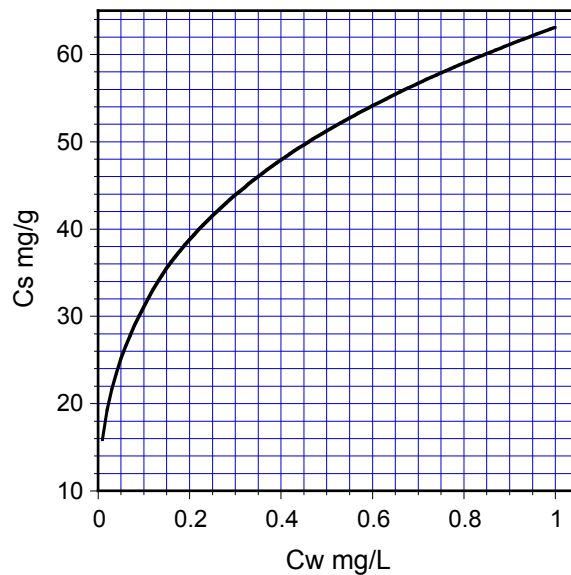


Water and wastewater treatment - Homework 10

1. Adsorption

An adsorption isotherm for the adsorption of atrazine on activated carbon has been determined and is shown in the graph below.

a) Determine the parameters (K , $1/n$) for a Freundlich isotherm.



b) An activated carbon filter should be used to remove atrazine. The specifications are as follows:

Carbon type F400: $\rho_F = 450 \text{ g/L}$

Influent concentration 1 mg/L

Flow rate $50 \text{ m}^3/\text{h}$

EBCT 20 min

(i) Calculate the minimum GAC usage rate and the maximum specific throughput

(ii) How much water can be treated before the compound breaks through?

(iii) What is the filter bed life (lifetime of filter before compound breaks through)?

2. Membrane fouling

The water authority decides to operate the membranes in a dead-end mode, with intermittent back-flushing. The flux is kept at a constant value of $70 \text{ L m}^{-2} \text{ h}^{-1}$. Pilot experiments show a typical pressure diagram of the filtration cycles as shown in Figure 1.

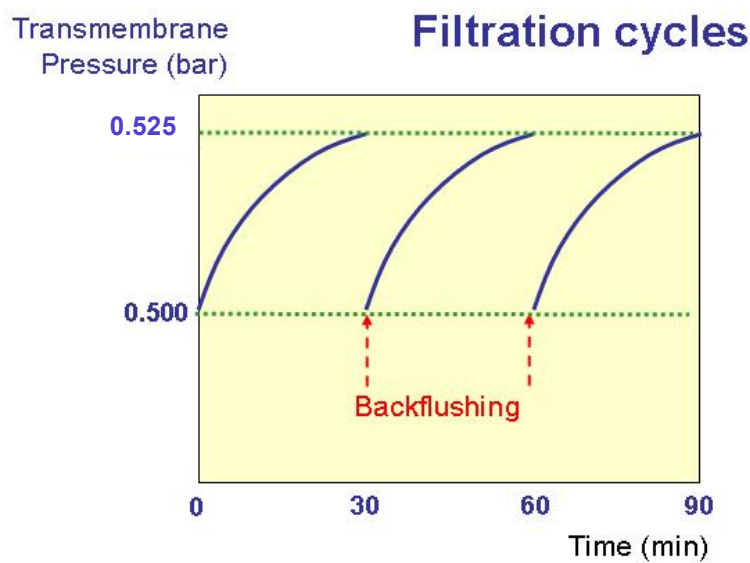


Figure 1: Trans-membrane pressure during filtration cycles

a) Discuss the mode of fouling (reversible vs irreversible).

b) Observation above shows that the cake layer formed by deposition of the particulate fraction is effectively removed during backwashing. Calculate the

thickness and porosity of the cake layer formed on the membrane. The concentration of particles is 600 mg/L, the average particle diameter 0.05 μm , and the particle density 1500 kg/m³, T=20°C, $\mu = 1.002 \times 10^{-3} \text{ Ns/m}^2$, 1 bar = 10⁵ Pa = 10⁵ kg m⁻¹s⁻². Assume in a first approximation that the porosity can be neglected for the calculation of the thickness of the cake layer.

c) In 3b) we have neglected the porosity. How does this result affect the fouling layer thickness and also the porosity (qualitative answer)?

d) How does the calculated porosity from 3b) compare to deep bed filtration ($\epsilon=0.4$)?