Course Work

Upgrading Water or Wastewater Treatment Plants

THT311 2019

Assignment

- **You can choose between two case studies for your Course Work:**
  - Upgrading of the drinking water treatment plant in the city of xxxxxxxx, in country yyyy **OR**
  - Upgrading of the wastewater treatment plant in the city of xxxxxxxx, in country yyyy.

  Please choose a treatment plant from your home city or any other city in your country. Please make sure that no one else is doing the same case study.

Evaluation criteria

- **Understanding of the problem**
  Demonstrate why it is necessary to upgrade and what could be the possible reasons for the needs or existing problems
- **Demonstration of knowledge on possible solutions**
  Several alternatives, flow sheets, advantages and disadvantages of each system
- **Demonstration of detailed designing for at least 2 solutions and selection of one with justification**
  Show basic calculations or dimensioning; cost comparisons; flow sheets and any other details; list of monitoring instruments and with indications of where to place them

Marking

Reasons for problems & solutions/understanding of the problem	**10%**
Which unit processes or treatment concepts can solve the existing problems?	**10%**
Comparison of unit processes/treatment concepts with adv & disadv of unit processes - (why you will include them in the 2 choices)	**15%**
Flowsheets of complete processes of two alternatives	**10%**
Disadv & adv of the two flowsheets and justification for the priority/selection	**15%**
Economy/size comparison/justification	**10%**
Monitoring: Instrumentation & flow sheet	**10%**
Special issues (odour, taste)	**10%**
Report format: Design, format, references, etc	**10%**

Course work content development

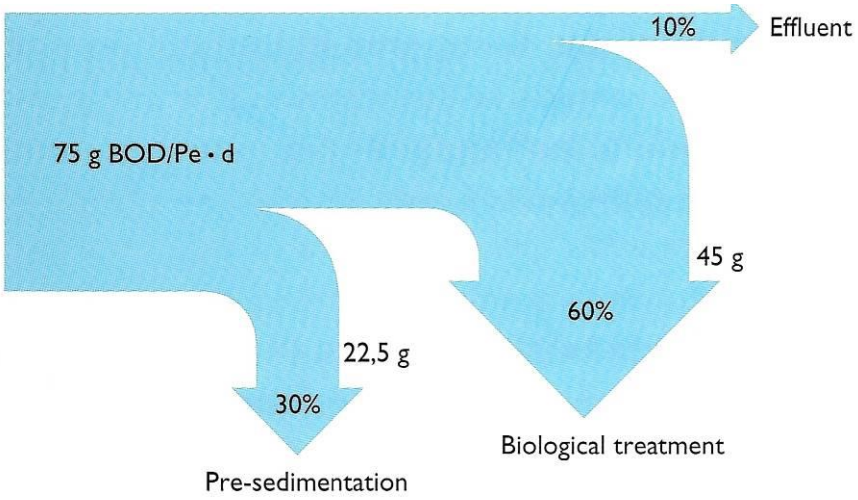
Common upgrading needs:

- Capacity increase
  - Population (or other users) increase
  - Need for expanding
  - outdated DWTP/WWTP
- New or increased treatment efficiencies
  - New discharge licences /law & regulations
  - Reduction of non-compliance events
- Improved economy and management
  - Reduction of physical footprint
  - Energy and resources recovery/reuse
  - Increased and improved automation

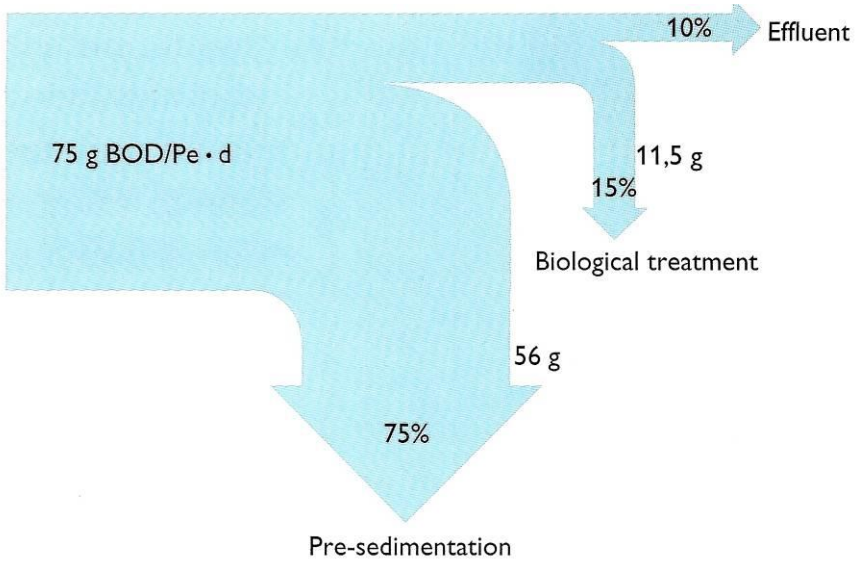
Capacity increase

- Removal of particles
  - Most pollutants have a significant fraction as particles and colloids
  - Adding a pre-sedimentation tank will often help
  - Particles can be removed by high efficiency screens (0.1-0.5 mm opening), Salsnes, etc
  - Colloids can be removed by coagulation
  - Replace conventional sedimentation tanks with ballasted systems (Actiflo etc)
  - Replacing Activated sludge systems with biofilm systems

Capacity increase with coagulation



Without pre-precipitation



With pre-precipitation

Increase treatment efficiencies

- How to increase
  - Colour removal in a DWTP?
  - P removal in a conventional biological WWTP?
  - N removal in a conventional chemical WWTP?
  - SS removal?

Process alternatives

1. Mechanical treatment
2. Chemical treatment:
    a) Chemical enhanced mechanical treatment, high load
    b) Chemical treatment, low load, called primary precipitation
3. Biological treatment:
    a) High load activated sludge method (0,5 kg BOD_5/kg SS*d)
    b) Normal load activated sludge method (0,2 kg BOD_5/kg SS*d)
4. Biological/Chemical treatment:
    a) Simultaneous precipitation (by normal load activated sludge)
    b) Pre-precipitation (pre-precipitation followed by normal load activated sludge)
5. Nitrogen removal, biological/chemical (by pre-denitrification, simultaneous precipitation)

TABLE 5. WASTEWATER SPECIFIC LOAD AND COMPOSITION USED FOR COST CALCULATIONS

	Specific load g/(pe*d)	Wastewater composition, g/m^3 at 250 l/pe*d	at 400 l/pe*d
BOD_5	62.5	250	150
SS	62.5	250	150
Tot P	3.0	12	7.5
Tot N	12.0	48	30

Treatment efficiencies

	BOD_5		SS		Tot. P		Tot. N		Sludge production	
Process	%	mg /l	%	mg/l	%	mg/ l	%	mg/l	g DS/m^3	%
Raw WW	0	250	0	250	0	12	0	48	-	-
Mechanical	30	175	60	100	15	10	15	40	125	4
Chemical:										
a) High load	50	125	80	50	70	3.6	25	36	250	3
b) Low load	70	75	90	25	90	1.2	30	34	350	3
Biological:										
a) High load	70	75	80	50	30	8.4	25	36	185	2
b) Normal load	~90	20	90	25	30	8.4	30	34	205	2
Biological/chemical										
a) Simultaneous precipitation	~90	20	~90	20	~90	1,0	35	31	250	2
b) Pre-precipitation	~95	10	~95	15	~95	0,5	35	31	380	2
Biological/chemical, N-rem.: Predenitrification, simultaneous prec.	~95	10	~97	10	~90	1,0	70	15	275	1,5

Reduction of physical footprint

- Introduce a chemical stage;
- AS-BF;
- flotation instead of sedimentation;
- filtration instead of Sed/Flotation,
- adding flocculants,
- adding a high efficiency screens

Automatic surveillance and process control

- Continuous and more efficient/accurate surveillance
  - Connected to alarm systems
  - More process data for optimisation

- Increased automation
  - Less dependency on operational personal
  - Reduced need for work force
  - Better control in extreme events