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LETTER REGARDING DRAFT TREATABILITY STUDY WORK PLAN IN SITU CHEMICAL OXIDATION PILOT STUDY AT OPERABLE UNIT 4 (OU 4) NTC ORLANDO FL
10/5/1999
FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

FLORIDA

# Department of Environmental Protecti

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Jeb Bush
Governor

Twin Towers Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

David B. Struhs
Secretary

October 5, 1999

Mr. Wayne Hansel
Code 18B7
Southern Division
Naval Facilities Engineering Command
P.O. Box 190010
North Charleston, South Carolina 29419-0068

RE: Draft Treatability Study Work Plan No. 3, Operable Unit 4, Area C, In-Situ Chemical Oxidation Pilot Study, Naval Training Center Orlando, Florida

Dear Mr. Hansel:

I have completed my review of the Draft Treatability Study Work Plan for Operable Unit 4, In-Situ Chemical Oxidation Pilot Study, NTC Orlando. I have also attached comments from Bill Neimes, P.E., on the Work Plan.

The Work Plan states that groundwater elevation measurements will be taken prior to the pilot study startup. Groundwater elevation measurements should be collected during each sampling event from wells associated with the pilot study and in the vicinity of the pilot study. This information will be important in validating the groundwater model used to predict the treatment flow cell, determining induced hydraulic gradients from the injection and extraction wells in order to calculate groundwater flow velocities, and in determining whether unexpected flow conditions develop that may require modifying the monitoring plan or installing more monitoring wells.

If I can be of any further assistance with this matter, please contact me at (850)488-3693.

Sincerely,

David P. Grabka
Remedial Project Manager

cc: Barbara Nwokike, Navy SouthDiv
Nancy Rodriguez, USEPA Region 4
Richard Allen, HLA, Jacksonville

Steve McCoy, TetraTech NUS, Oak Ridge
Bill Bostwick, FDEP Central District
Al Aikens, CH2M Hill, Orlando

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Florida Department of

Memorandum **Environmental Protectio**

**TO:** David Grabka - Project Manager

**THROUGH:** Tim Bahr - Technical Review Section

**FROM:** Bill Neimes - Technical Review Section

**DATE:** September 23, 1999

**SUBJECT:** Draft Treatability Study Work Plan
Naval Training Center, Orlando, Florida
Operable Unit 4
Assessing In-Situ Chemical Oxidation Using $KMnO_4$

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I have reviewed the Treatability Study Work Plan prepared by Harding Lawson Associates and dated September 1999. This work plan details a proposal for the above ground treatment of recovered groundwater by potassium permanganate and subsequently injecting this treated groundwater back into the aquifer upgradient of the contaminant plume. The treated groundwater that is to be injected will contain some percentage of unused potassium permanganate for the treatment of groundwater in-situ. This report was well prepared and other than one comment on the treatment system and a couple of other comments I believe that this work plan is ready for approval.

- **Reactor Kinetics.** My comment on the treatment system concerns the interpretation of data taken from the batch treatment studies performed by Carus for use in this treatment system. Figure 2-1 of this work plan provides information for all of the batch testing performed by Carus for groundwaters from this site and another site. This figure neatly shows a logrithrimic reduction in contaminant concentrations at different time periods. Using the data provided in this graph, the work plan demonstrates that for an initial concentration of 5000 ug/l PCE, a minimum detention time of approximately 2 hours is required for a reduction to 3 ug/l PCE. Since the detention time for the proposed treatment system is over 10 hours, the work plan notes that there will be enough of a safety factor in this design for adequate treatment of PCE. My concern with this design is that all of the treatability studies were performed on batch runs, however, the actual design of this system will be two mixed reactors in series. With the information provided I have done some work calculating the order of the reaction and the reaction coefficient for the different batch studies. Although there are not enough data points to accurately calculate a reaction rate for the 4000 mg/l $KMnO_4$ concentration, there were five data points for the 1000 mg/l $KMnO_4$ concentration. I plotted the reduction over time for the 1000 mg/l $KMnO_4$ concentration and came up with a first order reaction and a reaction rate of $0.92^{-hr}$. This data is shown on Attachment 1. Since the reaction order is first order, I then plotted the available data for a $KMnO_4$ concentration of 4000 mg/l and derived a reaction rate of $4.1^{-hr}$. There was only two data points available for

plotting the $KMnO_4$ concentration of 4000 mg/l so the reliability of this reaction rate coefficient is questionable. However, this is the only information available for calculating a reaction rate at 4000 mg/l $KMnO_4$.

Using this reaction rate value of $4.1^{-hr}$ and plugging this into the first order stir tank reactor of two tanks in series, each with a detention time of 5.33 hours, the final PCE concentration calculates to a value of 35.5 ug/l.

Equation for 1st order stir tank reactor with n tanks:

$$Cf = Co(1/[1+kT/n])^n$$

Where: Cf - final concentration, ug/l
Co - initial concentration (assume 5000 ug/l)
k - $4.1^{-hr}$
T - detention time - 5.33 hours
n - number of tanks - 2

From this information, it appears that the design in this Treatability Study Work Plan will not meet the required treatment efficiency for eventual reinjection. Based on this, I would recommend that the type of treatment unit be reconsidered. A stir tank reactor is not as efficient as a plug flow reactor and I would suggest that the designers considered changing one of the tanks to a plug flow reactor. Although a plug flow reactor is much more efficient than a stir tank reactor, a plug flow reactor is more dependent upon a consistent influent concentration and is prone to variations in the influent flow. On this basis, I would consider including a combination, stir tank reactor - plug flow reactor in series. In this type of treatment, the stir tank reactor would provide a buffering capacity for any influent flow variations and the subsequent plug flow reactor would provide an efficient means of treating the PCE to injection standards of less than 3 ug/l.

My calculations show that a plug flow reactor with a detention time of 5.33 hours can treat a influent concentration of 5000 ug/l PCE to an effluent concentration of 2 X 10-6 ug/l.

**- Deep Well.** There is sufficient monitoring planned for both the upper zone and deeper zone during this pilot test and I would not recommend any more monitoring in these zones. However, there are no monitoring wells that can monitor groundwater below the injection wells. How can we determine if the injected fluid will not migrate vertically downward? With this, I would recommend that a deep monitoring well be installed at a depth between 40 to 50 feet bls and located somewhere by the three injection wells so that groundwater below the injection wells could be monitored.

- **Groundwater Monitoring Schedule.** I agree with the groundwater monitoring schedule set forth on Table 2-1 and believe that this schedule should be adhered to during the treatability study. However, if during the beginning of the treatability study the monitoring data indicate either faster or slower movement of the injected fluids, then the schedule should be adjusted accordingly.

Please see me in my office if you have any comments or questions.

attachments

cc: Greg Brown