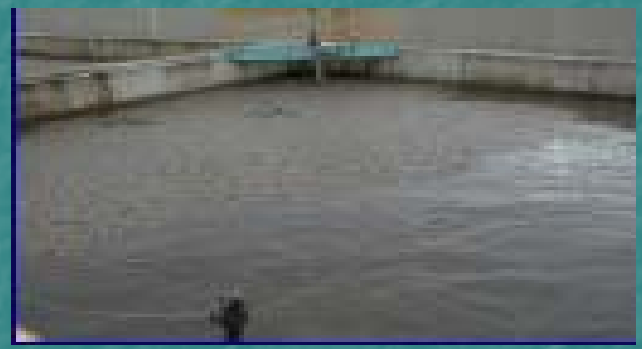
SEPARATION OF ACTIVATED SLUDGE PROBLEMS

Written case study on water treatment problems

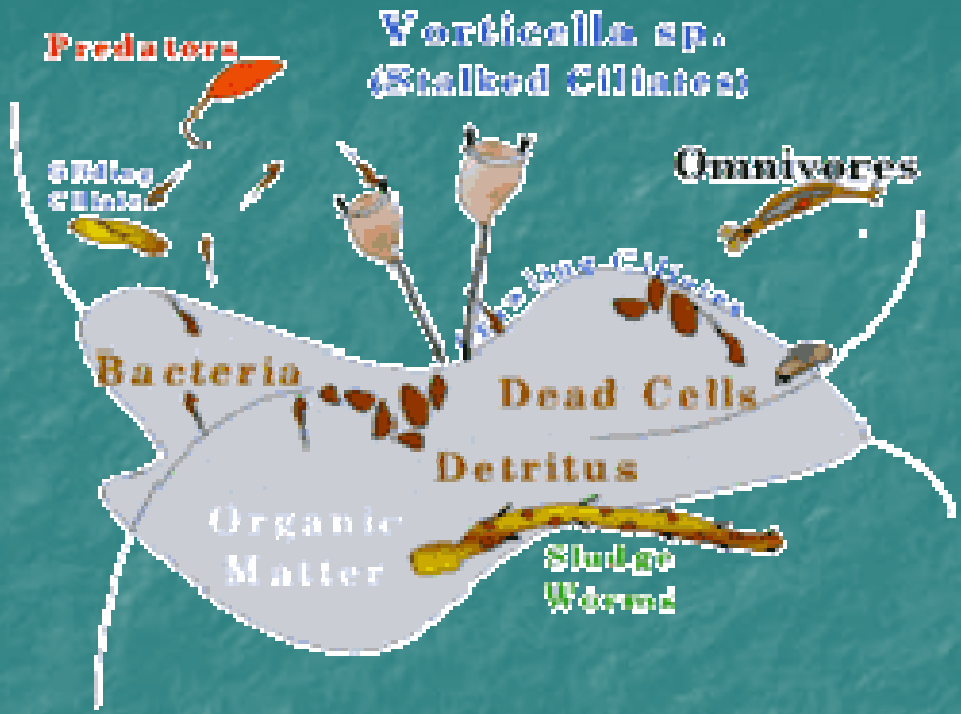
Presented by: Hala Almshawit

Introduction:

- Activated sludge represent biological wastewater treatment in WWTP
- Treatment of wastewater from biomass newly formed by microbial growth in secondary settling tank.
- If this part of the activated sludge process fails!
- We need to know:
  - What is the structure of activated sludge?
  - What is a well-settled activated sludge?



Floc components



Paramecium sp.

Vorticella sp.

Zoogloea sp.

Well settled activated sludge

- Overflow rate (v)= Qe / A → 0.7 - 1.4 m/h

- Sludge Volum Index (SVI):
- ☑ SVI < 120 satisfactory.
- ✘ SVI > 150 bulking.

- It leaves a clear supernatant after sedimentation.

- WSAS do not interfere during sedimentation and thickening.

- Does not rise and float within at least a 2-3 h period after sedimentation.

- Cone settleability :The important thing is stability

1- Dispersed growth:

Visual observation :

- Individual cells or small clumps with diameter of up 10-20µm.
- The sedimentation rate is too low for gravity sedimentation, and no zone settling occurs in secondary settling tanks.

Principal causes:

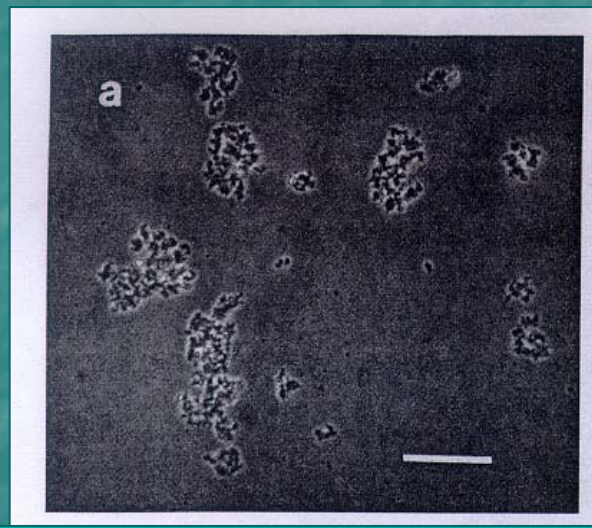
Low production of extracellular polymers substances which can have two causes:

- High concentration of readily degradable substrates
- The presence of some toxic or inhibitory compounds in wastewater.

2- Formation of microflocs (pinpoint flocs):

Visual observation:

- Larger dimension (about 50-100μm) particles have roughly spherical and compact form.
- Filaments not predominant ,and cone settleability test may show some well- settling material but a cloudy supernatant.



Principal causes:

- High sludge age (low concentrations of exogenous substrates (endogenous metabolism)) the destruction of EPS of activated sludge will occur.
- Macrostructure failure, when the filamentous microorganisms disappear.

Solutions:

- Redesigning secondary settling tanks to be more suitable to reflocculation process.
- All structures with high turbulence, should be avoided.
- Keep F/M ratio in the range 0.05 to 0.2

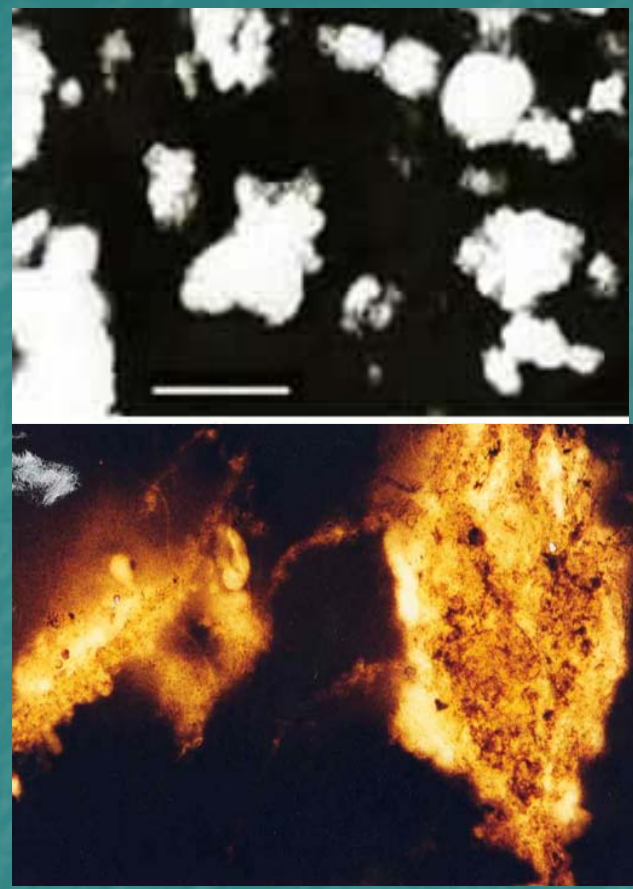
3- Viscous bulking:

Principal causes:

- Excessive EPS production by microorganisms.
- !!! lack of nutrients/micronutrients (F/M too low).
- Dissolved oxygen too low.
- Toxic compounds (mainly chromium and sulphide).
- High presence of Zoogloea “animal glue”:
  - Readily biodegradable substrates VFA,
  - Excessive anoxic retention.

Visual observation:

- Poor sludge dewaterability.
- Diluted return (and waste) activated sludge.
- When it is intensively aerated, a foaming may appear.
- The activated sludge sticky.



3- Viscous bulking:

Solutions:

- Ozonation leads to replacing of open structures of fingered zoogloeal colonies by dense compact flocs.
- Addition of synthetic cationic polymers or minerals.

4- Rising sludge:

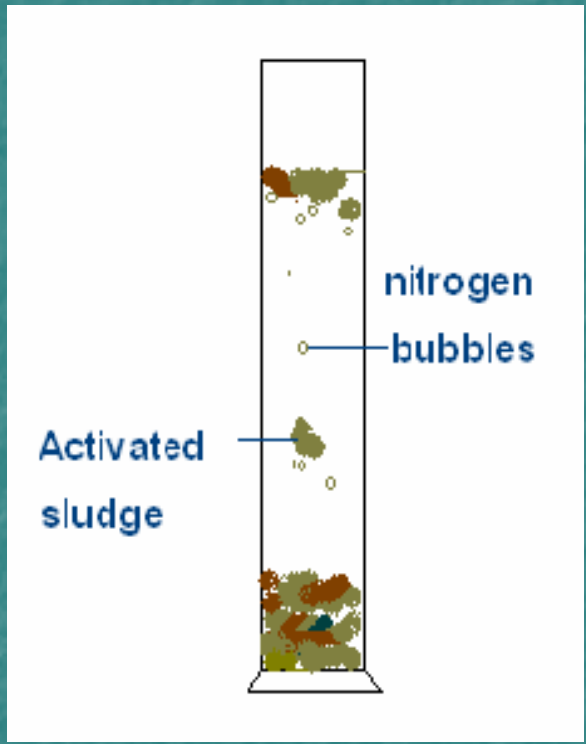
Visual observation:

- In glass cylinder, two phases can be distinguished:

  - First the activated sludge settles rapidly (compact bottom layer of settled sludge and a clear supernatant).

  - Sludge starts to float and move up to the water surface.

- Rising sludge flocs will escape from clarifiers.

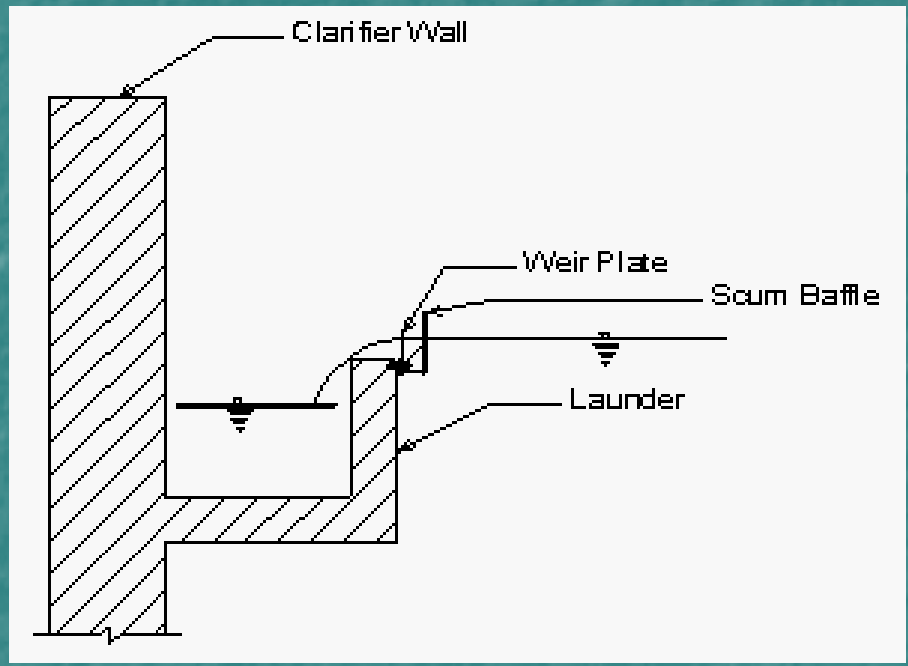


Princible causes:

- The bubbles of nitrogen act as a sludge carrier .
- A critical nitrate concentration for sludge rising at 20°C is about 6-8mg/l (NO_3 – N).

Solutions:

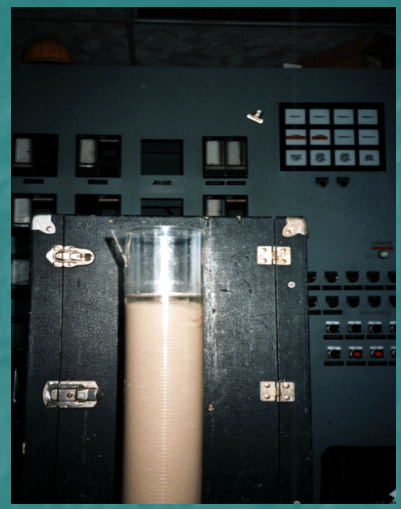
- Decrease nitrate concentration below the critical value.
- Installing baffles to protect the effluent weirs



5- Filamentous bulking:

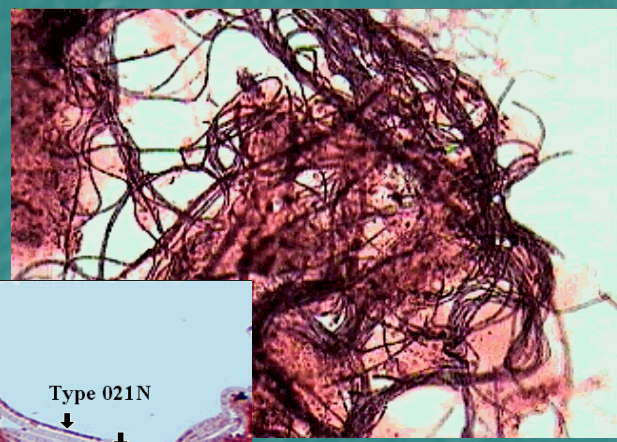
Visual observation :

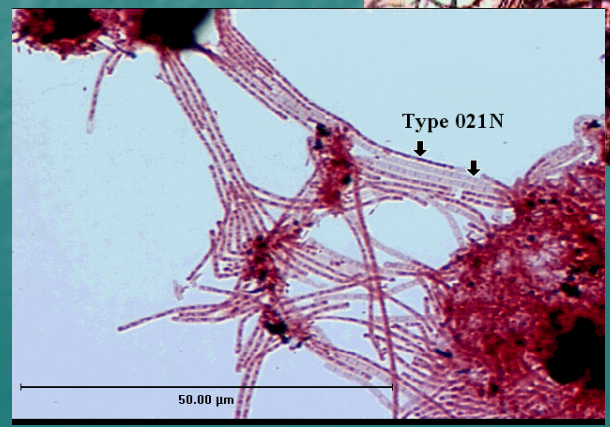
- Hydraulic overloading of sludge.
- Increase SVI and cone settleability



Principal causes:

- Presence of filamentous bacteria inside the floc.
- The filaments, prevent the compaction of individual flocs.





Solutions:

- Identification of the causative filament(s) leads to specific remedies

Causative Condition	Filament Types	Control
Low DO	Type 1701	Adjust the aeration rates
Limited Nutrients (N or P)	Thiothrix sp.	Nutrient addition,BOD ratio of 100:5:1 suggested

- Materials and Polymers Addition:
  Coagulants/precipitants such as lime or ferric chloride.
  Toxicants as chlorine and hydrogen peroxide.

6- Foaming caused by filamentous microorganisms

Visual observation/Characterisation:

- It is a system of three phases-air-water-microbial cells (hydrophobic cells).
- Escape from aeration basin to the secondary settling tank.
- If temperature drops below freezing point, the foam freezes.

Principal causes:

- EPS has surface active agents properties (biosurfactants).
- The cell walls of foam forming microorganism are hydrophobic.
- Dosing of fatty compounds into influent wastewater lead to biological foam creation.

Solutions

- Dilution.
- Using Antifoams/Defoamers.
- Mechanical remove of scum as much as possible before clarifiers, and should be not recycled back into the plant.

Monitoring

Control parameters:

- Microscopic examination of sludge.
- Dissolved Oxygen (DO).
- BOD (or COD) load.
- Nutrient requirements.
- F/M loading.
- Sludge age (Mean Cell Residence Time).
- Mixed liquor suspended solids (MLSS).
- Upflow velocity (clarifier).
- PH value.
- Cone settleability.
- Sludge volume index (SVI).
- Surplus sludge production.
- Mixing considerations.

Conclusion

- The problems related to the presence of filamintous organisms or EPS production.
- The best approach is to investigate the long term control methods suitable for your plant.

References

- Madigan,Martinko,and Parker.Ninth Edition.Brock Biology of Microorganism.ISBN:0-13-081922-2.
- J.Wanner. Activated sludge bulking and foaming control.ISBN No.1-56676-121-2. (Activated sludge separation problems p: 87-111).
- Loy A, Wagner M: Bacterial community composition and function in sewage treatment systems. Current Opinion in Biotechnology 2002, 13:218–227
- yan Liu, Herbert H.P. Fang:influences of Extracellular Polymeric Substances(EPS) on Flocculation, Settling and Dewatering of Activated Sludge.Critical Reviews in Environmental Sceince and Technology,33(3):237-273
- http://www.ensic.unancy.fr/COSTWWTP/Work_Group/Wg4/Lisboa/Wanner_pres.pdf
- http://www.activatedsludge.info/
- http://www.college.ucla.edu/webproject/micro7/studentprojects7/Rader/asludge2.htm
- http://www.tramfloc.com/antifoam-select.doc
- http://www.envirocentre.ie/downloads/BPDCS002%20wastewater.pdf
- http://www.dec.state.ny.us/website/dow/bwcp/ta_sludbulk.html
- http://www.h2o2.com/applications/municipalwastewater.html
- http://www.aquanova.cz
- http://www.tramfloc.com/tf38.html
- http://www.environmentalleverage.com/What%20are%20Filamentous%20Bacteria.htm
- http://www.engitech.com/asm.htm

Thankyou for your attention

Contenents:

- Introduction
- Flocs components
- Well settled activated sludge characteristics
- Activated sludge separation from treated wastewater Problems.
  - Problem description
  - Solution
- Monitoring
- Conclusion

Activated sludge separation from treated wastewater Problems :

1. Dispersed growth .
2. Microflocs (pinpoint flocs).
3. Viscous bulking.
4. Rising sludge.
5. Filamentous bulking.
6. Foaming and scum formation due to filamentous microorganisms.