Characterization of a Creosote-Contaminated Tie Yard Site and the Effects of Phytoremediation

By

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Thesis submitted to the faculty of Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

in

ENVIRONMENTAL ENGINEERING

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June 1998
Blacksburg, Virginia

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(ABSTRACT)

A creosote treatment facility was active during the 1950's and 1960's at a railroad tie yard site. In 1990, creosote contamination was discovered along a creek bank at the site. Phytoremediation was selected as the remedial technology and hybrid poplar trees were planted at the site in 1997. A research project was designed to: 1) characterize the site through collection of soil and ground water samples; 2) assess phytoremediation effects of 3 grasses, clover, fescue and rye, in creosote-contaminated surface soils; 3) perform assessment of the hybrid poplar tree phytoremediation system; 4) develop a hybrid poplar tree evapotranspiration model. This thesis is focused on the first and second items on the research agenda.

Soil and ground water samples were collected and analyzed for 6 polycyclic aromatic hydrocarbons (PAHs), acenaphthene, fluorene, phenanthrene, fluoranthene, pyrene and chrysene. Site characterization revealed multiple creosote sources. Areal subsurface bedrock DNAPL distribution, approximately 6500 ft^2, was much greater than previously reported. Total PAHs ($\sum$ 6 PAHs) in the soil and ground water ranged from below detection limits (BDL) to 8,276 mg/kg and BDL to 1.58 mg/L, respectively. Aqueous phase PAHs should be available for hybrid poplar tree and

microbial uptake. Dissolution and diffusion of PAH constituents from the free product phase to the aqueous and soil phases contaminated both matrices. PAH cosolvency effects were also evident. The presence of more soluble PAHs in the aqueous phase enhanced the solubility of two hydrophobic PAHs, chrysene and benzo(b)fluoranthene.

Phytoremediation effects of fescue, rye, and clover grasses were assessed in creosote-contaminated surface soils. Over the 9 month period, clover grass growth was very poor. Clover data was not used in comparative analyses. Rye and fescue grasses exhibited acceptable growth. In planted and control (unplanted-amended) plots, acenaphthene, fluorene, phenanthrene, fluoranthene, and pyrene soil concentrations were reduced 72, 50, 73, 55 and 49 percent, respectively. Chrysene reduction was not statistically significant. During the first 4 months of the study, dry site conditions limited grass growth and subsurface biological activity. The site received approximately 16 inches of precipitation during the last 3 months of the study, including multiple, intense precipitation events. The subsurface was saturated for prolonged periods of time and oxygen transfer to indigenous microorganisms was likely limited. The root structures of fescue and rye grasses were neither dense nor complex enough to promote phytoremediation effects. PAH reductions were generally greater for constituents with higher aqueous solubilities. It is thought that PAH losses were primarily due to solubilization and/or microbial uptake.