

Are Karst Bedrock Aquifers at Greater Risk from Alternative Alcohol-Fuel Mixes Compared to Regular Gasoline?

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Abstract

The United States government is promoting alternative fuels that reduce our dependency on foreign oil. Tennessee is promoting E-85, a fuel that consists of 85 percent ethanol and 15 percent gasoline. The environmental fate of gas-alcohol mixtures, however, has not been investigated. The consequences of an uncontrolled spill of E-85 or a related mixture would, therefore, be very difficult to predict. The objective of this research was to determine if a commercial grade E-85 mixture would dissolve more readily in water and move faster through water-saturated soil than regular gasoline. A better understanding of E-85 mobility in the subsurface is of practical importance if E-85 is to become widely used and stored in underground storage tanks like conventional fuels. Solubility-in-water studies comparing gasoline with E-85 found that the ethanol component in E-85 acted as a co-solvent and enabled aromatic compounds to dissolve five times more rapidly in water than regular gasoline. These enhanced solubility characteristics may allow the aromatic rings to move faster and further through water-saturated soils and karst conduits than regular gasoline. Additional experiments were conducted to determine if regolith soils would affect the dispersal rate of E-85 fuel compounds. Sterile soil-column studies using soils collected from karst regions of Middle Tennessee demonstrated that aromatic compounds, such as benzene, toluene or xylene (BTX), from the E-85 moved 3 to 4 times faster than BTX compounds in regular gasoline when transported by water through the soil. These results suggest that leakage of E-85 from underground storage tanks could result in wider contamination of aquifer materials in a shorter time than regular gasoline. Additional work compared the biodegradation of E-85 with regular gasoline. Using static reactors with karst bacteria, E-85 biodegradation rates were almost 5 times greater than regular gasoline. This is in agreement with previous reports finding that dissolved-phase fuels were more bioavailable and degraded faster. Additional studies are needed to more thoroughly address issues concerning E-85 solubility and biodegradation.