Transport of LNAPL and biofilm growth in subsurface under dynamic groundwater conditions

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The focus of this study was to investigate transport of light non-aqueous phase liquids (LNAPL) and biofilm growth in subsurface under stable and dynamic groundwater table conditions. A series of practical experiments were conducted using two-dimensional sand tank setup having dimensions of 125 cm length by 90 cm height by 10 cm width and integrated with an auxiliary column. Transport of toluene, the selected LNAPL, was investigated under stable groundwater table condition before considering three different groundwater fluctuating scenarios. Three different groundwater fluctuation conditions were maintained by raising and falling 5cm magnitude of fluctuation in 1, 2 and 4 hours. Thereafter, numerically runs were conducted for the LNAPL transport and biofilm growth under varying groundwater conditions for the experimental domain. The results show that a large LNAPL-water interphase under fluctuating groundwater conditions contributes to high concentration of dissolved LNAPL plume in saturated zone. Transport of dissolved LNAPL and oxygen was also comparatively more in case of fast fluctuating groundwater resulting in closely spaces concentration isolines of toluene containing plume. Biofilm growth was found to be increasing as plume moves away from the LNAPL pool, which fortifies detrimental impact of toluene on the survival of indigenous microorganisms. A high biodegradation rate was observed in regions having concentration ranges from 140-160 mg/L. The response of the microbial community was also affected by oxygen derived from fluctuating groundwater condition. The results of this study may help to implement effective bioremediation designs to decontaminate LNAPL polluted sites under varying subsurface conditions.

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