1.85 WATER AND WASTEWATER TREATMENT ENGINEERING
HOMEWORK 4 – DUE MARCH 10, 2005

Question 1 (5 points)

A suspension of three sizes of spherical particles is to be filtered at a rate of 15 m/hr through a 60-cm rapid sand filter. The bed sand has a diameter of 0.5 mm and a porosity of 0.4. Particle counting indicates that there are 5, 25, and 125 mg/L each of 0.1, 1.0, and 10.0-micron diameter particles, respectively. The particles have a density of 1.05 g/cm^3. The water temperature is 25C.

a. Assuming discrete particle settling, determine the single collector efficiency, η, for each particle size using the theoretical model of Yao et al. (1971) as given in the notes for Lectures 7 and 8. (2 points)

b. If the attachment efficiency, α, is 0.2, what is the concentration of each particle after the water passes through the filter bed? (2 points)

c. If the attachment efficiency, α, is 1.0, what is the concentration of each particle after the water passes through the filter bed? (1 point)

Question 2 (5 points)

Viessman and Hammer Problem 11.22.

The water defined by the analysis given below is to be softened by excess-lime (and soda ash) treatment.

a. Sketch an meq/L bar graph (1 point).

b. Calculate the softening chemicals required (3 points).

c. Draw a bar graph for the softened water after recarbonation and filtration, assuming that 80% of the alkalinity is in the bicarbonate form (1 point).

CO_2	8.8 mg/L
Ca^{2+}	40.0 mg/L
Mg^{2+}	14.7 mg/L
Na^{+}	13.7 mg/L

ALK (HCO_3^-)	135 mg/L
SO_4^{2-}	29.0 mg/L
Cl^-	17.8 mg/L