DEWATS - Exercise 2

A small quarter with 130 persons wishes to install a wastewater treatment plant. After long information and negotiation meetings with you as responsible engineer, the inhabitants of the quarter decide to install a baffled septic tank. But before taking a final decision they wish to know how much space this tank would require and how it would look like.

Question 1: Possible design
Question 2: Volume per capita
Question 3: Wouldn't it be better (less space consuming) to construct a traditional septic tank?

P=150 people
$Q_{d,max}$=25m^3*d
$Q_{h,max}$=2m^3*h (peak flow)

Results:

Settling chamber:

choice: HRT in chamber = 2h (required: HRT= 2-3h)

V_{tot} = V_{ww} + V_{scum} + V_{sludge} = 4m^3 + 1.3m^3 + 2.6m^3 **= 8m^3**

V_{ww} based on HRT and $Q_{h,max}$=2m^3*h: Vww = $Q_{h,max}$ * HRT = **4m^3**

V_{scum} = P * scum accumulation rate = 130 * 10l/cap*a = **1.3m^3**

V_{sludge} = P * sludge accumulation rate = 130 * 20l/cap = **2.6m^3**

Dimensions:
Typical depth: 1.5 – 2.5 m
length to breath ratio: approx. 1:1 to 2:1
length to height ratio: approx. 1.5:1

choice: width = 2m — control: l:w = 1.3 → OK
depth = 1.5m — l:d = 1.8 → OK
length = 2.7m

Up-flow chambers:

HRT in total system must be greater than 12 hours
choice: HRT in up-flow chambers =12 hours

V_{tot} based on HRT and $Q_{d,max}$=25m^3*h: V_{tot} = $Q_{d,max}$ * HRT = **13m^3**

V_{uf} = V_{tot} – V_{ww} (in settling chamber) = 13 – 4 = **9m^3**

Dimensions:

choice: depth and width should be equal to the settling chamber (easier to construct)
→ length of up-flow filter = 9/(1.5*2) = 3m

How many up-flow chambers? → length to height ratio should be about 0.5 to 0.6
→ **4 chambers of 0.75m length each**.

control: length up-flow chamber total = 4*0.75 =3m → OK
up-flow velocity=$Q_{h,max}$/A = $Q_{h,max}$/(0.75*2) = 1.3m/h → OK (0.5 – 1.5m/h)

Space must be foreseen for the down-flow of the wastewater → 0.25m length per chamber

V_{tot} = 8m^3 (settling chamber) + 4(2*1.8*1.0) **= 14.5m^3** (only "empty volume" without construction mass)

Volume per capita = 14.5 / 130 = **110 l/cap**

Compared to the septic tank in exercise 1, the required treatment volume per capita is 3 times lower. This is due to the fact that there is a basically different dominant treatment process:

Septic tank: Sedimentation, longer HRT
Baffled septic tank: anaerobic degradation, smaller HRT

But: cost aspects must also be considered!