***Problem 1.*** A wastewater containing 5 mg/L of hydrogen sulfur (H2S) causes odor in a wastewater treatment plant. The odor problem due to H2S will be removed by increasing the pH of wastewater using slake lime (Ca(OH)2). Assuming the initial pH of wastewater is 7.6, to obtain % 99 odor removal,

1. What should be the final pH of wastewater after slake lime addition?
2. Calculate how many grams of pure hydrated lime (Ca(OH)2) should be used daily?

Not: The daily flow rate of wastewater is 10.000 m3/d.

 No hydrogen sulfur loss during odor removal.

***Problem 2.*** A domestic wastewater contains 10 mg/L of ammonium nitrogen (NH4+-N). The pH of wastewater is 9. The daily flow rate of wastewater to the treatment plant is 2000 m3/d. Based on information given in the problem:

1. Calculate the level of odor caused by ammonia as mg/L.
2. If the final pH of wastewater after acid addition for odor control is determined 7, what should be odor (H2S) removal as percentage?
3. To obtain odor removal you calculated in part b, how many kilograms of sulfuric acid (H2SO4) with 95% purity you should daily add to the wastewater.
4. Calculate daily operational cost due to the acid consumption. Do you think the cost you calculated is acceptable?

*Note: Assume no ammonia loss during odor removal.*

***Problem 3.***A municipal wastewater contains 1000 mg/L of total volatile solids, which is also named as **“total organic matter”**. The COD concentration of wastewater is measured around 1300 mg/L, 70 % of which is biodegradable. The organic carbon content of the wastewater is 30%. Now, assume that this wastewater is being treated in an activated sludge process with 95% of BOD removal efficiency. Based on this information, answer the following questions:

1. What should be influent BOD and TOC before the treatment of wastewater?
2. What should be effluent COD and BOD after treatment?
3. What might be effluent TOC as mg/L and percent mineralization of total carbonaceous organic matter after the activated sludge treatment?

***Problem 4.*** A groundwater nearby agricultural facilities will be used as potable water for a community in the city of Çanakkale. The groundwater with a pH of 7.6 and temperature of 25 oC was analyzed for its chemical impurities (Table 1). Using information given in the Table, answer the following questions:

Table 1. Chemical impurities of groundwater

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| **Ionic species** |
| *Cations* | *C (mg/L)* | *MW (g/mole)* | *Anions* | *C (mg/L)* | *MW (g/mole)* |
| Na+ | 145 | 23 | Cl- | 230 | 35.5 |
| K+ | 38 | 39 | SO42- | 110 | 96 |
| Ca2+ | 48 | 40 | NO3--N | 20 | 14 |
| Mg2+ | 26 | 24.4 | HCO3- | 130 | 61 |
| Fe2+ | 5 | 56 |  |  |  |
| Al3+ | 3 | 27 |  |  |  |

1. Check with the electro-neutrality to make sure if it is in the standard error limit.
2. Estimate the total inorganic dissolved solid (TDS) concentration, specific conductivity (SC) and ionic strength (μ).
3. Calculate alkalinity and acidity of groundwater as mg/L CaCO3
4. Calculate total hardness of groundwater as mg/L CaCO3
5. Calculate Sodium Absorption Rate (SAR) of this groundwater and evaluate the results.
6. Calculate the Langelier and Ryznar Index and interpret your results.
7. For what purpose do you think this water is more suitable: drinking water, irrigation, cooling, heating, swimming, etc.?