

Worarat Sripongphichit 2006: Investigation of Fossil Fuel Contamination in Unsaturated Zone Using Digital Image Analysis. Master of Engineering (Environmental Engineering), Major Field: Environmental Engineering. Department of Environmental Engineering. Thesis Advisor: Assistant Professor Cheema Chomsurin, Ph.D. 125 pages.
ISBN 974-16-2160-4

This study is to investigate fate and transport of light non-aqueous phase liquid (LNAPL) in the unsaturated zone with heterogeneous structure. The selected LNAPL for the investigation was BTEX; benzene, toluene, xylene and ethylbenzene which are ingredients in gasoline (benzene 91). It was studied in a two dimensional reactor with the size of 14.5 x 30 x 3 in and the reactor was packed with sand (1.77 in diameter) and soft clay at the bottom of the reactor as an impermeable layer. Images were taken using high resolution digital camera. Matlab v. 7 was used to quantify volume and surface area of the contamination.

The first part of the investigation was to study mechanisms that control movement of LNAPL when groundwater level changes. It was found that, once was introduced into subsurface, LNAPL moved downward and form LNAPL plume over groundwater level and the plume move according to movement to the groundwater level (upward or downward). The movement of LNAPL depends on balance between gravity, viscosity and capillary forces and LNAPL residue was visualized. It was also found that LNAPL can move into the clay layer when groundwater was lowered below the layer. Finally, when groundwater moved upward, LNAPL residue was found below the water level and this shows that LNAPL can cause groundwater contamination due to groundwater fluctuation. The second part of the investigation was to study mass transfer from LNAPL plume to liquid, air and solid within the system; through dissolution to groundwater, volatilization to air within the unsaturated zone and adsorption into soil. From calculation, it was found that mass transfer due to dissolution from interface to capillary fringe was at the highest percentage compared to other mechanisms. Xylene was found in highest percentage among VOC contamination from gasoline due to its high composition within gasoline and due to its chemical properties; fraction of BTEX in gasoline, organic carbon partitioning coefficient (K_{oc}), Henry's constant and others.

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23 / May / 2006