

Exercises VI: Treatment of wastewater solids II

Applied wastewater engineering

Exercise 1: Thickening of sludge

The wastewater treatment plant of Marrakech currently has 1'200'000 population equivalents with a maximum two-hourly dry weather flowrate entering the primary treatment of 9'000 m³/h. The primary clarification is composed of three basins of 3'600 m³ each. The sludge extracted from the primary clarifiers has a total solids content of 1.0 % and is thickened to 4.0 % by three gravity thickeners with a total surface area of 550 m². The overflow is returned to the primary treatment.

- a) Gravity thickening
 1. Draw a scheme for exercise a).
 2. What is the minimal residence time in the primary clarifier at the maximum dry weather flowrate? What is the yield of TSS removal of the primary clarifier?
 3. Assume that the gravity thickeners have a capture rate of 85 %, compute the solids loading rate (kg TSS/m²·d) and the maximum overflow rate (m³/m²·d). Take into account the return flow of the gravity thickener.
Use the TSS removal yield you determined for the primary clarifiers and not the sludge production for your calculations. Do both values respect design parameters given in the course?
 4. You visit the installation and the operator tells you that he has great difficulties with the gravity thickeners: their capture rate is currently only 33%. He asks you whether the design parameters (same as in 2.) are still respected.

- b) Mechanical thickening: The community of Marrakech is considering replacing the gravity thickeners by gravity-belt thickeners. The capture rate is estimated to be at least 92 %.
 1. They want to know how many machines they would require with a belt size of 3.0 meters if they operate them 16 hours per day.
 2. They also ask you to design a sludge storage tank of untreated sludge. They would like to be able to stop the operation of the gravity-belt thickeners for at least 16 hours.

Exercise 2: Sludge stabilisation

- a) What are the main advantages of the anaerobic digestion compared to aerobic digestion?
- b) How does alkaline stabilisation 'stabilise' sludge?