UNIVERSITY OF HOUSTON

Cullen College of Engineering

Thursday, May 14th, 2020

2: 00 PM

Defense held online via Zoom:

https://uofh.zoom.us/j/8756799085?pwd=VXlZOFgrMWpmRGJuUXZpZVJ6Q1Jhdz09

Password: YW

Yifei Wang

PhD Dissertation Defense

William G. Rixey, Faculty Advisor

"Aquifer Experiments for Characterizing NAPL Sources and Dissolved Plumes following Releases of Ethanol-Blended Fuels"

Abstract

This research investigated impacts of releases to the subsurface of ethanol-blended fuels. The overall purpose was to study the evolution of a dissolved plume and non-aqueous phase liquid (NAPL) that is formed/displaced for different fuel ethanol contents in order to develop an understanding of how ethanol fuel contents affect the release, transport, and transformation of ethanol as well as hydrocarbon impacts on water quality.

In the first part of the research, low (E25) and high (E85) ethanol fuel blends were released in the unsaturated zone of a pilot-scale aquifer. Pore water concentrations were monitored in the unsaturated zone, in the saturated zone, and in the effluent following the releases. The second part of the research involved smaller-scale studies of ethanol fuel releases in 2D physical model continuous flow cell experiments to better quantify and understand ethanol recovery and the extent of transformation from the large-scale releases of these fuels. These experiments allowed for the visualization of the transport of ethanol in the pore water and the formation of NAPL from the fuel releases.

Evaluation of the impacts of these ethanol fuel releases has shown: 1) retention of ethanol in the unsaturated zone for releases containing high ethanol content due to buoyancy, 2) for low ethanol content fuels a fraction of the ethanol was released slowly, controlled by diffusion from the NAPL source, and 3) more rapid source depletion (for high ethanol content) of the more soluble hydrocarbon components in the fuel due to lower NAPL saturation. This research is useful for assessing the extent and persistence of groundwater impacts for realistic spills or leaks of fuels containing ethanol. The results of this research not only apply to ethanol but are also relevant to other alcohols being considered as alternative fuels.