Fall 1998

RPM News

▲ Remedial Project Manager News ▲

"Communicating Navy Installation Restoration Program News and Information Among All Participants"

Reduce Overall Cleanup Costs

Optimizing Remedial Action Operations and Long-Term Monitoring

The Navy's Installation Restoration Program (IRP) is progressing to cleanup contaminated sites. In the past, we have focussed our efforts on characterizing our sites and we are continuing to do this, but we are also finding that our attention has shifted to remedy selection, remedial design and, remedial action construction. If we look at the information provided in NORM, we see that the number of Navy sites in the remedial action operations (RAO) and long-term monitoring (LTM) phases will more than double between FY98 and FY03. As might be expected, the cost associated with RAO and LTM will also approximately double and will consume approximately 25% of the total cleanup budget. The dilemma is that funding requirements for RAO and LTM are increasing, but actual total cleanup budget is to remain level. The Navy will be forced to find ways to reduce RAO and LTM costs without sacrificing quality, hence RAO and LTM optimization.

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Before the discussion of optimization can begin, we should first understand what RAO and LTM are. RAO refers to the period when a remedy is being operated but cleanup goals have not yet been reached. This includes operation and maintenance of the system(s) as well as any associated environmental and system(s) monitoring. An operating pump and treat system that has not yet reached cleanup goals would be in the RAO phase. Duration of the RAO phase will depend on site specific conditions and remediation technology. For example, RAO at a pump & treat site with chlorinated solvents will generally require many years, whereas, RAO at a soil vapor extraction site with gasoline contamination may only require 2 to 3 years. LTM occurs after cleanup goals have been reached. LTM may be required to ensure that a remedy remains protective and that no further remedial action is required. In the past, there has been confusion about the difference between RAO and LTM. This is understandable because there is often a significant monitoring component associated with the RAO phase. Just remember that LTM begins after cleanup goals have been reached or, after the RAO phase is completed.

Optimization of RAO and LTM is not rocket science, but it requires that we know what to require of our RAO and LTM contractors. We must ask our contractors to collect the right data and analyze that data to help us make decisions to reduce RAO and LTM operations without a reduction in quality. In addition, we also need to develop acquisition strategies for obtaining services for RAO and LTM. To encourage contractors to perform optimization, we may need to provide incentives based on the cost savings as a result of optimization. Currently, there are no guidelines specific for RAO and LTM.

For optimizing there are some key strategies to keep in mind, but ultimately an optimal LTM plan will be based on sound decision logic. The strategies include reducing sampling frequency, number of monitoring wells, and analytical parameters; modifying sampling procedures to reduce time for field sampling; streamlining data management; analyzing monitoring data; and revising monitoring activities as the project progresses.

(continued on page 2)

RPM NEWS
Remedial Project Manager News

Published By
NFESC

Using Appropriated Funds

Commanding Officer:
Capt. Donald G. Morris

Environmental Department Head (Acting):
Mark Hollan

Information Management Branch:
Mr. Tom Flor

Reduce Overall Cleanup Costs

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Basic strategies for Optimizing RAO include maximizing contaminant mass removal at the lowest cost; reducing operation cost by reducing on-site labor; reducing analysis requirements for monitoring effectiveness of the remediation technology; reducing remediation process monitoring; using remote monitoring for systems that require frequent site visits; and data management and analysis to quantitatively assess progress toward site cleanup. In addition, the LTM optimization strategies will be applicable during RAO for site monitoring.

Recognizing a need to reduce future costs, the Department of the Navy (DON) formed a working group with representatives from Engineering Field Divisions/Activities (EFDs/As), Naval Facilities Engineering Service Center (NFESC), and Chief of Naval Operations (CNO). The Group is to develop guidance for optimizing RAO and LTM at Navy sites. In addition, the Group will also develop guidelines to cost-effectively obtain contract services for RAO and LTM. Case studies will be conducted at selected sites and the lessons learned from the case studies will be used to develop the necessary optimization guidance for Navywide application. The Group recently selected sites for case studies for optimizing LTM. The Group is currently selecting sites for case studies for optimizing RAO. The draft optimization guidance will be available for comments in October 1999. The guidance for acquisition strategy will be available in August 1999.

The Working Group members are:

LANTDIV	(757) 322-4764
CNO	(703) 602-5329
NORTHDIV	(610) 595-0567 x 165
SOUTHDIV	(803) 820-7483
EFACHES	(202) 685-3282
SWESTDIV	(619) 532-2546
EFAWEST	(650) 244-2539
NFESC	(805) 982-1556

For further information, you can contact the group member from your EFD/A or the NFESC.

What's New In The Federal Register?

Find out quickly and easily

New service provides summary of the latest regulatory actions that may impact your projects

Keeping up to date on new federal environmental regulation can be critical to the success of your mission. To help you keep up to date, Naval Facilities Engineering Service Center (NFESC) scans the Federal Register for significant regulatory actions with potential to impact Navy and Marine Corps activities. Regulatory committee meeting notices related to regulation development are also included. A weekly summary is available free by e-mail to interested Department of Defense (DoD) personnel.

Summary entries are categorized so the reader can scan for topics of their own interest. Currently, the major topic categories include: Atomic Energy Act (AEA), Comprehensive Environmental Response, Compensation & Liability Act (CERCLA), Climate Change, Clean Water Act (CWA), Energy, Emergency Planning & Community Right to-know Act (EPCRA), Hazardous Material Transportation, Natural and Cultural Resources, National Environmental Policy Act (NEPA), Noise, Occupational Safety & Health Act (OSHA), Resource Conservation & Recovery Act (RCRA) Hazardous Waste, RCRA Ordnance, Safe Drinking Water Act (SDWA), Site Remediation, Solid Waste, Spill Prevention, Control & Countermeasure/Oil Pollution Act (SPCC/OPA-90), and Toxic Substance Control Act (TSCA). For each entry, a brief summary of the action is provided, along with the regulation citation (e.g., 63CFR 32), a point of contact for further information, and an Internet address linking to the document's full text.

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For more information about this service, (805) 982-1276, DSN 551-1276
(805) 982-2640 (805) 982-1548

Modified Direct Push Monitoring Well Technology

Introduction

Efficient economic sampling events are necessary components of environmental projects. RPMs make a concerted effort to avoid allocating a disproportionate amount of project funds and time for sampling. Subsurface contaminants may be characterized more efficiently by using direct push well (DPW) technology and modified borehole geophysical techniques. The cost of installing DPWs is about 50% lower for shallow DPWs and 75% lower for deep DPWs when compared to traditional well installation. DPW installation up to 30 feet requires about 30% of the time required to install conventional wells. Additionally, the downward migration of contaminants is minimized when compared with traditional drilling methods and no investigative derived wastes (IDW) are generated that require disposal.

Technical Description

The DPWs consist of a double screen system, protected by a steel drive tube with a sacrificial tip that is driven to within five feet of the desired screened interval (**Figure 1**).

Once a desired depth is reached, a 1-1/4 inch diameter outer screen (**Photo 1**) is pushed out of the drive shoe and into the aquifer. A 3/4-inch inner screen is then lowered down into the outer screen. Bentonite slurry is placed in the annular space through the drive shoe to seal the well. A packer prevents the grout from reaching the screened interval. This method minimized the downward migration of contaminants that can occur with traditional drilling methods.

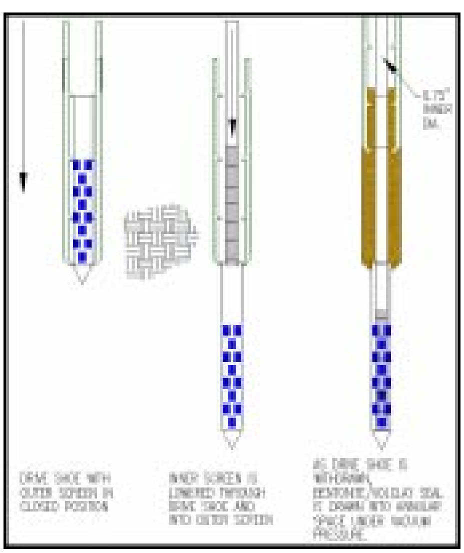

Figure 1 - Installation Steps for a Modified Direct Push Well

Photo 1 - 1.25 Inch Outer Screen

Previous soil investigations at two sites at Naval Station Mayport detected tetrachloroethene (PCE) and pesticides (benzene hexachloride and arsenic). However, groundwater impacts were not characterized. Contaminants in the subsurface were characterized using DPW technology and modified borehole geophysical survey techniques.

Specific tasks included:

1. Boreholes were drilled at each site using a rotary wash method. An experienced geologist used geophysical logging tools at each borehole to characterize subsurface geology prior to installing the DPWs.
2. Forty-two DPWs were installed at depths of 3-10 feet (shallow), 10-15 (intermediate), and 27-32 feet (deep). Some wells were clustered to characterize shallow, intermediate, and deep geological conditions in specified areas.
3. Four 2-inch diameter monitoring wells, using hollow stem auger techniques, were installed adjacent to DPWs to compare sampling and logging data, aquifer test results, and installation costs.

A series of chemical analyses and hydrogeologic tests were run on DPW wells and adjacent 2-inch hollow stem auger wells. Analyte concentrations, specific conductance, and turbidity in the DPWs were within the same magnitude as conventional wells (approximately 6% to 30% higher at the DPWs). Hydraulic conductivity values for DPWs using the Bouwer and Rice Method of Data Evaluation were 20% to 50% lower than the conventional wells. Hydraulic head values were the same.

Advantages of Technology

- The cost of installing DPWs is about 50% lower for shallow DPWs and 75% lower for deep DPWs when compared to traditional well installation.
- DPW installation up to 30 feet requires about 30% of the time required to install conventional wells.
- Additionally, the downward migration of contaminants is minimized when compared with traditional drilling methods.
- No IDW is generated.

Disadvantages

- Hydraulic conductivity values for DPWs may be lower than conventional wells.

Points of Contact:

(805) 982-4890
DSN 551-4890

(904) 270-6730 x31

SCAPS Helps Closeout Site with Local Regulators

The SCAPS platform consists of a 20-ton truck, equipped with a cone penetrometer and Laser Induce Fluorescence (LIF) system used to detect and delineate petroleum, oil, and lubricant plumes in subsurface soil, and to characterize geologic conditions. SCAPS pushes sensors into the ground to detect petroleum hydrocarbons in situ and in real-time.

The Site Characterization & Analysis Penetrometer System (SCAPS), available from both the Navy's San Diego and Jacksonville Public Works Centers, was used in the past year to help close out a former Naval underground storage tank (UST) site. Contamination consisted of diesel and gasoline fuels in both the soil and groundwater.

The following two interviews were conducted by written correspondence between the author and Engineering Field Activity (EFA) West Remedial Project Manager (RPM), John Pfister and the site's regulatory representative, assistant engineer Lane Davis of the Santa Clara Valley, California Water District. The interviews focused on how SCAPS was used at the former UST site, the level of SCAPS success at the site, and the interviewees' overall impressions of SCAPS.

Interview with EFA West RPM, John Pfister

1. *Describe the former UST site and its history*
   The former UST site is now the Naval and Marine Corps Reserve Center (NMCRC) and is located in a residential area of northern San Jose, California. The facility, operating as a refueling center since the early 1940's, had contained two petroleum USTs, one housing gasoline and the other diesel. Currently, it is being used as a meeting place for Naval Reserve Commands.

   In 1990, contaminated soil was detected near the site's two USTs. After UST removal and excavation were performed, the Local Regulatory Oversight Agency (LOA) representative permitted backfilling the site. In 1996, EFA West received a request from the LOA for additional investigation activities, because there was no evidence that all the affected soil was removed. The Navy had assumed that all necessary corrective actions were taken; however, because there was no site closure letter issued, the LOA requirements had not been satisfied.

2. *Why did you choose to use SCAPS at your site?*
   I chose to incorporate SCAPS into the petroleum cleanup program because of the unit's capabilities to conduct rapid, real-time site assessments.

3. *When and for what reason was SCAPS employed at the site?*
   SCAPS was deployed on August 19 and 20, 1997 at the former UST site. As a result of a request for additional information from a LOA, EFA West was required to obtain additional site characterization information.

4. *What were the goals for using SCAPS at the site?*
   The primary goal in the deployment of SCAPS was to provide site-screening information to verify whether impacted soils were removed during the initial tank excavation. In addition to the Laser Induced Fluorescence (LIF) data verifying the existence of petroleum contamination, SCAPS was used to collect both soil and groundwater samples for lab analysis.

5. *Describe the SCAPS efforts*
   Four pushes and eight confirmation samples (seven soil and one groundwater) were taken. The length of time needed to perform the SCAPS characterization was two days in the field, two weeks in the laboratory, and four months to prepare the report, (including review and revision periods).

6. ***How would you compare the characterization processes between SCAPS and the previous method(s)?***
Initially, the USTs were removed and excavation soil samples were collected. These soil samples were taken at discrete depths, while SCAPS provided a continuous, real-time analysis of the site from the surface to groundwater (17 feet below ground surface).

7. ***What is the current site closure status?***
SCAPS helped determine that impacted soils remained onsite. However, based upon the continuous LIF soil analysis, it was determined that there was *no apparent connection between the impacted soils and the groundwater* at the site. In addition, the *concentrations detected in the groundwater were below regulatory limits* for drinking water. Therefore, based upon this information, the LOA made the decision to close the site.

8. ***What were the cost savings assuming site closure?***
At the time the scope was submitted, significant cost savings were realized due to the free SCAPS investigation. However, most of the site's cost savings were achieved after a "no further action" was issued by the LOA due to the findings of the SCAPS investigation.

9. ***What is your overall impression of SCAPS?***
SCAPS can save time and money collecting site information and by providing a foundation for a site closure strategy. The continuous, real-time data collection is a unique feature of this technology. SCAPS can provide an accurate depiction of the site and in some cases, such as in the case of NMCRC San Jose, site closure. SCAPS can also collect soil and groundwater samples to correlate the LIF data to conventional laboratory analysis.

10. ***Would you use SCAPS again?***
Yes. I have also used SCAPS for characterization activities at former Naval Station Treasure Island.

11. ***Would you recommend it to other RPMs?***
Yes. SCAPS can provide useful preliminary site investigation information for petroleum sites. SCAPS is ideal for heavy-end petroleum hydrocarbon sites with soil contamination and can extend the investigation to 150-feet below surface using the LIF. SCAPS can provide an indication of groundwater contamination using LIF, but one must collect a sample(s) to verify level of contamination. SCAPS also has the capability to install and sample a temporary monitoring well.

Interview with site Regulator, Lane Davis

1) ***From whom did you first learn about SCAPS?***
Navy RPM, John Pfister proposed the use of this technology in response to our regulatory directive. The directive entailed investigating the extent of residual petroleum hydrocarbon contamination at the site, San Jose Naval Reserve, 995 East Mission Street, San Jose, CA.

2) ***What were your first impressions of SCAPS?***
Our first impression was whether it could perform to the level presented in the flyer information submitted to us. As a proactive regulatory agency, we are interested in hearing about new technologies, and if they appear feasible and effective (scientifically and fiscally) we are open to their use. We have had consultants use cone penetrometer testing in the past for characterization at fuel leak sites; however, the use of the LIF probe created some hesitation.

3) ***Who convinced you to try SCAPS at the UST site?***
John Pfister asked us to let him demonstrate the effectiveness and benefits of this technology at the site, the District agreed.

4) ***How would you address another regulator's concerns about using SCAPS at their site(s)?***
As a screening tool used for contaminant screening and sample retrieval location, combined with traditional sample retrieval and analysis, it appears that SCAPS is one tool of many that may be considered as appropriate technology in performing environmental investigations.

5) ***Under what site circumstances would you accept the use of SCAPS?***
I think that its use may be appropriate at many fuel leak investigation sites in Santa Clara County.

6) ***Would you consider the use of SCAPS to help close the UST site a success story?***
I think that SCAPS helped determine appropriate sampling depths and locations. The data collected during this phase of investigation allowed regulatory closure of this case.

7) ***How would your characterize the Navy personnel who operated the SCAPS unit? Were they responsive to your concerns?***
The Navy personnel were professional, efficient, and knowledgeable regarding the use of this technology.

8) ***What are your overall impressions of SCAPS?***
SCAPS would be welcomed back as an investigative tool to be used at UST sites in this county.

For more information about SCAPS or its Scheduling into your process, please contact:

PWC – San Diego, CA
(619) 556-9506
DSN 522-9506

PWC – San Diego, CA
(619) 556-9506
DSN 522-9506

New Technology For Chlorinated Compounds in Groundwater

Permeable Reactive Wall

INTRODUCTION

Remedial Project Managers (RPMs) faced with remediating sites having groundwater contamination resulting from chlorinated hydrocarbons such as trichloroethene (TCE), perchloroethene (PCE), dichloroethene (DCE), and vinyl chloride (VC) may solve their problem by using permeable reactive walls. Permeable reactive walls are a passive in-situ technology. One method of installation is accomplished by constructing a trench across the contaminated groundwater flow path by using a funnel-and-gate system. The gate or reactive cell is filled with treatment media (usually zero-valent iron particles) that react with contaminants forming non-toxic, easily biodegradable by-products. The reactive media bordered by a porous material like pea gravel facilitates the uniform flow of contaminated groundwater through the cell. This technology can reduce overall remediation costs while saving considerable time in comparison with the traditional pump and treat methods. Additionally, contaminated soil is not dug up and removed nor is contaminated water pumped and treated. This technology allows normal site usage to continue during remediation, because there is no surface equipment. Electricity is not required, maintenance is minimal, little oversight is required and there is no equipment to repair such as pumps and motors. This technology has been approved and endorsed by the Environmental Protection Agency (EPA), Interstate Technology and Regulatory Cooperation (ITRC) Working Group initiated by Western Governor's Association, Department of Energy (DOE) and Department of Defense (DoD).

Technical Description

The most common reactive media used in the gate is zero-valent iron (Fe^{O}), which is derived from scrap metal that is treated to remove its valence electrons. During site remediation an abiotic reaction occurs on the zero-valent iron surface, which results in the reductive dehalogenation of the chlorinated hydrocarbons in groundwater to form non-toxic iron, chloride, and hydroxide ions and readily biodegradable, light hydrocarbon chain (C2-C5) compounds (ethanes, ethenes, etc.) The basic chemical reaction is as follows:

Fe^{O} + X-C1 + H_20 Æ Fe^{++} + X-H + $C1^{-}$ + OH^{-}

EFA West installed a pilot scale funnel-and-gate system at Moffett Field in April 1996. The reactive wall system has been treating groundwater contaminated with the chlorinated hydrocarbons (TCE, cis 1,2, DCE, and PCE) for the past 2 1/2 years. Performance evaluation criteria include quarterly water quality sampling, gaseous analyte detection, slug and tracer testing, flow velocity meter testing, and hydraulic capture efficiency measurements.

Demonstration results indicate that the Moffett Field reactive wall is reducing the influent TCE, PCE, and DCE concentrations to non-detectable limits within the first few feet of the iron cell (Figure 2).

In 1995, the EPA identified permeable barriers as an emerging technology for groundwater clean up, and suggested it may be appropriate for use at approximately 20% of sites impacted by chlorinated hydrocarbons. Numerous State regulatory agencies together as the (ITRC) and the EPA have published a design guidance document for permeable reactive barriers in September 1997 entitled, "Regulatory Guidance for Per-

Figure 1 - Construction of funnel-and-gate system at Moffett Field

meable Barrier Walls Designed to Remediate Chlorinated Solvents." The document can be found on the Internet at *www.gnet.org* under Government Center, Interstate Cooperation, ITRC Working Group, and then reports.

Design Process and Construction

The design process begins by collecting contaminated groundwater from the site and then performing a bench scale test or treatability study to determine the reaction half-life. This information along with the groundwater flow velocities and modeling, is used to determine the required residence time and the reactive wall design size.

Various construction technologies can be used to install the reactive walls, such as trenching (Figure 3), caisson deployment, clamshell digging, or pressure jetting.

Advantages of Technology

- Passive in-situ detoxification and treatment of groundwater using no external energy source.
- Potential to treat chlorinated hydrocarbons to very low or non-detect levels.
- Long-term unattended operation; usually more cost effective than traditional pump-and-treat systems.

Disadvantages of Technology

- Unknown long-term effects from chemical and/or biological precipitate formation.
- Construction complications from subsurface utilities and/or aboveground structures.

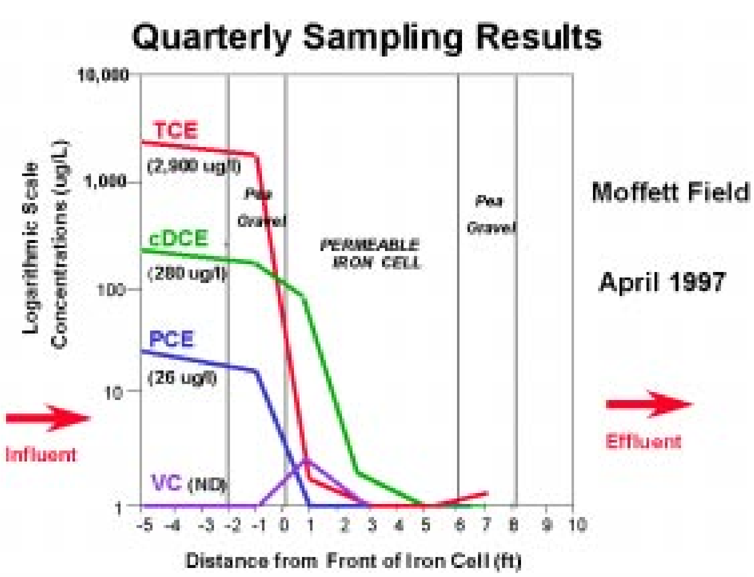

Figure 2 - Quarterly performance sampling results from Moffett Field.

Figure 3 - Specialized "track type" trencher with hopper for reactive media.

Moffett Field Demonstration Results

- Actual hydraulic flow capture of funnel-and-gate systems is similar to modeling predictions.
- Flow meters and tracer studies show forward flow through the reactive cell at about 1/2 to 1 foot per day.
- Water quality results indicate reductions of chlorinated hydrocarbons to below MCLs or below detection limits.
- Iron cell coring results show minimal effects from chemical precipitation
- Long-term use of the reactive wall technology can be up to four times more cost effective than groundwater pump-and-treat.

Lessons Learned

- A proficient knowledge and understanding of the site hydrogeologic characteristics is necessary
- A competent confining layer is required beneath the reactive wall to prevent potential underflow of contaminants
- Site specific bench scale studies and groundwater modeling are strongly recommended
- The keys to successful implementation of this technology are in proper design and construction deployment.

Points of Contact:

EFA WEST, Code 18
(650) 244-2563
DSN 494-2563

NFESC, Code 411
(805) 982-4991
DSN 551-4991

Website: *www.nfesc.navy.mil*

Non-Point Source Pollution Problems?

Here's A Cost Effective Solution

Introduction

Many Navy activities are located adjacent to environmentally sensitive areas such as estuaries, lakes, rivers and oceans where water quality is easily impaired. Contaminated runoff and wastewater from urban, industrial, and agricultural areas is highly variable and may contain low concentrations of pesticides, metals, oils, nutrients, sediments and other substances. It is imperative that non-point source (NPS) pollution be treated before reaching environmentally

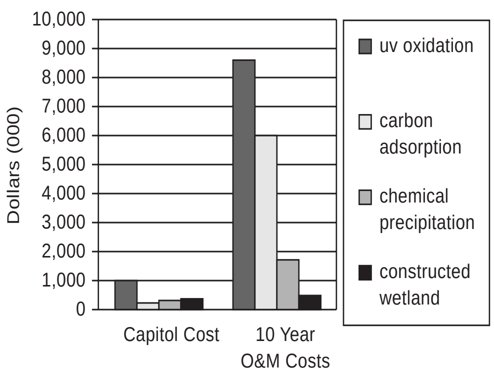

Figure 1 - Technology Cost Comparison.

sensitive habitats. The chemical and physical properties of stormwater contaminants vary. Conventional wastewater treatment plants can effectively remove contaminants, but are costly to build and operate, especially when considering the high flows and low-contamination loading typical of stormwater. An alternative approach is to divert contaminated runoff into a constructed wetland. Wetlands remove contaminants from water through many naturally occurring biological, chemical, and physical mechanisms. Additionally, wetlands are cost effective and require little operation and maintenance. Figure 1 illustrates the cost-effectiveness of constructed wetlands in comparison with three traditional cleanup technologies for treatment of 300 gpm wastewater containing 44 ppm total petroleum hydrocarbons. Per Figure 1 cost savings derived from treatment wetlands results from reduced operation and maintenance costs.

Technical Description

Wetlands treat contaminated water using a combination of removal mechanisms, including (Figure 2):

- Filtration and uptake of contaminants.
- Settling of suspended particulates due to decreased water velocity and trapping action of plant leaves and stems.
- Biodegradation of dissolved organic contaminants and nutrients as dense microorganism populations in sediment and water scavenge for food.
- Precipitation of metals and other inorganic compounds due to the reducing conditions of wetland sediments and soils.
- Photo-oxidation and physical degradation of contaminants.

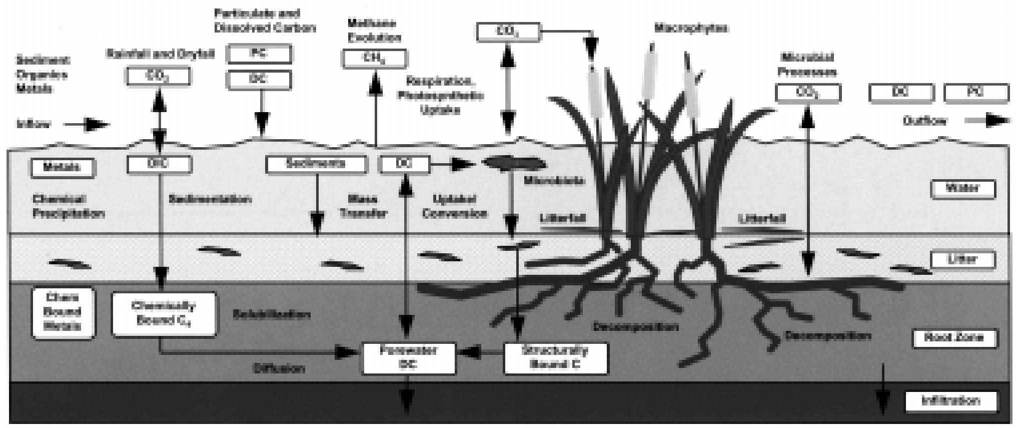

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Figure 2 - Contaminant removal mechanisms of wetlands.

Figure 3 - Constructed wetland at Little Creek Naval Amphibious Base, VA.

An innovative tidal wetland was constructed at the Naval Amphibious Base Little Creek in Norfolk, Virginia, to demonstrate treatment of NPS pollution (Figure 3). The wetland system consists of two adjacent 0.44 acre cells treating roughly 1.7 Mgal water per day. The cells accept water from a conal that drains into Little Creek Cove. The cove is part of the Chesapeake Bay tidal system.

The wetland was constructed during summer 1996 and planted shortly thereafter. Approximately 20,000 salt tolerant native wetland plants were planted. Preliminary results and observations from the constructed wetland indicate that heavy metal contamination of site sediment is being reduced. Arsenic, lead, and chromium levels in sediment are falling while concentrations of these metals in plants are increasing, suggesting that the plants are actively removing the metals from soil. Contaminant levels in stormwater samples have been non-detect to very low.

The system hydraulics perform well. Water flows into and out of the wetlands as designated on each tide cycle. Wildlife, establishment is encouraging as waterfoul, fish, blue crabs, rabbits, muskrats, and other animals have been seen.

Advantages of Technology

- Cost-effective treatment of NPS pollution.
- Reduced operation and maintenance costs compared to conventional water treatment plants.
- Conservation and enhancement of natural resources and creation of wildlife habitat.
- Improved community relations through favorable land use goals.
- Compliance with water quality goals.
- Flood protection.
- Aesthetic value.

Point of Contact:

(805) 982-1668
DSN 551-1668

NAVFAC Awards $$$ for RAC Contracts

NAVFAC recently awarded a billion dollars in RAC contracts to several firms. IT Corp., Foster Wheeler Environmental, and CH2M Hill were all awarded cost-plus-award-fee contracts. Early in the acquisition planning process, we held an industry forum to solicit feedback and improve our acquisition strategy.

Based largely on input from private industry, we used a new approach which included a new two-phased award process and a single, paperless solicitation (on the Internet) to award multiple contracts. To streamline the process, proposals were limited to 50 pages and oral presentations were incorporated into the process.

Through incorporating the lessons from private industry and new acquisition methods, these contracts were awarded in a record 4.5 months (previous process took over 12 months) and pre-award costs to the government and industry were reduced approximately 80%. This tremendous success is a striking example of how working with the private sector to refine our acquisition process have made improvements for everyone. Win-Win at its best.

How do you spell VOC Off-Gas Relief?

A new database is available to help you select from the latest technologies

by NFESC
Southwest Division

Introduction

The Navy has approximately 350 sites contaminated with chlorinated and non-chlorinated hydrocarbons in need of remediation. Many commonly used treatment technologies, such as soil vapor extraction, result in the removal of volatile organic compounds (VOCs) from the soil matrix. In addition, many pollution prevention (P2) and compliance projects need technologies to control or reduce VOC emissions from on-going facility operations, such as painting/depainting and degreasing. The VOC off-gas generated during remediation of these sites must be treated prior to their release into the atmosphere. The VOC release must be controlled by on-site systems to meet stringent air emission standards. If the standards cannot be met, emission reduction credits may need to be purchased, which result in additional costs as well as impacting future operations needing emission credits.

Emissions are controlled or reduced in a variety of ways. There is no easy way for remedial project managers (RPMs) to research all of the proven technologies, and thus to select an optimum system for their application. RPMs (and facility operators) are constantly seeking innovative technologies, which are better, cheaper, and faster for applications to their sites. As a step towards assisting the RPMs, NFESC in partnership with Southwest Division has recently developed an easy-to-use database of VOC off-gas treatment technologies. The main objectives of the database are to present cost and performance data on the available VOC off-gas treatment technologies and provide tools to evaluate and screen these technologies. Data in the database has been pre-screened and normalized by NFESC, and has been packaged such that it requires little training to use. Virtually all the data are either contained on the main screen or can be found only one mouse click away.

This project was conducted under a cooperative working relationship with the Naval Facilities Engineering Command, Southwest Division; NFESC; and NAVFAC Headquarters. Based upon the success of this project, the Navy now has a process in place to select and fund similar type projects on an annual basis. According to this process, the activities/Engineering Field Divisions submit potential project applications to the Alternative Restoration Technology Team (ARTT) for review. The ARTT selection committee then selects the most promising projects, which offer the greatest overall cost savings to the Navy.

The project was very successful because it utilized the research, development, testing, and evaluation (RDT&E) program to solve critical real world problems encountered within Navy clean-up programs. The database can be easily extended to pollution prevention and compliance areas that need to use VOC off-gas treatment technologies due to the similarity of technology applications.

Database Structure

The database is structured in the hierarchy of treatment technologies, then by individual commercial systems of the respective technologies. Based upon a literature search conducted by NFESC, there are seven technologies that could be applicable to VOC off-gas treatment. These are:

- Alkali Bed Reactor
- Catalytic Thermal Oxidation
- Flameless Thermal Oxidation
- Plasma Destruction
- Thermal Oxidation
- UV Oxidation
- Vapor Phase Adsorption

Technology/System Profile

Each technology and specific system configuration is fully described in a profile and illustrated by a schematic diagram. The pros and cons of each technology are provided in an easy-to-read tabular format, and performance and cost data are displayed on screen as the user scrolls through the available technologies. Information provided for each system configuration includes:

- Destruction removal efficiency
- Unit cost range
- Inlet concentration limit
- System flow capacity
- Subcomponents
- Number of units installed
- Secondary hazardous waste generated
- Vendor and point of contact

Unit Cost Estimator

The database has a built-in *Unit Cost Estimator* for calculating unit treatment cost in dollars per pound of VOC treated. This approach allows the user to better assess the relative cost effectiveness of each treatment option. The cost estimator also allows the user to estimate a site-specific application of any of the database technologies by customizing various parameters.

Query/Report Wizard

The heart of the database is the query and report generation module that allows the user to define which database fields to query and which fields to report. This feature was purposely modeled after the NORM query/report wizard to take advantage of a query routine already familiar to the targeted user – the RPM. This feature can be used to prepare user defined tables or lists for the purpose of comparing technologies or their subsystems against one another.

Technology Screening/Evaluation Tools

The NFESC made it easier to compare the strengths and weaknesses of the treatment technologies by providing two kinds of graphics-based screening tools. One is a "Consumer Reports"-like *Screening Matrix* offered from the main screen menu bar. The *Screening Matrix* displays each treatment technology and its associated commercial configurations and rates them according to thirteen different criteria. The screening criteria are:

- Development status
- Availability
- Contaminants treated
- Destruction removal efficiency
- Hazardous waste generated
- Footprint size
- On-site utilities
- Size threshold
- Scale up/down
- Regulatory acceptance
- Community acceptance
- Cost
- Capital or O&M intensive

The second technology evaluation tool features a runtime version of *Expert Choice™ Pro 9.0* software. *Expert Choice™* is a system for the analysis, synthesis, and justification of complex decisions and evaluations. Based on the Analytical Hierarchy Process, this tool allows a decision maker to compare tangible factors with intangible factors. Sensitivity analysis can be performed in five different ways (all graphical) to determine how changes made to one or more judgements affect the final priorities. The NFESC modeled the VOC off-gas treatment technologies into the *Expert Choice™* application to assist with the evaluation and comparisons of the database technologies.

Help

Plenty of online *Help* is available to assist the users. *Help* includes a complete glossary of all terms used within the database, details of the cost model used for the *Unit Cost Estimator*, and provides all major cost and performance assumptions used in formulating the data.

A snap shot of the database main screen is shown in Insert (1). A procedure to interpret the snap shot screen is given in Insert (2), which shows step-by-step description and explanation of all the features of the screen.

Benefits

The database provides an effective tool for RPMs to search available VOC off-gas treatment technologies, including emerging, innovative, and conventional technologies. It allows the user to compare and select technologies that meet site-specific conditions by letting the user make tradeoffs on different parameters in order to determine the optimum technology/system. The easily accessible, normalized data along with the graphical evaluation tools provided by the database will not only save time required to research the technologies, but will assist RPMs in selecting optimum technologies that are better, cheaper, and faster.

Future Plans

The database is currently available on CD ROM and is available to DoD personnel only. It will be available to DoD personnel for download from NFESC web page, at *http://www.nfesc.navy.mil*, by October, 1998. Future efforts include the development of an interactive Internet version that can be executed online through the NFESC web page. The database will be updated by expanding upon cost and performance fields and to incorporate other technologies as they become available. The Internet version of the database is expected to be available by February 1999. The database will be maintained by NFESC and updated semi-annually.

Point of Contact:

(805) 982-1263
DSN 551-1263

TechData Sheets

Biocell Technology (TDS-2017-ENV)

Want an inexpensive way to deal with small quantities of contaminated soil? Try using a biocell. A biocell is an innovative method for treating small quantities of contaminated soils ranging between 20 to 200yd^3 per year. The technology involves loading petroleum-contaminated soils into a dumpster or container, and using enhanced bioremediation to treat the excavated soil. Clean soil can then be returned to the original excavation site or used as fill where needed. The biocell systems are relatively easy to design and construct and at most Navy sites, treatment can be completed in a relatively short period of 3 to 6 months. Biocells are applicable to a wide range of site conditions and petroleum-based contamination. For more information on biocell technology please see the inserted Tech Data Sheet.

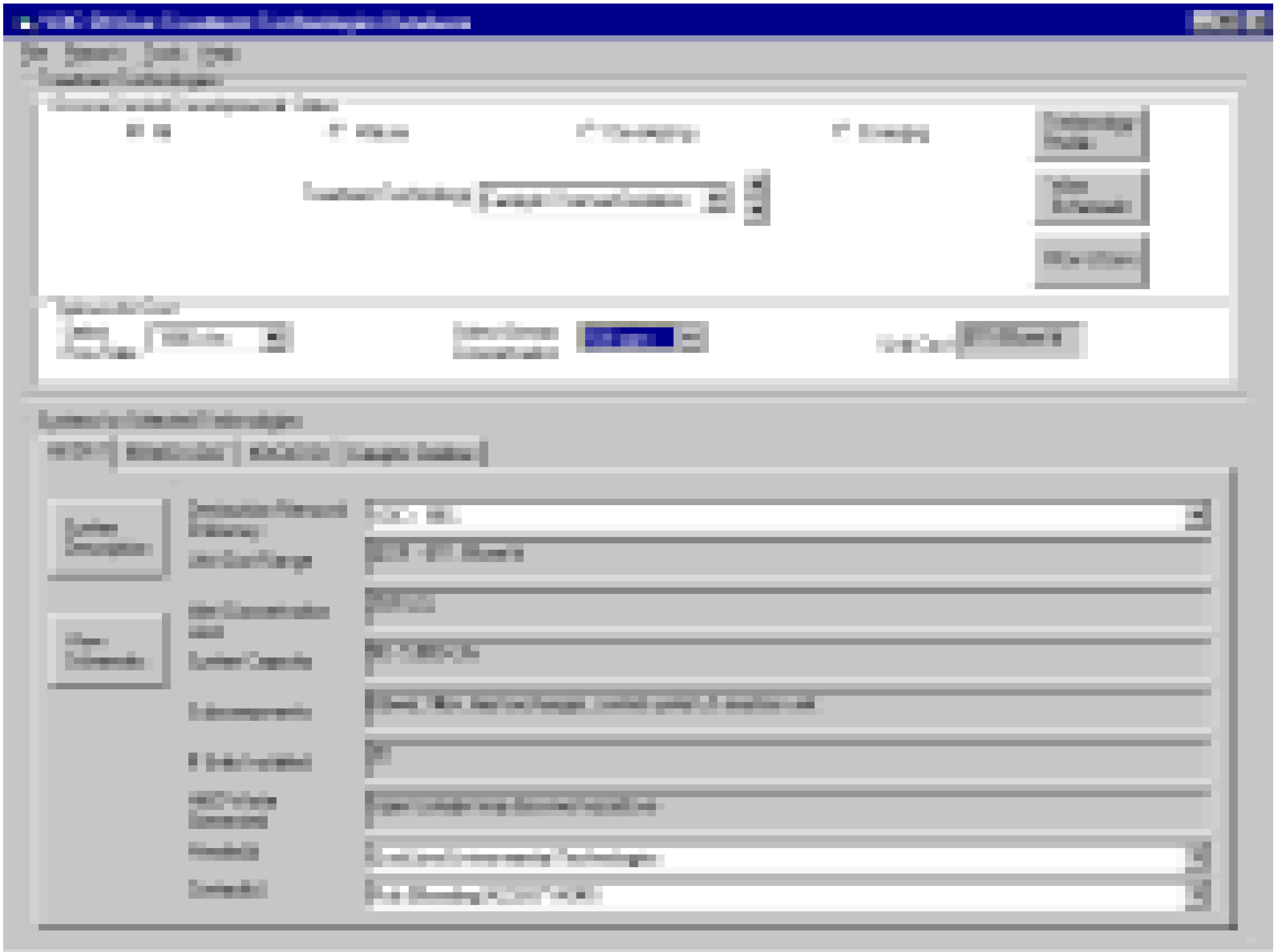
Polymer Coating (TDS-2057-ENV)

Tired of using expensive plastic covers, over stockpiles of soil, which are labor intensive to install and difficult to keep secured during strong winds and rainstorms. Try using a polymer coating. A commercially available polymer coating can be used as a highly effective cover to control dust and erosion. The polymer coating is simply sprayed onto the soil and dries quickly. Since the coating is benign it may be mixed with the soil and be put into the ground. Compared to a plastic cover, a polymer coating is more effective in reducing stormwater contamination caused from erosion and in reducing dust or particulate matter in the air. It will also last longer, and require less maintenance than a plastic cover. It will also facilitate regulatory compliance with National Pollution Discharge Elimination System requirements for erosion control and with United States Environmental Protection Agency requirements for reducing particulate matter in the air. For more information on polymer coatings please see the inserted Tech Data Sheet.

CALENDAR OF EVENTS

DATE	COURSE NAME	LOCATION	PHONE	WEBSITE
Oct 12-14	Construction Site Erosion Control	Madison, WI	(800) 462-0876	http://epdwww.engr.wisc.edu/
Oct 19-23	McCoy's 1998 RCRA Seminars	Chicago, IL	(303) 526-2674	
Oct 26-29	Introduction to Global Positioning Systems (GPS)	Madison, WI	(800) 462-0876	http://epdwww.engr.wisc.edu/
Nov 16-20	McCoy's 1998 RCRA Seminars	Orlando, FL	(303) 526-2674	
Nov 30-Dec 3	Stormwater Detention Basin Design	Las Vegas, NV	(800) 462-0876	http://epdwww.engr.wisc.edu/
Dec 3-4	Effective Environmental Management: Tools for Facilitating Compliance with State and Federal Regulations	Madison, WI	(800) 462-0876	http://epdwww.engr.wisc.edu/
Dec 8-10	Implementing Cost-Effective Sanitary Landfill Technologies	Madison, WI	(800) 462-0876	http://epdwww.engr.wisc.edu/
Dec 14-18	McCoy's 1998 RCRA Seminars	Denver, CO	(303) 526-2674	

Naval Facilities Engineering Service Center
1100 23rd Avenue, Bldg. 1100
Port Hueneme, CA 93043-4370



Insert (1) Snap Shot of VOC Offgas Database Screen

Insert (2)

EXPLANATION TO VOC OFFGAS DATABASE SCREEN SHOT

Select A Technology Development Status

- All: displays all technologies
- Mature: displays the mature technologies only
- Developing: displays the developing technologies only
- Emerging: displays the emerging technologies only
- Treatment Technology: click to select technology of interest
- Technology Profile tab: click to display the profile for the selected treatment technology, including: description, applicability, limitations, development status, regulatory issues, parameters affecting costs or performance, and implementation issues.
- View Schematic tab: click to view a schematic for the selected treatment technology
- Technology Pros & Cons tab: click to view a description of pros & cons for the selected treatment technology

Select Typical Unit Cost

- Select A Flow Rate: select from a list of pre-defined flow rates (1000, 2000, and 3000 cfm)
- Select An Off-gas Stream Concentration: select from a list of pre-defined concentrations (500, 1,000, and 2,000 ppm)
- Unit Cost: shows the calculated unit cost (per lb of VOC removed) for the selected flow rate and concentration

Tabs below the "Selected Typical Unit Cost" section (These tabs are for the individual systems under the selected treatment technology. Select the system of interest by clicking the tab corresponding to the system.)

❑ A profile for the selected system is shown in the boxes below the system tabs. System profile shown for each system includes the following:

- Destruction Reduction Efficiencies: shows typical DRE of the system
- Unit Cost Range: shows a range of unit cost for the selected system for treating off-gas stream ranging from 3000 cfm, 2000 ppm to 1000 cfm, 500 ppm.
- Inlet Concentration Unit: shows the highest contaminant concentration that can treated by the system
- System Capacity: shows the off-gas flow (in cfm) limitation for the system
- Subcomponents: shows the subcomponents of the system; such as blowers, condensers.
- # Units Installed: the number of system units known to have been deployed for field use.
- Haz Waste Generated: shows the types of hazardous wastes generated from the use of the system
- Vendor(s): lists the names of companies who provide the system
- Contact(s): list the point of contact for each vendor

❑ System Description button: click to view a description of the selected system

❑ View Schematic button: click to view a schematic for the selected system

TechData Sheet

Naval Facilities Engineering Service Center
Port Hueneme, California 93043-4370

TDS-2017-ENV (2nd Revision) July 1998

Biocell Technology

Remediation of Petroleum-Contaminated Soils

Problem

Many Navy installations have to dispose of small quantities of petroleum hydrocarbon contaminated soils. These soils are generated at facilities that have fuel stored in underground or aboveground storage tanks, maintenance and vehicle wash areas, and training areas where fuel has been spilled on the ground. Private industry also faces similar problems at service stations, maintenance garages, and other facilities where fuels are used. Off-site disposal is traditionally used to dispose of these small quantities of contaminated soil. However, off-site disposal can be very expensive.

Solution

As a solution to expensive off-site disposal, biocell technology provides an innovative method for treating small quantities of soils contaminated with low to intermediate concentrations of petroleum hydrocarbons. The technology involves loading petroleum-contaminated soils into a commercially available 40-yd^3 dumpster or any other container similar in size, and stimulating aerobic microbial activity within the soils through aeration. Soil can be treated in amounts ranging from a small quantity, by simply filling a portion of the container, to a large quantity, by using multiple containers (modular approach). Adding moisture and nutrients such as nitrogen and phosphorus can enhance microbial activity. The microbial activity degrades the petroleum-based constituents adsorbed to soil particles, thus reducing the concentrations of these contaminants. Clean soil can then be returned to the original excavation site or used as fill where needed.

Demonstration

The ability of biocell technology to reduce the concentration of petroleum constituents in excavated soils through the use of aerobic biodegradation has been successfully demonstrated. The Army's Waterways Experiment Station (WES) developed a 10-yd^3 biocell. A significant portion of the WES research was aimed at simplifying the technology so that an activity could build a 40-yd^3 system using readily available commercial materials. A 10-yd^3 biocell was tested at the Naval Construction Battalion Center's Hydrocarbon National Test Site in Port Hueneme, California in October 1996 (Figure 1). After 105 days of biocell operation, the total petroleum hydrocarbons (TPH) concentrations in the soil decreased from 736 ppm to 147 ppm.

Figure 1. The 10-yd^3 biocell at Port Hueneme, California.

Technical Description

Biocells use naturally occurring microbes to degrade fuels and oils into carbon dioxide and water. Under optimum nutrient, moisture, oxygen, and temperature conditions, native bacteria in the contaminated soil use the TPH as a food source. Clean soil can then be returned to the original excavation site or used as fill where needed. Volatile organic compounds (VOCs) produced during operation of the biocell are treated by using a granulated activated carbon (GAC) adsorption system. Biocells are capable of treating soils contaminated with petroleum-based fuels and lubricants, including diesel fuel, jet fuel, and lubricating and hydraulic oils. The microbes use the contaminants as a food source and thus destroy them. By carefully controlling air flow and moisture levels, the treatment time can be reduced.

The biocell system consists of commercial roll-off dumpsters or containers converted into fully contained bioremediation units. Individual units can treat contaminated soil ranging in quantities from 20 to 40 yd^3 at a time, and several units may be combined at one site for larger soil volumes. Biocell containers have an impermeable liner to reduce the potential migration of leachate to the subsurface environment. A leachate collection system is installed at the bottom of the container to capture excessive moisture in the system. Perforated pipes, installed under the contaminated soil, are connected to a blower that facilitates the aeration of the soil. The blower should pull air through the soil and GAC canisters versus blowing the air as demonstrated by WES to eliminate the potential for VOCs to escape through the cover. If off-gas treatment is not required, blowing air through the soil is recommended. The container is covered with an impermeable liner to prevent the release of contaminants and/or contaminated soil to the environment, and to protect the soil from wind and precipitation (Figure 2). Biocells operate very effectively in temperate climates such as California and Hawaii. They will also operate effectively in the colder climates of Alaska and Iceland; however, the treatment duration will be longer.

Benefits

Biocell technology offers the following benefits:

- Biocell systems are relatively easy to design and construct.
- At most Navy sites, treatment can be completed in a relatively short period of 3 to 6 months.
- Biocells may be cost-competitive with off-site disposal.
- Biocells are applicable to a wide range of site conditions and petroleum-based contamination.
- Soil volumes to be treated range between 20 to 200 yd^3 per year.

Cost Analysis

Based on WES's design and the successful demonstration of a 10-yd^3 biocell, the Naval Facilities Engineering Center (NFESC) has developed a document entitled "Biocell Application Guidance" TR-2092-ENV to provide Navy installations a general overview of the biocell technology, design, operation and maintenance procedures, and economics. The document lists the basic materials and parts required to build a biocell. It also details the cost effectivness of operating a biocell.

The unit cost per yd^3, amortized over 5 years with three operations per year, is \$40.83/yd^3 for one biocell, \$36.75/yd^3 for two biocells, and \$34.56/yd^3 for three biocells, respectively. When the container is not at full capacity the costs per yd^3 are significantly higher. Therefore, soil should be stockpiled until the biocell can be operated at 100 percent capacity. When compared to off-site disposal costs, which range between \$40.00/yd^3 and \$480.00/yd^3, biocell technology could be a very cost-effective option.

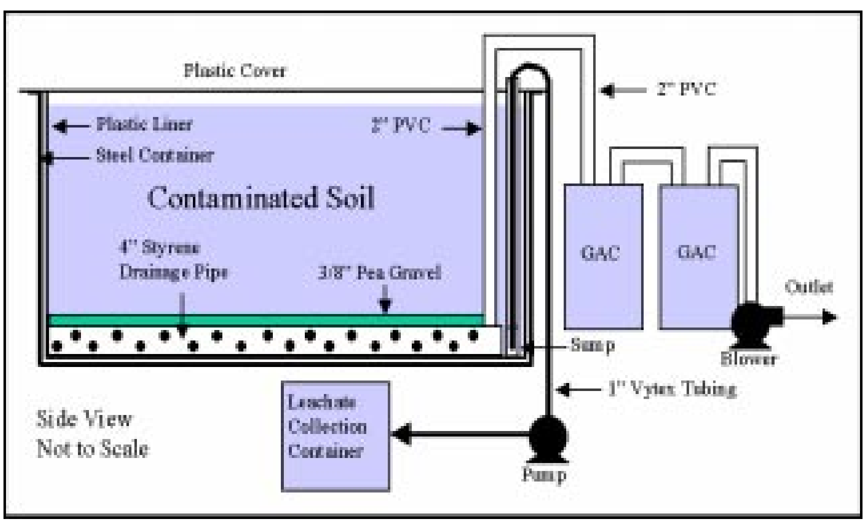


Figure 2. Schematic of a 40-yd^3 biocell.

For more information about biocell technology and a copy of "Biocell Application Guidance" TR-2092-ENV, contact:

Restoration Development Branch,
NFESC Code 411
(805) 982-1671, DSN: 551-1671

- or -

Technical Application Branch,
NFESC Code 414
(805) 982-1600, DSN: 551-1600

TechData Sheet

Naval Facilities Engineering Service Center
Port Hueneme, California 93043-4370

TDS-2057-ENV **July 1998**

Demonstration of a Polymer Coating on Contaminated Soil Piles

Conducted by:
South West Division NAVFAC
San Diego, CA

Problem

Stockpiles of contaminated soils at cleanup sites must be protected to reduce dust and sediment from entering stormwater runoff. Many Navy facilities have stockpiles of contaminated soils, awaiting remediation or off-site disposal. These soil piles are traditionally covered with two types of plastic covers: a clear cover that quickly deteriorates under ultraviolet light and a high density polyethylene cover, which is very expensive. Plastic covers are difficult to install and keep secured during strong winds and rainstorms.

Solution

As a solution to these expensive plastic covers, a commercially available polymer coating can be used as a highly effective cover to control dust and erosion. A coating is a cost-effective method to protect soil from wind and rain, while being unaffected by ultraviolet light. Compared to a plastic cover, a coating is more effective in reducing stormwater contamination caused from erosion and reducing dust or particulate matter in the air.

The coating lasts longer and requires less maintenance than a plastic cover. Since the coating solution is benign, it can be mixed with the soil and put into the ground.

The coating meets National Pollution Discharge Elimination System requirements for erosion control and meets the United States' Environmental Protection Agency requirements for reducing particulate matter in the air.

Demonstration at Naval Shipyard Long Beach

A polymer coating was demonstrated on stockpiles of contaminated soil at Naval Shipyard (NSY) Long Beach (Figure 1). Approximately 11,000 yd^3 of contaminated soil needed covering to contain petroleum vapors and protect against erosion from wind and rain. Due to ultraviolet deterioration and constant winds, a plastic cover lasted about 2 months before a replacement was needed. A polymer coating, under the tradename SOIL-SEMENT®, was proposed to the Regional Water Quality Control Board (RWQCB) as an alternative to the plastic cover. The RWQCB approved the technology as an experiment for the site. The coating has been in place since September 1997 and has endured numerous rainstorms and high winds without having any dust or erosion problems.

Figure 1. Soil pile at Naval Shipyard, Long Beach.

Technical Description

SOIL-SEMENT® is a polymer emulsion. The formulation contains polymers, which are considered non-hazardous by the Occupational Safety and Health Administration definition. It does not contain any hazardous solvents and is non-toxic and non-hazardous.

SOIL-SEMENT® has the unique ability to penetrate, saturate, and bond surface dust and aggregate together and "cement" this to the base to create a hard, dust-free, and water-resistant surface. The effectiveness results from the length and strength of its polymer molecules and their ability to bond with surface materials. It has a unique chemical structure made of molecules attached in relatively straight-linked chains and then cross linked between other chains that may be 1,000,000 molecules long. The molecular structure is much stronger compared to the smaller molecular structure of oil, calcium, petroleum resin, and asphalt emulsion products which range from 100 to 10,000 molecules. As a result, the coating can be made as strong as steel or as resilient as rubber.

SOIL-SEMENT® is environmentally safe; is non-toxic, non-corrosive, and non-flammable; does not pollute groundwater; does not disturb vegetation; and does not change the pH of soil. When drying, it does not contribute any pollutants to stormwater runoff. It will actually reduce pollutants by reducing total suspended solids present in stormwater runoff.

SOIL-SEMENT® is a concentrate that is diluted with water prior to application. Simply sprayed onto the soil, it dries in 2 to 3 hours and cures in 24 to 36 hours (Figure 2). When the soil pile is reclaimed, the coating breaks up and can be handled as normal soil. The number of applications depends on the activity of the soil pile. An inactive soil pile may only need one application and may last a year or longer. The application may last longer by either increasing the concentration and/or increasing the number of applications.

Figure 2. Applying SOIL-SEMENT® to a soil pile.

In addition to contaminated soil piles, a polymer coating can be used for a variety of applications such as: construction sites, dirt roadways, coal piles, dirt helicopter pads, slope stability, and an alternative to the 6-inch daily soil cover in landfills.

Additional information on the other applications of polymer coatings is available from the Naval Facilities Engineering Service Center.

Benefits

SOIL-SEMENT® has the following benefits:

- Is cost effective compared to a plastic cover
- Minimizes particulate matter in air
- Creates a stabilized surface which will not shift or break
- Protects against wind and rain
- Is not affected by ultraviolet light
- Prevents rain water from seeping into the soil
- Dries clear which preserves the natural appearance
- Mixes with the soil and can be put into the ground

Cost Analysis

Soil piles at NSY Long Beach were covered on two occasions with a visqueen cover at a cost of approximately $32,000 each. After the visqueen cover failed a second time, SOIL-SEMENT® was applied at a cost of $25,000. The cost savings of SOIL-SEMENT® versus a third visqueen cover was $7,000. However, if SOIL-SEMENT® had been initially applied, the cost savings would have been $64,000.

SOIL-SEMENT® concentrate is $3.00 to $4.00/gallon. The amount required varies, depending on the surface area of soil, activity of soil (how often the soil is disturbed), and duration of soil control. Therefore, to determine the cost for coating a soil pile, the surface area, activity of the soil, and duration of soil control must first be estimated. Coating an inactive soil pile for a year or longer will cost 4 to 5 cents per ft^2. In contrast, a construction site with a large amount of soil activity will require a stronger concentration and will cost 5 to 12 cents per ft^2. Since cost is a strong function of surface area, the soil pile must be constructed to minimize the surface area to lower the cost. This can be done by forming a taller pile with a circular or square base.

For more information about **polymer coatings**, contact:

Restoration Development Branch
NFESC Code ESC411
(805) 982-1671, DSN: 551-1671, or

- or -

Technical Application Branch
NFESC Code ESC414
(805) 982-1657, DSN: 551-1657, or