Emerging Environmental Issues in Thailand with Emphasis on Hazardous Chemicals and Global Warming

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THAILAND

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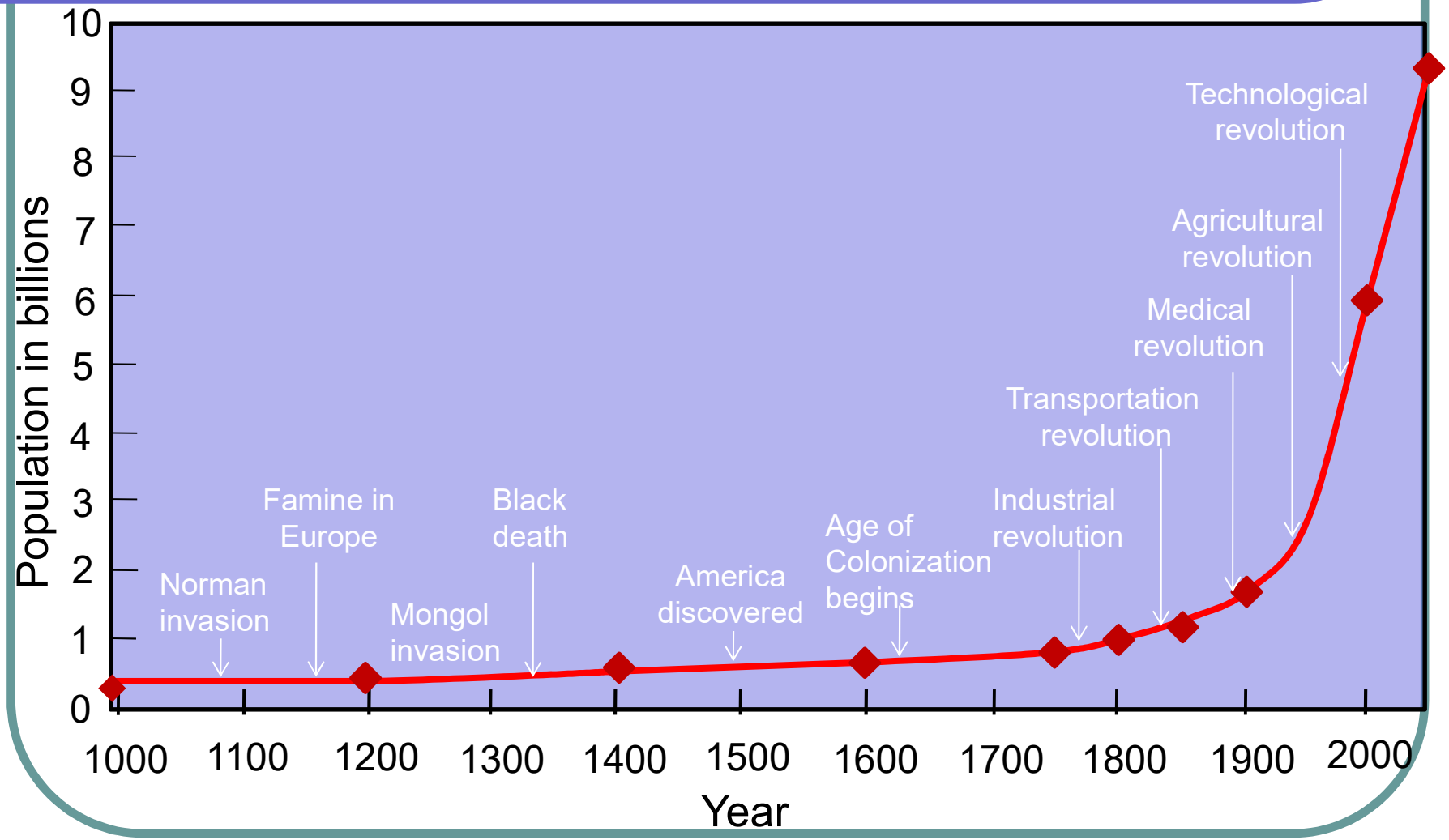
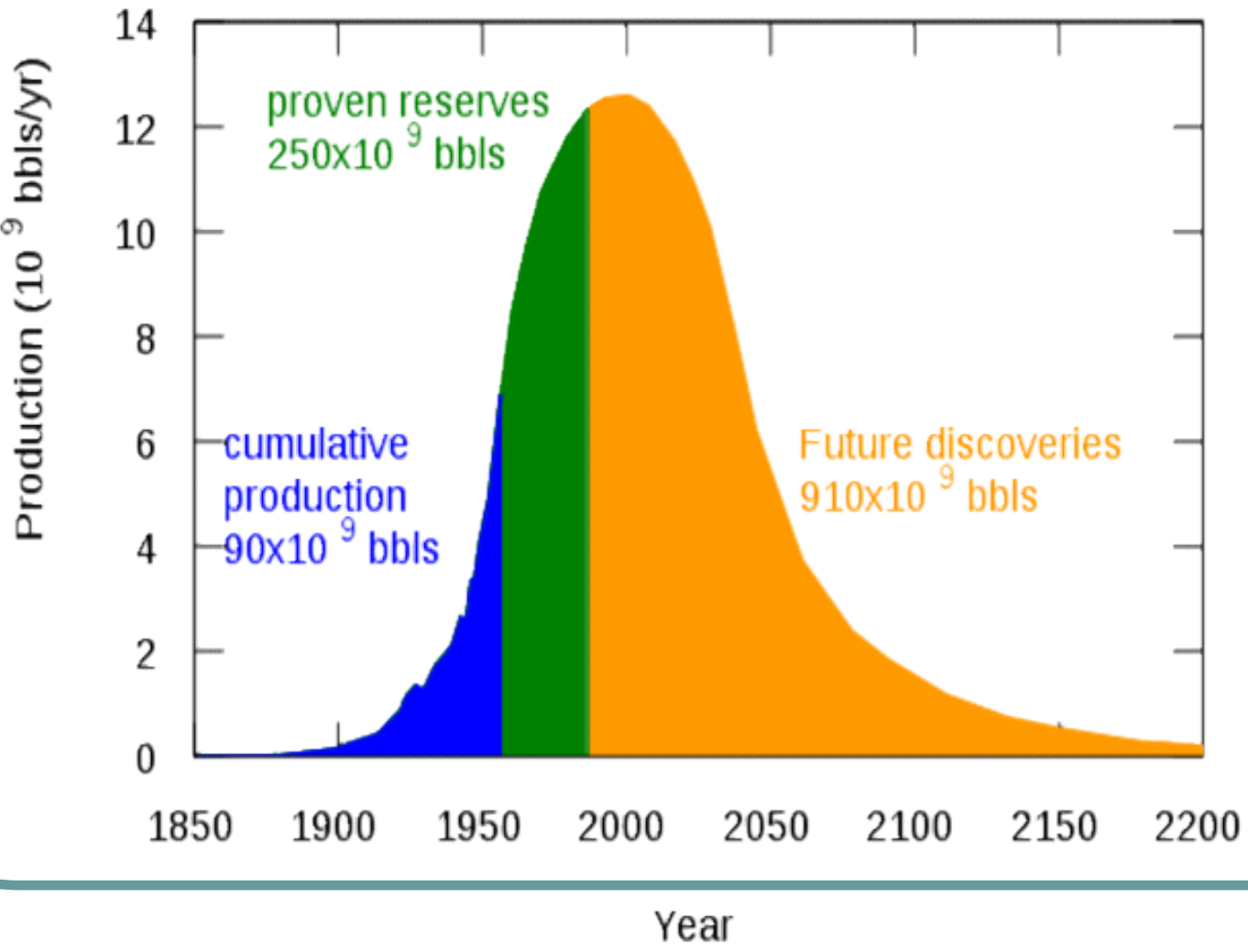
Suthirat Kittipongvises

World Population Growth and Technological Advancement

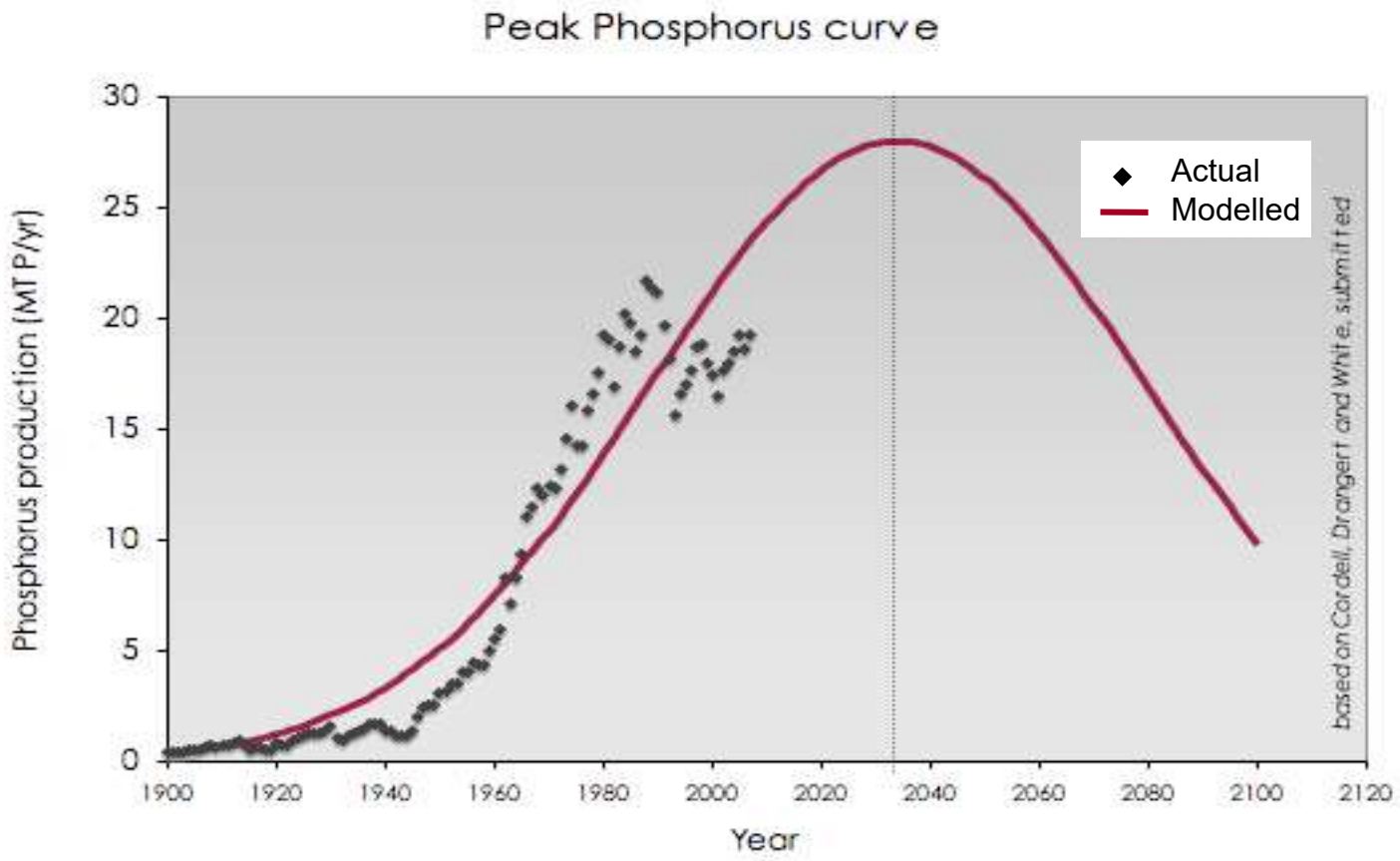


Polprasert, 1996

Peak Oil Projection

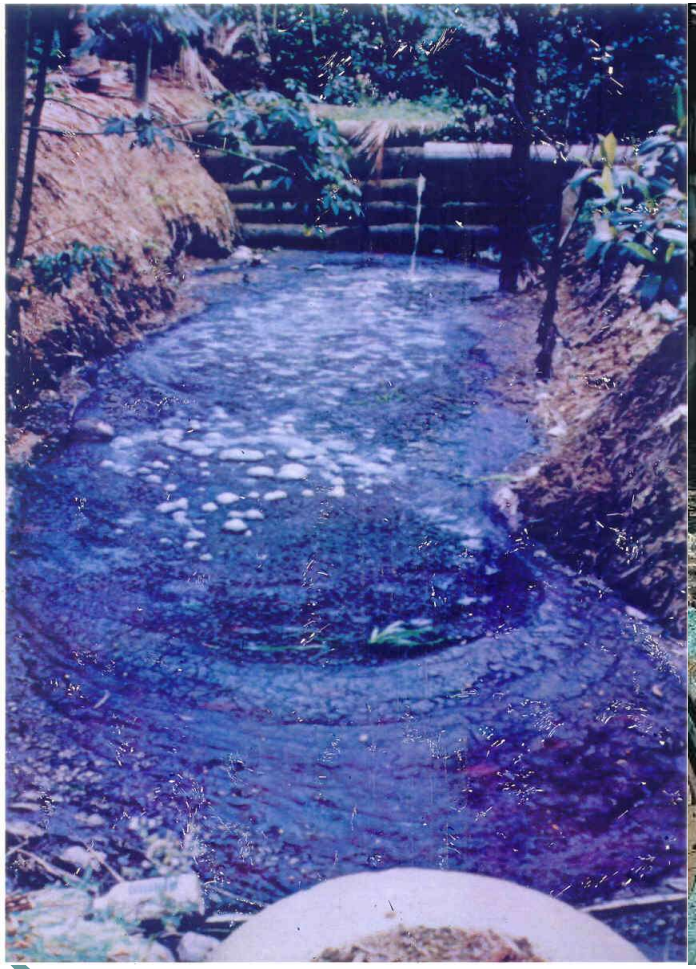


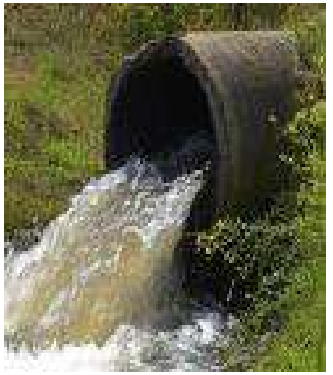
Sustainable Phosphorus Futures



Source: phosphorusfuture.net

Problems-Water





Problems- Solid wastes

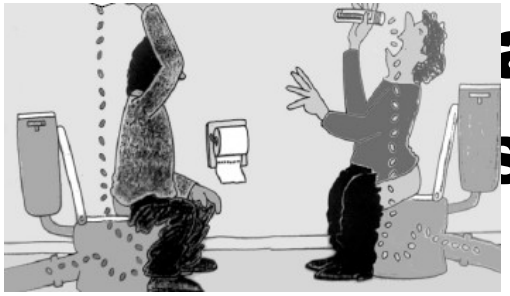
Problems- Fecal Sludge

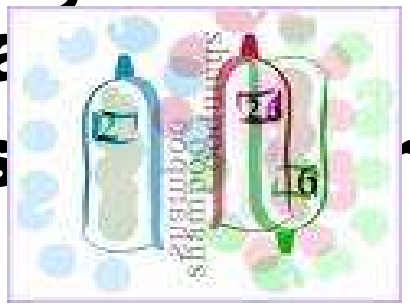
Problems- Hazardous Wastes

Problems- PPCPs

- **P**harmaceuticals and **P**ersonal **C**are **P**roducts

Large quantities of PPCPs can enter water bodies e.g. *Flushing* unused medications down the toilet, *Rinsing* soap,





Occurrence of PPCPs in water environment


- **In Italy, amount of PPCPs (antibiotic, antiflamatory, etc.)**
  discharged to SF water in amounts ranging between 60-180 kg/d

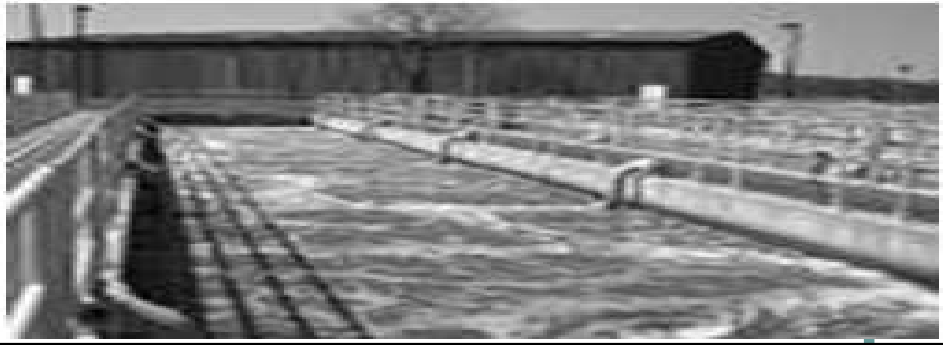
- **In USA, Naproxen was detected in *Louisiana and Ontario surface water* at 22-107 ng/l and Tricosan detected at 10-21 ng/l of sewage treatment plant**

- **In China, the distribution of clobric acid (lipid regulation drug), caffeine , and DDET (*N,N*-diethyl-3-toluamide or insect repellent) at 19, 16**

Problems- Global warming





GHGs
CO_2
CH_4
N_2O
HFCs
PFCs
SF_6

"Human activities are considered as a major source of GHG emissions"

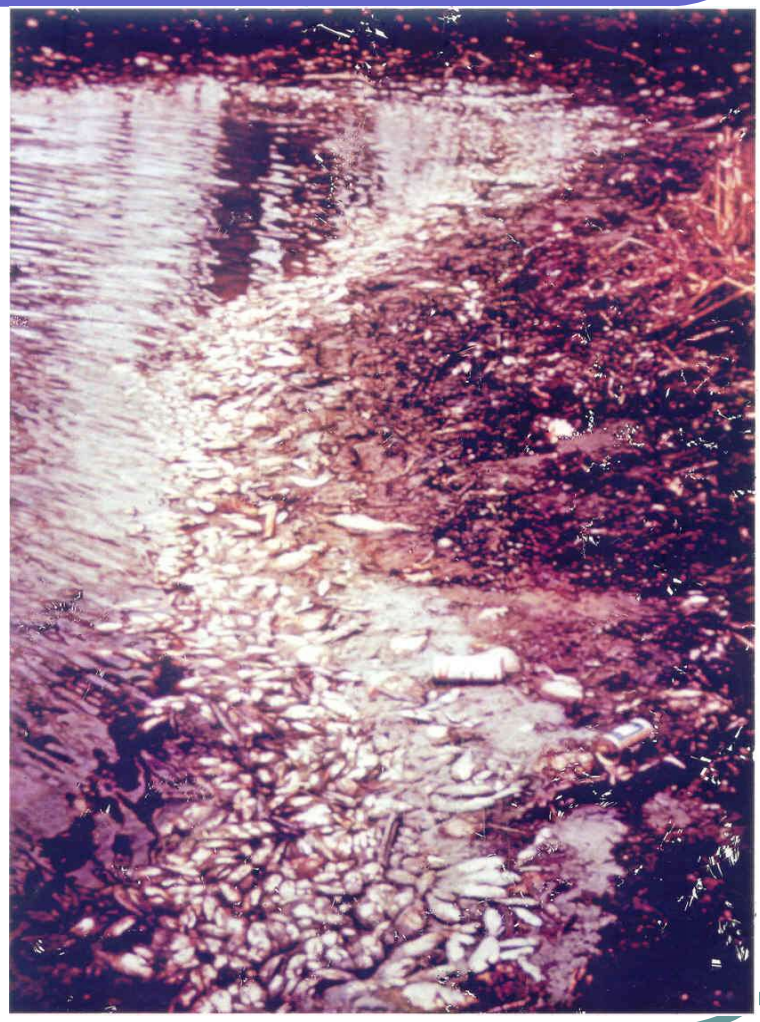
- fuel combustion, deforestation → *CO_2 emission*
- industrial processes → *CFCs, HFCs, PFCs emission*
- Solid waste, WWTP, animal farming → *CH_4 emission*

Global warming & Climate Change

Environmental Impacts

Emerging Environmental Issues

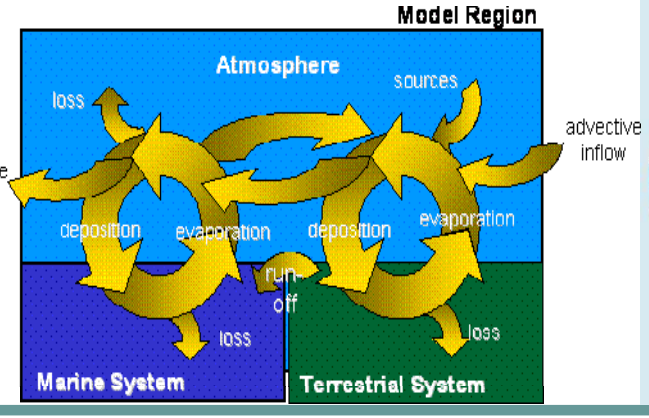
Impact-Water pollution

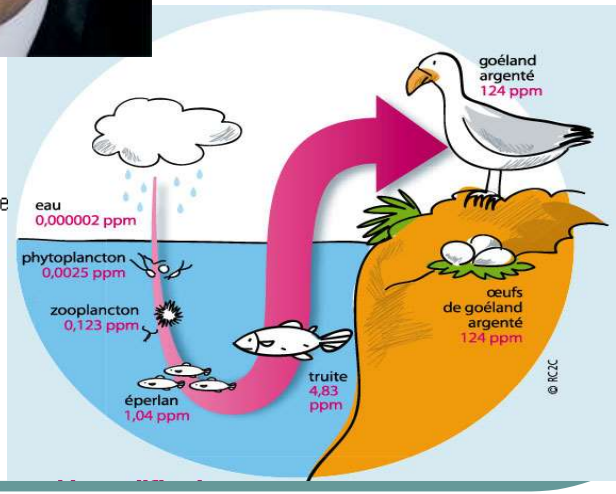


Source: http://media-2.web.britannica.com.

Impact- Hazardous wastes

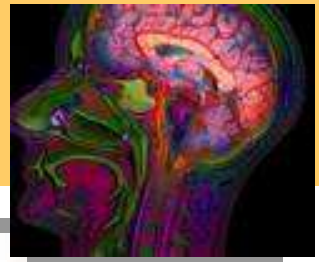
Suspected Dioxin Poisoning





Impact- PPCPs

Human health effects to hormone disrupting compounds include….

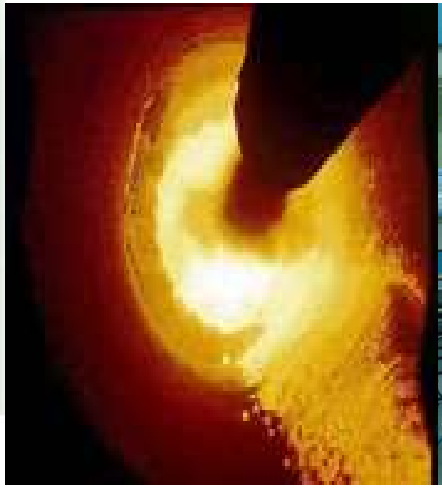


- ***Reproductive problems***
- ***Changes in hormone lev***
- ***Brain and behavior prob***
- ***Impaired immune functions***
- ***Various cancers.***

Possible Solutions

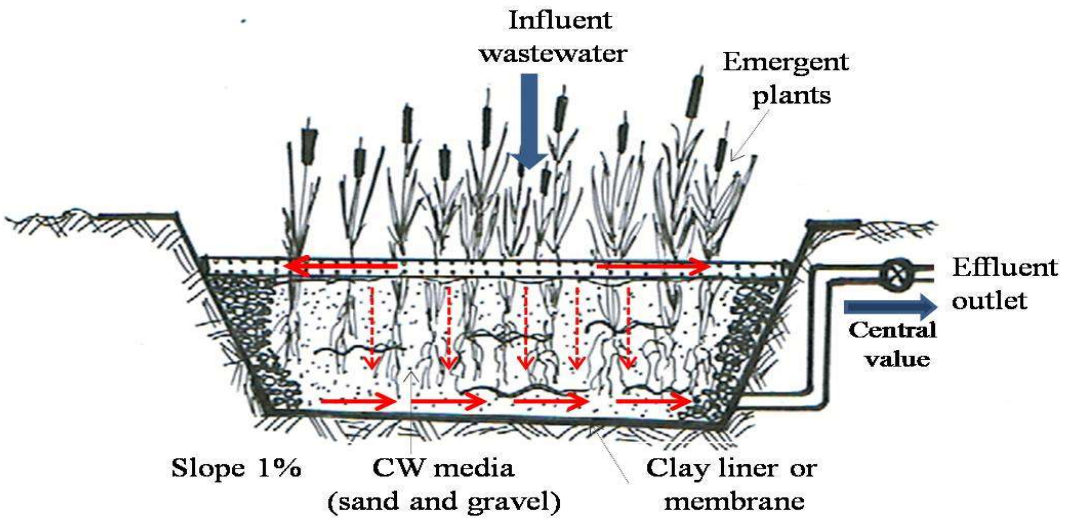
- (1) Constructed Wetlands
- (2) Thermal Process Treatment
- (3) Nano-Phyto Remediation Technology
- (4) Bio-hydrogen production



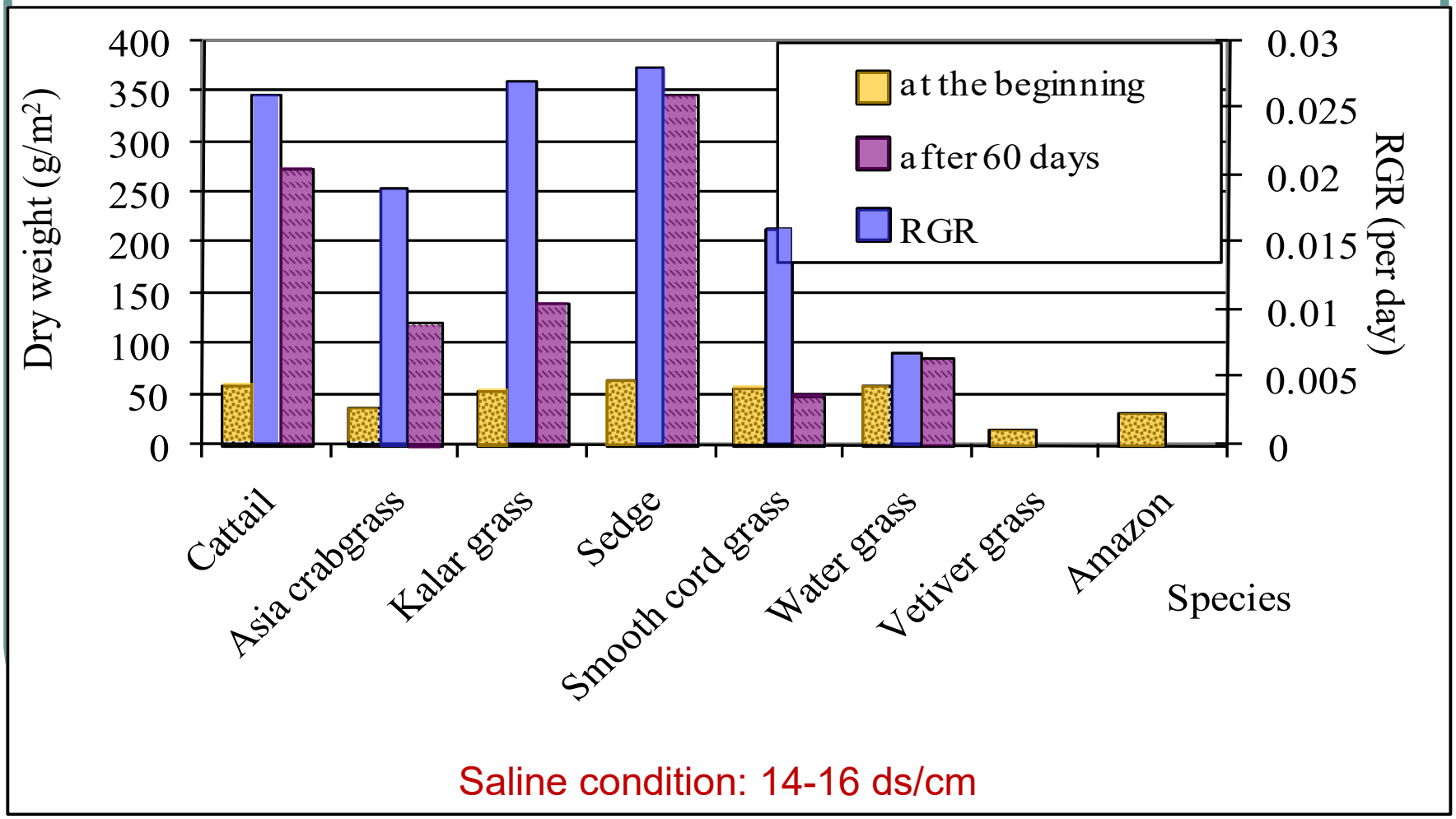



Constructed Wetlands

- The major treatment mechanisms responsible for wastewater degradation are the interactions between emergent aquatic plants and bacteria which use the photosynthetically produced O_2 for oxidation of the organic matter.



Constructed wetland treatment under high saline conditions



Saline condition: 14-16 ds/cm

Comparative study of integrated constructed wetland systems employing oyster shells and alum sludge as filter media or P removal

Oyster shells

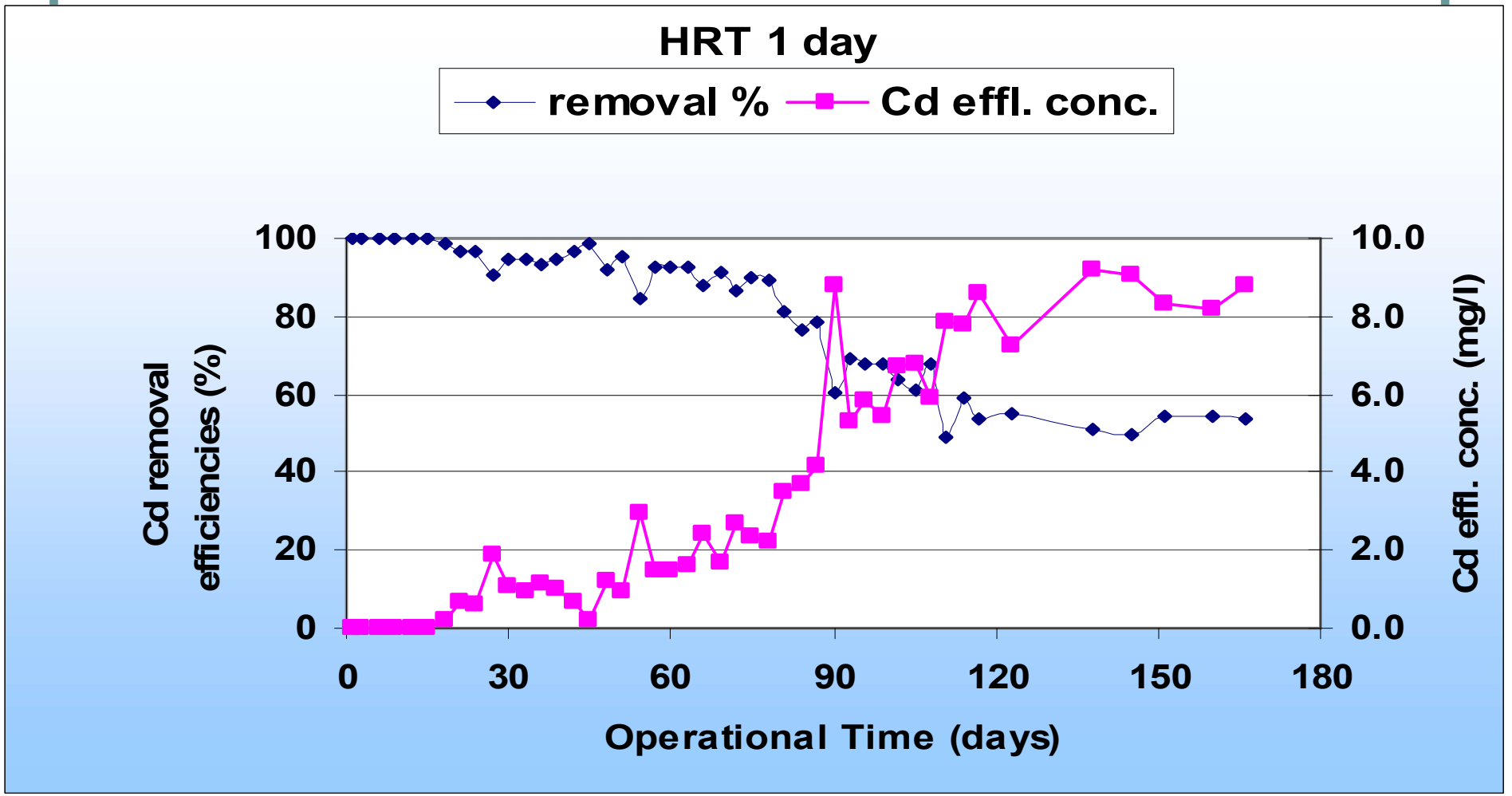
Alum sludge

ICONWEP pilot-scale test

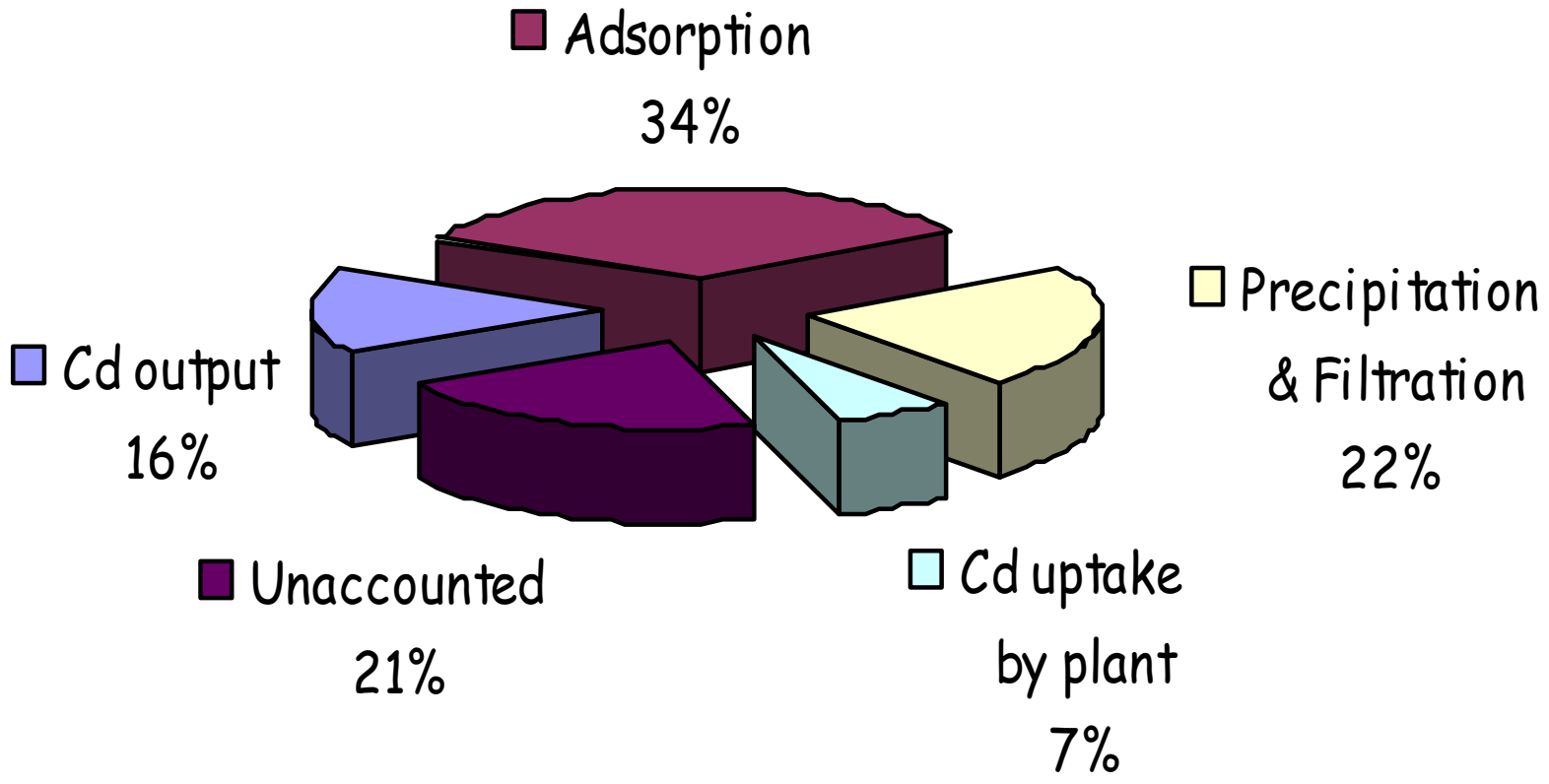
Averages values of influent and effluent water quality for ICONWEP and during 240 days of operation

	ICONWEP I				ICONWEP II		
	Influent Conc	OS CW Effluent	OS Filter Effluent	Efficiency (%)	AS Filter Effluent	OS CW Effluent	Efficiency (%)
BOD_5	35.4	4.2	2.6	92.7	8.0	3.8	89.5
TN	18.9	5.7	1.5	92.1	18.9	5.9	68.8
PO_4-P	17.9	0.7	0.1	99.4	0.1	0.1	99.4
TSS	41.5	7.5	3.5	91.6	3.6	4.2	89.9

Cd removal characteristics and efficiencies

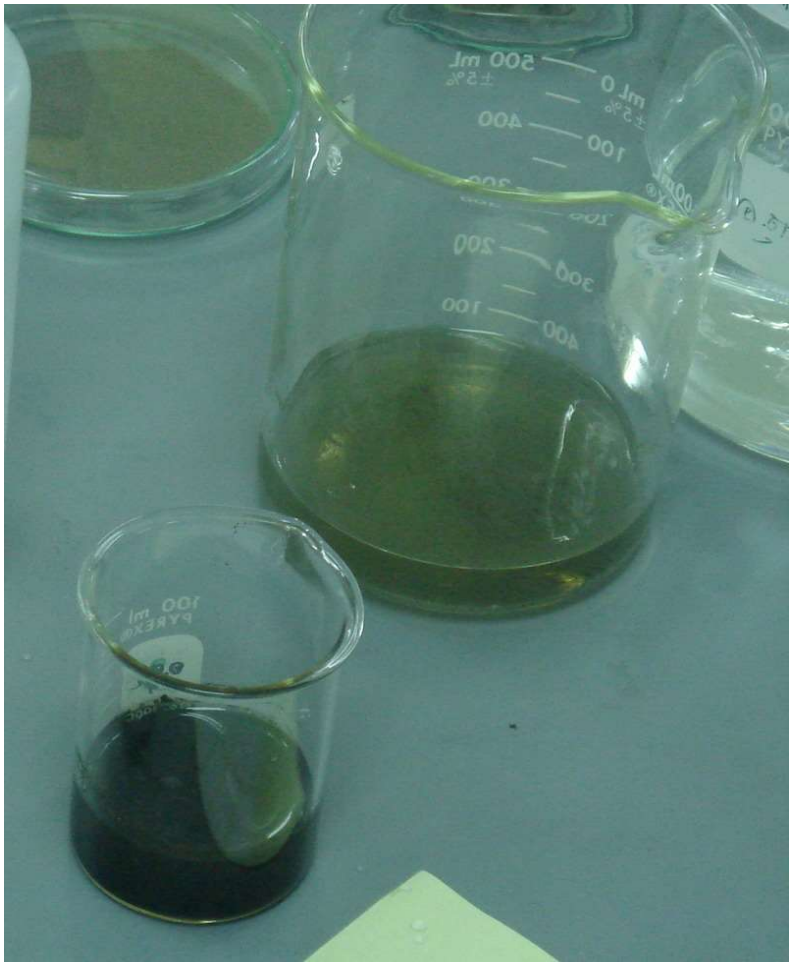


Cd mass balance in SFCW unit

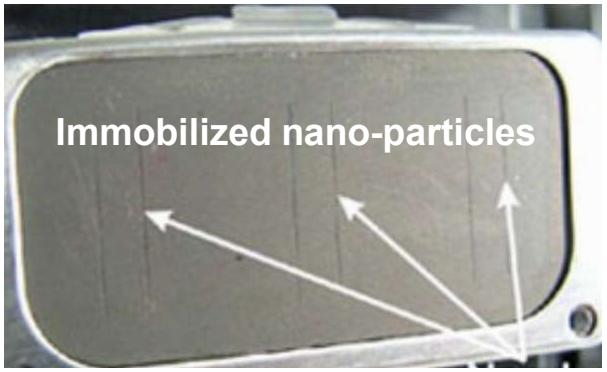


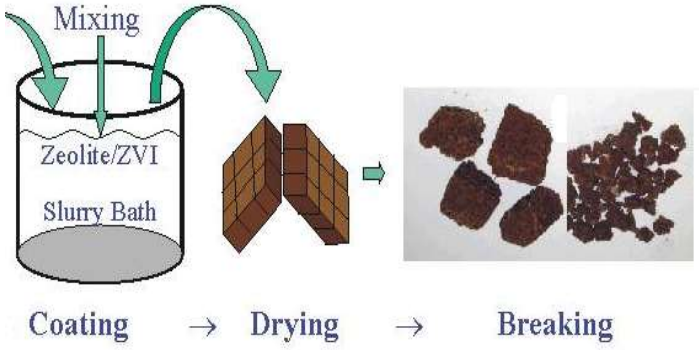
Synthesis of nZVI

Synthesis of nZVI

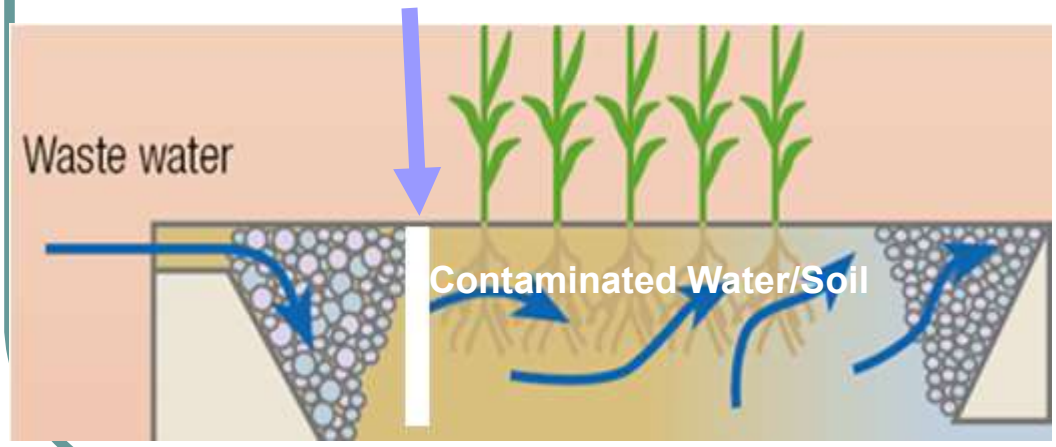


Nano-Phyto Remediation Technology





"Zero-valent iron"

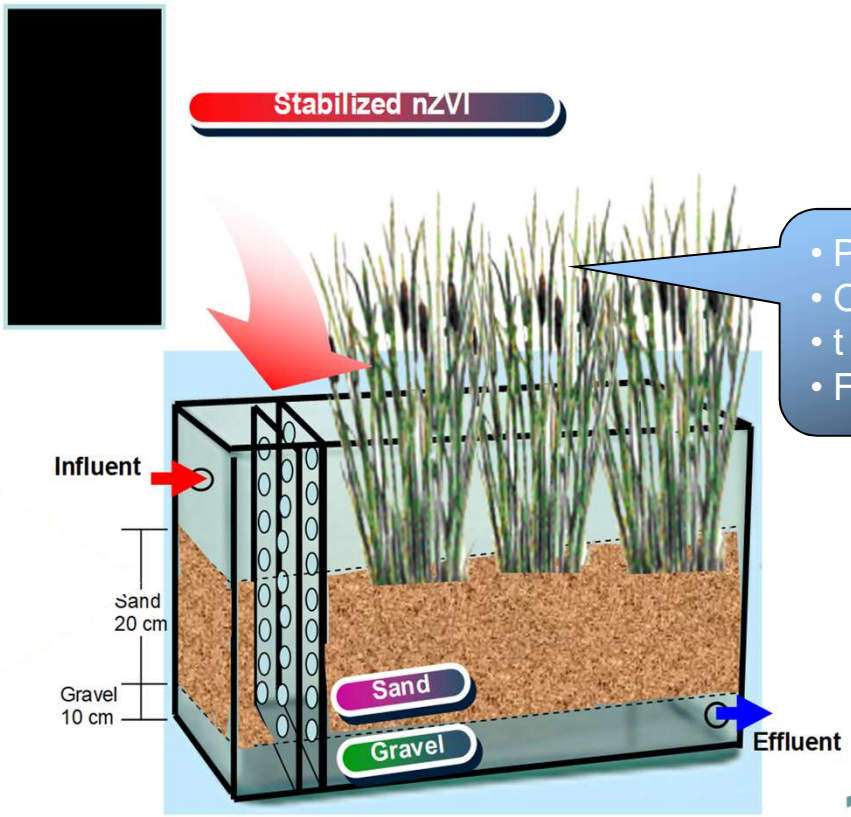


For PPCPs, PCBs,Dioxin Contaminated Water/Soil

Construction and operation

$$4Fe^{3+} + 3BH_4^- + 9H_2O \rightarrow 4Fe^0 \downarrow + 3H_2BO_3^- + 12H^+ + 6H_2$$

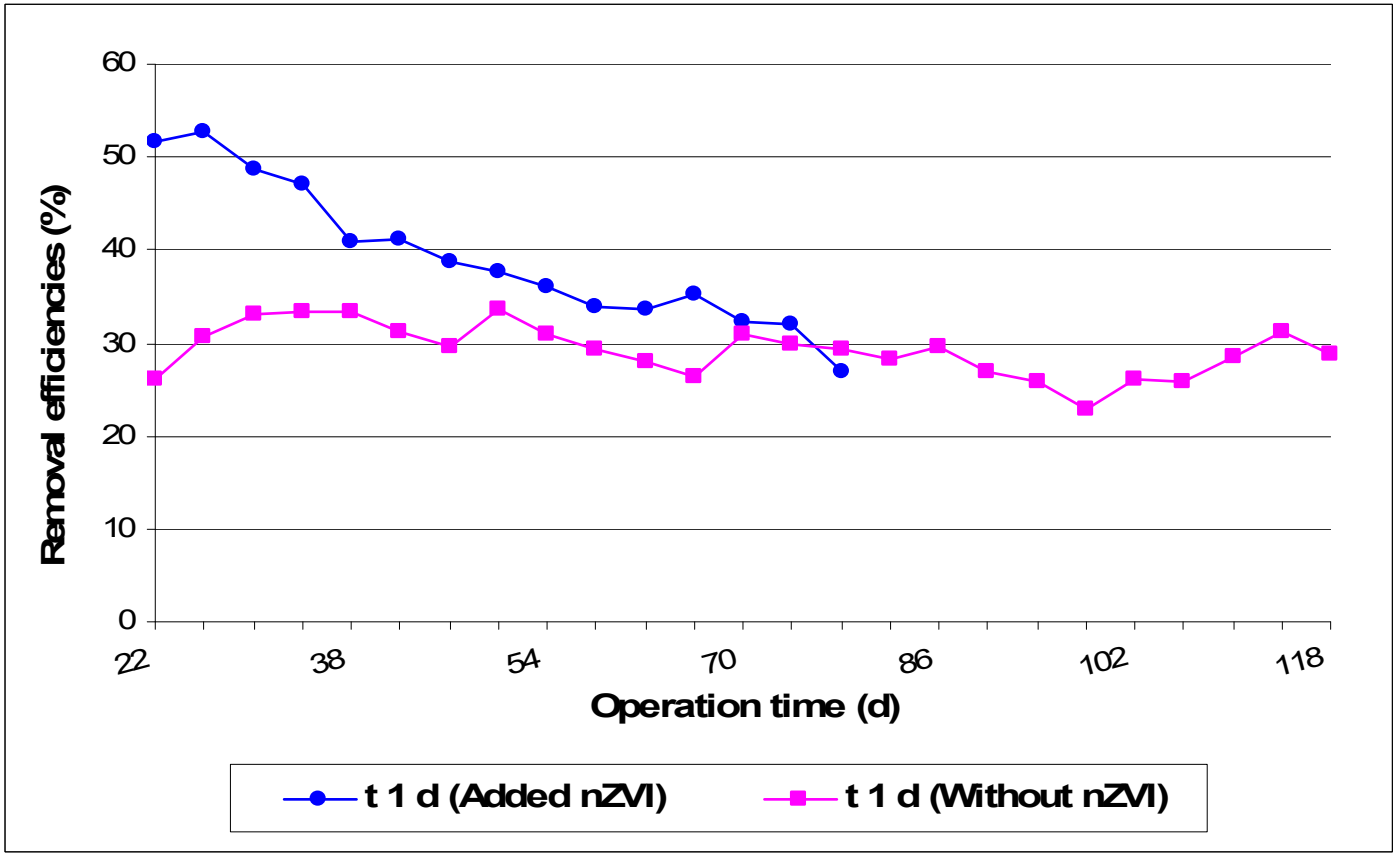
The stabilized nZVI was synthesized by mixing dried nZVI, Carboxymethyl cellolose (CMC), glycerol and water at a ratio of 22:6:32:40 (% weight).



- PFOA : 5 mg/L and
- OLR :100 kg COD/ha-day
- t :1 day
- Flow rate was 2.77 L/day

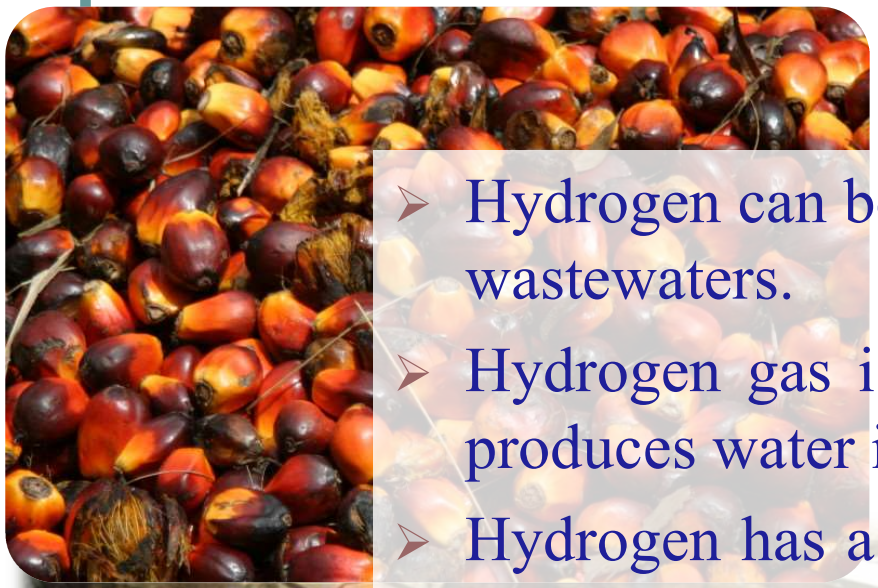
Results/Discussion

Effects of nanoparticles on PFOA removal in SFCW unit



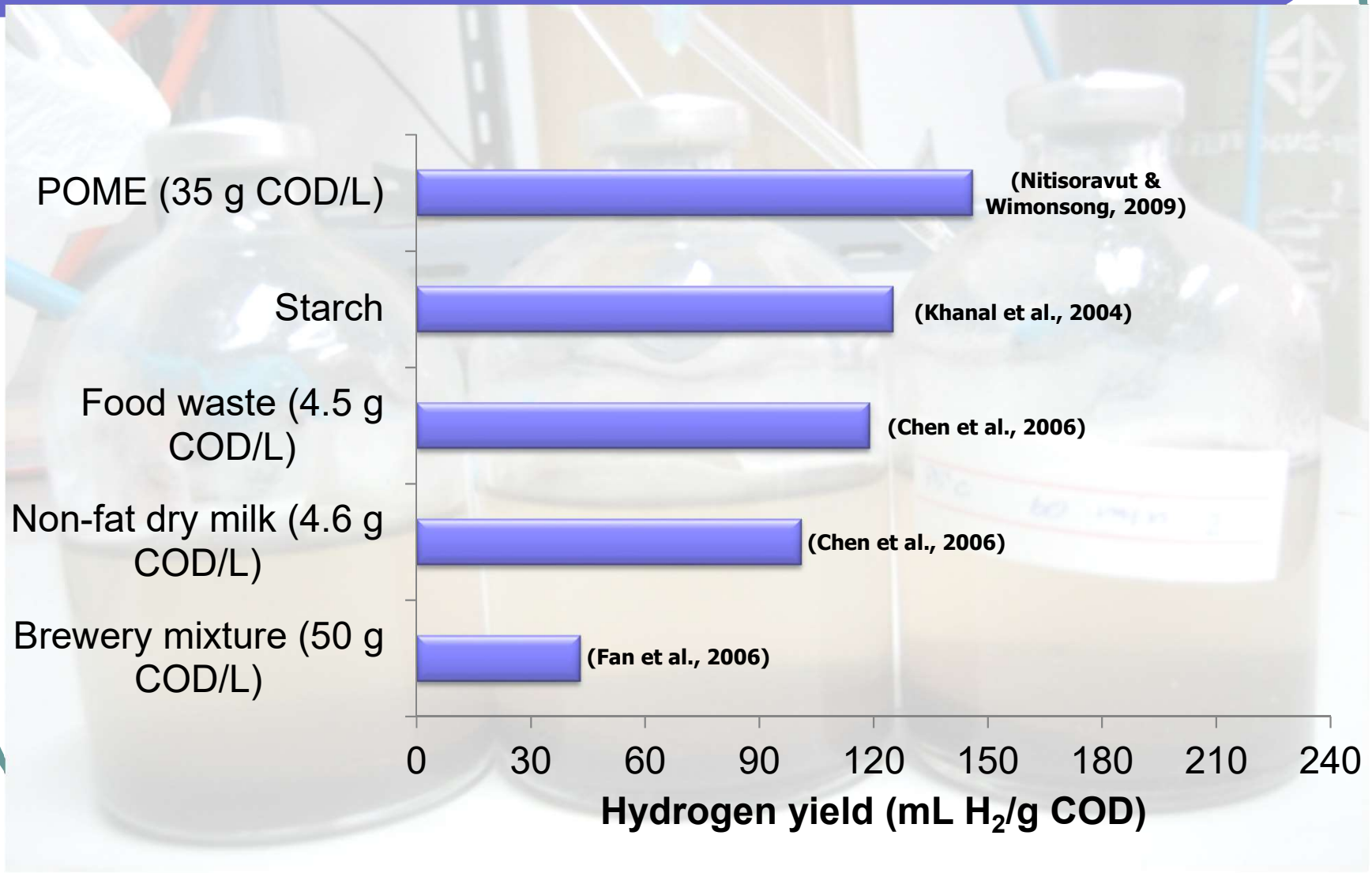
Bio-hydrogen production

from agricultural wastes or wastewaters



- Hydrogen can be generated from various wastes and wastewaters.
- Hydrogen gas is a clean fuel. When combusted, it produces water instead of greenhouse gases.
- Hydrogen has a high energy yield of 122 kJ/g, 2.75 times greater than hydrocarbon fuels.

Yields of bio-hydrogen production from different waste materials by dark-fermentation.



Effects of nZVI on H_2 production

Stoichiometric equations:

$$4Fe^0 + C_6H_{12}O_6 + 12H_2O \longrightarrow 2Fe_2O_3 + 6CO_2 + 18H_2$$

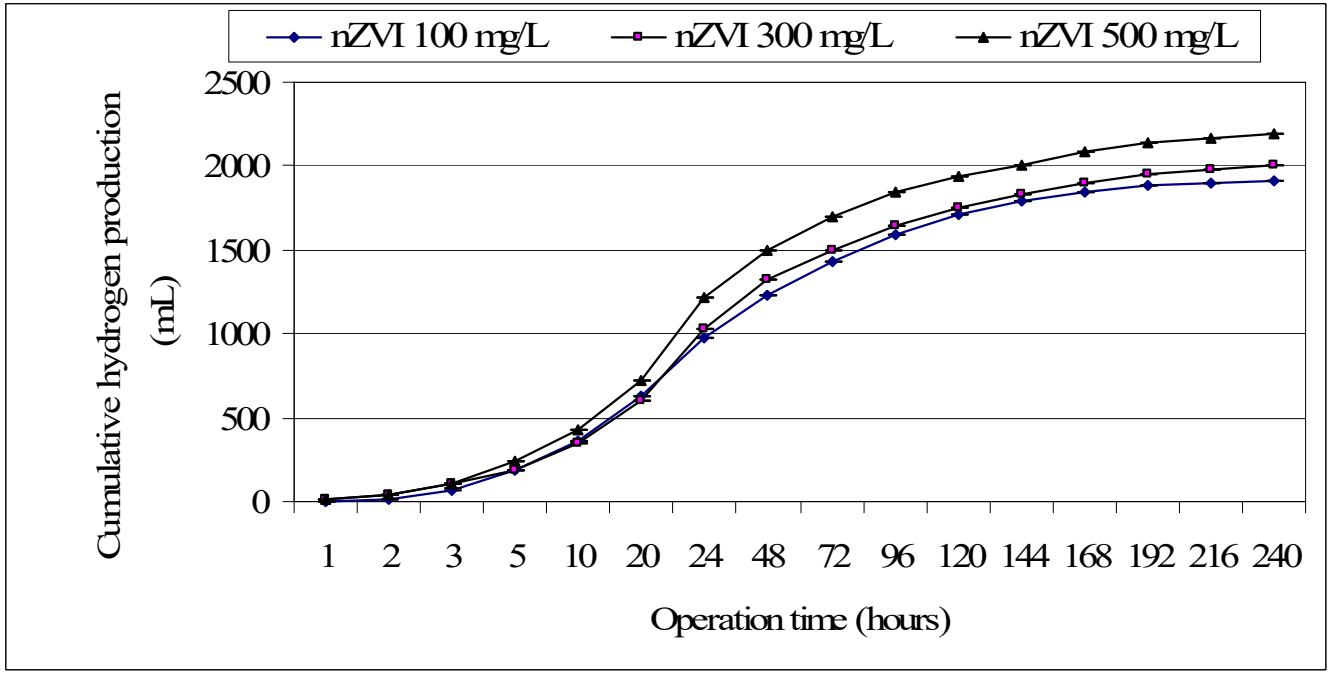
180 g 36 g

$$C_6H_{12}O_6 + 6H_2O \longrightarrow 6CO_2 + 12H_2$$

180 g 24 g

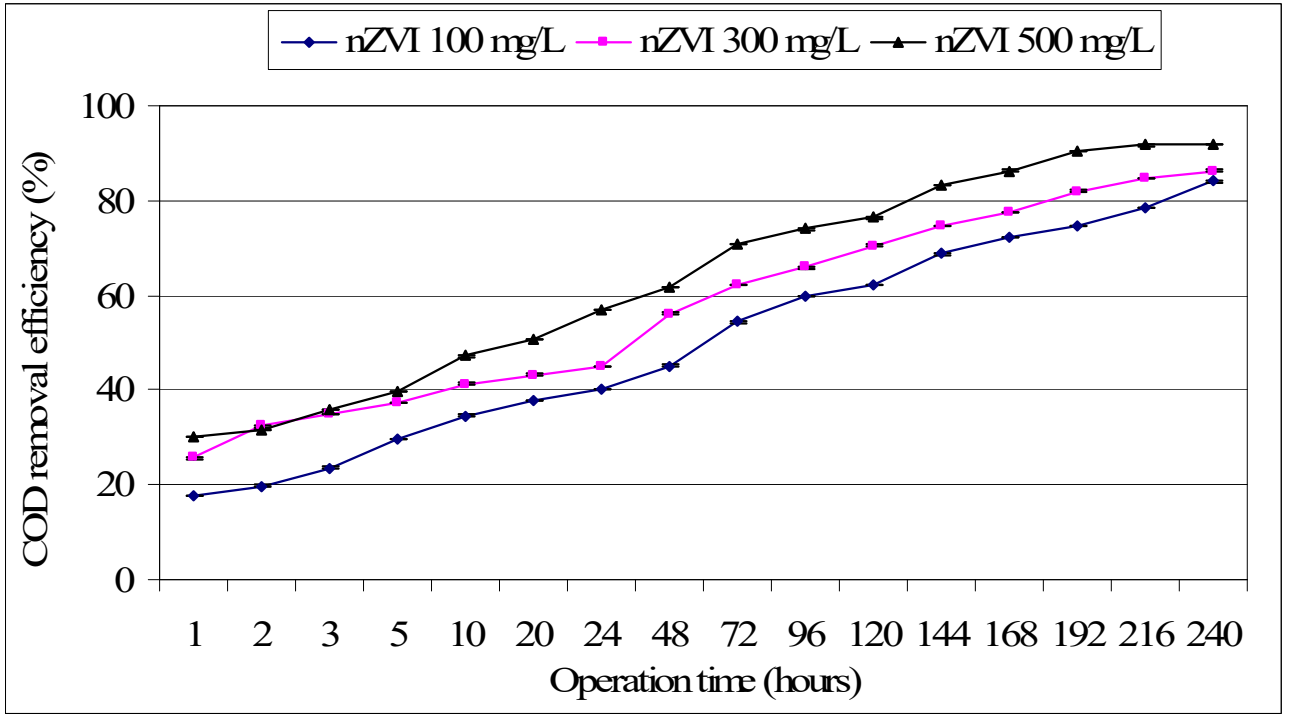
Effects of nZVI on H_2 production

Phase-3



Effects of nZVI on H_2 production

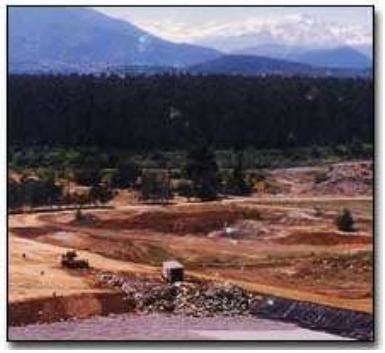
Phase-3



Optimization Challenges for Fermentative Hydrogen Production

- Feedstock selection
- Inoculum Selection and Start-up
- Prevention of Product Inhibition
- Metabolic Shift
- Population Shift
- Development of Sustainable Process Technology

Environmentally sound technology for *contamination control*


- Thermal process treatment

  Co-Processing in Cement Kilns &

  High- Temperature Incinerator

Thermal process treatment

Cement kilns

High-temperature incinerator

DRE of hazardous wastes by co-processing in cement kilns

- Sri Lanka, PCBs,

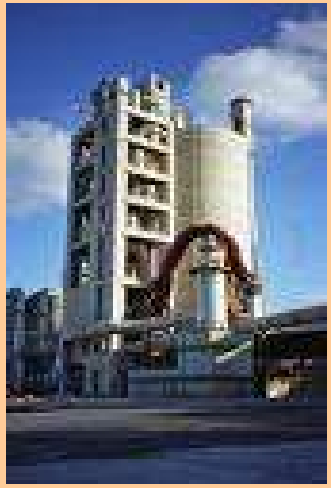
  DRE 99.99999999002%

- Colombia, Contaminated soil *(DDT, Aldrin, Dieldrin)*

  DRE 99.9999%

- Vietnam, Insecticides

  DRE 99.999996%



Global warming mitigation

WASTE TO ENERGY POTENTIAL through Clean Development Mechanism (CDM)

Examples of CDM projects

- Energy efficiency improvements, industrials sectors
- Renewable energy technologies
- WASTE TO ENERGY e.g. biogas production from WWTP &solid waste management
- Reforestation

with

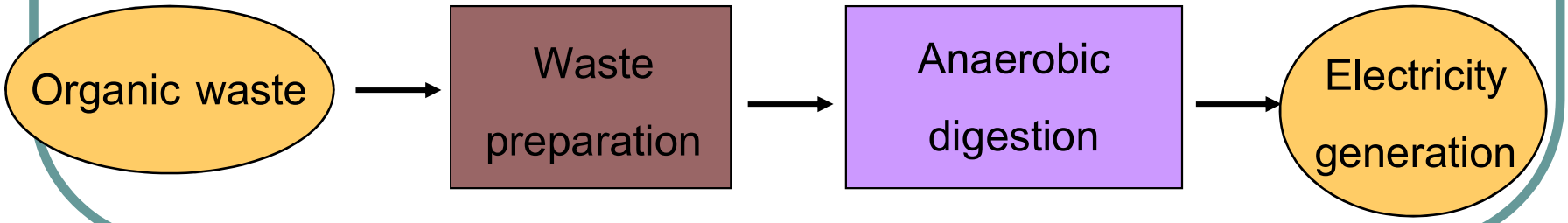
Solid waste management

ORGANIC WASTE RECYCLING & CDM

Thailand

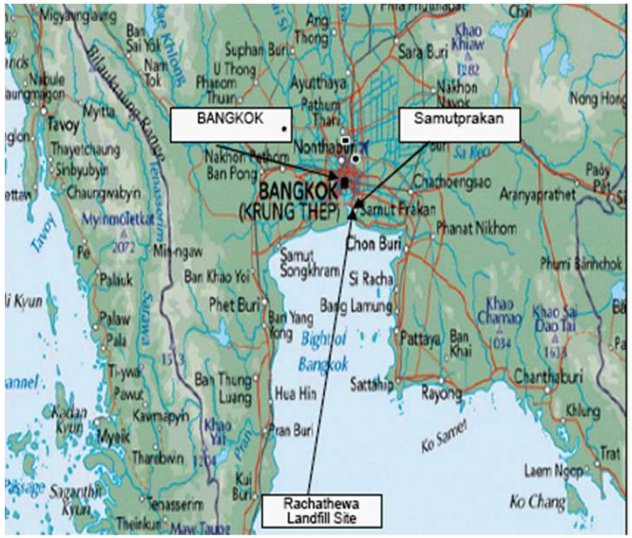
Case study 1 : Organic waste recycling project, Anaerobic Digestion from MSW

- Rayong Municipality, Thailand
- Raw materials: Sorted organic wastes
- Anaerobic digestion
- Product: biogas for electricity generation



source: Jutidumrongpan (2008)

Case study 2: CDM Project implementation Rachathewa Landfill Site



- Receives waste approximately 3,500 t/d (40% of municipal solid waste of BMA)
- Total area 200 Rai

Overview of the Rachathewa landfill sites

Rachathewa Landfill Site
Gas to energy project

Waste Production (MSW)

Waste Disposal

Site 1&2 Disposal areas

Methane production

Methane collection

Flaring

Electricity Generation

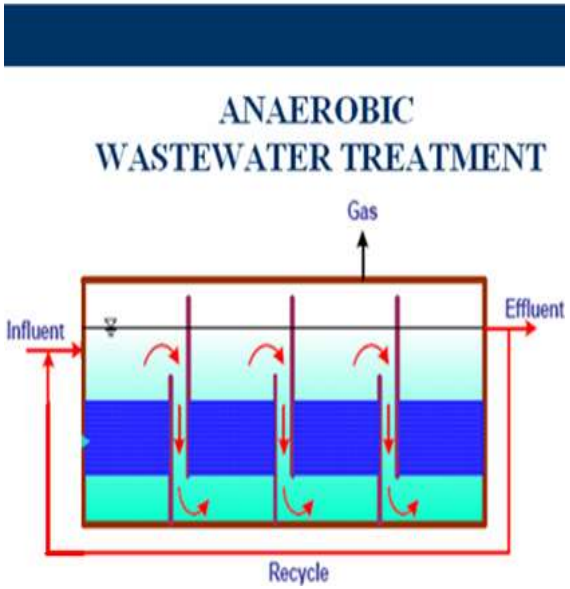
Case study 3: CDM Project implementation at the tapioca processing factory

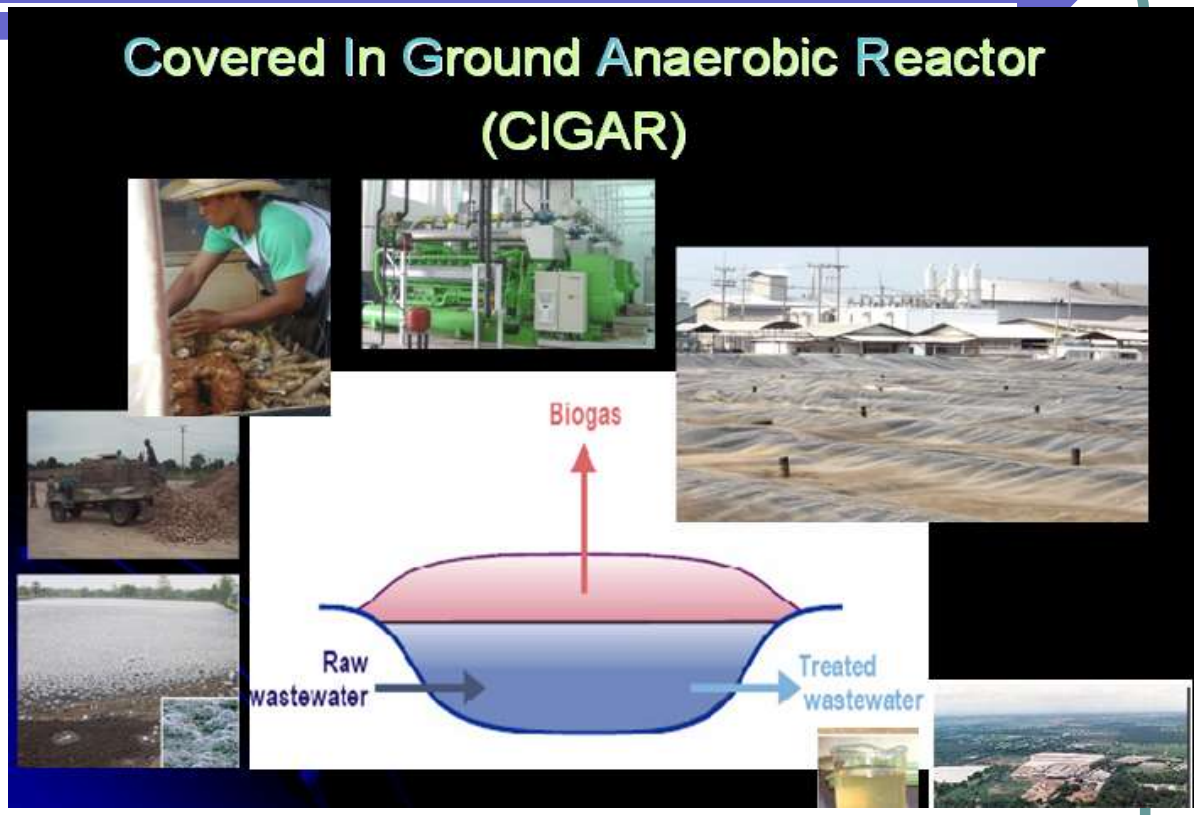
Korat Waste To Energy Project

Biogas plant at
Sanguan Wongse Industries
ABR "Anaerobic Baffle Reactor"
for treating Wastewater

Korat - *Waste to energy project*

ABR has the potential to provide a higher efficiency at higher org loading rate





COD Inputs = 20,000-30,000 mg/l
Flow = 7,000 m^3/d

Biogas generation = 50,000- 80,000 $m^3$of CH_4/d
GHG Reduction = 374,000 tCO_2equiv./yr

Conclusions

- Solid & hazardous wastes are serious problems which need to be properly managed.
- There are evidences of health and environmental impacts caused by mismanagement of SW/HW
- There are environmentally sound technologies for control of SW/HW
- With proper management, environmental problems including global warming effects could be minimized.


THANK YOU
for your attention