

THE PENNSYLVANIA STATE UNIVERSITY
ENERGY AND MINERAL ENGINEERING
ENVSE 408 CONTAMINANT HYDROLOGY
ASSIGNMENT 9

A mixture of 80% TCE and 20% TCB (by weight) is used for the cleaning of military aircraft engines and spills onto a permeable apron of the facility. The DNAPL product is used at an average rate of 1000 liters/year for a period of 10 years, and spills (approximately evenly distributed in time) over an area of $10\text{ m} \times 10\text{ m}$. Mean groundwater infiltration for the site is 0.5 m/yr .

The apron overlies a sandy aquifer with a bulk density of 1650 kg/m^3 , porosity of $n = 0.25$ and residual wetting and non-wetting saturations of $S_{w0} = 0.20$ and $S_{nw0} = 0.20$, respectively. There is no discernible organic matter within the soil and assume a mean soil temperature of 20°C . The distribution coefficients, K_d , for TCE and TCB are 0.1 and 1 L/kg , respectively. If the static water level is at a depth of 5 m , evaluate the following.

Assignment

1. Determine the equilibrium concentrations of TCE and TCB that partition to the solid, aqueous and gaseous phases.
2. Determine how long it takes for the loading of TCE and TCB to reach the water-table following the initiation of the spill. Assume plug-flow with no dispersion. Does “free” product reach the water-table? What will be the annual TCE and TCB loading at the water-table?

Based on these results, determine the time taken to deplete the spilled material using natural aqueous washing.

3. The site is covered with an impermeable membrane when the facility is closed at the end of year 10. If the vadose zone is vented by circulating air (at a mean temperature of 20°C) horizontally at a rate of $400\text{ m}^3/\text{month}$, determine the rate of removal of the two components, TCE and TCB.

How long will it take to remove the complete spill using this method?

State and defend any assumptions you have to make.