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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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Mr. James Harris
Commander Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street
Norfolk, VA 23511-2699

Ref: Final Administrative Order on Consent
U.S. EPA Docket No. RCRA-III-038-CA

Subject: **Hydrogeological Comments on the Basis of Design for the Biosparging Pilot Test at Solid Waste Management Unit 2E, NAS Oceana (October 2, 1996)**

Dear Mr. Harris,

Mr. Jack Hwang, Hydrologist, U.S. Environmental Protection Agency (EPA) has reviewed the above referenced pilot test design proposal for remediation of contamination at the Solid Waste Management Unit (SWMU) 2E. Based on Mr. Hwang's review, EPA has the following comments:

Comments

1. It appears from the review of this design proposal that the Navy has assumed that the biosparging technology will be effective at the location within SWMU 2E area before thoroughly evaluating all screening parameters. Current guidance referenced on the subject of biological processes recommends the use of laboratory treatability tests along with field pilot studies to verify and quantify the potential effectiveness of the biological technology and provide necessary data to design a treatment system. Therefore, it is recommended that the Navy perform laboratory analysis and conduct treatability studies to evaluate the effectiveness of the biosparging technology for remediating the contamination at the SWMU 2E. This may be accomplished by evaluating the screening parameters and/or the findings of the analysis and studies below:

a. **Dissolved Ferrous Iron**

The high concentration of dissolved ferrous iron in the groundwater at the proposed test area for this SWMU is greater than the concentration range recommended for this technology to be moderately to most effective. In tables A-3 and A-12 of the

Corrective Measures Study (CMS) for SWMUs 2E, 15 and 24 (Draft Final Report) the dissolved iron concentrations in wells 2E-MW6, 2E-MW8 and 2E-MW6 are in excess of 20 mg/L. The presence of these high concentrations of dissolved ferrous iron in groundwater can reduce the permeability of the saturated zone soils during the sparging operations. When dissolved iron is exposed to oxygen, it is oxidized to ferric iron oxide which, because it is less soluble than ferrous iron, can precipitate within the saturated zone and occlude soil pore space. This can reduce the region available for air and groundwater flow, thereby reducing permeability. Precipitation of iron oxide occurs predominantly in the saturated zone near sparging well screen. This oxidation can render sparging wells useless after even short periods of operation. Therefore, it is recommended that the Navy analyze the groundwater from the sparging well (2E-MW4) for ferrous iron concentrations and observe the effects of ferrous iron oxidation on sparging operations. Also, it is recommended that analysis of the wet chemistry parameters be added to Week 3 and Week 6 under Extended Test in Table 2 of this proposal.

The Navy shall conduct the field tests for air and water permeability at the pilot test site, before and after the pilot test in the proximity of the sparging wells to determine the effect on the permeability due to the precipitation from the high iron concentrations.

b. **Oxygen Delivery and Inorganic Nutrient Level**

Laboratory biodegradation studies can be used to estimate the rate of oxygen delivery and to determine if the addition of inorganic nutrients are necessary. A common biodegradation study for biosparging is the slurry study. Slurry studies involve the preparation of numerous "soil microcosms" consisting of small samples of site soils from the aquifer mixed into a slurry with the site ground water. The microcosms are divided into several groups which may include control groups which are sterilized to destroy any bacteria, non-nutrified test groups which have been provided oxygen but not nutrients, and nutrified test groups which are supplied both oxygen and nutrients. Microcosms from each group are analyzed periodically during the test period for bacterial population counts and constituent concentrations. Specify whether the results of this type of laboratory treatability test(s)are available. If so, please evaluate the findings of the test(s). If this information is not available, it is recommended that the Navy conduct this type of laboratory study. Results from this study will provide useful supplemental information in addition to the field pilot test.

c. **Biodegradability**

Laboratory microbial screening tests are used to determine the presence of a population of naturally occurring bacteria that may be capable of degrading petroleum product constituents. Samples of soils from the aquifer shall be analyzed in an off site laboratory. Microbial plate counts determine the number of colony forming units (CFU) of heterotrophic bacteria and petroleum-degrading bacteria present per unit mass of dry soil. In general, biosparging will not be effective if the heterotrophic bacteria population density is less than 1,000 CFU/gram. It is recommended that the Navy conduct this type of screening test. Results from this study will also provide useful supplemental information in addition to the field pilot test.

d. **Presence of Free Product**

The proposed sparging well 2E-MW4 has approximately one foot thick of free product. Typically, biosparging can create groundwater mounding which could cause free product to migrate and contamination to spread. Also, in general, concentration of Total Petroleum Hydrocarbons (TPH) in excess of 50,000 ppm, or heavy metals in excess of 2,500 ppm, in soils are considered inhibitory and/or toxic to aerobic bacteria. Therefore, the level of bacterial activity will be significantly diminished near the smear zone. That is, it will take a very long time to cleanup the smearing zone.

2. It may be misleading to solely base the conclusion of the effectiveness of the biosparging technology for remediating the petroleum contamination at SWMU 2E on the field measurement of the dissolved oxygen distribution.

3. The Navy should evaluate the need for adjusting or adding the following system design features and/or components to control volatilization, migration of vapors and subsurface pressure. Specifically, based on the factors stated below, the Navy should evaluate the need for these components as objectives of the pilot test.

a. **Soil Vapor Extraction/Bioventing Control Systems**

Neither soil vapor extraction nor bioventing is proposed to be implemented in conjunction with the biosparging system. However, the ground water contaminants at SWMU 2E include volatiles (e.g. benzene).

b. **Off-gas Ventilation System**

Off gas from the subsurface vents should be monitored.

c. **Placement of Sparging Wells**

Both sparging wells are located very close to the underground utility trench (less than 15 ft?) which could potentially present a path for the off-gas.

d. **Soil Permeability**

SWMU 2E has an approximately 5-foot thick silt-clay soil layer. The permeability of this soil layer and the air is low. This low permeability may cause the gas pressure from the biosparging system to build up and the majority of gas to flow through preferential vapor migration pathways and/or quick relieve points.

4. Biosparging is an in-situ remediation technology that uses indigenous microorganisms to biodegrade organic constituents in the saturated zone. The biosparging process is similar to air sparging, however, while air sparging removes constituents primarily through volatilization, biosparging promotes biodegradation of constituents rather than volatilization. Biosparging uses lower flow rates than air sparging. When volatile constituents are present, biosparging is often combined with soil vapor extraction or bioventing. Therefore, the Navy shall provide a more detail technical justification for using **air** sparging design parameters from the pilot test conducted at SWMU 2B at the Oceana Facility as initial design parameters for this **biosparging** pilot test system.

5. The Navy shall provide a more detailed description about the use of helium tracer. For example, the method of injection to be used, the field measurements to be conducted and the basis for interpretation of recovery from helium data.

6. The Navy shall provide a section in the proposed pilot test plan discussing the anticipated test results, the percent reduction, the methods of analysis, the interpretation of data and the criteria to be considered, to determine if biosparging is an effective remediation technology for SWMU 2E.

If you have any questions, please feel free to contact me at your convenience at (215) 566-3428. Otherwise, I look forward to meeting with the Navy and CH2M Hill on January 30, 1997 to discuss the matter in further detail.

Sincerely,

Linda Holden
Remedial Project Manager
RCRA Operations Branch

cc: Robert E. Greaves, 3HW90
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