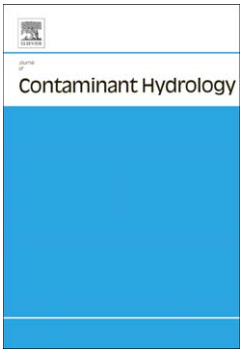

Infiltration and Evaporation of Small Hydrocarbon Spills at Gas Stations

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Infiltration and Evaporation of Small Hydrocarbon Spills at Gas Stations

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Abstract

Small gasoline spills frequently occur at gasoline dispensing stations. We have developed a mathematical model to estimate both the amount of gasoline that infiltrates into the concrete underneath the dispensing stations and the amount of gasoline that evaporates into the typically turbulent atmosphere. Our model shows that the fraction of infiltrated gasoline can exceed the fraction that evaporates from the sessile droplets. Infiltrated gasoline then evaporates and is slowly released to the atmosphere via slow diffusive transport in pores. Tentative experiments show that our theoretical approach captures observed experimental trends. Predictions based on independently estimated model parameters roughly describe the experimental data, except for the very slow vapor release at the end of Stage II evaporation. Our study suggests that, over the lifespan of a gas station, concrete pads underneath gas dispensing stations accumulate significant amounts of gasoline, which could eventually break through into underlying soil and groundwater. Our model also shows that lifetimes of spilled gasoline droplets on concrete surfaces are on the order of minutes or longer. Therefore contamination can be carried away by foot traffic or precipitation runoff. Regulations and guidelines typically do not address subsurface and surface contamination due to chronic small gasoline spills, even though these spills could result in non-negligible human exposure to toxic and carcinogenic gasoline compounds.