PROBLEM 1

The data in the following table were obtained from a pilot plant study on the filtration of settled secondary effluent from an activated sludge plant. Using these data, estimate the length of run if the maximum allowable headloss is 10 ft. The filtration rate is 4.0 gal/ft^2·min, and the influent suspended solids concentration is 15 mg/l. Uniform sand with a diameter of 0.55 mm and a depth of 2 ft was used in the pilot filters. Headloss data can be obtained from the figure given below.

Depth, in	C/C_0	Depth, in	C/C_0
0	1.00	12	0.36
2	0.70	14	0.33
4	0.57	16	0.32
6	0.49	18	0.31
8	0.44	20	0.31
10	0.39	22	0.31
		240	0.31

PROBLEM 2

Using the equation developed by Fair and Hatch, and Rose, determine the headloss through a 30 in sand bed. Assume that the sand bed is composed of spherical unisized sand with a diameter of 0.6 mm, the porosity is 0.40, and the filtration rate is 6 gal/ft^2·min. The temperature is 18 ^{o}C.

PROBLEM 3

Determine the required backwash velocity to expand a granular medium bed to a porosity of 0.70. Also determine the depth of the expanded filter bed for the following data:

Granular medium = sand — Sand size = 0.5 mm

Sand density = 2600 kg/m^3 — Filter depth = 0.6 m

Temperature = 20 ^{o}C.

PROBLEM 4

For a given filtration operation, it has been found that straining is the predominant particulate matter removal mechanism and that the change in concentration with distance can be approximated by a first-order equation ($dC/dx = -rC$). If the initial concentration of particulate matter is 10 mg/l, the removal-rate constant is equal to 8 in^{-1}, and the filtration velocity is 2.5 gal/ft^2·min. Determine the amount of material captured within the filter in the layer between 1 and 2 in over 1 hr period. Express your answer in mg/in^3. Estimate the headloss in the layer at the end of 6 h.