

## 1.34 WASTE CONTAINMENT AND SITE REMEDIATION TECHNOLOGY HOMEWORK 6 – DUE APRIL 23, 2004

### Question 1

Where does your trash go? That is, what is its eventual disposal point and how does it get there? (You can answer for either home or school, a one- or two-paragraph answer will suffice.) (2 points)

### Question 2

In Homework 4, we considered Acme Manufacturing, a metal fabrication plant contaminated by the chlorinated organic solvents trichloroethylene (TCE) and 1,1,1-trichloroethane (usually abbreviated 1,1,1-TCA or just TCA).

You want to consider a treatment wall (permeable reactive barrier or PRB) as a treatment alternative for this site. What reactive medium would you select for a PRB in order to treat the ground-water contaminants at this site? (1 point)

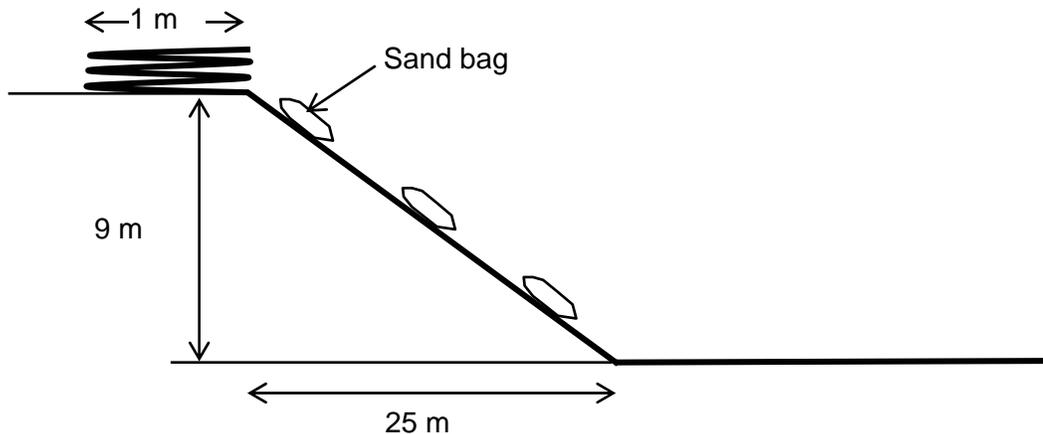
Laboratory column tests show that TCE has a half-life of 6 hours and TCA of 1 hour in the reactive medium you have selected. The tests also showed that the material has a porosity of 0.3 and hydraulic conductivity of  $2 \times 10^{-2}$  cm/sec. Assume that the PRB will be installed in the road at the downgradient property line and that the concentration of TCE is 1,500  $\mu\text{g/L}$  and of TCA is 20,000  $\mu\text{g/L}$  at the downgradient edge of the property. Assume the hydraulic gradient in the aquifer is 0.0055, the hydraulic conductivity of the aquifer is  $1.6 \times 10^{-2}$  cm/sec, and the porosity of the aquifer is 0.25. How thick must the reactive wall be to reduce the contaminants to their MCLs? (2 points)

### Question 3

MIT people often make the analogy that getting an education at MIT is like drinking from a firehose. Suppose a naïve M.Eng. student has taken the analogy literally and has been consuming 5 liters of MIT water per day, 7 days a week, for the last 34 weeks. The student weighs 60 kg. Unfortunately, years ago, the backwash from the cooling towers at the MIT power plant were accidentally connected to a drinking water line and as a result the water is contaminated by 50  $\mu\text{g/L}$  of pentachlorophenol (not really!). Calculate the risk level of cancer over a 70-year lifetime due to the student's consumption of MIT water. (2 points)

#### Question 4

A 60-mil (1.5-mm) thick HDPE membrane liner with a density of  $0.94 \text{ g/cm}^3$  is being installed on the side slope of a landfill as shown in the sketch below. The HDPE has been placed on the downslope of the landfill and excess liner has been “accordioned” at the top of the landfill as shown. This material will be used to construct a runout and anchor trench later. The excess liner is 6 meters long and has been folded back and forth on itself five times so that six lengths of liner, each one-meter long, have been stacked on top of each other. Finally, in order to prevent wind from picking up the liner, bags of sand have been placed on the liner. There are three bags placed on the slope as shown. The bags are placed every three meters along the slope (i.e., along the direction into the page). Each bag has a mass of 20 kg and covers an area of  $400 \text{ cm}^2$ . The friction angle between the HDPE and underlying soil is 17 degrees.



- Without the bags in place, would the liner be safe from slipping down the slope?
- With the bags in place, would the liner be safe from slipping?
- For either case a or b, if you find the liner is not safe from slipping, provide a specific (i.e., quantitative) recommendation to prevent the liner from slipping. Allow for a factor of safety for liner slippage of 1.3.

(1 points each part)