SAMPLING PROGRAM DEVELOPMENT AND PERFORMANCE EVALUATION OF POINT OF ENTRY (POE) TREATMENT UNITS INSTALLED AT GASOLINE-CONTAMINATED WELL SITES

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Problem and Research Objectives:

USEPA estimates that there are over 1.5 million underground storage tanks (UST) in the United States containing hazardous substances or petroleum, and as many as 200, 000 of these may be leaking. A recent study in Suffolk County, NY found that 17% of the 500 UST recently removed showed signs of leaking. Of particular concern are petroleum storage tanks which are ubiquitous due to our reliance upon oil and gasoline. In many instances, contamination of drinking water supplies from leaking UST affect individual wells in rural areas. Contamination of private wells presents unique problems for regulatory agencies and utilities. Typically, bottled water is provided for drinking as a short-term measure while an alternate supply is located. However, bottled water is a costly solution and does not reduce the health effects from inhalation or dermal exposure when the contaminated water is used for other domestic purposes (e.g., bathing). In addition, the political, legal, economic and technical constraints involved in remediation of leaking UST may delay the securing of an alternate water supply for years. A potential solution to individual well studies of VOC contamination and treatment of public water supplies are reported in the literature; there is little information about factors which affect design and performance of POE systems. Further, few studies have addressed the effects of non-purgeable dissolved organic carbon (NPDOC) and microbial activity on VOC treatment systems.

The research reported is part of an ongoing two-year study funded by the New Hampshire Department of Environmental Services to evaluate the use of point-of-entry (POE) treatment techniques for removing petroleum contamination from individual wells. The main objective of the study is to relate spatial and temporal variations in ground water quality (e.g., VOC, NPDOC, microbial numbers) to the selection, design and preformation evaluation of POE systems.

Principle Findings to Date:

Raw Water Quality:

Experimental data collected, for the first one-hundred days of operation, show several interesting trends in raw water quality. First, there are significant and rapid temporal changes in raw water concentrations of VOC's, NPDOC, iron, manganese and microbial numbers (HPC) at virtually all sites. Second, study sites which are located in the same contaminant plume show significant spatial changes in the type and concentration of contaminants. Results from samples collected on the same days at two wells located approximately 100 meters apart and screened at the same elevation show up to one order of magnitude difference in contaminant concentration. Third, virtually all contamination sites have elevated levels of NPDOC with several exceeding 3 mg/L for three times the background levels found in New Hampshire. GCMS results indicate that the majority of the NPDOC is MTBE and hydrophilic, non-volatile petroleum hydrocarbons. Fourth, microbial activity is measured by R2A, HPC ranges from 1 x 105 to 3 x 106 CFU/100 ml and, in most cases, is well above typical levels (104 CFU/100 ml) observed in New Hampshire ground water. Relationships between VOC concentrations, NPDOC, microbial activity and other water quality parameters are being investigated and will be discussed in the final report.

POE System Performance:
Preliminary analysis of POE performance indicates that the aeration system is insensitive to changes in raw water BTEX concentrations. Consistently high (>90%) removals by aeration, despite significant variations in raw water concentrations of benzene, toluene and xylene, were observed at all sites. The flexibility of the bubble plate unit is not surprising since it operates at a volumetric air/water ratio above 160/1.

POE systems containing GAC are affected by the variations in VOC and NPDOC. The NPDOC has a significant effect on the carbon bed life. During the first year of study, the GAC was replaced to significant MTBE breakthrough at three of the POE sites. BTEX compounds will control selection, design and operation of the POE systems, particularly when GAC units are used.

An economic evaluation of POE systems is being performed focusing on capital and operation and maintenance (O&M) costs. Field data collected to date indicates POE system power costs range from $0.30 to $0.50 per thousand gallons treated. Capital cost data and maintenance records for each unit are being compiled and cost data will be presented in the final report at the end of the two-year study.