Tuesday, September 20, 2005

Guadalajara Hacienda Restaurant • 9799 Katy Freeway (south side of Katy Freeway between Bunker Hill and Gessner)
Social 5:30 p.m., Dinner 6:30 p.m.

Cost: $25 Preregistered members; $30 non-members & walk-ups

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by ***Sandra Parker***
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Evaluation of In Situ Chemical Oxidation of a Chlorofluorocarbon and Trichloroethene Plume at NASA's Johnson Space Center

A leaking process discharge line at the Energy Systems Testing Area at NASA's Johnson Space Center (JSC) resulted in the release of 1,1,2-trichloro-1,2,2-trifluoroethane (chlorofluorocarbon 113 or CFC-113) and trichloroethene (TCE) into two hydrostratigraphic units from the 1960's through the 1980s. Contaminants migrated through deposits of interbedded clay and saturated sand to a depth of 80 feet below ground surface. Historically, the co-mingled plumes contained CFC-113 and TCE concentrations of up to 90 milligrams/liter (mg/L) and 0.05 mg/L, respectively. The level of TCE in groundwater exceeded the maximum contaminant level (MCL) in isolated locations within the shallow saturated sand zone (SS-1) at 10 to 20 feet below ground surface and a lower saturated sand zone (SS-2) at 60–80 feet below ground surface. Though CFC-113 concentrations did not exceed the MCL, JSC desired that both CFC-113 and TCE be treated. A groundwater pump and treat system installed in the early 1990s controlled migration of the affected groundwater but did not reduce the TCE concentrations to below the MCL in a timely fashion.

These results indicate that sodium permanganate is effective at remediating a co-mingled plume of CFC-113 and TCE.

To attain JSC's objective of reducing TCE concentrations to below the MCL and to reduce CFC-113 concentrations to the maximum extent practicable in an expedited manner, in situ chemical oxidation (ISCO) using sodium permanganate in groundwater was investigated and tested at the site. Few studies exist in the literature describing the effectiveness of permanganate oxidation of CFC-113. Some evidence indicates that high concentrations of CFC-113 might interfere with the direct oxidation of TCE. Bench-scale ISCO treatability studies using batch reactors and column tests indicated that sodium permanganate completely mineralized low concentrations of TCE in the presence of CFC-113, which itself was partially mineralized. The presence of high concentrations of CFC-113 did not inhibit the oxidation reaction at a TCE concentration of 0.1 mg/L.

Groundwater monitoring conducted during pilot oxidant injection test. The purple color in the purging lines indicates the presence of the oxidant in groundwater.

Pilot injection tests in both affected saturated zones confirmed bench-scale results that ISCO is effective at oxidizing both the CFC-113 and TCE. The initial results of the pilot tests indicated that TCE was oxidized to concentrations below the MCL within both saturated zones, while the CFC-113 concentrations were reduced from 50 to 65 percent in these zones. These results indicate that sodium permanganate is effective at remediating a co-mingled plume of CFC-113 and TCE. ■

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Biographical Sketches

Ms. Sandy Parker has her BS degree in Environmental Science from Stephen F. Austin State University and is currently an Environmental Specialist for NASA at the Johnson Space Center (JSC) in Houston, Texas. Ms. Parker has been with NASA since 1989 and is responsible for environmental compliance at JSC, Sonny Carter Training Facility and Ellington Field. Major areas of oversight include the largest hazardous waste generators; the metal finishing shop and the photographic laboratory, oversight of the petroleum storage tank program, pollution prevention, cardboard recycling and the restoration program. She was responsible for installing an innovative treatment system that completely recycles photographic waste water and generates de-ionized water for re-use in the photographic laboratory, thereby eliminating the largest hazardous waste stream at JSC. Ms. Parker is currently conducting a study to determine if an in situ chemical oxidation treatment will reduce volatile organic constituents in a groundwater plume at JSC. Prior to working for NASA, Ms. Parker held environmental positions for the Texas Department of Water Resources, Texas Eastern Corporation and the Texas Water Commission. Among Ms. Parker's accomplishments she received the NASA Flight Space Awareness Award in 1992.

Mr. Michael Madl is a project engineer with the environmental consulting firm Malcolm Pirnie, Inc., in Houston, Texas. Mr. Madl's primary area of expertise is the characterization of sites contaminated with hazardous chemicals and developing various in situ remediation technologies for site restoration. His in situ remediation work has focused on cleanup of volatile organic compounds through bioaugmentation, biostimulation, chemical oxidation, permeable reactive barriers, air sparging, and monitored natural attenuation. Another area of expertise consists of the characterization of munitions and explosives of concern (MEC) and munitions constituents (MC) at other than operational military ranges under the Military Munitions Response Program (MMRP) for the United States Navy and Marine Corps. He also conducts range environmental vulnerability assessments for operational ranges for the Navy and Marine Corps. Mr. Madl previously supported two Department of Defense test and evaluation agencies at the Pentagon. He has Bachelor of Science degrees in Environmental Science and Biology from the College of William and Mary, and received a Master of Science degree in Environmental Engineering and Science from Clemson University.