Design Assignment 7.
Secondary Treatment for the Greater Drain, OR Sewage Treatment Plant

Next step for the Greater Drain project: A preliminary design for a secondary treatment aeration tank and clarifier. For this preliminary level we will keep the analysis simple and straightforward.

Anne Arobick wants an idea of how big the aeration tanks and secondary clarifers will need to be. Determine the characteristics of an aeration system needed to treat the peak flow of wastewater you have already calculated, and for the BOD load you have calculated as the effluent of the primary clarifier. For this assignment, report all dimensions and specifications in **American Customary Units** (ft, gal, lbs, etc). (It's good to get a little practice in such units).

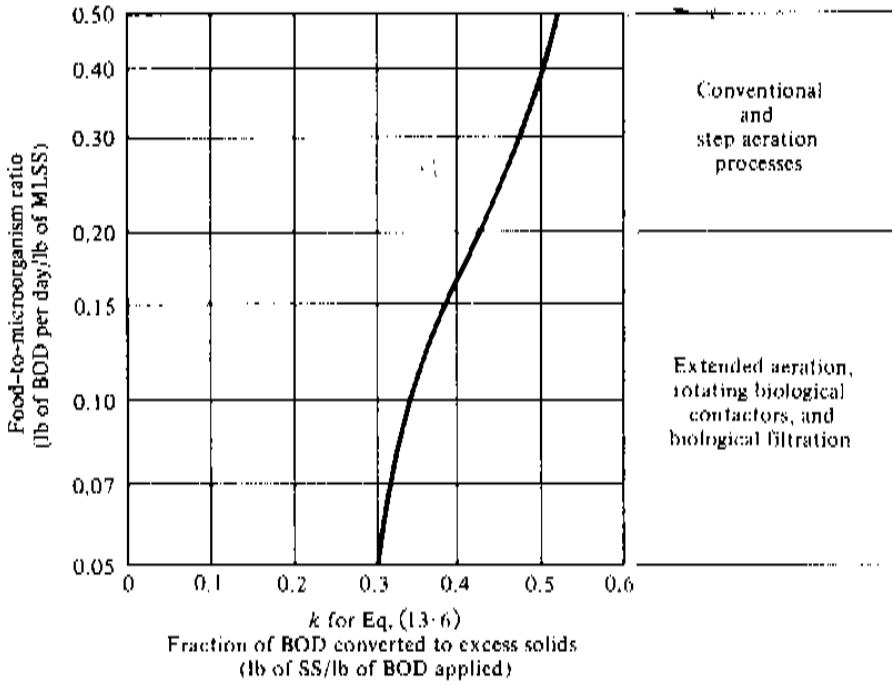
Base your design on the criteria below for a conventional activated-sludge process. You do *not* need any kinetic biological parameters for this level of design.

PROCESS	lb-BOD/1000 ft^3/day	Sludge Age	Aeration Period
Conventional	30 - 50	5 - 15 days	5.0 - 7.0 hr

Effluent characteristics: Assume the system meets the minimum effluent standard of 30 mg/L TSS and 30 mg/L BOD.

1. Report the minimum tank volume (assuming for now just a single tank; we can divide this into multiple tanks later). Note that there are two criteria here that govern volume: BOD loading and aeration period. Calculate the volume that correspond to the smallest (cheapest) tank that suits each criterion (this gives you two possible tank sizes). Since you have to meet *both criteria*, you must choose the *larger* of these two possible sizes.

2. Find the sludge age. The sludge age depends on the characteristics of the effluent (given above) and the waste sludge. The waste sludge properties, in turn, depend on the F/M ratio (U) at which we operate the system. The following graph is useful:



For a value of F/M, this chart shows the expected value of *k*, which is defined as the fraction of applied BOD that appears as excess biological growth, assuming a typical effluent characteristic of 30 mg/L TSS and BOD. To use *k*, find the pounds per day of BOD load, multiply that by *k*, and that is the pounds per day of "excess" biological growth which must be disposed of as waste sludge each day. Note that the lower the F/M ratio, the smaller the amount of waste sludge produced. Therefore, plan on operating the system at the lowest F/M that is indicated on the graph for a *conventional* process. Calculate sludge age in terms of total solids (TSS not VSS).

3. For the F/M ratio used above, find the MLSS (in terms of total solids).

4. Find the recycle rate assuming the clarifier sludge has a solids content of 1.5% by weight.

5. Determine the diameter and side-water depth of two parallel secondary clarifies using the following simple criteria that account for the hindered settling of secondary solids, rather variable loading rates, and the occasional poor sludge settleability.

   Overflow rate during peak flows < 1200 gpd/ft

   Side-water depth: > 10 ft

   Weir loading rate < 20,000 gpd/ft (I checked and there is no minimum acceptable weir loading rate, only a maximum that should not be exceeded).