ENV-405 | Water and Wastewater Treatment

Lecture 2. Chlorine and UV disinfection

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Exercice #1 | Hydrolysis of chlorine

Q1. Calculate the equilibrium concentrations of HOCl and Cl_2 (aq) in solution for a chlorine addition of 2 mg/L at 25°C. Assume that the pH is 5 and does not change and that at pH 5 the amount of HOCl that disassociates to H^+ and OCl^- is insignificant.

Q2. Express the chlorine concentrations in terms of milligrams per liter of Cl_2(aq)

Exercice #2 | Chlorine disinfection – water disinfection verification

See Excel file “Homework_2_2”

Imagine you are responsible for operating the water distribution system in a small village. On August 3rd, you receive a call from the cantonal authorities. They ask you to prove that your disinfection system has been working properly during the last six days.

Your water supply system is simple: spring water is pumped into a reservoir. Before entering the reservoir, the water is disinfected with liquid chlorine. From there, the water flows directly to consumers.

You have access to monitoring data recorded between July 28th and August 2nd. In addition, you carried out a detailed analysis of the spring water (before and after treatment) on July 17th. You may assume that the raw water quality has not changed significantly since that date.

Your task: show that the disinfection system has been effective.

Q1. How can you demonstrate that the water treatment provided adequate disinfection during the required period?

Q2. With your data analysis from July 17th, what other parameters could you use to support your conclusion about the good water quality supplied to consumers?

🎾 Think like an engineer! If you have several possibilities to calculate or justify your answer, always choose the most cautious (conservative) approach to ensure safety.

Good luck with your analysis!

PS: You can try to solve this problem alone as an engineer or get some hints at the end of this homework. 😉

Exercice #3 | UV disinfection – calculation of admissible flow rate

A monochromatic low-pressure high-intensity UV lamp is placed in the middle of an annular reactor with the following characteristics:

- Lamp power: 1 W/cm of the lamp
- Lamp length: 1 m
- External diameter “Lamp + quartz sleeve”: 2 cm
- Internal diameter of the cylindrical reactor: 12 cm
- The UV lamp and the quartz sleeve are brand new
- The reactor can be considered as a plug flow reactor

Q1. Calculate the maximum flow rate allowed for groundwater (UV_{254} = 0.01 cm^{-1})

Exercice hints #2 | Chlorine disinfection: case study

1. Comment on the water quality monitored online during the week
2. Calculate an average *Ct*
    a. Argue why you use method B from the lecture 2
    b. Calculate the average hydraulic residence time
    c. Calculate the C_{inlet} considering the water quality (DOC,…)
    d. Determine the CF
3. Compare it to the SVGW recommendation and comment
4. Comment on the water quality analyzed before and after treatment on July 17th (THM, micropollutants…)