Current issues in Korea and Future perspectives

Algal bloom

- Green/red
- Excessive N, P in the influent + optimal conditions for algal growth → excessive growth of algae
- Taste & odor problems, high turbidity water
- Cyanotoxin – toxic compound generated by Cyanobacteria

Non-point source control

- Point sources are treated, but rivers are still not clean enough in some cases → loadings from non-point sources
- Significant non-point sources: urban stormwater runoff, agricultural runoff, CSO,…

<비점오염원 배출경로>

자료 : 한강수계 테마원 홈페이지 (http://www.hgeco.or.kr/).

<비점오염 사례>

자료 : Riverkeeper 홈페이지 (http://www.riverkeeper.org/).

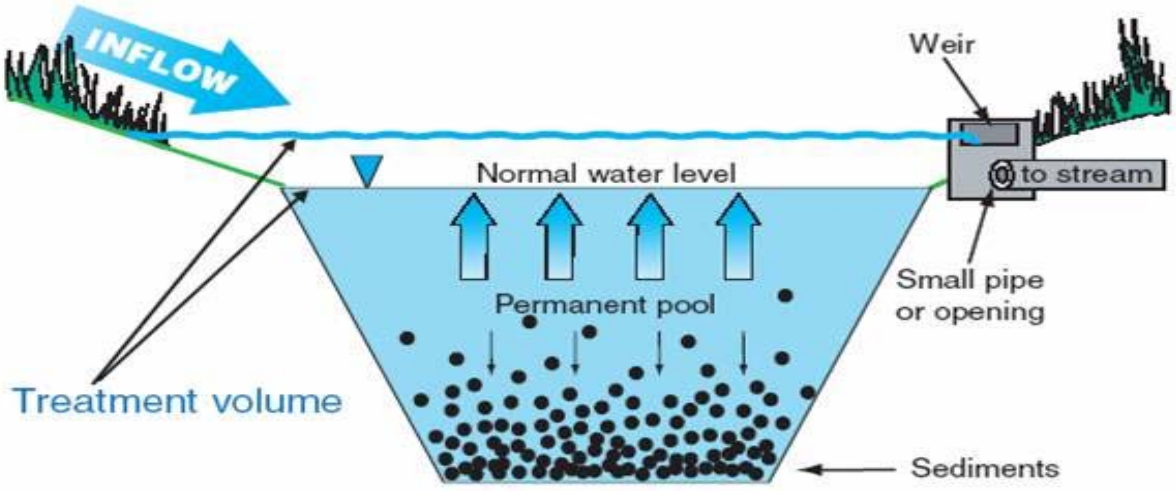
Non-point source control

- Under the new provision of Water Quality and Ecosystem Protection Act of Korea, new urban or industrial development projects should include non-point source control facilities (effective March 2015)

ex) A new-city development project at Si-heung (배곧신도시) modifies its design to include non-point source control facilities

Non-point source control

- Examples of non-point source control facilities
  - Stormwater retention basin: stores stormwater to allow particulates & particulate-associated contaminants to settle



Non-point source control

- Examples of non-point source control facilities
  - Stormwater infiltration system: allow infiltration of stormwater for filtration & treatment by reactive media

Non-point source control

- Examples of non-point source control facilities
  - Wetland treatment: constructed wetlands to remove contaminants by plants, algae, bacteria, or photochemical reactions

Non-point source control

- Examples of non-point source control facilities
  - Bioretention zones: improve permeability of urban area for flood control + improve landscape + contaminant removal by plants & filtration

Environmental outbreaks

- Oil spills
  - Tae-an oil spill: Dec 7, 2007, a barge was crushed into an oil tanker → released 12,547 kL of crude oil → >2,000,000 people (>1,000,000 volunteers) worked to collect and wipe petroleum

Environmental outbreaks

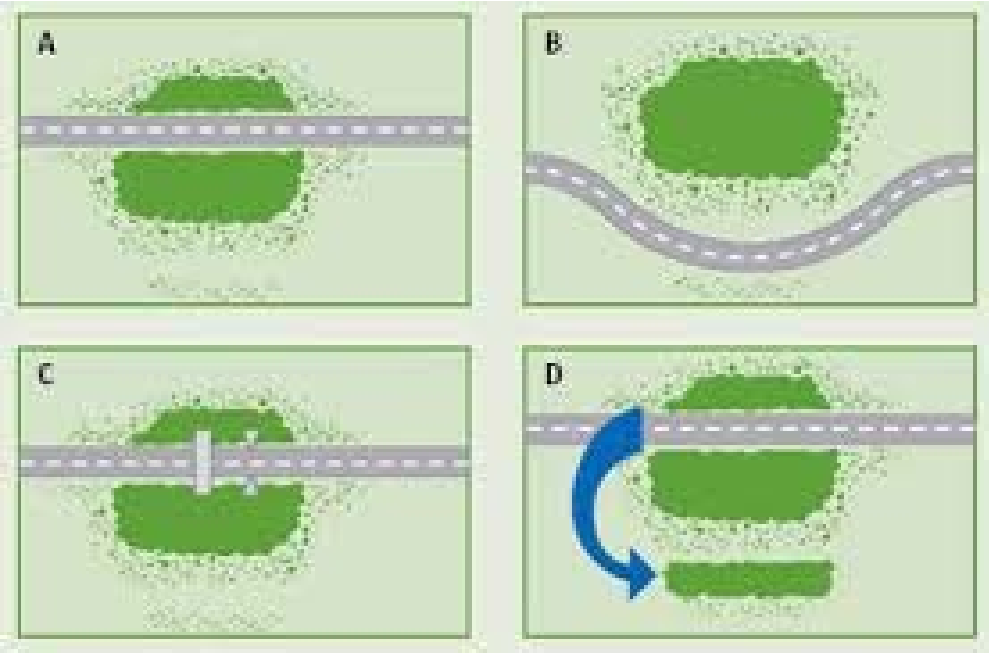
- Chemical spills
  - Gu-mi HF spill: Sep 27, 2012, a worker accidently opened the valve of a tank containing hydrogen fluoride (HF) → 5 deaths, 18 injured, significant damage to crops and cattle

Animal carcass disposal

- Foot-and-mouth disease outbreak in Korea (2011)
  - Massive burial of animals (3,310,000 pigs / 150,000 cows)
  - Inadequate design of the burial sites (remember the sanitary landfill guidelines!): significant leachate problems

Introduction of ecological engineering concepts

- Ecological engineering: an emerging area of study towards "the design of sustainable ecosystems to integrate human society with its natural environment for the benefit of both"

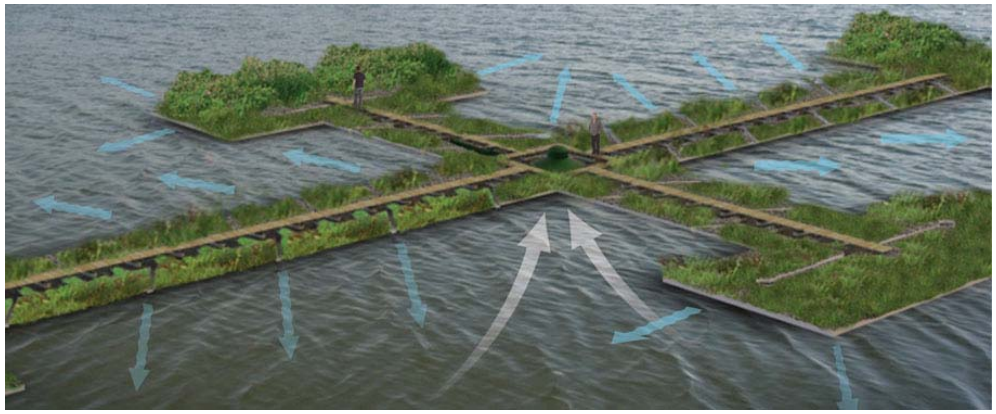


example: an eco-bridge

Introduction of ecological engineering concepts

- Introduction of ecological engineering concepts to environmental engineering
  - Phytoremediation
  - Wetland treatment
  - Non-point source treatment using ecological concepts
  - Plant bioreactors
  - Remediation of natural water bodies using plants, clams, etc.

http://wtu.hometech.blogspot.com



http://www.floatingislandinternational.com

http://coz.southernfriedscience.com

Reclamation of treated wastewater

- Apply advanced treatment, e.g., reverse osmosis, UV disinfection, to obtain treated water with high quality
- Non-potable & potable reuse
- Advantages
  - Reliable water resource
  - Cheaper option than seawater desalination
  - Better water cycle, sustainable
- Limitations
  - Drinking water price is still very low!
  - Potential failure of the treatment process
  - Public acceptance

http://wisatasingapura.web.id

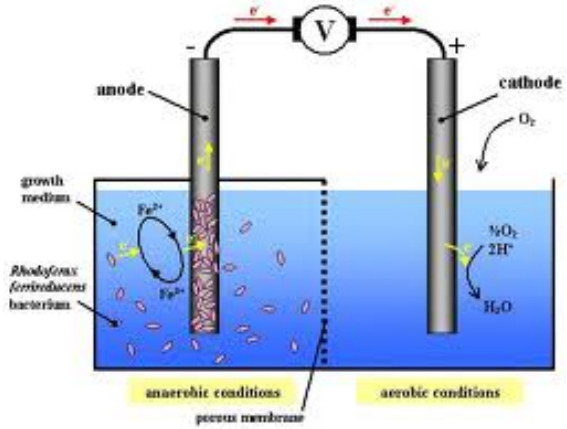

http://gulfnews.com


http://bbc.com

Energy recovery from wastewater

- Wastewater = water + nutrients + carbon (=energy)
- Energy in wastewater > energy needed to treat wastewater
- Available techniques to recover energy from wastewater
  - CH_4 generation by anaerobic treatment of wastewater or sludge
  - Electricity generation (ex: microbial fuel cells)

http://www.biocycle.net



http://www.sflorg.com

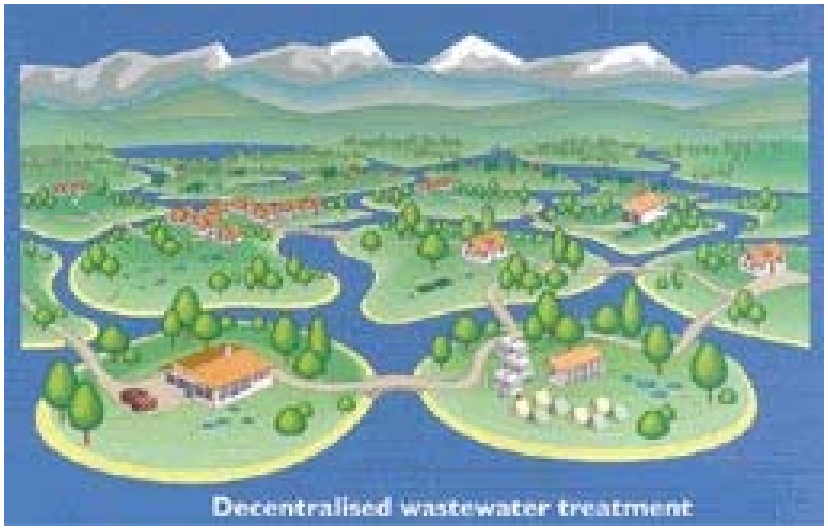
Waste to energy, waste to products

- CH_4 generation from organic wastes (anaerobic processes)
- Composting
  - Convert biodegradable organic wastes into stable form
  - Agricultural use
- Bioplastic production from wastes
  - Some microorganisms accumulate polymer material called “polyhydroxyalkanoate” in their cells under certain conditions
  - Biodegradable and biocompatible plastic
- Bio-oil production from biomass
  - Pyrolysis of organic wastes (straw, nut shells, sewage sludge, etc.) or algae to produce bio-oil

http://www.nrc-cnrc.gc.ca

Decentralized systems

- Centralized systems (current): massive pumping costs, less sustainable (advantage: economy of scale)
- Decentralized systems: minimize the water import/export, create a water cycle within a smaller scale, and improve sustainability by rainwater collection, energy & nutrient recovery, water reuse, etc.



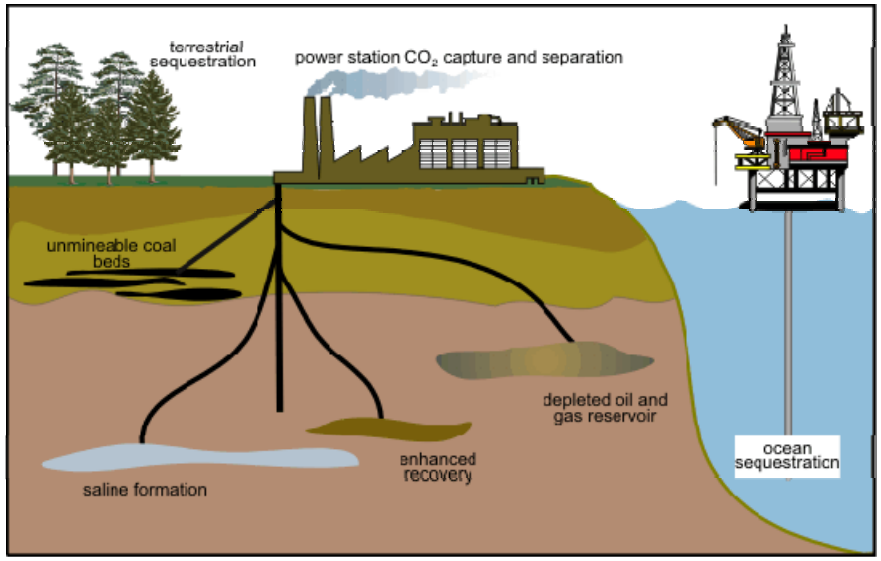
http://www.sukritiengineers.com

Decentralized systems

- Works to be done
  - Develop a new paradigm and techniques for water & wastewater treatment and management
  - Needs better operation & maintenance strategy
  - Need to balance and harmonize centralized & decentralized systems

Global warming

- Two approaches to react to global warming
  - Active approaches: reduce greenhouse gas
    - Reduce GHG emissions by seeking for alternative energy & better control of GHG sources
    - Carbon dioxide capture and sequestration (CCS): CO_2 collection, pressurization, and injection to the underground or deep ocean
  - Passive approach: adaptation



http://gilmourbiology.wikispaces.com/

Waiting for your brightness and efforts!