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Modeling of benzene biodegradation during 2-D transport through quartz sand

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Biodegradation of aqueous benzene in a homogeneous sandy aquifer was investigated by conducting a laboratory-scale two-dimensional plume test. Benzene solution and benzene-degrading bacteria (*Pseudomonas aeruginosa*) were introduced as a pulse type along the width of the aquifer model through a recharge zone situated at the upper-left part of the model and followed by a steady state flow. Solution samples were collected at various locations on the front side of the model to capture two-dimensional plumes at discrete time intervals. Results showed that at early time the benzene plume had a banded shape propagating from upper-left corner to the lower-right corner of the aquifer model but lost its shape as time passed by due to considerable mass attenuation. As the benzene plume traveled down the flow path, the plume size and peak concentration decreased rapidly. The mass recoveries of benzene at 9, 16, and 22 hr were determined to be 37, 13, and 8 %, respectively, showing that a significant attenuation of the aqueous benzene occurred in the aquifer. The major processes responsible for mass attenuation of aqueous benzene were biodegradation along with volatilization and irreversible sorption. Model simulation with showed that benzene transport and attenuation is relatively well described by the given mathematical models. The simulation indicated that among the Monod and microbial parameters the maximum specific growth rate of bacteria ($\mu_{\max}$) and half-saturation constant of benzene (K_c) should be determined carefully in the modeling process to accurately predict the attenuation of benzene plume during transport through the aquifer.