

Theoretical and Experimental Study of using Horizontal Wells to Recover DNAPL

H. Zhan, J. Chung

Texas A&M University
College Station, Texas, USA

DNAPLs represent a significant threat to the quality of groundwater aquifers throughout the world. DNAPLs are denser than water and are trapped by capillary forces and as pools of liquid suspended on low-permeability strata. The DNAPL pool is usually thin and horizontally widely spread. Vertical wells are proven to be extremely inefficient for collecting the DNAPLs owing to the limited contact area between the well screen and the DNAPL pool. Horizontal wells, however, can provide much better recovery because they can be oriented to have much larger contact areas with the pool. In this paper, we utilize the fact that the pressure of two-liquid flow is balanced across the interface, thus analytically solve the problem for the water-DNAPL interface. The horizontal well is treated as an infinite-conductivity boundary with a finite radius. The solution for the horizontal well source is obtained through the superposition of point source solution. The experimental study provides direct observation of the water-DNAPL interface change with time. The relationship between the interface change with thickness of the DNAPL, the well location, and the well pumping rate is investigated. The experimental study also provides the critical pumping rate at which the cusp of the interface reaches the horizontal wellbore. The experimental study confirms the theoretical results.