the lines of respiratory illnesses, cancer, and other illnesses, such as cardiovascular illnesses, brain illnesses, and reproductive system illnesses, through human, animal, and in vitro studies. It is clear that these illnesses caused by the petrodiesel fuel exhaust emissions have been one of the most significant reasons to develop alternative biodiesel fuels. Part IX presents a representative sample of the population papers in the field of crude oils covering major research fronts. It covers crude oil spills in

general, crude oil spills and their cleanup, properties and removal of crude oils, biodegradation of crude oil-contaminated soils, and crude oil recovery besides an overview paper. Part X presents a representative sample of the population papers in the field of petrodiesel fuels in general covering major research fronts. It covers combustion of biodiesel fuels in diesel engines, bioremediation of biodiesel fuel-contaminated soils, biodiesel power generation, and desulfurization of diesel fuels besides an overview paper. Part XI presents a representative sample of the population papers in the field of emissions from petrodiesel fuels covering major research fronts. It covers diesel emission mitigation, diesel particulate emissions, and diesel NOx emissions, besides an overview paper. Part XII presents a representative sample of the population papers in the field of the health impact of the emissions from petrodiesel fuels covering major research fronts. It covers respiratory illnesses, cancer, cardiovascular, brain, and reproductive system illnesses, besides an overview paper. This book will be useful to academics and professionals in the fields of Energy Fuels, Public Environmental Occupational Health, Pharmacology, Pharmacy, Immunology, Respiratory System, Allergy, and Oncology. Ozcan Konur is both a materials scientist and social scientist by training. He has published around 200 journal papers, book chapters, and conference papers. He has focused on the bioenergy and biofuels in recent years. In 2018, he edited Bioenergy and Biofuels, which brought together the work of over 30

experts in their respective field. He also edited the Handbook of Algal Science, Technology, and Medicine with a strong section on the algal biofuels in 2020. This chapter describes ex situ bioremediation of the petroleum portion of radiologically co-contaminated soils using microorganisms isolated from a waste site and innovative bioreactor technology. Microorganisms first isolated and screened in the laboratory for bioremediation of petroleum were eventually used to treat soils in a bioreactor. The bioreactor treated soils contaminated with over 20,000 mg/kg total petroleum hydrocarbon and reduced the levels to less than 100 mg/kg in 22 months. After treatment, the soils were permanently disposed as low-level radiological waste. The petroleum and radiologically contaminated soil (PRCS) bioreactor operated using bioventing to control the supply of oxygen (air) to the soil being treated. The system treated 3.67 tons of PCRS amended with weathered compost, ammonium nitrate, fertilizer, and water. In addition, a consortium of microbes (patent pending) isolated at the Savannah River National Laboratory from a petroleum-contaminated site was added to the PRCS system. During operation, degradation of petroleum waste was accounted for through monitoring of carbon dioxide levels in the system effluent. The project demonstrated that co-contaminated soils could be successfully treated through bioventing and bioaugmentation to remove petroleum contamination to levels below 100 mg/kg while protecting workers and the environment from radiological contamination. This book provides a balanced,

comprehensive introduction to major application of Visible Near Infrared Diffuse Reflectance Spectroscopy (VisNIR DRS) in detecting oil contaminated soils. Moreover, the approaches will provide a methodology that could be adapted by many of the reclamation agencies and organizations involved, directly benefiting the people, wildlife and the environment. This updated book is appropriate for students preparing for careers in industry and environmental organizations. Basic knowledge of chemistry and statistics is prerequisite. In the process of Savannah River Site (SRS) operations limited amounts of waste are generated containing petroleum, and radiological contaminated soils. Currently, this combination of radiological and petroleum contaminated waste does not have an immediate disposal route and is being stored in low activity vaults. SRS developed and implemented a successful plan for clean up of the petroleum portion of the soils in situ using simple, inexpensive, bioreactor technology. Treatment in a bioreactor removes the petroleum contamination from the soil without spreading radiological contamination to the environment. This bioreactor uses the bioventing process and bioaugmentation or the addition of the select hydrocarbon degrading bacteria. Oxygen is usually the initial rate-limiting factor in the biodegradation of petroleum hydrocarbons. Using the bioventing process allowed control of the supply of nutrients and moisture based on petroleum contamination concentrations and soil type. The results of this work have proven to be a safe and cost-effective

means of cleaning up low level radiological and petroleum-contaminated soil. Many of the other elements of the bioreactor design were developed or enhanced during the demonstration of a "biopile" to treat the soils beneath a Polish oil refinery's waste disposal lagoons. Aerobic microorganisms were isolated from the aged refinery's acidic sludge contaminated with polycyclic aromatic hydrocarbons (PAHs). Twelve hydrocarbon-degrading bacteria were isolated from the sludge. The predominant PAH degraders were tentatively identified as Achromobacter, Pseudomonas Burkholderia, and Sphingomonas spp. Several Ralstonia spp were also isolated that produce biosurfactants. Biosurfactants can enhance bioremediation by increasing the bioavailability of hydrophobic contaminants including hydrocarbons. The results indicated that the diversity of acid-tolerant PAH-degrading microorganisms in acidic oil wastes may be much greater than previously demonstrated and they have numerous applications to environmental restoration. Twelve of the isolates were subsequently added to the bioreactor to enhance bioremediation. In this study we showed that a bioreactor could be bioaugmented with select bacteria to enhance bioremediation of petroleum-contaminated soils under radiological conditions. Environmental regulations place new responsibilities on property owners; Providing environmental impairment liability insurance coverage; Issues affecting contaminated soils management, the railroad industry perspective; Implications of dealing with real estate-based cleanup statutes; Current issues in

management of motor fuel contaminated soils; EPRI sponsored research on underground storage tanks; Health effects research initiatives at the Agency for Toxic Substances and Disease Registry, applicability to contaminated soils; Underground storage tanks releases in Arizona, causes, extent, and remediation; State of research and regulatory apporach of state agencies for cleanup of petroleum contaminated soils; Analysis of petroleum contaminated soil and water, an overview; Field screening techniques, quick and effective tools for optimizing hazardous waste site investigations; Onsite analytical screening of gasoline contaminated media using a jar headspace procedure; Problems associated with analysis of petroleum derived materials in the environment; Three common misconceptions concerning the fate and cleanup of petroleum products in soil and groundwater; The effect of water soluble organic material on the transport of phenanthrene in soil; Stabilized petroleum waste interaction with silty clay subgrade; Enhanced bioremediation techinques for in situ and onsite treatment of petroleum contaminated soils and groundwater; Biodegradation of dissolved aromatic hydrocarbons in gasoline contaminated groundwaters using denitrification; Bioremediation of petroleum contaminated soils using a microbial consortia as inoculum; Cutoff walls to contain petroleum contaminated soils; Thermal desorption of hazardous and toxic organic compounds from soil matrices; Hot mix asphalt technology and the cleaning of contaminated soil; Removing petroleum products from soils with ozone, ultraviolet, ultrasonics, and

ultrapure water; Cleanup of a gasoline contaminated site using vacuum extraction technology; Using soil vapor contaminant assessment at hydrocarbon contaminated sites; Application of quantitative risk assessment evaluation of underground storage tanks to insurance, banking, and real estate transactions; Assessment and remediation of residential properties contaminated with home heating oil, case studies; Overview, Risk assessment/risk management; Creative approaches in the study of complex mixtures, evaluating comparative potencies; How much soil do young children ingest, an epidemiologic study; Percutaneous absorption of Benzo(a)pyrene from soils with and without petroleum crude contamination; An overview and suggested methodology to determine the adequacy of cleanup of contaminated soils; Toward economically efficient management of underground storage tanks, a risk based approach; The California leaking underground fuel tank field manual, a guidance document for assessment of underground fuel leaks; Letting the sleeping dog lie, a case study in the no-action remediation alternative for petroleum contaminated soils; Council for Health and Environmental Safety of Soils (CHESS), a coalition to standardize soil contamination problems. This document is for owners of contaminated sites who wish to remediate their sites using the independent process (Cf. p. 1). This book combines the results of current research with essential background material to provide complete, in-depth coverage of every aspect of in situ and ex situ bioremediation, as well as an extensive overview of the physical and chemical processes

currently available for treating petroleum-contaminated soils. Critical information has been collected and assembled under one cover to provide a convenient reference for anyone who must contend with this worldwide problem. Remediation of Petroleum Contaminated Soils: Biological, Physical, and Chemical Processes describes how to optimize the biodegradation of petroleum hydrocarbons in soil-water systems. It reports on the susceptibility of various petroleum components to biodegradation by microorganisms, and considers all groups of microorganisms for their potential contributions. The book also deals with problem areas such as the transport of organisms, oxygen, or nutrients throughout the subsurface, as well as biodegradation of polynuclear aromatic hydrocarbons (PAHs) and nonaqueous phase liquids (NAPLs). In addition, the book presents a variety of methods for monitoring bioremediation. This reference discusses current soil remediation processes and includes many innovative approaches. It also investigates means of controlling volatile organic compounds (VOCs) and leachate, and addresses methods for collecting and treating these secondary waste streams. The expansive coverage of this book will furnish readers with a wide range of options for developing treatment strategies and for customizing procedures for specific requirements. These three volumes provide valuable information to help bring rational and scientifically feasible solutions to petroleum contaminated soils. State-of-the-art information on both technical and regulatory issues is covered, including environmental fate,

health effects, risk assessment and remedial alternatives. They show why petroleum contaminated soils are a problem - and propose solutions for that problem. These books are an excellent reference for regulatory personnel and environmental consultants at all levels. Petroleum contamination is ubiquitous during extraction, transportation, refining, and storage. Contamination damages the soil's ecosystem function, reduces its aesthetics, and poses a potential threat to human beings. The overall goals of this dissertation are to advance understanding of the mechanisms behind ozonation of petroleum-contaminated soil and to configure an effective integrated bioremediation and ozonation remedial strategy to remove the overall organic carbon. Using a soil column, I conducted batch ozonation experiments for different soils and at different moisture levels. I measured multiple parameters: e.g., total petroleum hydrocarbons (TPH) and dissolved organic carbon (DOC), to build a full understanding of the data that led to the solid conclusions. I first demonstrated the feasibility of using ozone to attack heavy petroleum hydrocarbons in soil settings. I identified the physical and chemical hurdles (e.g., moisture, mass transfer, pH) needed to be overcome to make the integration of chemical oxidation and biodegradation more efficient and defines the mechanisms behind the experimental observations. Next, I completed a total carbon balance, which revealed that multiple components, including soil organic matter (SOM) and non-TPH petroleum, competed for ozone, although TPH was

relatively more reactive. Further experiments showed that poor soil mixing and high soil-moisture content hindered mass transfer of ozone to react with the TPH. Finally, I pursued the theme of optimizing the integration of ozonation and biodegradation through a multi-stage strategy. I conducted multi-stages of ozonation and bioremediation for two benchmark soils with distinctly different oils to test if and how much ozonation enhanced biodegradation and vice versa. With pH and moisture optimized for each step, pre-ozonation versus post-ozonation was assessed for TPH removal and mineralization. Multi-cycle treatment was able to achieve the TPH regulatory standard when biodegradation alone could not. Ozonation did not directly enhance the biodegradation rate of TPH; instead, ozone converted TPH into DOC that was biodegraded and mineralized. The major take-home lesson from my studies is that multi-stage ozonation and biodegradation is a useful remediation tool for petroleum contamination in soil. Paul T. Kostecki, Associate Director, Northeast Regional Environment Public Health Center, School Of Public Health, University Of Massachusetts At Amherst, Received His Ph.D. From The School Of Natural Resources At The University Of Michigan In 1 980. He Has Been Involved With Human And Ecological Risk Assessment And Risk Management Research For The Last 12 Years. Dr. Kostecki Has Co-Authored And Co-Edited Over 50 Articles And 16 Books On Environmental Assessment And Cleanup Including: Remedial Technologies For Leaking Underground Storage

Tanks, Soils Contaminated By Petroleum Products; Petroleum Contaminated Soils, Vols. 1 To 3: Hydrocarbon Contaminated Soils And Groundwater, Vols. 1 To 4; Hydrocarbon Contaminated Soils, Vols. 1 To 5; Principles And Practices For Diesel Contaminated Soils, Vols. 1 To 5; Sesoil In Environmental Fate And Risk Modeling, Contaminated Soils, Vol. 1 And Risk Assessment And Environmental Fate Methodologies.Dr. Kostecki Also Serves As Associate Editor For The Journal Of Soil Contamination, Chairman Of The Scientific Advisory Board For Soil And Groundwater Cleanup Magazine As Well As An Editorial Board Member For The Journal Of Human And Ecological Risk Assessment.In A Addition. Dr. Kostecki Serves As Executive Director For The Association For The Environmental Health Of Soils (Aehs) And Was The Scientific Advisor For The Workshop On Assessment And Remediation Of Oil Contaminated Soils Held In Kuwait 18-22 March 1995.Dr. Manaf Behbehani Obtained His B.S. In Biology From The University Of Akron, Usa (1969) And M.S. In Zoology From The Same University (1972). He Continued His Graduate Studies At The University Of New Hampshire Receiving Ph.D. In Marine Ecology And Invertebrates In 1978. Since Then, He Has Been Teaching Ecology And Marine Biology Courses At The Faculty Of Science, Kuwait University. From 1 982-1987, He Held The Post Of Marine Scientist At The Regional Organisation For The Protection Of The Marine Environment (Ropme) In Kuwait. Dr. Behbehani Has Worked On A Number Of Pioneering Research Projects, Namely To Study The

Zooplankton Of Kuwaiti Waters And The Western Section Of The Arabian Gulf, And To Study The Distribution, Abundance And Taxonomy Of Marine Invertebrates Living In The Intertidal Zones Of Kuwait. He Has Published Several Scientific Articles And Has Served As External Examiner For Several Masters Thesis. From 1991-1995, Dr. Behbehani Was Vice-Dean For Planning And Laboratories At The Faculty Of Science, Kuwait University And Is Presently Chairman Of The National Biodiversity Committee, State Of Kuwait. He Was The Chairman Of The Scientific Committee For The Workshop On Assessment And Remediation Of Oil Contaminated Soils, The Proceedings Of Which Are Published In This Book. This study evaluated the TPH (total petroleum hydrocarbon) cleanup standard for petroleum contaminated soils (PCS). Regulators from thirteen states were surveyed to characterize current standards used for PCS cleanup and regulatory viewpoints on the use of a TPH versus a BTEX (benzene, toluene, ethylbenzene, xylene) cleanup standard. BTEX was identified as the compound specific standard used most frequently by states for cleanup of PCS. The research found that the regulatory community considers BTEX the most mobile and toxic surrogates of petroleum. Regulators, however, expressed concern that the use of a compound specific standard, without an accompanying analysis for TPH, might result in residual soil contamination that may present risk. This study also evaluated the ratio of BTEX to TPH in soil against the ratio found in a pre-spilled product. Based on JP-4 contaminated soil data contained in

the Air Force Installation Restoration Program Information Management System database, this study demonstrated that the ratio of BTEX to TPH is statistically less than the pre-spilled product ratio. The results indicate that the assumption used by the California Leaking Underground Storage Tank manual and Stokman and Dime's research, that the ratio of BTEX to TPH remains constant in soil over time, is not valid. A conclusion is made that the use of this assumption in deriving TPH levels, which are protective of groundwater and human health, may be overly conservative. Lastly, this research identifies potential cost savings that would result if a BTEX based standard, versus a TPH based standard, were required at all Air Force petroleum contaminated sites. This study shows that only 13% of sites requiring cleanup under a TPH standard would require cleanup under a BTEX based standard. These three volumes provide valuable information to help bring rational and scientifically feasible solutions to petroleum contaminated soils. State-of-the-art information on both technical and regulatory issues is covered, including environmental fate, health effects, risk assessment and remedial alternatives. They show why petroleum contaminated soils are a problem - and propose solutions for that problem. These books are an excellent reference for regulatory personnel and environmental consultants at all levels. These three volumes provide valuable information to help bring rational and scientifically feasible solutions to petroleum contaminated soils. State-of-the-art information on both technical and regulatory issues is covered,

including environmental fate, health effects, risk assessment and remedial alternatives. They show why petroleum contaminated soils are a problem - and propose solutions for that problem. These books are an excellent reference for regulatory personnel and environmental consultants at all levels.

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