EXECUTIVE SUMMARY

A. OBJECTIVE

The objective of this project was to design, install, operate, and monitor a pilot-scale bioventing system to evaluate the potential for using the technology to remediate non-petroleum hydrocarbon contaminants, primarily 1,2-dichlorobenzene (DCB).

B. BACKGROUND

Bioventing is a remedial technology that has been proven successful for achieving in situ treatment of various types of hydrocarbon contamination at sites under varying geologic and climatic conditions. The effort described in this report focused on the use of bioventing to remediate soils contaminated with non-petroleum contaminants, primarily 1,2-DCB. The study was conducted in Chemical Disposal Pit (CDP) 1 at Operable Unit (OU) 1 at Hill Air Force Base (AFB), Utah. The base is located approximately 25 miles north of Salt Lake City and five miles south of Ogden. The project was performed for the Air Force Research Laboratory located at Tyndall AFB, Florida, by Battelle Memorial Institute of Columbus, Ohio.

C. SCOPE

The demonstration included both field and laboratory components to achieve the project objective. Laboratory experiments were included as part of this treatability study to support any conclusions about the effect of biodegradation on any mass reductions of compounds of interest (COIs) observed in the field. These laboratory experiments allowed for more controlled tracking of the fate of the COIs, including volatilization and biodegradation removal mechanisms.

The field portion of this demonstration entailed installing separate bioventing systems into each of two plots. A fully operational bioventing system was designed and installed in the active plot, and a non-operational system was installed in the control plot. Because of the close proximity of both plots, five relief wells were placed between the two plots to hinder oxygenation in the control plot during air injection into the active plot.

This report includes descriptions of the bioventing system design, installation, operation, and monitoring procedures; laboratory monitoring and analytical methods; analytical results and data reduction procedures; and recommendations based on the results. The data from the analyses described in this report have been tabulated and graphed, and are included in a Data Package (Volume II) that complements this report. This report serves as an addendum to the Air Force's *Bioventing Principles and Practices Manual*.

D. RESULTS

Based on respiration rates and stoichiometry, a total of 1,490 kg (3,400 lbs.) of organic degraded in one year of operation within the volume of soil that was monitored (10 to 20 ft bgs). Note that this value ignores removal in the upper soil layer, which was not represented by soil sampling. It should also be noted that the system delivered oxygen to a volume of soil greater than the volume that was monitored and that the presence of compound extended beyond the boundaries of the test cell. These facts suggest that bioventing probably supported degradation of more mass of compound than were estimated by these calculations.

The difference in mass between initial and final soil sampling indicated significant removal of 1,2-DCB. Soil sampling results indicated that dichlorobenzene compounds were removed at an average rate of 65.7% when analyzed individually, and 68% when quantified as a single compound by GC, over the one year of bioventing. It is noteworthy that tetrachloroethylene, which is volatile and known not to be aerobically biodegradable, either directly or by cometabolism, was removed at a rate almost one order of magnitude less than DCB.

The mass losses for the COIs that could be attributed to biodegradation were calculated as the difference between the total mass removed as measured through initial and final soil sample analyses and the mass volatilized from the system as determined through surface emission testing. Note that only the 12- and 17-ft bgs layers were included in the soil mass loss calculation because the soil-sampling interval was between 10 and 20-ft bgs; also, the fact that the surface emission test was conducted immediately following system startup when emission rates would be the highest. These factors suggest that these estimated biodegradation rate are conservative.

VI. CONCLUSIONS

This study demonstrated that non-petroleum hydrocarbon organic compounds can be treated effectively using conventional bioventing technology. The focus in this demonstration was on 1,2-DCB, which was shown to be removed 74% over one year of operating a standard bioventing system. Other dichlorobenzene isomers were also effectively removed, with 1,3-DCB being removed at 42%, and 1,4-DCB being removed at 82%. Removal rates of the same order of magnitude were also demonstrated for many other compounds that were tracked.