GREAT LAKES NAVAL TRAINING CENTER
ENVIRONMENTAL FIELD ACTIVITIES - MIDWEST

BIO-PILE OPERATION AND MAINTENANCE MANUAL FOR SOIL REMEDIATION

FIRE FIGHTING TRAINING UNIT
GREAT LAKES, IL

October, 1997

Prepared by:

BELING CONSULTANTS
CONTRACT # N68950-95-D-9021

LETTER OF TRANSMITTAL

BELING CONSULTANTS

Professional Engineering and Environmental Services

October 28, 1997

Department of the Navy
Engineering Field Activity, Midwest
Naval Facilities Engineering Command
Bldg 1-A
2703 Sheridan Road, Suite #120
Great Lakes, IL 60088-5600

ATTENTION: J.P. Messier

SUBJECT: BIO-PILE OPERATION & MAINTENANCE MANUAL
SOIL REMEDIATION
FFTU PROJECT, GREAT LAKES, IL

Dear Mr. Messier:

Enclosed is the final draft of the Operations & Maintenance (O & M) manual for the treatment of soils excavated at the FFTU during demolition of subsurface structures and piping. The manual is provided in accordance with our Contract #N68950-95-D-9021 and pursuant to our timeline for deliverables due to you under the Contract #N68950-95-D-9021.

The O & M manual includes brief descriptions of the project, clean-up objectives, specific system requirements and appropriate operation and maintenance procedures.

Please call if you have any questions regarding this O & M manual.

Sincerely,

BELING CONSULTANTS, INC.

Molly Arp Newell, CHMM, PG
Manager, Environmental Compliance

cc: Donald Harrison, IEPA Federal Facilities
Laura Ripley, IEPA Federal Facilities

Contract #N68950-95-D-9021

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1.0 INTRODUCTION

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As a result of past fire fighting training exercises, soil and shallow groundwater contamination was identified at the Great Lakes Naval Training Center Fire Fighting Training Unit (FFTU). Based on the type of released materials, the chemical compounds of concern are Benzene, Toluene, Ethylbenzene, Xylene (BTEX) and Polynuclear Aromatic Hydrocarbons (PNAs). Bio-pile technology was the remedial method utilized in the field pilot study. The bio-pile technology involves placing petroleum-contaminated soils into piles or cells above ground and stimulating aerobic microbial activity within the contaminated soils.

1.1 Background and Objectives

The purpose of this operations and maintenance manual (O & M) is to describe practices for treating the soils at the bio-piles constructed at the FFTU site. This O & M Plan follows sound engineering principals and those of the *Bio-pile Design and Construction Manual* (NFESC, 1996, TM-2189-ENV).

1.2 Overview

Bio-pile treatment involves forming petroleum-contaminated soils into piles or cells above ground and stimulating aerobic microbial activity within the soils by aerating the soils with natural air flow. Microbial activity is enhanced by adding moisture and nutrients such as nitrogen or phosphorus.

The aerobic microbial activity degrades the petroleum-based constituents adsorbed to soil particles, thus reducing the concentrations of these contaminants. The bio-pile system installed at the FFTU includes the following:

1. an impermeable base to reduce the potential migration of leachate from the pile.

2. perforated air inlet piping installed above the base to induce air flow through the bio-pile.
3. a cover to prevent uncontrolled evaporation, water addition to the pile by precipitation and wind erosion.
4. in-pile monitoring equipment.
5. a moisture and nutrient application system.
6. a separate leachate collection system.

Well-organized and scheduled inspections, adjustments, and maintenance of these features must be performed for the safe, efficient, and cost-effective operation of the bio-pile treatment system. The design features and equipment selection for bio-pile treatment helped to minimize the O&M requirements. Because bio-pile systems operate at steady state for months, complex control equipment and remote-actuated valves are not required.

1.3 Scope.

This manual is intended to provide technical guidance on the operations and maintenance of bio-piles used to remediate soils contaminated with petroleum-based organic contaminants. The information in this O&M Manual refers to the site-specific design, construction, contaminant levels, equipment, and instrumentation used at the Great Lakes Naval Training FFTU site.

The description of bio-pile operations and maintenance is grouped into three sections as follows:

- The introduction (Section 1.0)

2.0 BIO-PILE SYSTEM MANAGEMENT

- A discussion of the O&M activities involved in bio-pile system management (Section 2.0)
- A discussion of the sampling and analysis methods used in bio-pile management (Section 3.0)

1.4 Clean-up Objectives

The general objective of the site remediation is to mitigate and minimize threats to and provide adequate protection of public health and the environment. The clean up goal for the soil and associated groundwater remediation are the cleanup objectives for petroleum contamination found in Title 35 Illinois Administrative Code Part 742 - Tired Approach to Clean-up Objectives.

2.0 BIO-PILE SYSTEM MANAGEMENT

Bio-pile treatment requires a period of operations and maintenance before cleanup goals can be reached. Typically, a bio-pile treatment cell is operated for 6 months to 1 year, after which time the treated soil should meet the remedial objectives. This section describes methods for operating the bio-pile system.

2.1 Crew Training and Experience Requirements.

The workers at the FFTU bio-pile site should be familiar with the chemical and physical hazards involved and methods to mitigate the hazards. Typical sources of hazards include organic contaminants in the soil, chemical fertilizers and heavy equipment. More information about the health and safety aspects of bio-pile operation is provided in the FFTU Health and Safety Manual.

2.2 System Start-up

Base line soil samples were collected during bio-pile construction. The soil type, soil moisture and content, contaminant type, and contamination concentration was measured and recorded. The initial temperatures, soil gas concentrations of O_2, carbon dioxide (CO_2), and Photo Ionization Detector (PID) readings will be measured at several monitoring points throughout the remediation period. Initial nutrients, microbes and moisture will be augmented based on bio-pile monitoring measurements.

2.3 Routine Inspections

Bio-pile systems are simple and reliable but are not immune to wear and breakage. This section describes routine inspections that are needed for continued operation of the bio-pile.

Once constructed, the bio-pile will be operated to optimize biological destruction of contaminants while limiting the quantity of volatile contaminants removed by vapor transport. Periodic monitoring is required to measure system performance, and system adjustments may be needed to adapt to declining contaminant concentrations or other changing conditions in or around the bio-pile.

A monthly inspection and operations check will be established and documented. A walk-by check will include visual inspection of the pile cover, berm, and piping. The inspector should be alert for unusual odors. Odors may indicate that the pile is not adequately aerated and not operating effectively. The weekly walk by check should be supplemented monthly by a more complete set of checks and measurements. Monthly checks and measurements include the following:

1. Record date and time of measurements and name of sample collector.
2. Record ambient air temperature.

3. Document a visual inspection of the bio-pile components.
4. Measure bio-pile temperature in each monitoring point.

2.4 Bio-pile Additive Requirements

The project engineer will examine the bio-pile monthly for the following:

1. Soil moisture content shall be maintained between 20 and 40 percent dry weight.
2. Soil pH shall be maintained between 6.5 and 7.5.
3. PID measurements of apparent volatile organic content.
4. Periodic addition of water and nutrients may required.
5. O_2 concentrations should be maintained between 15 to 20%.
6. Additional chemical analysis will be addressed under Section 3 -Site Sampling Plan.

If the monthly measurements indicate that the moisture concentration in the bio-pile is below 20%, water should be added through the soaker lines until the upper level of the target moisture content is reached.

If the monthly measurements indicate that the pH concentration in the bio-pile is outside of the recommended range, a buffer solution should be added through the soaker lines until the pH is corrected.

If PID measurements indicate that indigenous and supplemental microbes are deficient in nutrients and/or oxygen, an inoculation event many be scheduled in conjunction with aeration measures.

If the monthly measurements indicate that the O_2 concentration in soil gas in the bio-pile is below 5% to 8%, the number of air inlet pipes should be increased. Similarly, if the O_2 concentration in soil gas near an aeration leg approaches 20%, the air flow to the leg should be decreased to preserve warmth and moisture. The target O_2 concentration in the soil gas during bio-pile operation is 10 to 20%.

2.5 Supply Scheduling

To the extent possible, the bio-pile system should be operated on "just-in-time" inventory principles. Plans for receiving new soil for treatment and purchasing fertilizer chemicals are designed to minimize the time materials are stored on site. If the contaminated soil can be directly placed on the bio-pad rather than stored on the storage pad, the material would be handled only one time. However, scheduling must be flexible to account for the uncertainties inherent in environmental projects. Factors such as unexpected variations in the bio-degradation rate, long-term deviations from normal climatic conditions, delays in receiving analysis results for soils, or results indicating that required contaminant concentrations were not achieved may occur.

Beling will coordinate transport schedules with Navy Officials desiring to deliver additional soil for final disposition. Proper scheduling will optimize bio-pile the supplies, labor, and equipment resources.

2.6 Bio-pile Cover Repair

Openings in the bio-pile cover may allow excessive moisture input from rain or soil dispersion by wind erosion. A damaged cover should be repaired or replaced immediately if visual inspection detects more than a few small slits in the cover. Slits or tears at depressed areas in the cover will result in larger leaks after a rainfall. Small slits and rips will have little impact. Small tears in polyethylene liners can be repaired with a patch kit such as FABTAPE™, available from Reef Industries, or a similar product.

If a repair is completed with a patch kit, ensure that the surfaces to which the patch is applied have been cleaned to remove dirt and moisture. If a patch kit repair is not feasible and the cover damage is significant, replace the cover with 6 ml black plastic.

2.7 Bio-pile Piping Repair

Inspections may identify damaged valves, hoses or piping in the bio-pile treatment system. Large holes in the soaker hose may be repaired using duct tape. However, it may be easier to insert a replacement hose if the damage is too great.

Damaged delivery manifold piping or damaged valves should be replaced.

2.8 Spill Prevention and Contingency.

Bio-pile operation may generate small quantities of aqueous solutions such as nutrient addition solutions or leachate from the bio-pile. Piles of contaminated soil and agricultural chemicals will be present in the operating area. Spill prevention and control methods should be instituted to minimize the possibility of releases and allow rapid response should an accidental release occur.

2.9 Decontamination Procedures

Decontamination of sampling equipment and bio-pile equipment will be conducted. Decontamination procedures will be as follows:

Bailers and Sample Equipment:

1. The bailers and sample equipment will be decontaminated by disassembling and placing the parts in an Alconox and water mixture.

2. The parts will be brush scrubbed, double tap water rinsed and final rinsed with distilled water.
3. Any decontamination liquids which may be generated will be collected and added to the bio-reactor tank.

Bio-Pile Materials:

1. Upon confirmation of clean-up levels the bio--pile will be disassembled.
2. The PVC piping will be pressure steam cleaned of all soil buildup and reused.
3. Any decontamination liquids which may be generated will be collected and remediated in the bio-reactor tank.

3.0 SAMPLING AND ANALYSIS PROCEDURES

3.0 SAMPLING AND ANALYSIS PROCEDURES

This section outlines the methods of sampling and analysis for the bio-pile installation and routine monitoring. Procedures for sampling soil, soil gas, and leachate (if required) are described. Information is provided for the test parameters and the analytical methods required. All site activities will be recorded in the site record book. Individual checklists and data sheets will be placed in a binder.

3.1 Soil Monitoring Sampling

A minimum total of eight (8) soil monitoring samples will be randomly collected from the bio-pile. Soil samples will be collected from the contaminated soil layers on a monthly bases. A minimum of two (2) soil samples per event will be analyzed. The soil samples will be collected using stainless steel hand auger and packed with zero head space in 500 ml. jars with Teflon lined lids. After the sample is contained and properly labeled, place the sample on ice and ship it to a laboratory for analyses.

The collected samples will be screened using a PID meter. The sample with the highest PID reading will be analyzed. One (1) soil samples will be analyzed for BTEX (Method 8020) and one (1) for PNAs (Method 8310) per sample event. Review of analytical results will determine when final closure sampling will occur.

3.2 Soil Gas Sampling

This sampling method involves directly attach the gas detector to the monitoring point lines and proceed as described in steps 1 through 4:

Step 1. Calibrate the O_2/CO_2 detector and the TPH detector using the appropriate span gases.

Step 2. Attach the O_2/CO_2 detector to the monitoring point and draw soil gas through the detector until the reading stabilizes. Do not record the initial reading, because enough soil gas must clear through the detector to equal the amount originally in the monitoring point sampling line.

Step 3. Record the O_2 and CO_2 readings on Data Sheet DS-2 (Appendix D).

Step 4. Repeat steps 1 through 3 using the PID meter.

For PID readings, this direct soil gas sampling method can be used only when the soil gas oxygen concentrations are >10%. If the O_2 levels drop belong 10%, the 1:1 diluter must be used to collect accurate TPH concentrations. Directly collecting soil gas samples with the 1:1 diluter attached to the PID meter will improperly dilute the sample and generate incorrect data.

3.3 Bio-Pile Temperature Measurement

Soil temperature data are collected by means of soil temperature thermocouples placed in predetermined locations and depths during the bio-pile construction. The data are collected through he thermocouple lead located in the bio-pile. Temperature data are recorded along with soil gas data. To establish the net temperature increase in the bio-pile, changes in the ambient temperature also should be recorded.

3.4 Leachate Sampling

Leachate samples will be collected if leachate is generated. Samples are obtained by a grab sampling method. Grab samples of surface water are collected manually in a clean glass vessel and transferred immediately to a volatile organic analysis (VOA) vial. A Teflon™-lined cap is installed and the vial is inverted to check that there is zero headspace. Multiple vials may be filled from the single grab sample so that enough water is available for the analyses. After the sample is contained and properly labeled, place the sample on ice and ship it to a laboratory for analyses.

3.5 Soil Closure Sampling

Closure sampling of the bio-pile will be conducted following two (2) consecutive bio-pile monitoring events for which all the sample results were below the site specific cleanup objectives. The closure sampling will consist of a minimum of six (6) soil grab samples from six (6) borings collected from the bio-pile. Samples will be collected at every one (1) foot of depth and proceed until the asphalt base is encountered. The soil samples will be collected using stainless steel hand auger and packed with zero head space in 500 ml. jars with Teflon lined lids.

The collected samples will be screened using a PID meter. The soil sample with the highest PID reading per boring will be analyzed for BTEX (Method 8020) and PNAs (Method 8310).

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