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TENTH PERIODIC SOIL VAPOR SAMPLING RESULTS MAY 2002

AT THE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION JET PROPULSION LABORATORY PASADENA, CALIFORNIA

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ACRONYMS AND ABBREVIATIONS

bgs:	below ground surface
cc:	cubic centimeter
CCl_4:	carbon tetrachloride
CDHS:	California Department of Health Services
CRWQCB:	California Regional Water Quality Control Board
%D:	percent difference
DCE:	dichloroethene
Freon 11:	trichlorofluoromethane
Freon 113:	1,1,2-trichloro-1,2,2-trifluoroethane
FWENC:	Foster Wheeler Environmental Corporation
GC:	gas chromatograph
GEOFON:	GEOFON, Incorporated
JPL:	Jet Propulsion Laboratory
NASA:	National Aeronautics and Space Administration
OD:	outside diameter
OU-2:	Operable Unit 2
PCE:	tetrachloroethene
QA/QC:	quality assurance/quality control
RI:	remedial investigation
TCA:	trichlororthane
TCE:	trichloroethene
µg/L:	micrograms per liter
VOC:	volatile organic compound

1.0 INTRODUCTION

Presented in this report are the results of the tenth periodic soil vapor sampling event completed as part of the periodic monitoring program being conducted at the National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL) for Operable Unit 2 (OU-2) (on-facility soils). The purpose of this program is to monitor the horizontal and vertical distributions of volatile organic compound (VOC) vapors in the vadose zone beneath the JPL site. On May 14, 2002, GEOFON, Inc. (GEOFON) personnel collected soil vapor samples from selected soil vapor monitoring probes in well Nos. 4, 17, 32, 33, 36, and 37. The locations of the soil vapor monitoring wells are shown in Figure 1-1. The set of soil vapor monitoring wells included in this sampling event is based on the soil vapor sampling frequency developed for the periodic monitoring program. A summary of the soil vapor sampling frequency is presented in Table 1-1.

All soil vapor samples collected during this event were analyzed for VOCs by HP Labs in an on-site laboratory that is certified by the California Department of Health Services (CDHS). The analyses were performed in accordance with EPA Method 8021 and the California Regional Water Quality Control Board, Los Angeles Region (CRWQCB), protocols and guidance.

Sampling procedures are described in Section 2.0, and a summary of all VOCs detected during this tenth periodic soil vapor sampling event, including locations and depths, is contained in Section 3.0. Conclusions are provided in Section 4.0. A soil vapor data validation report for all samples analyzed during this sampling event is included in Appendix A and summarized in Section 5.0. Cited references are listed in Section 6.0. Laboratory reports for all samples analyzed, along with chain-of-custody forms, are included in Appendix B. The daily calibration verification standards for each day's sampling are also included in this appendix. Appendix C contains a summary of soil vapor sampling results from all events conducted during the periodic monitoring program.

2.0 SOIL VAPOR SAMPLING PROCEDURES

On May 14, 2002, soil vapor samples were collected and analyzed from soil vapor monitoring well Nos. 4, 17, 32, 33, 36, and 37. All sampling ports were plugged in monitoring well 34, preventing the collection of soil vapor samples during this sampling event. A description the soil vapor well construction procedures was presented in the first long-term soil vapor sampling report prepared for OU-2 (FWENC, 2000a). Well construction details are summarized in Table 2-1 of this report. Twelve (12) depth-specific vapor samples, including two (2) duplicate samples, were collected and analyzed for 25 primary target VOC compounds in accordance with the CRWQCB (1997) guidance.

Soil vapor samples were withdrawn from the soil through the sampling tips and 1/8-inch-outside diameter (OD) Nylaflow® tubing using calibrated, gas-tight, 60-cubic-centimeter (cc) sterile syringes fitted with a three-way on-off valve. Prior to collecting the soil vapor sample, four volumes of the length of the tubing were purged to flush the tubing and fill it with in-situ soil vapor. Since each foot of tubing has an internal volume of 1 cc, the total volume purged was easily measured with the calibrated syringes. Following purging, a 60-cc soil vapor sample was collected in the syringe, the valve was turned to the off position, and the sample was immediately transferred to the on-site mobile laboratory for analysis. During sampling, neither water vapor nor condensation was observed in the transparent sampling syringes. Because the purge and sample volumes were small, a vacuum pump was not required to evacuate the tubing or to collect a soil vapor sample. To demonstrate reproducibility of results, a duplicate soil vapor sample was collected and analyzed after every five environmental samples.

The samples were analyzed on-site in a mobile laboratory certified (Certification No. 1667) by the CDHS to perform analyses by EPA Method 8021 for the parameters listed in Table 2-2. The time between sample collection and analysis was, at most, only a few minutes.

3.0 ANALYTICAL RESULTS

The results from the previous remedial investigation (RI) for OU-2 (FWENC, 1999) indicated that four VOCs were more frequently detected in soil vapor samples at elevated concentrations relative to other VOCs. These four VOCs are carbon tetrachloride (CCl_4), 1,1,2-trichloro-trifluoroethane (Freon 113), trichloroethene (TCE), and 1,1-dichloroethene (1,1-DCE). Freon 113, $CC1_4$, and TCE were detected in most soil vapor samples, where VOCs were present, and were frequently the only VOCs present.

The VOCs most frequently detected during this tenth periodic sampling event were, as in the past, $CC1_4$, Freon 113, TCE, and 1,1-DCE. The $CC1_4$, Freon 113, TCE, and 1,1-DCE concentrations ranged from 1.5 to 7.4 micrograms per liter of vapor (µg/L-vapor), non detect (above the laboratory method detection limit) to 1.3 µg/L-vapor, 1.1 to 11 µg/L-vapor, and 1.1 to 1.7 µg/L-vapor, respectively. In general, concentrations of $CC1_4$, Freon 113, and 1,1-DCE measured during this event are lower than those measured during the previous sampling event conducted in February 2002 (GEOFON, 2002). Furthermore, many concentrations measured during this event are substantially lower than those measured during the OU-2 RI. TCE was the only chemical that was detected at higher concentrations during this event, as compared to the February 2002 results. TCE was detected at a concentration of 11 µg/L-vapor at a depth of 20 feet in well No. 4, as compared to the concentration of 8.9 µg/L-vapor that was reported at the same location during the February 2002 event.

Two other VOCs, 1,2-dichloroethane (1,2-DCA), and tetrachloroethene (PCE), were also detected during this sampling event. 1,2-DCA was detected in one well (No. 17) at a depth of 36 feet below ground surface (bgs), and PCE was also detected in well No. 17 at a depth of 36 feet bgs. Concentrations of these compounds were generally low relative to those of other compounds detected (1,2-DCA: 2 µg/L-vapor, and PCE: 2.4 µg/L-vapor). Compared to the previous vapor sampling event (February 2002), PCE concentrations increased during this sampling event from 1.6 to 2.4 µg/L-vapor respectively. Chloroform, 1,1,1-trichloroethane (1,1,1-TCA), and trichlorofluoromethane (Freon 11), which have been detected in prior events, were not detected during this event.

A summary of the analytical results for all samples collected during this sampling event is presented in Table 3-1, and the laboratory reports are presented in Appendix B-1. Chain-of-custody forms are included in Appendix B-2. Data from all periodic monitoring events conducted to date are tabulated in Appendix C.

Locations of detections with depth for $CC1_4$, Freon 113, TCE, and 1,1-DCE are shown in Figures 3-1, 3-2, 3-3, and 3-4, respectively. Total VOC concentrations with depth are presented in Figure 3-5.

4.0 CONCLUSIONS

The following conclusions are based on the results of the soil vapor sample laboratory analyses and the site conditions at the time of the sampling:

- The soil vapor monitoring probe at the depth of 118 feet in well No. 32 was plugged during this event.

- The VOCs (i.e., $CC1_4$, Freon 113, and 1,1-DCE) detected during this tenth periodic sampling event were generally lower than those measured during the prior sampling events and those measured during the OU-2 RI.

- In addition to the above VOCs, PCE and 1,2-DCA were also detected at a depth of 36 feet bgs in one soil vapor monitoring well (No.17) at a low concentration of 2.4 µg/L-vapor and 2 µg/L-vapor.

- VOCs were not detected above the laboratory method detection limit in soil vapor monitoring well No. 32.

- Based on the results of soil vapor samples collected during this sampling event, VOC concentrations generally continue to decline throughout the site. However, a slight increase of TCE was reported at a depth of 20 feet bgs at soil vapor monitoring well No. 4. Compared to the previous vapor sampling event (February 2002), the TCE concentrations increased during this sampling event from 8.9 µg/L-vapor to 11 µg/L-vapor in well No. 4.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL

This section briefly summarizes the quality assurance and quality control (QA/QC) procedures followed during the tenth periodic soil vapor sampling event. Analytical data reports for all soil vapor samples were sent to Laboratory Data Consultants, located in San Diego, California, for independent data evaluation. All data were usable as qualified. The validated data reports are presented in Appendix A, Soil Vapor Data Validation Report.

All sample analyses were performed using an external, three-point standard calibration method. For most target analytes, both detectors on the gas chromatograph (GC) were calibrated over a range equivalent to 5 to 200 µg/L analyte in soil vapor. Analytical system performance was verified at the beginning of each analytical day with an "opening standard" and a "closing standard" after the last environmental sample analysis for the day. A "continuing standard" was analyzed after the tenth environmental sample run that day. If ten or fewer samples were analyzed during the day, the closing standard substituted for the continuing standard. Results of the daily opening, closing, and continuing (if applicable) standards are presented in Appendix B-3.

During, each analytical day, the environmental sample analyses were bracketed by check standards, which verified acceptable system performance for the analytes listed in the daily calibration data summary tables (Appendix B-3). The percent difference (%D) of calibration factors in continuing standard mixtures were less than or equal to 20 percent for selected compounds and less than or equal to 15 percent for all other compounds (see Appendix B-3).

Field blanks of ambient air from inside the field laboratory trailer were analyzed immediately after the opening verification standard and were clean in all cases. No matrix spikes or laboratory replicates were required.

Two surrogate compounds (1,4-difluorobenzene and 4-bromofluorobenzene) were injected into the GC along with the environmental samples as a QA/QC check on recovery limits. In accordance with RWQCB (1997) protocols, surrogate recoveries should be in the range of 75 to 125 percent. All surrogate recoveries obtained during this sampling event satisfied this criteria by a wide margin, usually within a recovery range of 85 to 115 percent.

No sample analysis data obtained during this sampling event were rejected as unusable. Overall, the assessment of soil vapor and corresponding control sample data indicate that data quality objectives were achieved in terms of precision, accuracy, representativeness, comparability, and completeness for all analytes sampled.

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