

Exercises VII: Treatment of wastewater solids III

Applied wastewater engineering

Exercise 1: Anaerobic digestion

The A.I.M.L (Association intercommunale de Lucens et Moudon) is thinking about the extension of their wastewater treatment plant to 51'000 population equivalents. The plant will employ an enhanced primary treatment with an expected yield equal to a classical primary treatment with a minimal residence time during dry weather conditions of 2.0 h even though the residence time is shorter. The wastewater shall be further treated with a nitrifying biology (sludge age of 10 days). The minimal water temperature is 10°C, this temperature should be used for the sludge production (maximal sludge production). The primary and secondary sludges are mixed and then thickened to 6 % TS with a gravity-belt thickener.

- The A.I.M.L. contracts you to determine whether their current digesters (2x365 m³) are large enough for the extension project (as a first approximation you can neglect the return sludge of the gravity-belt thickener). If not, they would like to know how much extra volume will be necessary.
- At a meeting you explain them your design of the digesters of extension project. They ask you about the sludge loading factor with easily degradable TVS of your project for the current situation (37'000 PE) and the future situation (51'000 PE).
- Furthermore, they would like to know how much gas they will produce in average per day once the plant reaches 51'000 PE. Assume a reduction of 85 % of easily degradable TVS.

Exercise 2: Dewatering of sludge

A wastewater treatment plant is planning to renew their sludge dewatering units. The primary and secondary sludge is anaerobically digested before being dewatered and transported to an incineration plant. After analysing the data of their operation system, you computed the following numbers concerning the digested sludge:

Parameter	Unit	Quantile 50 %	Quantile 85 %
Dry solids content in digested sludge	% TS	4.2	4.6
Mass loading rate of stratified digester	kg TS/day	1'100	1'400

The community contracts you to work on the project and asks you to answer the following questions taking into account an estimated increase of 20 % in sludge production in the next 15 years.

- Will the current stratified digester of 500 m³ be large enough to keep the digested sludge for at least 10 days? If not, how much larger should it be?
- What flowrate (L/min) and mass loading rate (kg/h) will the new dewatering unit have to treat? They only want to operate it 5 days a week and 8 hours per day.
- They ask you to suggest a dewatering technology for the replacement and justify your choice. Discussing with the operator of the treatment plant you notice that he wants as little odour generation as possible as his office is in the same building. He also tells you that the community would like to see a dewatering technology implemented requiring little energy.

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- d) How much polymer will be required per year (maximum expected)?
- e) What quantity of sludge (t TS/year and t/year) will have to be transported to the incineration plant? You estimated the density of the dewatered sludge equal to 1.1 t/m^3 (compute the final TS content with an average expected value).