**Water and Wastewater Treatment**

**Problems on Filtration, Disinfection, Softening and Adsorption**

1. A rapid filter plant has units with a design capacity of 8000 m3/d at a rate of 120 m/d. What should be the capacity of the elevated storage tank if it is to hold sufficient amount of water for two consecutive 5-min washes at a rate of 0.8 m/min?
2. A groundwater supply has the following analysis:

Ca2+ = 3.7 meq/L HCO3- = 4.0 meq/L

Mg2+ = 1.0 meq/L SO42- = 1.2 meq/L

Na+ = 1.0 meq/L Cl- = 1.0 meq/L

K+ = 0.5 meq/L CO2 = 0.40 meq/L

Calculate the chemical dose needed and the residue produced for excess lime softening. (Assume excess lime = 1.25 meq/L; lower limits for removal of calcium and magnesium, respectively are 0.6 meq/L and 0.2 meq/L)

1. Results of a chlorine demand test on a raw water are as follows:

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| --- | --- | --- |
| Sample No. | Chlorine dosage (mg/L) | Residual chlorine after 10-min contact (mg/L) |
| 1  2  3  4  5  6  7  8 | 0.20  0.40  0.60  0.80  1.00  1.20  1.40  1.60 | 0.19  0.36  0.50  0.48  0.20  0.40  0.60  0.80 |

Sketch the chlorine demand curve. What is the chlorine dose required to attain a combined residual of 0.5 mg/L and a free residual of 0.5 mg/L? What is the combined residual present when a free residual of 0.5 mg/L exists?

1. Water with a flow rate of 1000 l/min is to be treated with powdered activated carbon (PAC) to reduce residual organics from an initial concentration of 5 mg/L to equilibrium concentration of 1 mg/L. The Freundlich adsorption isotherm was found to be a good model to describe the process with a best fit line equation of lnq = 5 + 0.5ln[C].
   1. Determine the required mass of PAC
   2. Calculate the annual cost of PAC if its unit price is $0.5 per kg