WATER AND WASTEWATER MONITORING

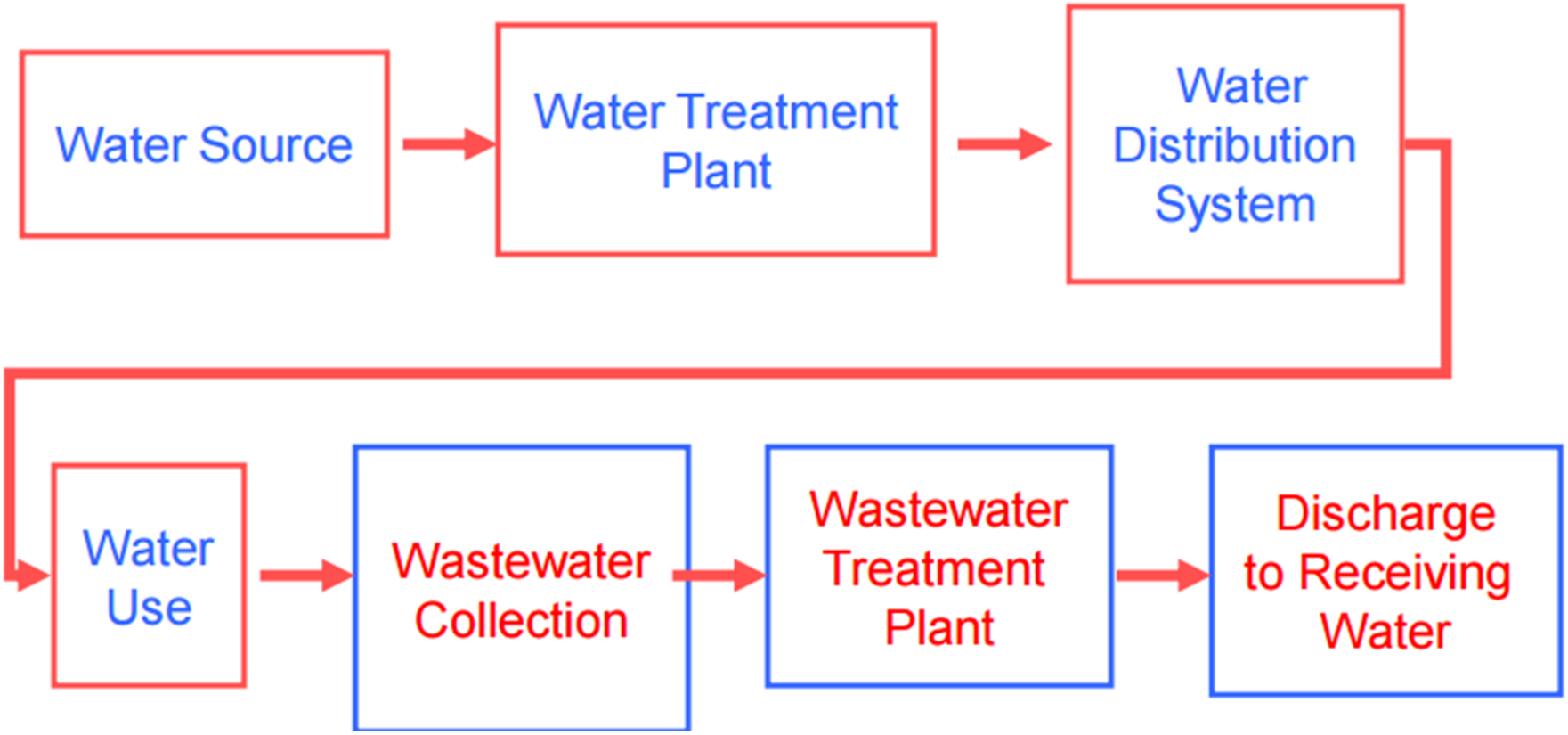
Biological Water and Wastewater Treatment

by
Risky Ayu Kristanti
Faculty of Engineering Technology
kristanti@ump.edu.my

Chapter Description

- Aims
  - Student explain the biological water and wastewater treatment.
  - Student sketch and illustrate process of the water and wastewater treatment.
- Expected Outcomes
  - Student should be able to explain the biological water and wastewater treatment
  - Student should be able to sketch and illustrate process of the water and wastewater treatment
- Other related Information
  - Environmental Protection Agency
  - Natural Resources Conservation Service
- References
  - Burden, Foerstner, McKelvie, and Guenther (2002) **Environmental Monitoring Handbook**, The McGraw-Hill Companies, Inc.
  - Jamie Bartram and Richard Balance. 1996. **Water Quality Monitoring: A Practical Guide to Design and Implementation of Freshwater Quality Studies and Monitoring Programmes**, CRC Press.

Water Use Cycle



Biological Water and Wastewater Treatment
By Risky Ayu Kristanti
http://ocw.ump.edu.my/course/view.php?id=635#section-10

WASTEWATER

- Wastewater is simply that part of water supply to the community or to industry which has been used for different purposes and has been mixed with solids either suspended or dissolved.
- Wastewater is 99.9% water and 0.1% solids. Treating the wastewater is simply to remove most or all of this 0.1% of solids

TYPE OF WASTEWATER FROM HOUSEHOLD

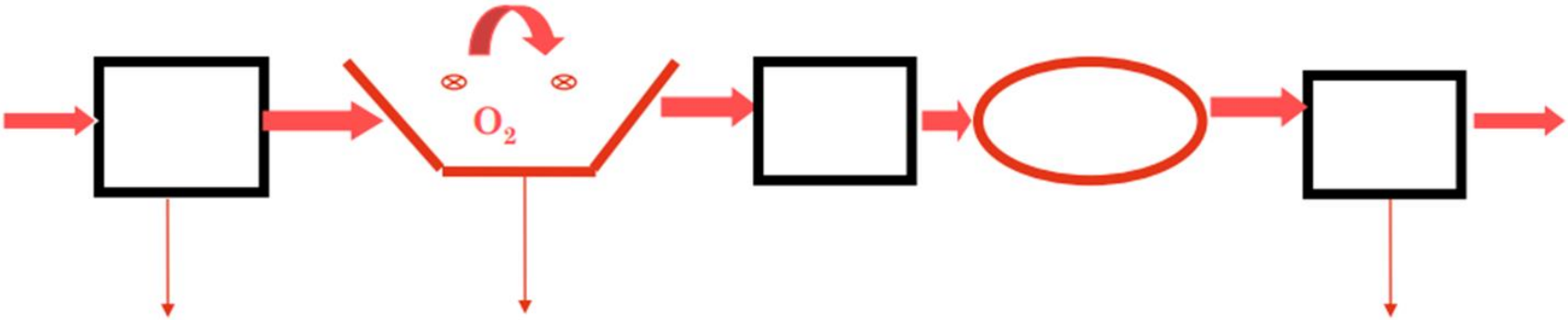
Type of wastewater	Source of wastewater
Gray water	Washing water from the kitchen, bathroom, laundry (without feces and urine)
Black water	Water from flush toilet (feces and urine with flush water)
Yellow water	Urine from separated toilets and urinals
Brown water	Black water without urine or yellow water

THE IMPORTANCE OF WASTEWATER TREATMENT

- To prevent groundwater pollution
- To prevent sea shore
- To prevent soil
- To prevent marine life
- Protection of public health
- To reuse the treated effluent

  → for agriculture, groundwater recharge and industrial recycle
- Solving social problems caused by the accumulation of wastewater

Treatment Process



Primary treatment

- screening
- grit removal
- removal of oil
- sedimentation

Secondary treatment

- Aerobic, anaerobic lagoons
- Trickling filter- activated sludge-oxidation ditch
- Mostly BOD removal technology

Tertiary treatment

- Nitrate removal
- Phosphorus removal
- Disinfection

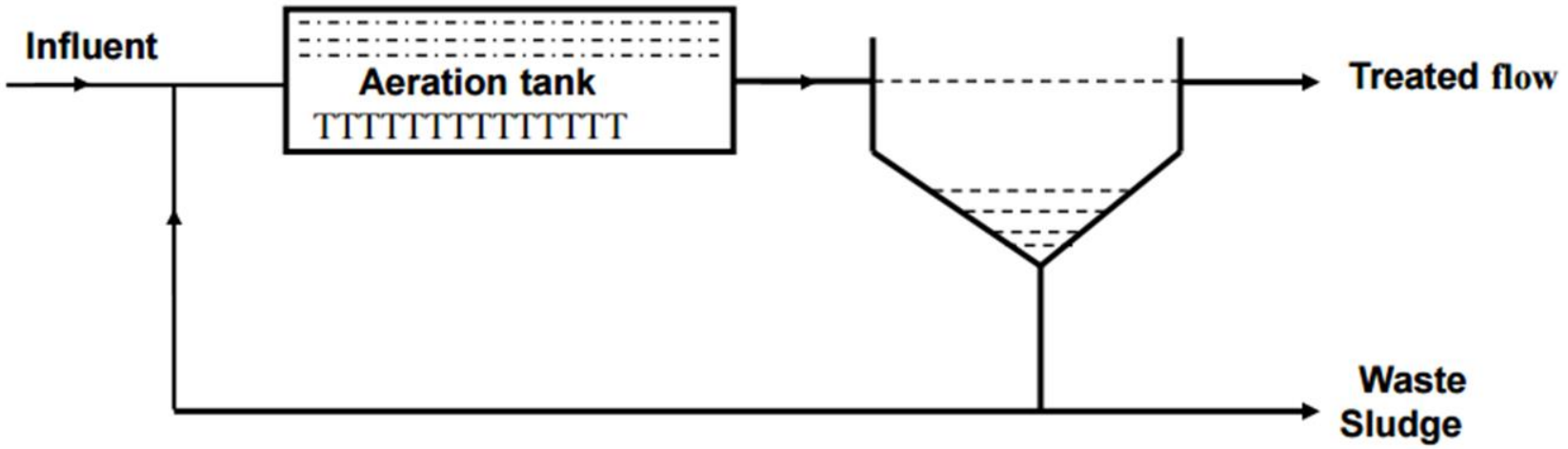
Conventional activated sludge system

The first version of activated sludge systems are called conventional activated sludge system.

This system is composed of two parts:

a. Aeration tank:

b. Final sedimentation tank



SEWAGE TREATMENT METHOD

- Sewage treatment methods may be classified into physical unit operations, chemical unit processes and biological unit processes.

- **Physical Unit Operations (Preliminary with/or Primary)**
- Physical unit operations are treatment methods, which use the application of physical forces to treat sewage. These include screening, mixing, flocculation, sedimentation, filtration and flotation.

SEWAGE TREATMENT METHOD

Chemical Unit Processes (Secondary Treatment)

Treatment methods in which the removal or conversion of pollutants by the addition of chemicals or by chemical reactions. These include precipitation, adsorption and disinfection.

Biological Unit Processes (Secondary Treatment)

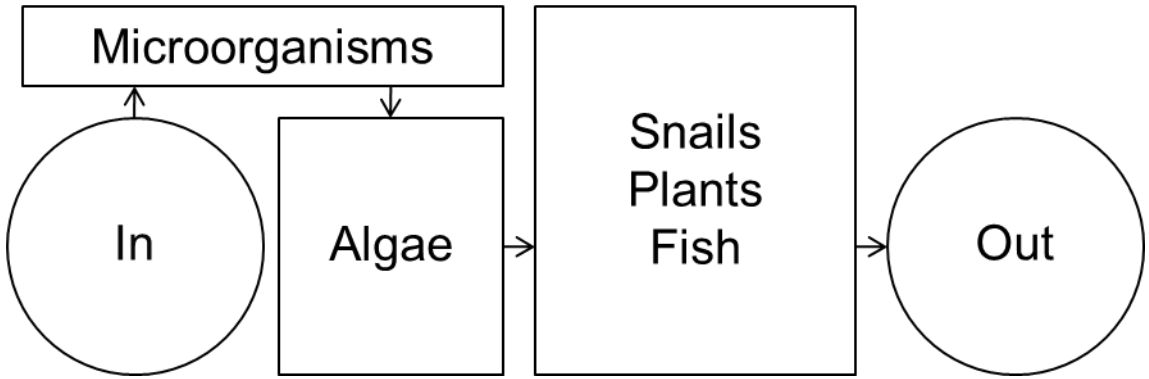
Biological unit processes describe methods, which remove pollutants by biological activity. Biodegradable organic substances are converted into gases that escape to the atmosphere and cell tissue is removed by settling.

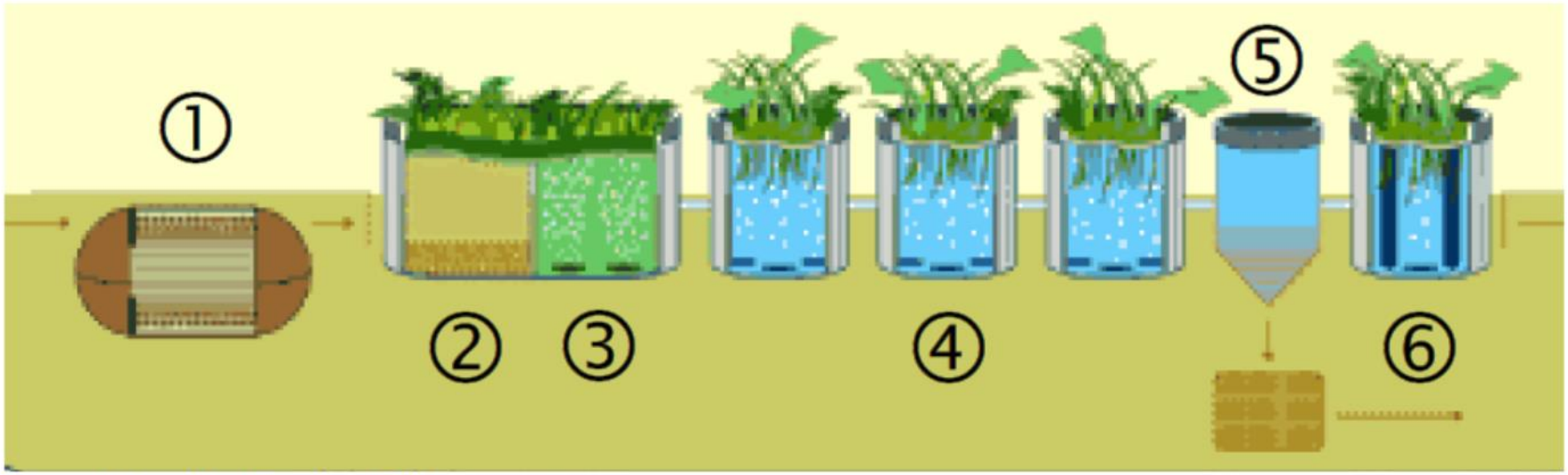
NEW APPROACH TO WASTEWEATER TREATMENT

- Land Application
  - Effluent from secondary treatment is sprayed onto forests, pastures, or crops.
- Wetland Systems
  - Example: Arcata, California, uses 20 acres of marshland for its secondary treatment instead of expensive treatment facilities.

NEW APPROACH TO WASTEWEATER TREATMENT

- "The Living Machine"
  - A man-made biosphere is created inside of a greenhouse-like structure.
  - This biosphere can process both human and industrial wastewaters.





Source: Living Machines Inc., 2001.

FIGURE 1 THE COMPONENTS OF THE LIVING MACHINE®: (1) ANAEROBIC REACTOR, (2) ANOXIC REACTOR, (3) CLOSED AEROBIC REACTOR, (4) OPEN AEROBIC REACTORS, (5) CLARIFIER, AND (6) "ECOLOGICAL FLUID BED"

WATER TREATMENT TECHNOLOGY

- Water Purification
  - *Sedimentation* - settling of large particles.
  - *Coagulation* - flocculation of small particles.
  - *Filtration* – Through sand, crushed coal, diatomaceous earth.
  - *Disinfection* - uses chlorine and can be residually effective, but some viruses and protozoa are resistant.

WATER TREATMENT PROCESS

Water Treatment

Water treatment is a process of removing contaminants from raw water to produce water that is chemically and bacteriological safe for human consumption. The water must also be aesthetically acceptable, free from apparent turbidity, colour, objectionable taste and odour. The conventional treatment plant comprises of the following processes:

Screening

Floating debris such as woods, leaves, aquatic plants and others are screened at the intake. After screening, the denser suspended matters are removed by allowing water to pass through chamber where it settles down to the bottom.

Aeration

Raw water pumped from the intake is mixed with air at the aerator. The aeration process provides oxygen from atmosphere for the oxidation of dissolved iron and manganese to their insoluble form thus enable their removal. The process also helps in the removal of taste and odour.

Coagulation / Flocculation

Coagulants, usually alum, are added leading to the formation of microscopic particles in water. This is followed by gentle agitation causing small particles in the water to collide and combine to become bigger settleable flocs.

- **Sedimentation**
- The flocs are allowed to flow through the sedimentation tank as uniform as possible for long enough period for them to settle. The clarified water will be collected from the top.
- If the flocs are light, another process will apply. In this process minute air bubbles are introduced. The flocs will stick to the air bubbles and float to the top. The clarified water will be collected from the bottom.This process is called Dissolve Air Flotation.

- **Filtration**
- The settled water then goes through filters where the fine particles and bacteria are trapped. The clean water then goes to the clear water tank. The filters are backwashed regularly through a combination of agitation by air and water to ensure efficient operations.

- **Disinfection /pH Adjustment**
- In the clear water tank, the water is disinfected to destroy microorganism still remain in water after filtration. Gaseous chlorine or chlorine compound are normally used for disinfections. The pH is adjusted using lime or soda ash.

- **Clear Water Tank**
- Treated water will be collected and kept in Clear Water Tank for distribution.

Conclusion of The Chapter

- The water and wastewater treatment contain primary, secondary and tertiary stages.
- Biological unit process describe methods which remove pollutants by biological activity.

Reference

Jamie Bartram and Richard Balance. 1996. **Water Quality Monitoring: A Practical Guide to Design and Implementation of Freshwater Quality Studies and Monitoring Programmes**, CRC Press.