



# Know Your Researcher @ Asian Institute of Technology



**C. Visvanathan**  
**Environmental Engineering and Management Program**  
**Asian Institute of Technology**  
**Thailand**

email: [visu@ait.ac.th](mailto:visu@ait.ac.th)

Web: <http://www.faculty.ait.ac.th/visu/>

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# Major Research Themes



## Membrane Technology & Water Treatment

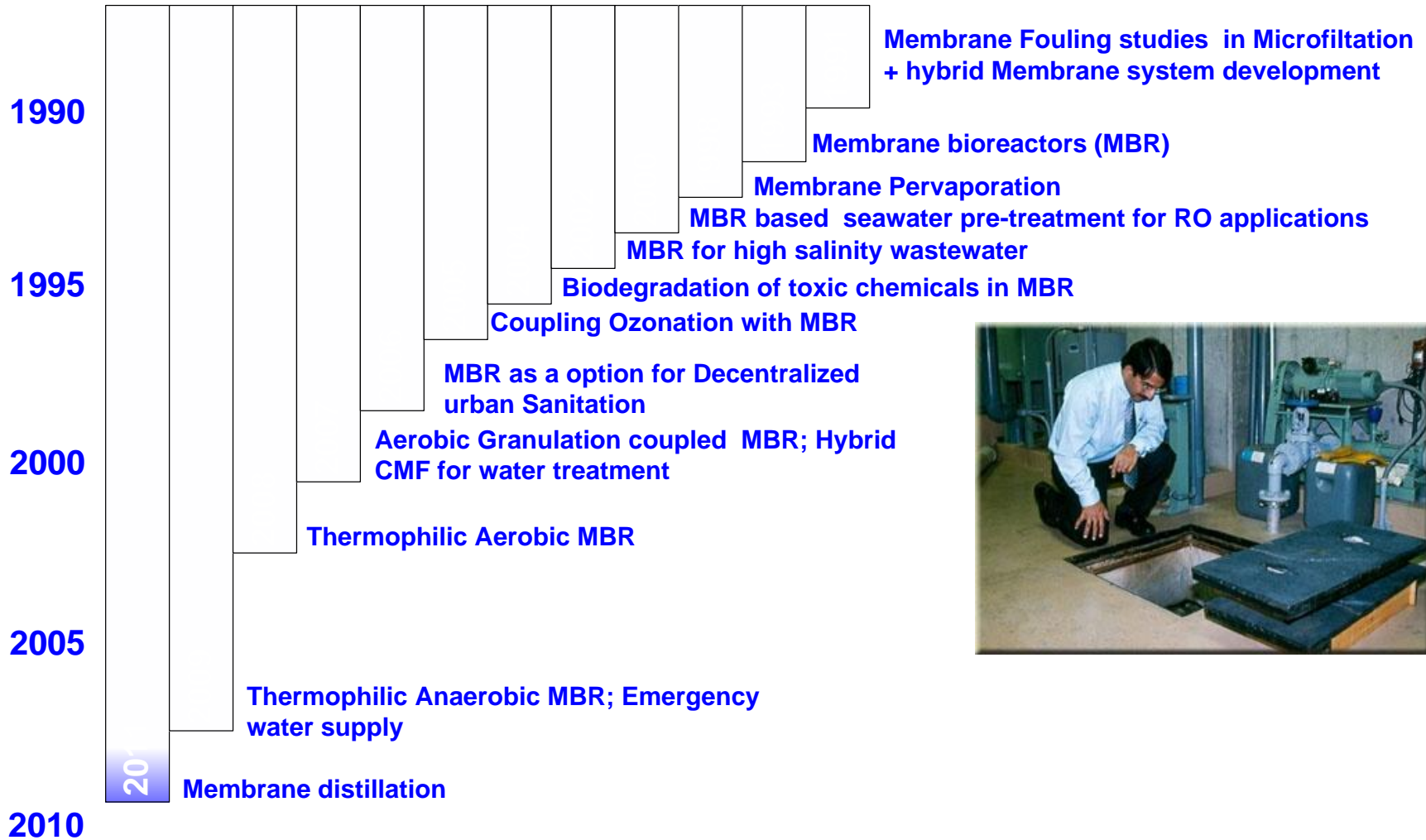


## Industrial Environmental Management

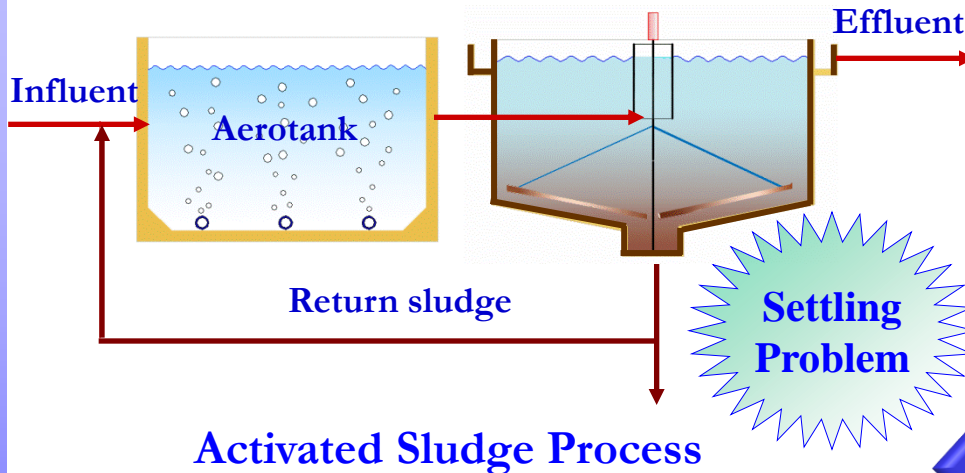


## Solid Waste Management

## Research Directions: *Keeping in touch with the rapidly developing Membrane Technology field*



## Research Directions: MBR



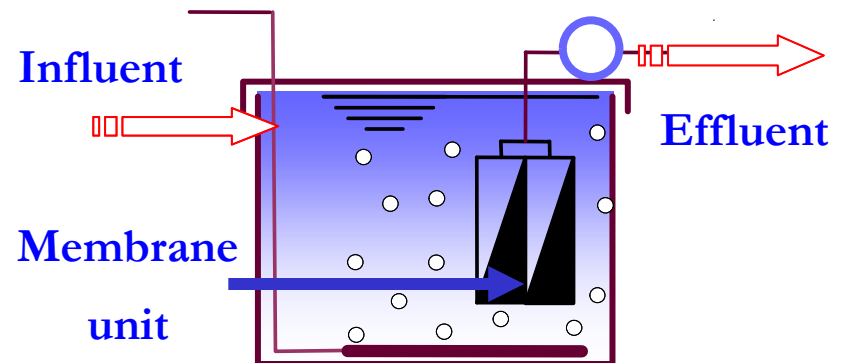
### *Conventional Activated Sludge:*

- Aerobic process;
- Low OLR (<math>2 \text{ kgCOD/m}^3 \cdot \text{d}</math>)
- Low biomass retention
- Effluent quality (SS>30 mg/L)



### *Submerged MBR*

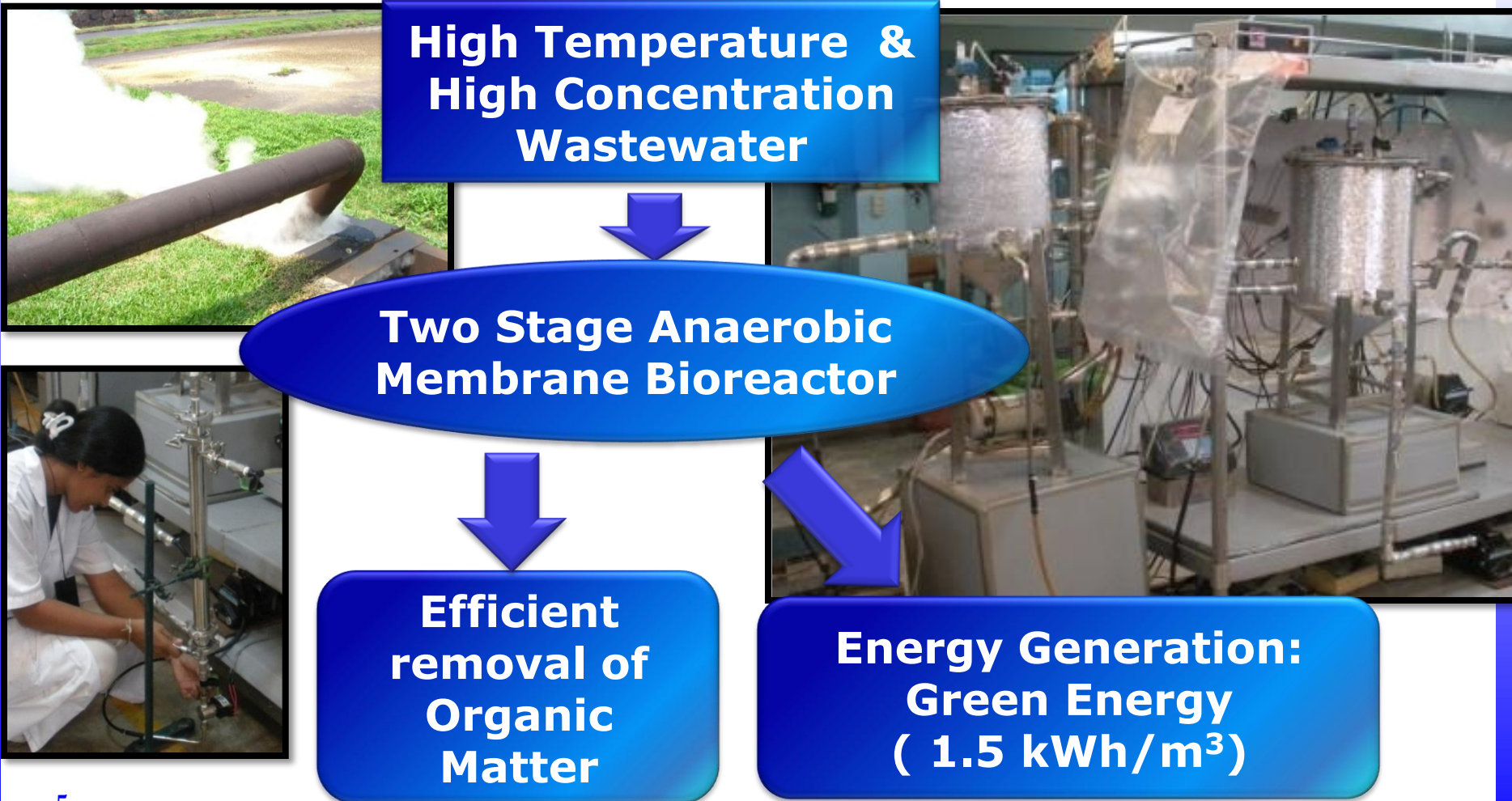
- Being popular due to cost reduction
- Water reuse and recycling;
- High SRT, OLR;
- Less footprint;
- Involve diversity of microbial population;
- Can remove recalcitrant



Submerged MBR as a single unit

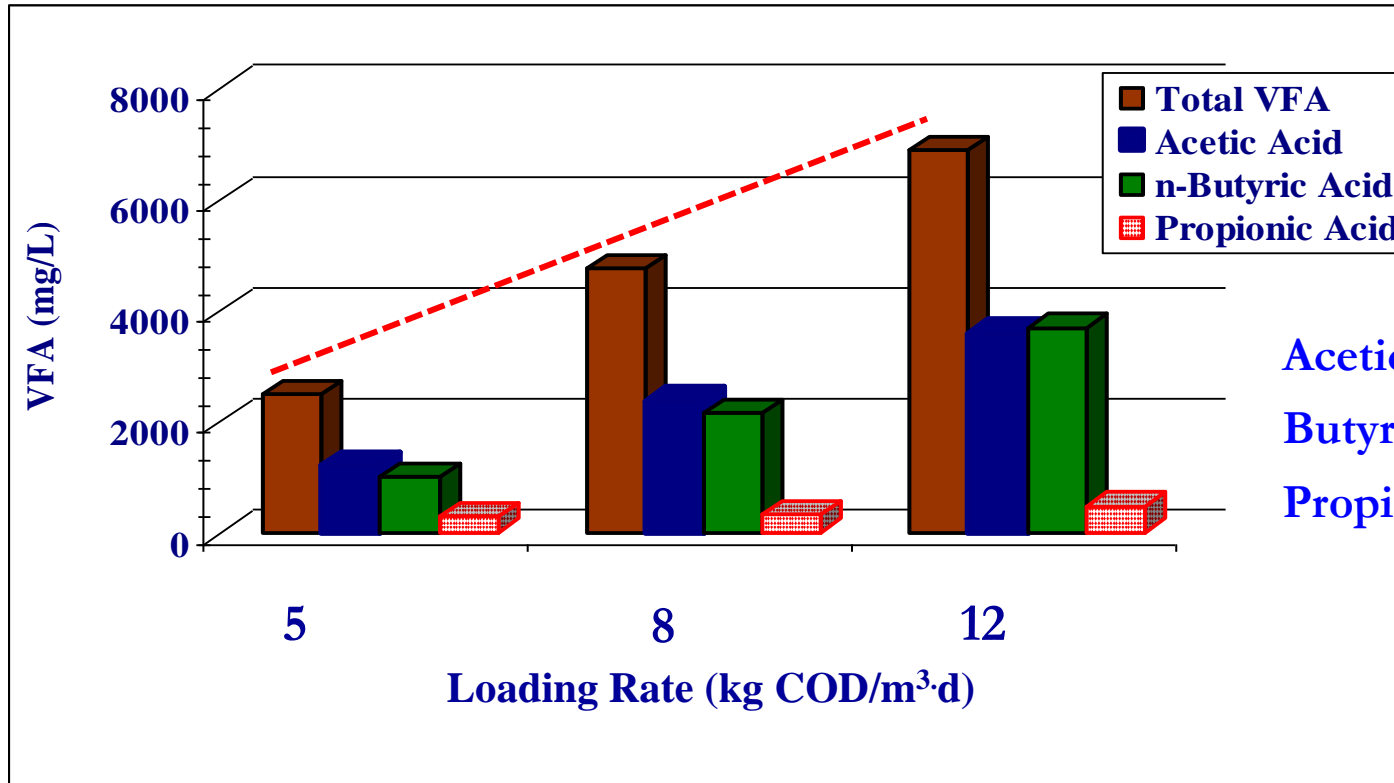
## Research Directions: *Two stage Thermophilic anaerobic MBR*

**Concept:** Treatment of high temperature effluent without cooling down while recovering energy as biogas



## Research Directions: *Two stage Thermophilic anaerobic MBR*

### Observations: Hydrolytic Reactor VFA Generation



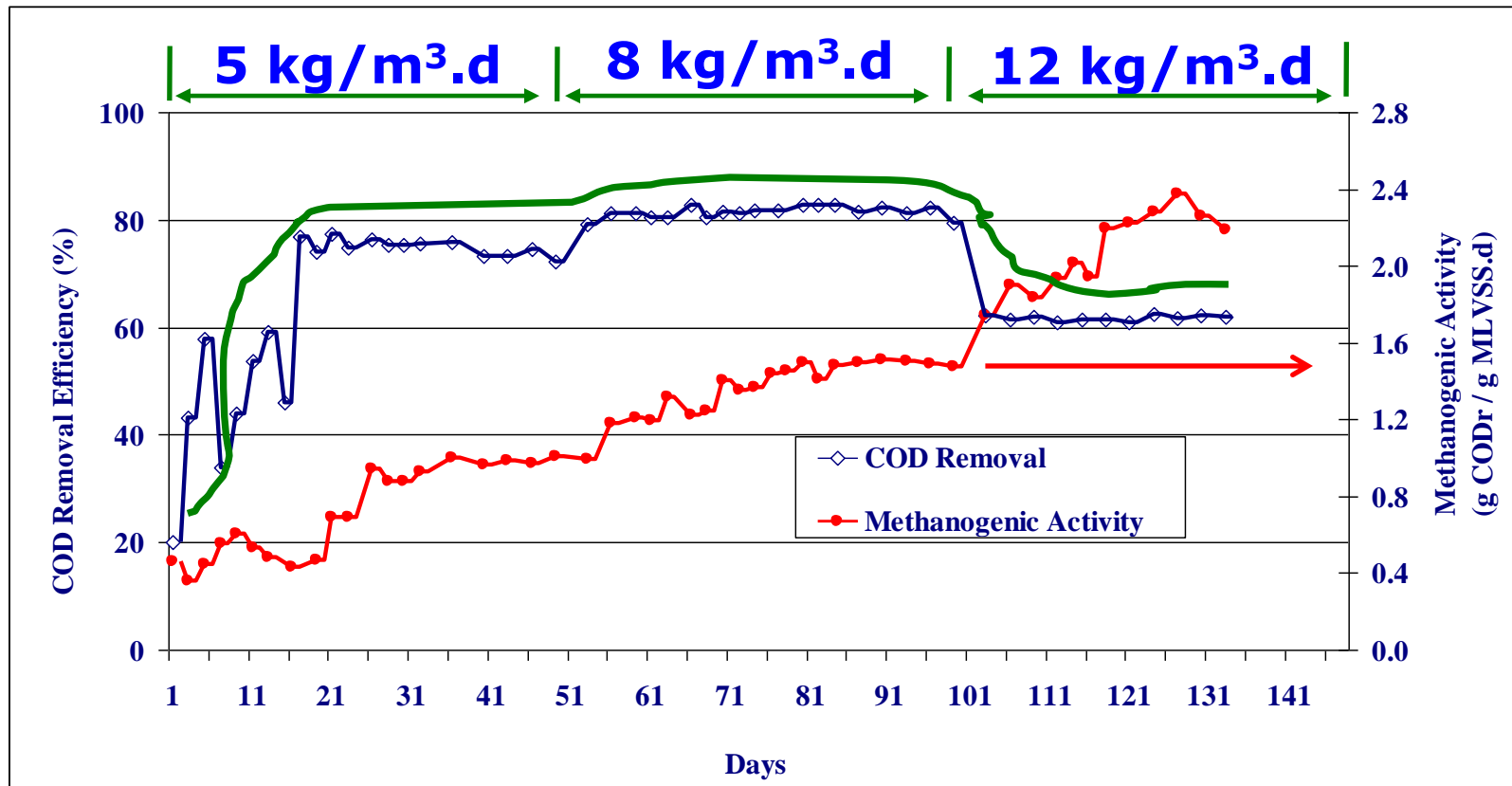
Acetic Acid : 41 - 53 %  
Butyric Acid : 47 - 53 %  
Propionic < 5 %

Acetic Acid & Butyric Acid : Most Favorable for Methane Formation. No propionic acid inhibition

Hydrolytic reactor achieved high VFA production irrespective to low operating biomass concentration. Hydrolytic reactor achieved biological activity of 3.82 VFA g/g MLVSS.

## Research Directions: *Two stage Thermophilic Anaerobic MBR*

Observations: Methanogenic Reactor, COD Removal Efficiency and Methanogenic Activity

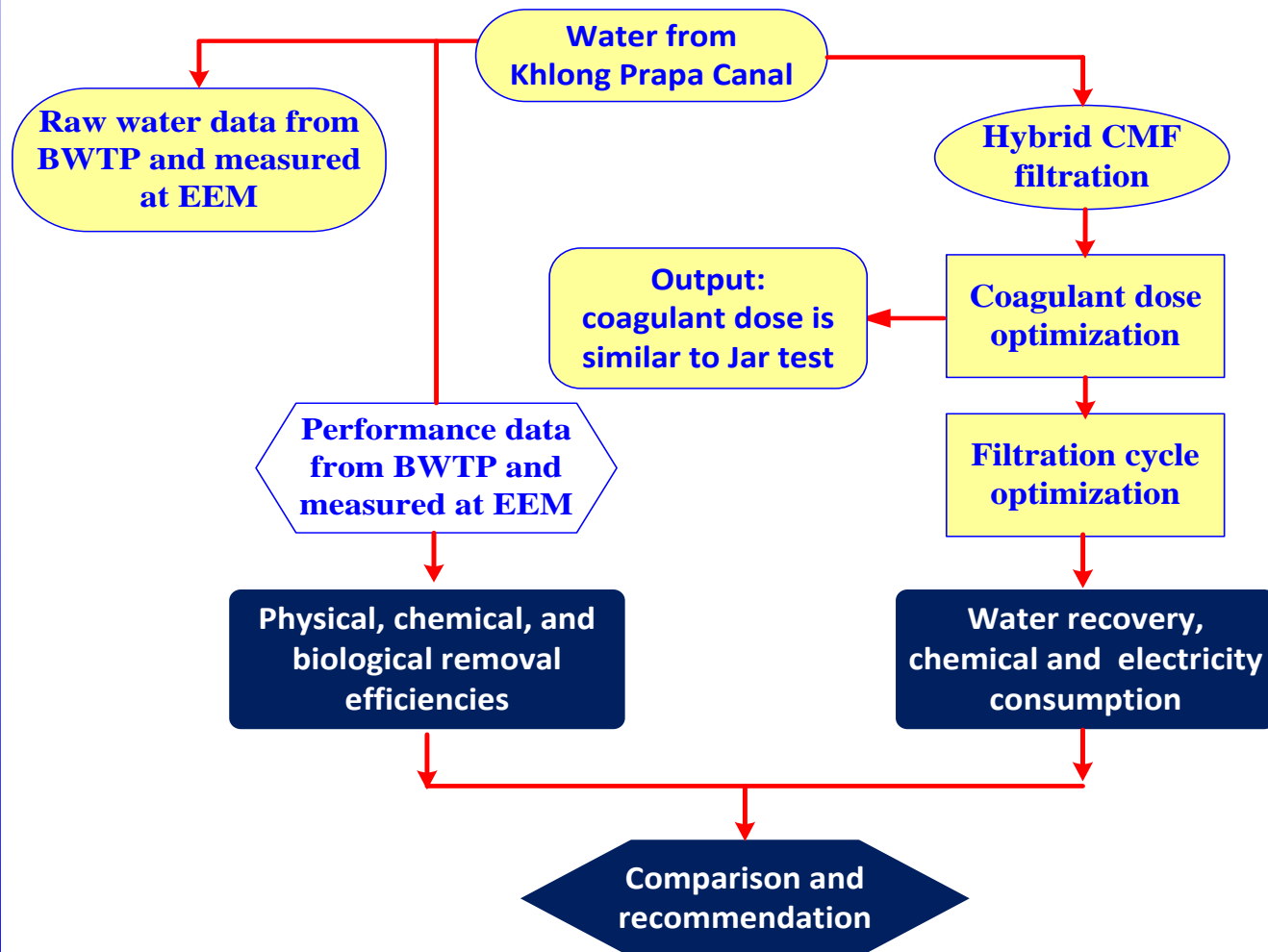


COD Removal Efficiency : 78, 81 & 61 %

Methanogenic Activity was increased continuously

## Research Directions: *Pilot scale hybrid CMF studies*

**Study:** Comparison of the treatment performances of hybrid CMF system and conventional process





## Research Directions: *Pilot scale hybrid CMF studies*



### Observations: *Filtration Cycle optimization*

Filtration cycle (h)	Filtration Duration (h)	TMP (kPa/day)	Max. TMP (kPa)	Ave. turbidity (NTU)	Filtrate Volume (L)
2.0	483.65	1.43	47	29	5,057
2.5	855.20	0.85	41	29	9,000
3.0	1594.97	0.19	29	26	16,859
3.5	488.98	0.79	29	24	5,185



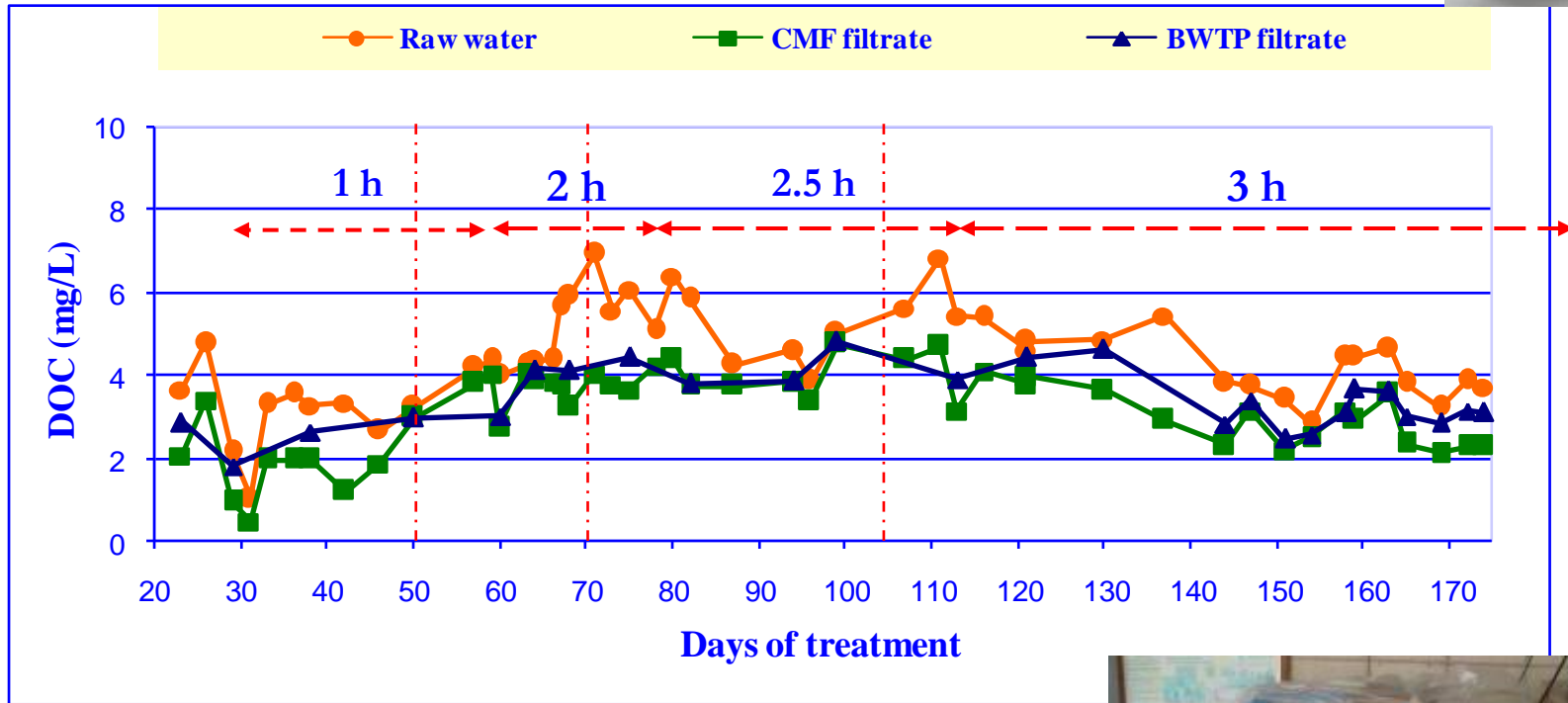
**Optimum filtration cycle is 3 h**

- Highest filtrate production
- Higher water recovery than 2 and 2.5 h, but comparable with 3 h
- Comparable power consumption with 2 and 2.5 h, but very less than 3.5 h

## Research Directions: *Pilot scale hybrid CMF studies*



### Observations: DOC Removal



### DOC Removal:

- 40 % removed by hybrid CMF
- 18 % removed by Bangkok Water Treatment Plant



**Industrial Partners:** *Working with diversified manufactures and system developers around the world*

## Applications and System Developments

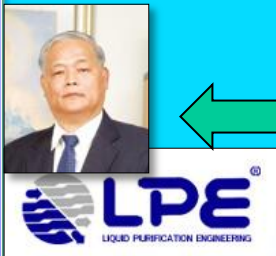


## Membrane Suppliers

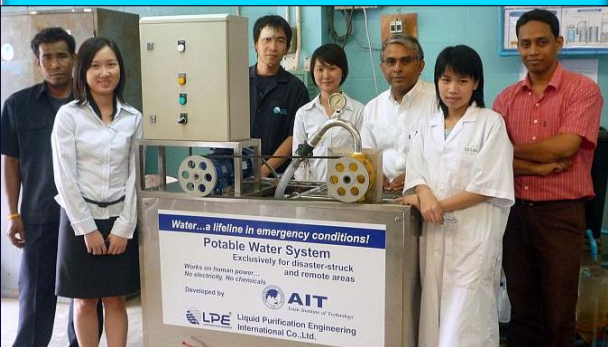


## Industrial Partners: *Different working models*

### Joint works & system developments



Hand pump driven, mobile potable water treatment unit. Exclusively designed for emergency water supply at disasters



### Implement & facilitate for market entry



Ceramic membrane water treatment studies at Bangkok water treatment plant, MWA

### Applications of new technologies



New product "PVA Gel"

New product "SiC membranes"

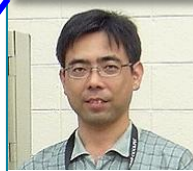
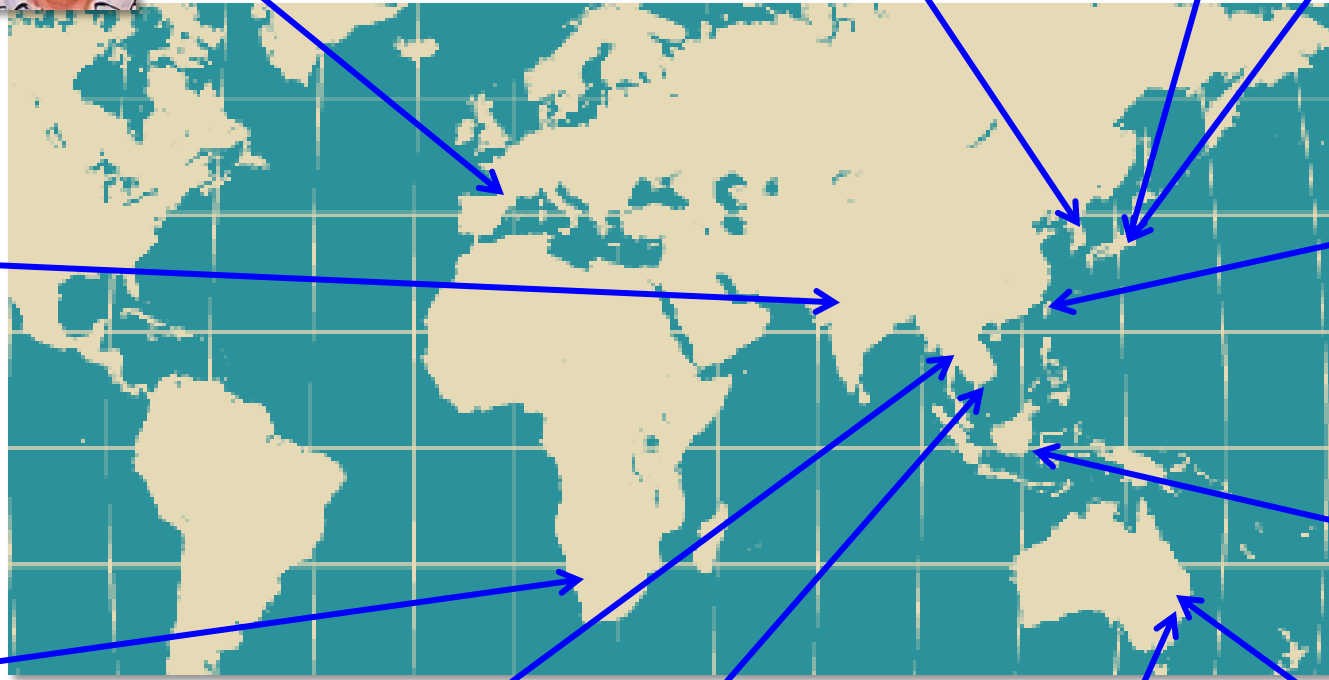
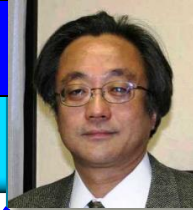


Application in two staged Anaerobic MBR and cross communications on the progress of works



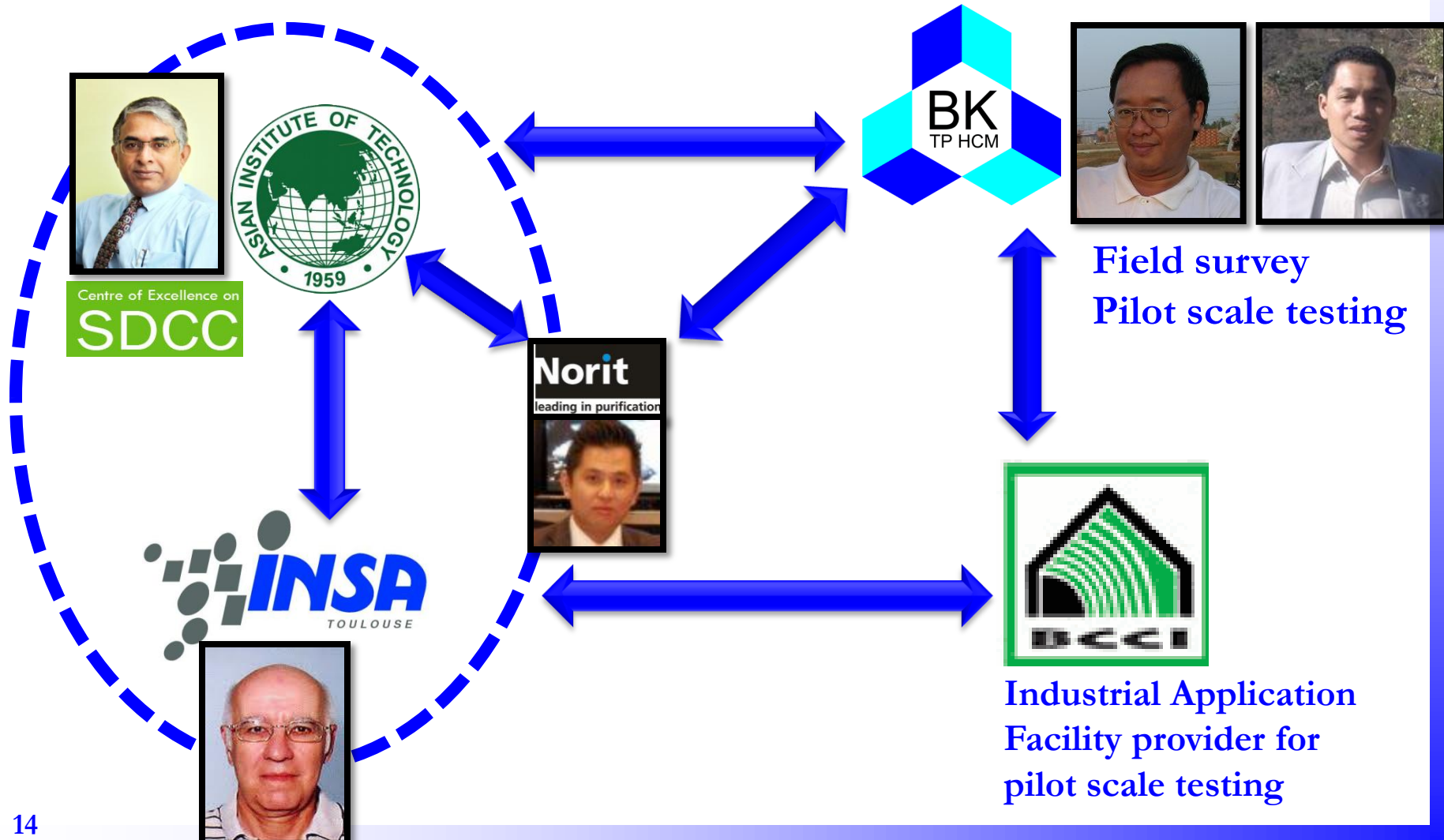
# Membrane Technology

## Research Partners:



## Research Partners: Wastewater Reuse Studies in Vietnam

Research interest has developed into a work plan with research partners and implemented at industrial level, joining with the industrial partners



## Training (12):

*Around the world under different schemes...*



### In Africa:

Presented series of lectures on Membrane Technology at the National Membrane Technology Division Workshop, organized by the Water Institute of South Africa (29 Sep. 1999)



### Gathering attention in the region:

Conducting an international workshop on “Membrane Technology for Wastewater Reclamation and Reuse” organized by at the National University of Science and Technology (NUST), Pakistan (13-14 May 2009)



### Introducing membrane based wastewater reuse technology to HCMC, Vietnam:

Organized national Training program on “Application of Membrane Technology for Water and Wastewater Treatment” in collaboration with HCMC University of Technology (22 Dec. 2010)



# Membrane Technology

Journal Publications (43):

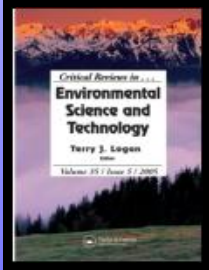
Citations in Refereed Journals: 388

 *h-index: 11*



## Addressing the issues of biology of specific wastewater treatment techniques

A. Abeynayaka and **C. Visvanathan**, “Mesophilic and thermophilic aerobic batch biodegradation, utilization of carbon and nitrogen sources in high-strength wastewater” J. of Bioresource Technology, 102, 2358-2366, 2011



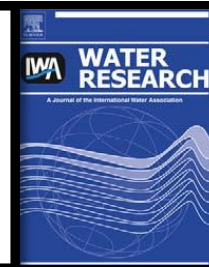
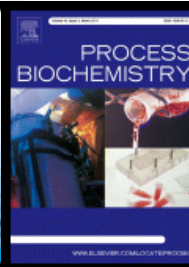
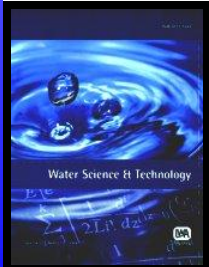
## Top Cited Review papers in the expertise areas (Cited 133 times in refereed Journals)

**C. Visvanathan**, R. Ben Aim and K. Parameshwaran. Membrane Separation Bioreactors for Wastewater Treatment. Critical Reviews in Environmental Science and Technology, 30 (1), 1-48, 2000.



## Exploring novel technological applications of Membrane process

K. Parameshwaran, **C. Visvanathan** and R. Ben Aim. Membrane as Solid/Liquid Separator and Air Diffuser in Bioreactor. Journal of Environmental Engineering, ASCE, 125 (9), 825-834, 1999.



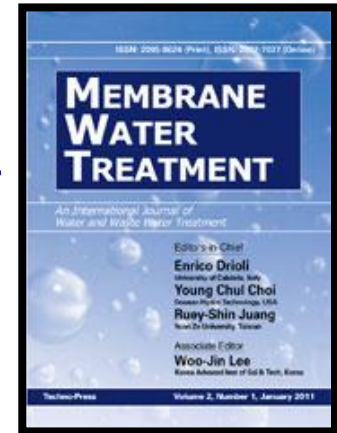


## Member of Journal Editorial Boards:



Editorial Board, *Bioresource Technology*,  
Elsevier Publishers, from Dec. 2007

Editorial Board, *International Journal of  
Membrane Water Treatment*, from Jan. 2010



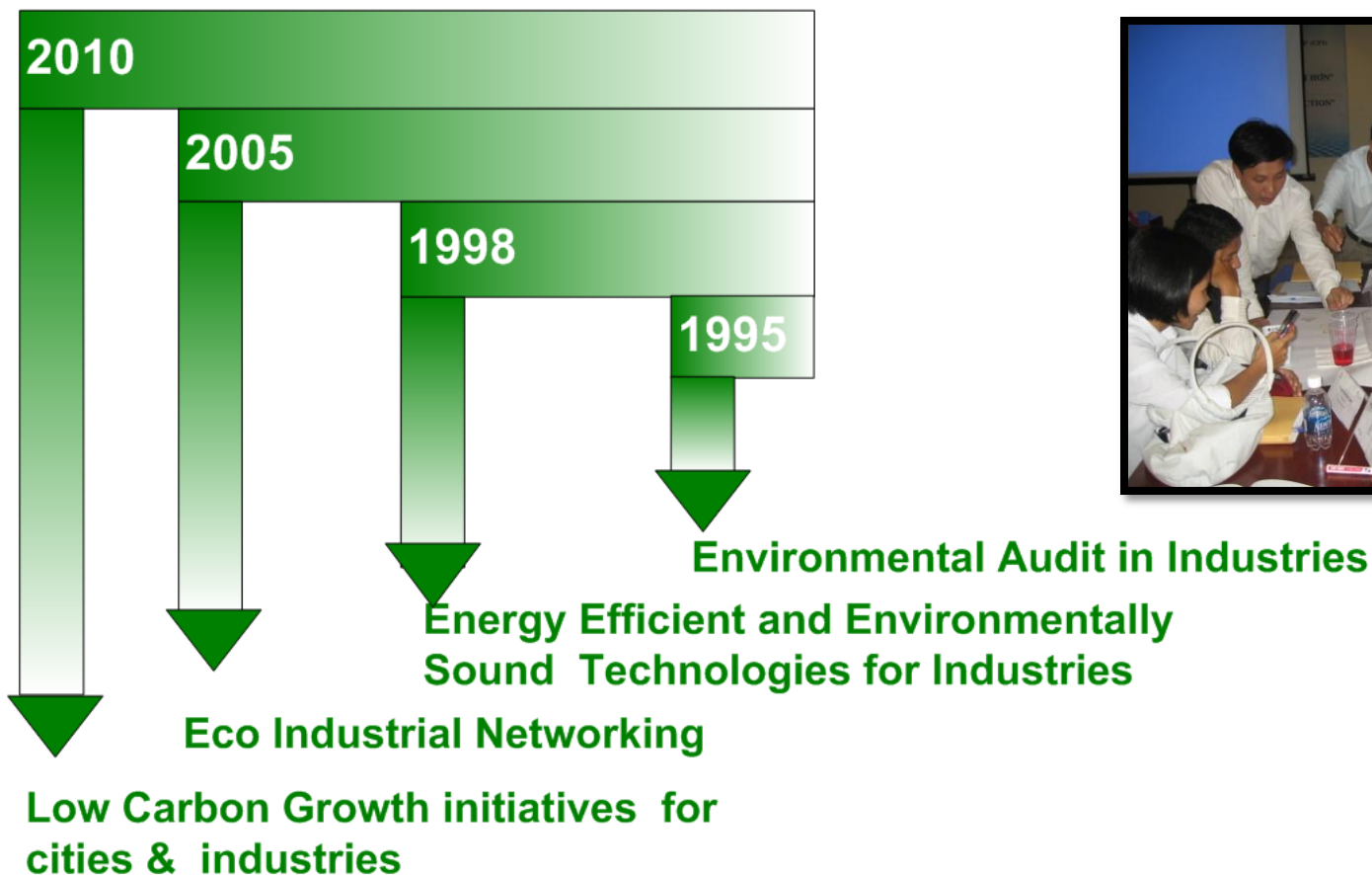
Editorial Board, *Reviews in Environmental  
Science & Bio/Technology*, from Jan. 2009



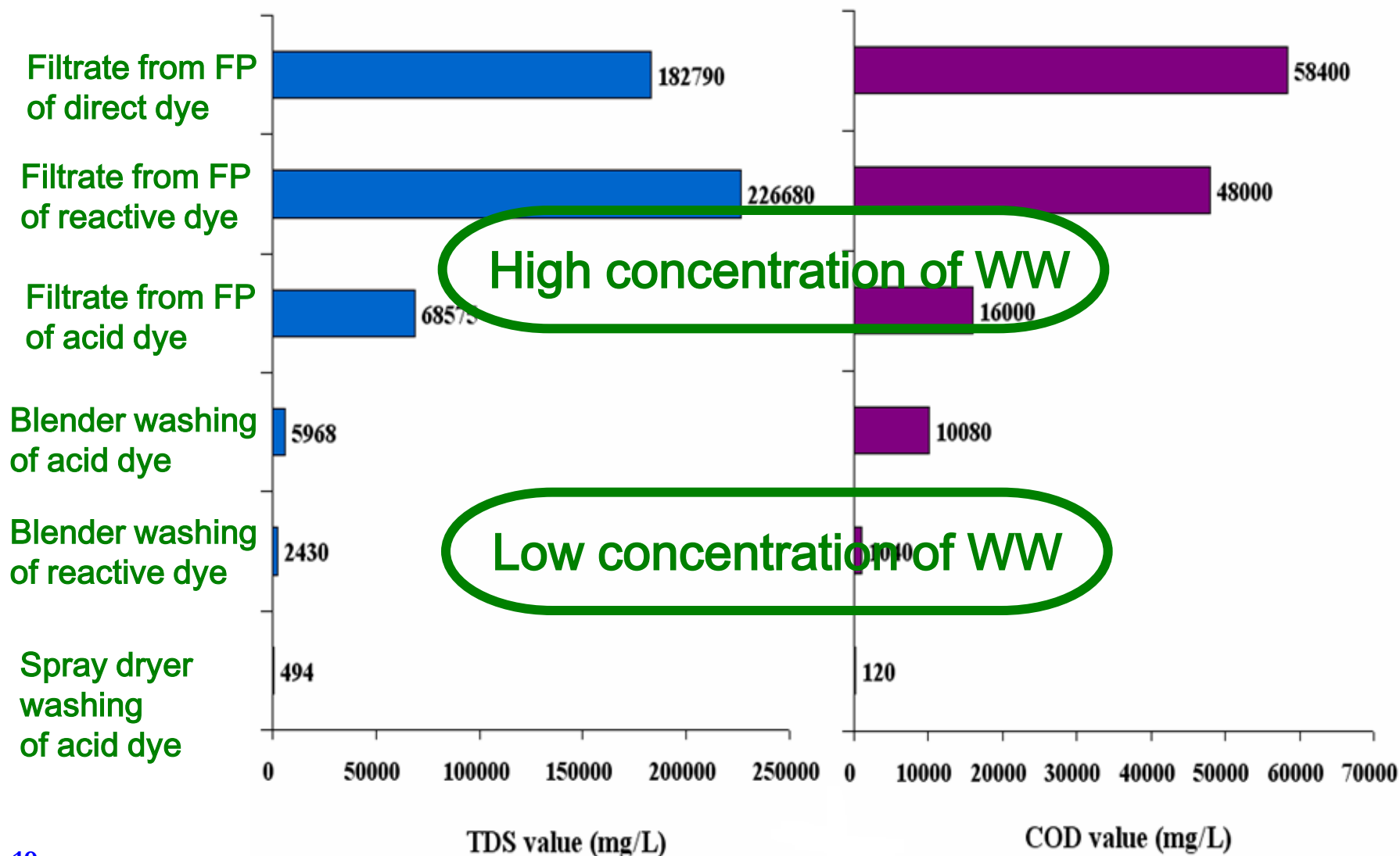
Associate Editor, *Global Journal of Environmental  
Science and Technology*, from Jul. 2010

# Industrial Environmental Management

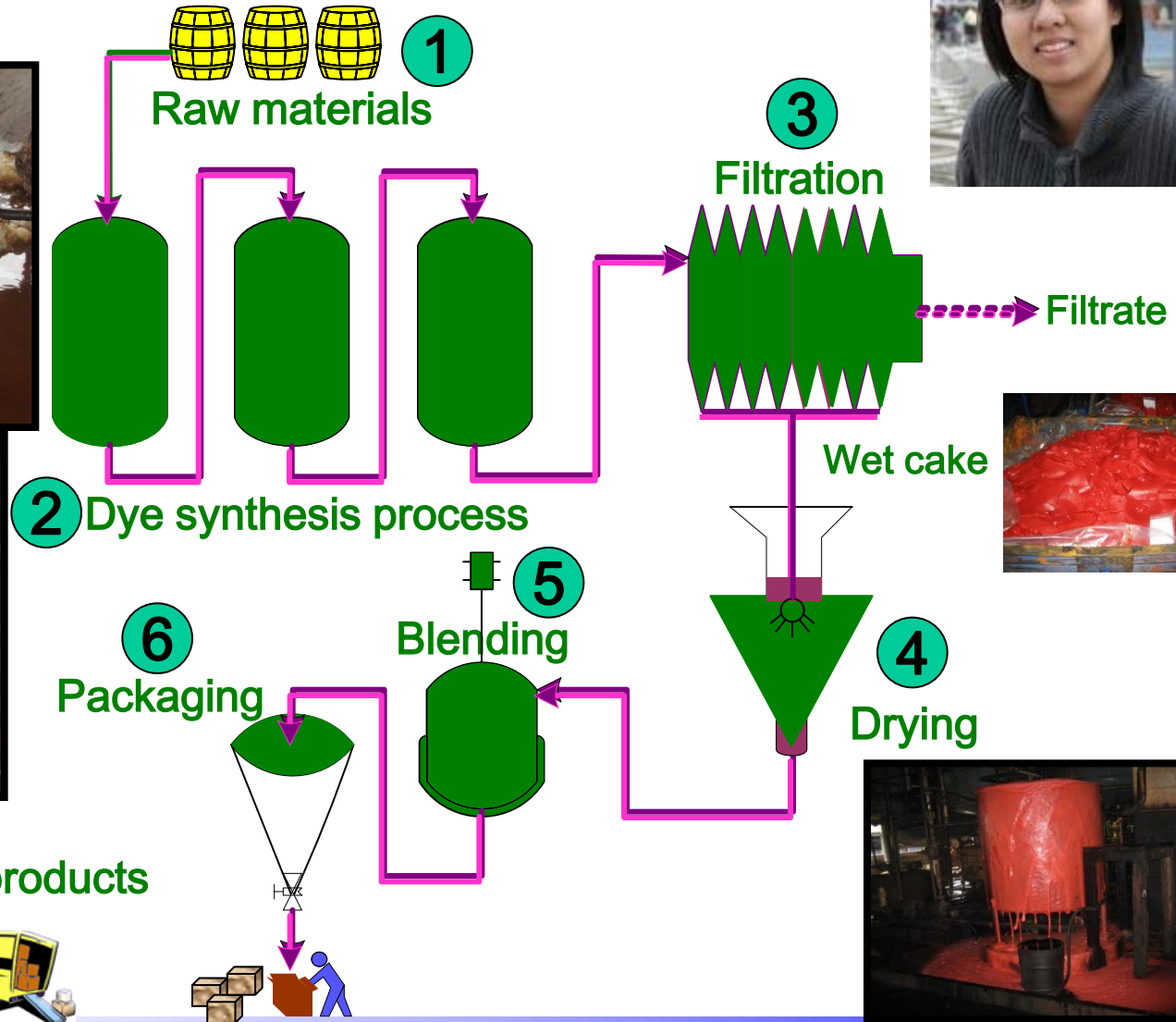
**Research Directions:** *Working with industries to assist their environmental management issues.*



## Research Directions: *Waste management studies in dye manufacturing industries*

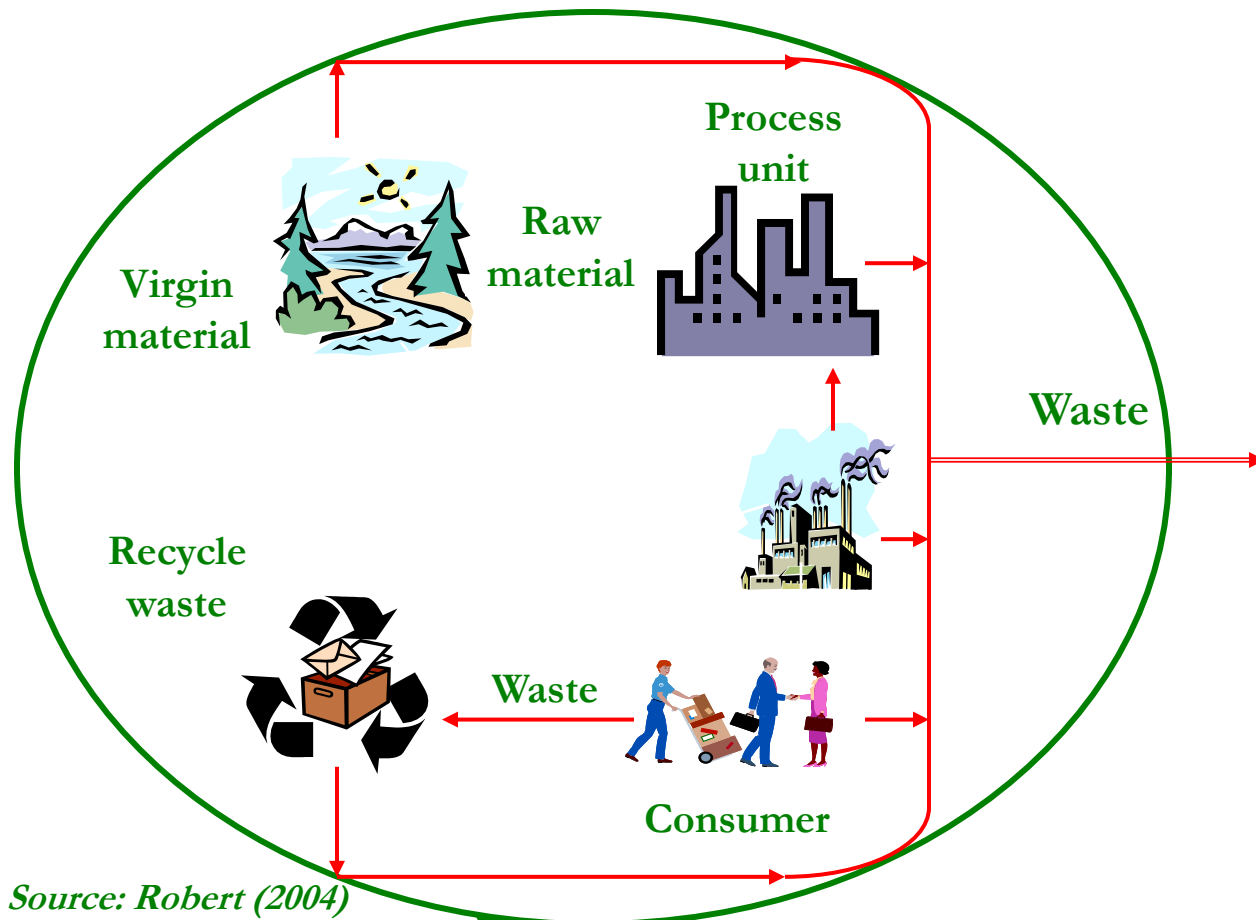


## Research Directions: *Waste management studies in dye manufacturing industries*



# Industrial Environmental Management

## Research Directions: *Environmental and Techno-Policy Analysis of an Agro Eco-Industrial Network in Chachoengsao Province*

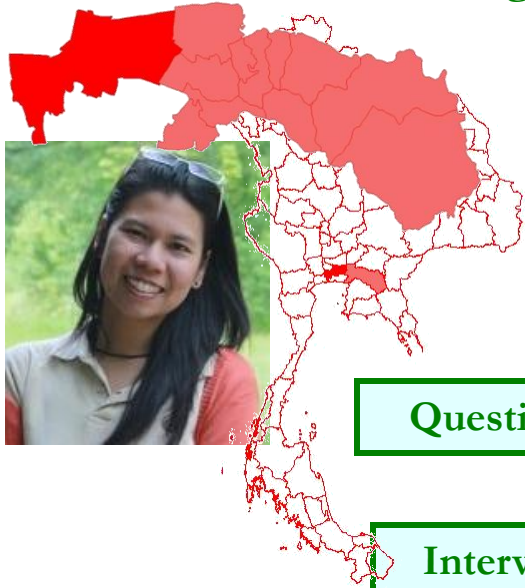


- Novel approach to achieve Sustainable Industry
- New concept to environmental management and innovative business strategy
- Tool for formulating policy, regulations and incentives

- Industries as “Eco-systems”
- Energy flows and material exchanges between industries and natural ecosystems

# Industrial Environmental Management

Research Directions: *Environmental and Techno-Policy Analysis of an Agro Eco-Industrial Network in Chachoengsao Province*



Questionnaire

Interviews

Observation/survey

- Environmental baseline
- Socio-economic information
- Industry lists
- Actors & institutional
- Industrial/Environmental, related policies, standard & indices

Problem Identification/  
Study Objectives

Field Study and Data Collection

Field Study

Secondary Data Sources

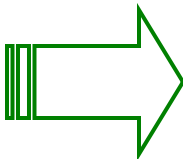
Collected Data

Material Flow Network

Literature Review

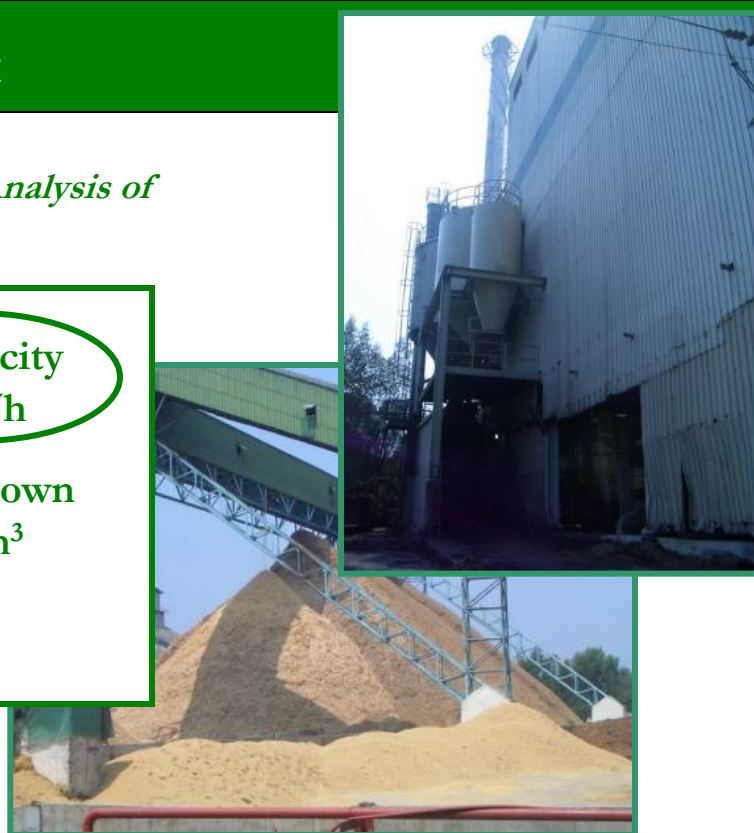
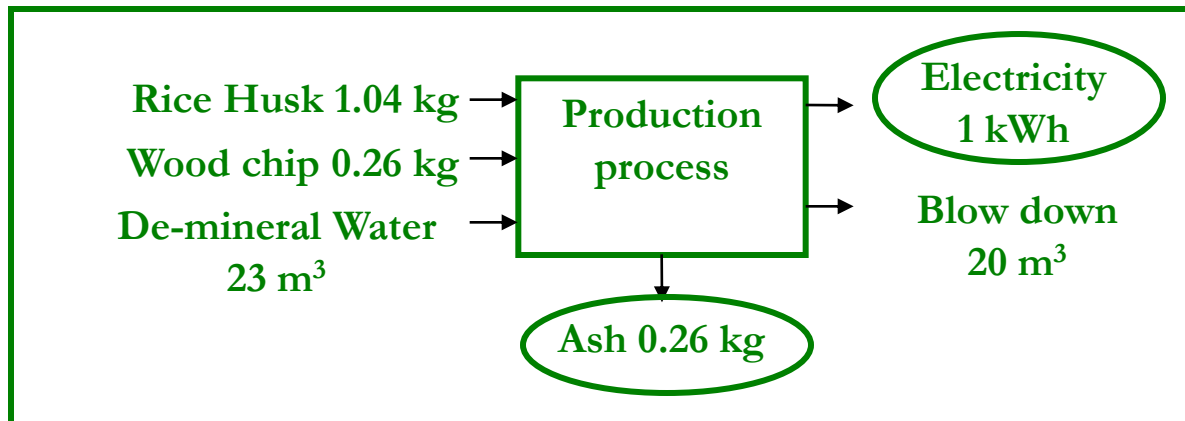
Desk Review & Propose the Sustainable Development Options

Conclusion and Recommendation

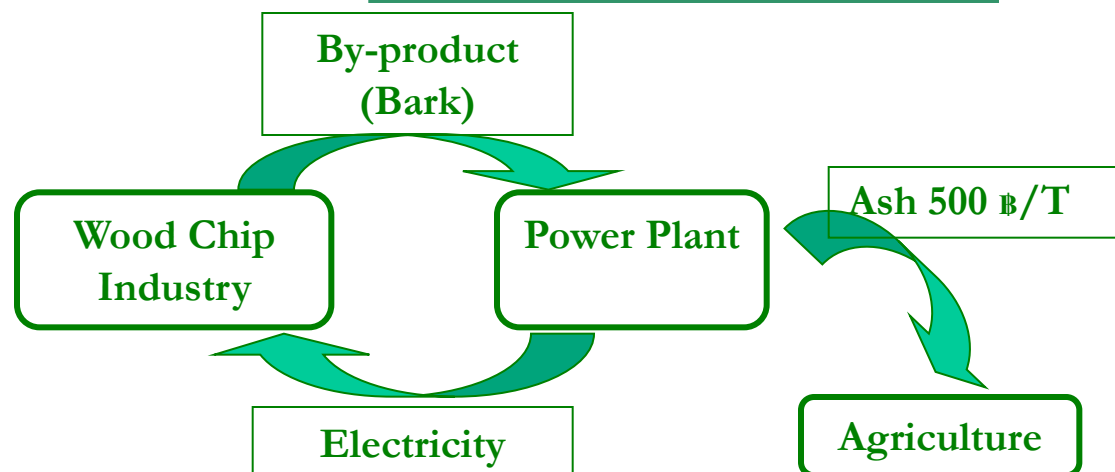


# Industrial Environmental Management

Research Directions: *Environmental and Techno-Policy Analysis of an Agro Eco-Industrial Network in Chachoengsao Province*



- Fluidized Bed Combustion
- Electricity 10.4 MW/d ;
  - Sale to local customers = 1 MW/d
  - EGAT= 8 MW/d
  - In-plant use= 1 MW/d

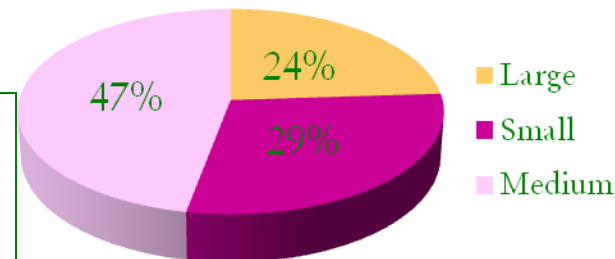


# Industrial Environmental Management

**Research Directions:** *Environmental and Techno-Policy Analysis of an Agro Eco-Industrial Network in Chachoengsao Province*

## Existing waste management

- **Pig Manure;**
  - Solid → Sale to the farmer & composting
  - Wastewater → Directly discharged/ Pond/ Treatment system
- **Existing Wastewater treatment system**
  - Anaerobic filter tank
  - Stabilization pond



Total 320 pig farms



Parameter	Value
Generation rate (L/pig/d)	27
BOD (mg/L)	2,500
COD (mg/L)	6,800
Biogas Production (L/pig/d)	93
Organic fertilizer (kg/d)	0.36



# Industrial Environmental Management

Research Directions: *Environmental and Techno-Policy Analysis of an Agro Eco-Industrial Network in Chachoengsao Province*

Description	Chicken
Total farms	202
Total Number ( x1,000)	5,971
Average body weight (kg)	2
Wet waste (%TLW/d)	6.6
Total Solid (%TWW)	25.3
Biogas Production (m <sup>3</sup> /kg waste)	0.1

Note: TLW = Total life weight, TWW = Total wet weight

## Litter

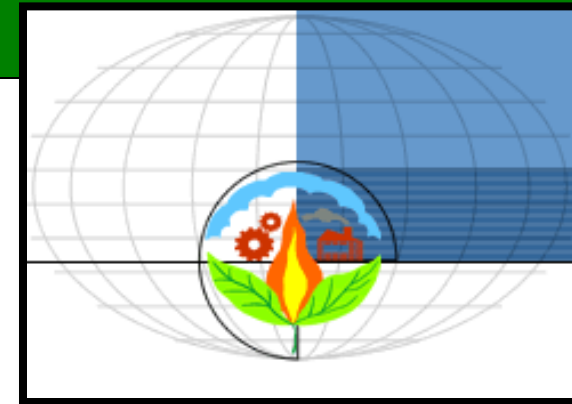
- ✓ Sale for organic fertilizer 1,000 ₪/Ton
- ✓ Chicken cum Fish farm/ sale for fish feed



# Industrial Environmental Management

## Research Directions: Small and Medium Scale Industries (SMIs) in Asia: Energy, Environment and Climate Interrelations

- Five Sector Reports (Tea, DC, Brick, Foundry, and Textile) illustrating production processes, energy use, pollution and E<sup>3</sup>ST options : Benchmarking/References to be published: Peer Review by Sector Experts.
- One cross country Policy Report on SMI with policy options to promote E<sup>3</sup>STs.
- Various Capacity Mobilization and Strengthening programs.
- Identification of E<sup>3</sup>STs: Technology Fact Sheets (39 nos.) prepared for dissemination.
- Regular Newsletter (hardcopy & Website).
- Publications (Journal, Conference, and other articles).
- Road Map CD.
- Newsletters: VI volumes, 22 issues.

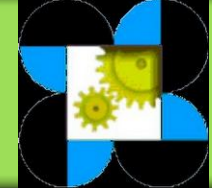
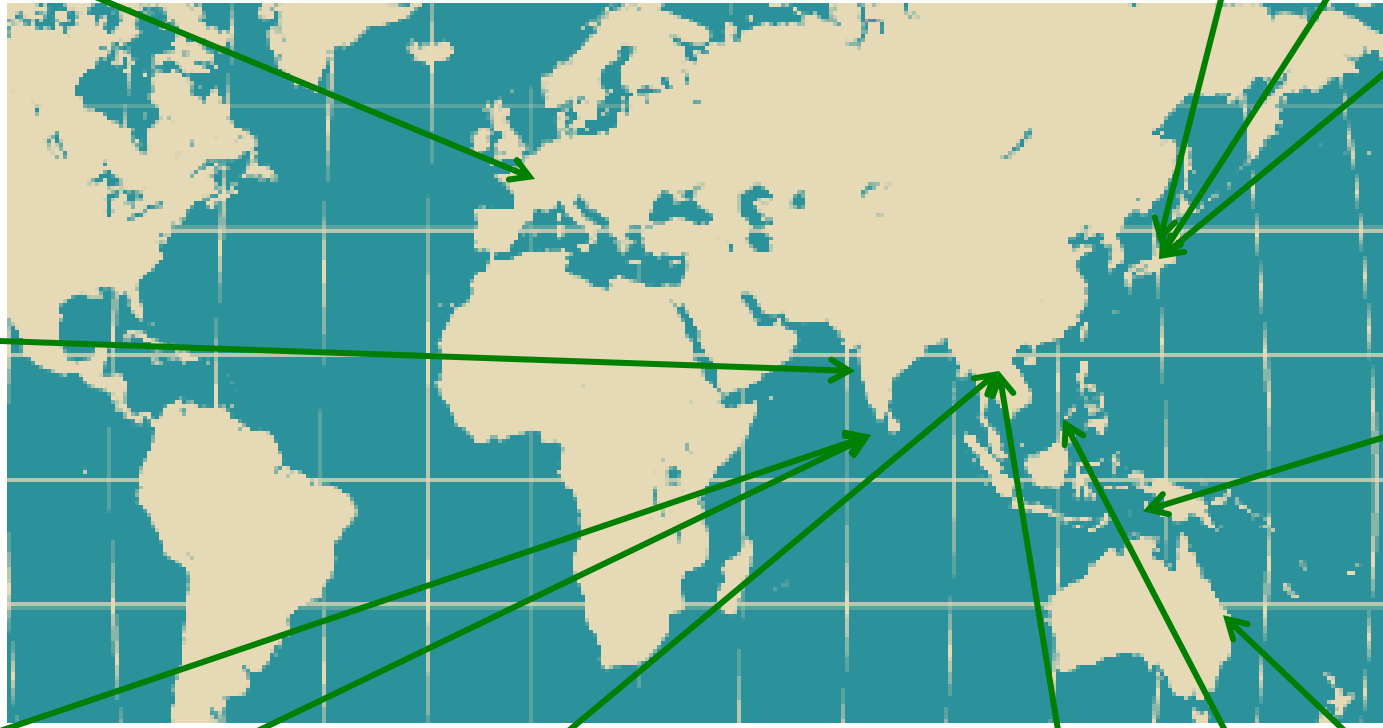


## Industrial Partners: *Leading bodies in the world*





## Research Partners:



C. Visvanathan: Know your Researcher

# Industrial Environmental Management

## Research Directions: Small and Medium Scale Industries (SMIs) in Asia: Energy, Environment and Climate Interrelations



The Center for Environmentally  
Sound Technology Transfer  
(CESTT), China



NEDCEN,  
Vietnam

Coordination



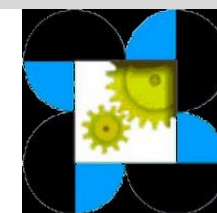
ISB

Industrial  
Services  
Bureau, Sri  
Lanka



PSG College of  
Technology,  
India

Industrial Technology  
Development Institute  
(ITDI),  
Philippines



# Industrial Environmental Management

## Research Directions: Eco-Industrial Clusters in Urban-Rural Fringe Areas



Department of Civil Engineering,  
University of Peradeniya, Sri Lanka



Department of Environmental Science and Engineering,  
Tsinghua University, China

Coordination and  
Compilation



**IGES**



Department of Chemical Engineering  
Institut Teknologi Bandung,  
Indonesia

# Industrial Environmental Management

## Consultancy (13) & Training (22)



Over 10 consultancies and training programs in Cleaner Production as a “Cleaner Production Curricula Expert” for UNIDO in Asia and Africa

UNIDO Consultant to Sri Lanka - National Cleaner Production Centre, to develop a Training Program on Curriculum Development in Cleaner Production for the National Universities, 5-9 June, 2006, Colombo, Sri Lanka

Cleaner Production Expert for UNIDO to compile a report on "Role of Academic Institutions in Industrial Chemical Management: Cases of Asean Nation", December, 2005

Cleaner Production Centre in Ethiopia through UNIDO to assist them to compile a status report on the existing Multilateral Environmental Agreements and their link to Cleaner Production. June, 2004



# Industrial Environmental Management

## Project Case Work Based Training:





# Industrial Environmental Management

Journal Publications (35) :

Citations in Refereed Journals: 132

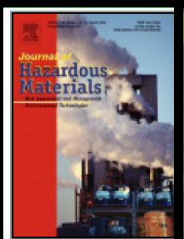
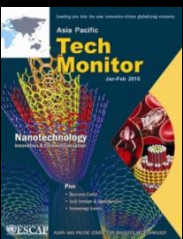
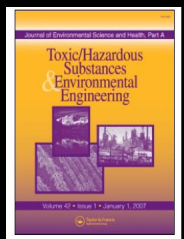
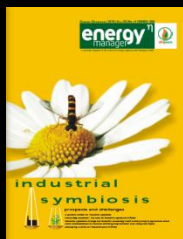
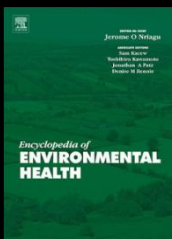
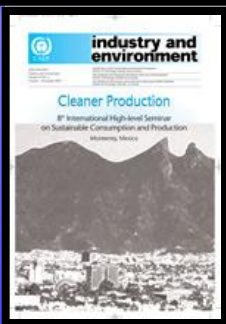
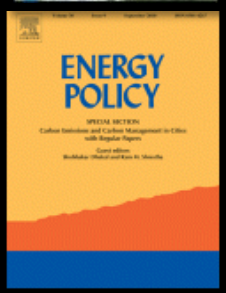
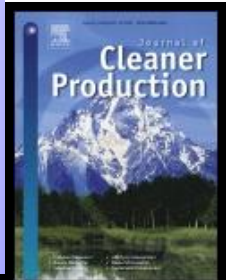
 *h-index: 8*

V. Jegatheesan, J.L. Liow, L. Shu, S.H Kim and C. Visvanathan, “The Need for Global Coordination in Sustainable Development”, *Journal of Cleaner Production*, 17, 637-643, 2009.

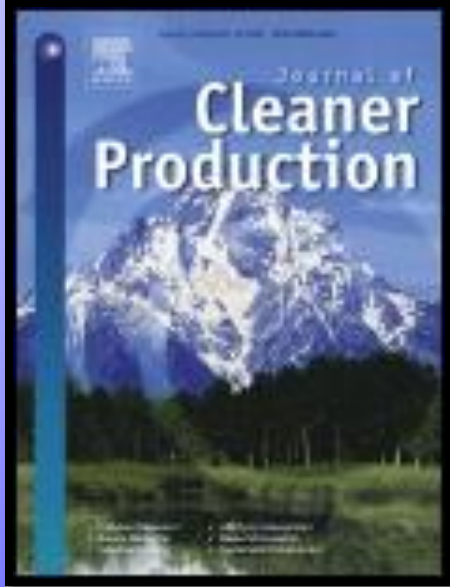
N.T. Van Ha, A. Prem Ananth, C. Visvanathan and V. Anbumozhi, “Techno Policy Aspects and Socio-economic Impacts of Eco-Industrial Networking in the Fishery Sector: Experiences from An Giang Province, Vietnam”, *Journal of Cleaner Production*, 17, 1272-1280, 2009.

M. Thiruchelvam, S. Kumar and C. Visvanathan. Policy Options to Promote Energy Efficient and Environmentally Sound Technologies in Small and Medium Scale Industries. *Energy Policy*, 31, 977-987, 2003.

B. Mohanty, C. Visvanathan and G. Senanayake. Energy Efficient and Environmentally Sound Industrial Technologies in Asia: Part I – Assessment of the Economic Viability of Technological Options. *UNEP Industry and Environment*, 21 (1&2), 70-73, 1998.



## Member of Journal Editorial Boards:

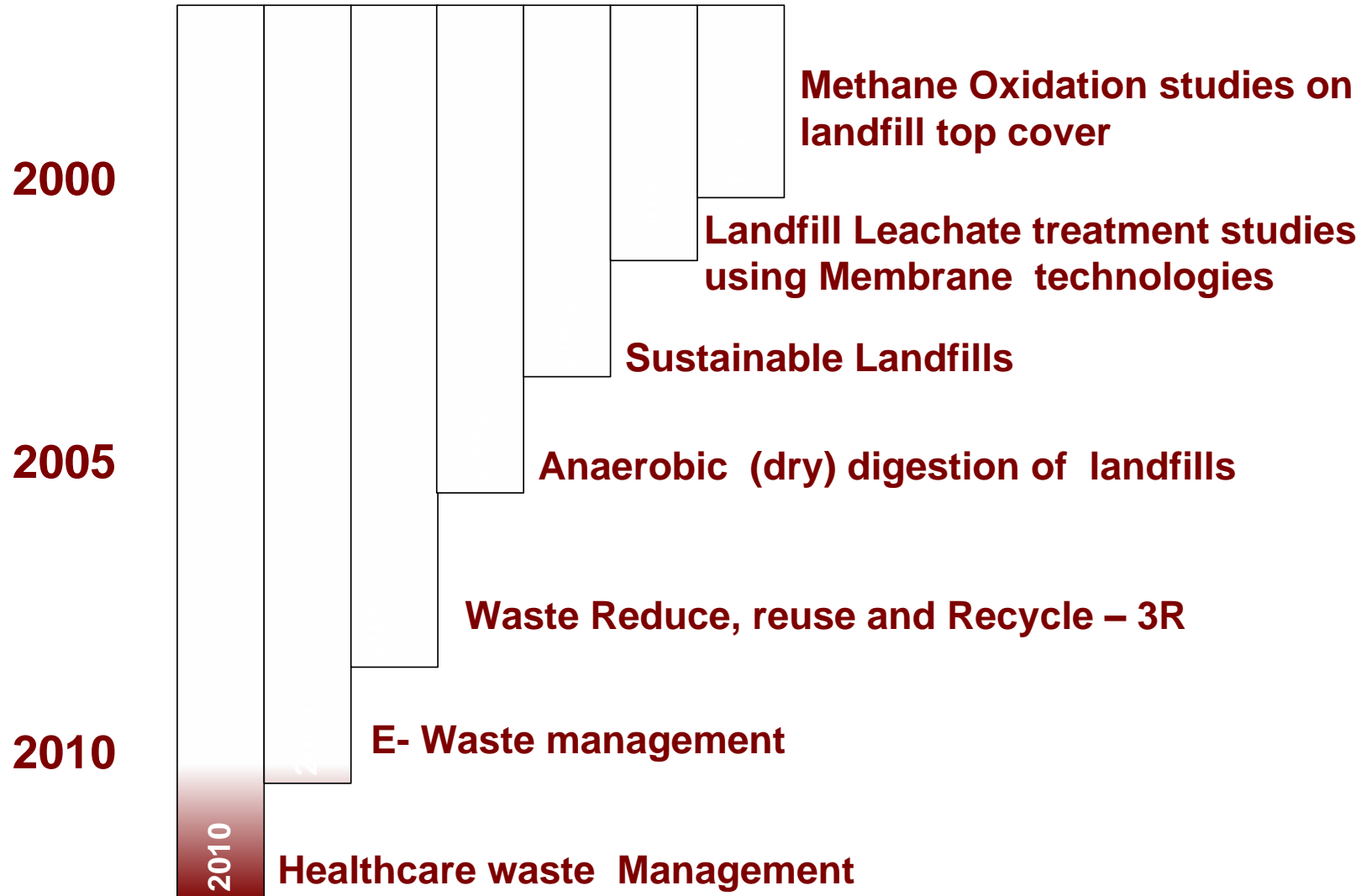


**Invited Guest Editor for Volume: 17, Issue 7, Journal of Cleaner Production, Theme: Present and Anticipated Demands for natural Resources: Scientific, Technological, Political, Economic and Ethical Approaches for Sustainable Management. With: Dr. V. Jegatheesan., 2009**

**Technical Advisor for the Trade Journal ET4Thai (Environmental Technologies for Thai Industries) , (ISBN: 1686-4166), from 2008**

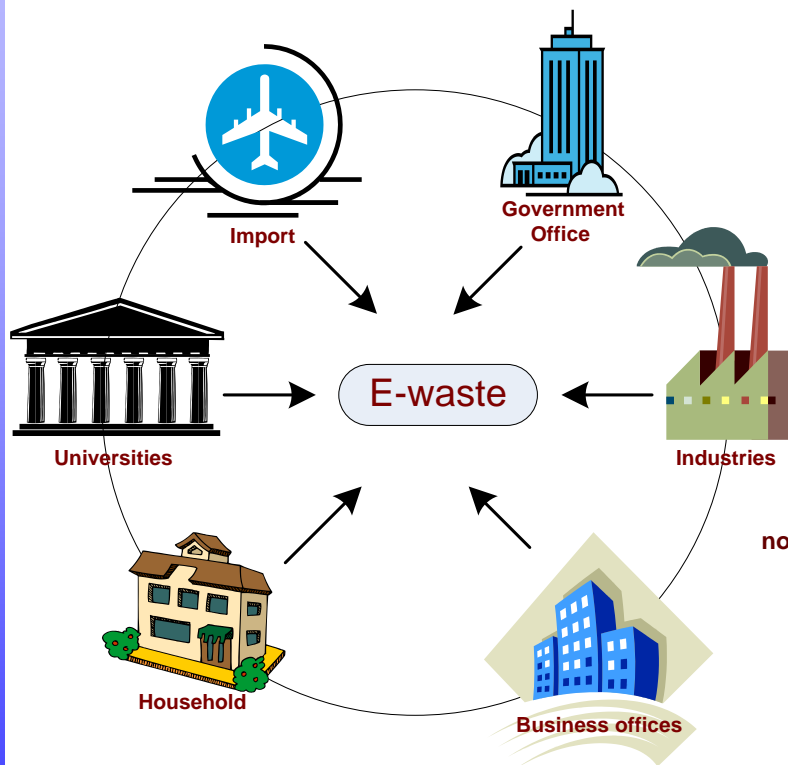
**Technical Advisor, Scientific Editor of Energy & Environment News Letter - AIT, from 2008**

## Research Directions: *Dealing with Regional Waste Issues*



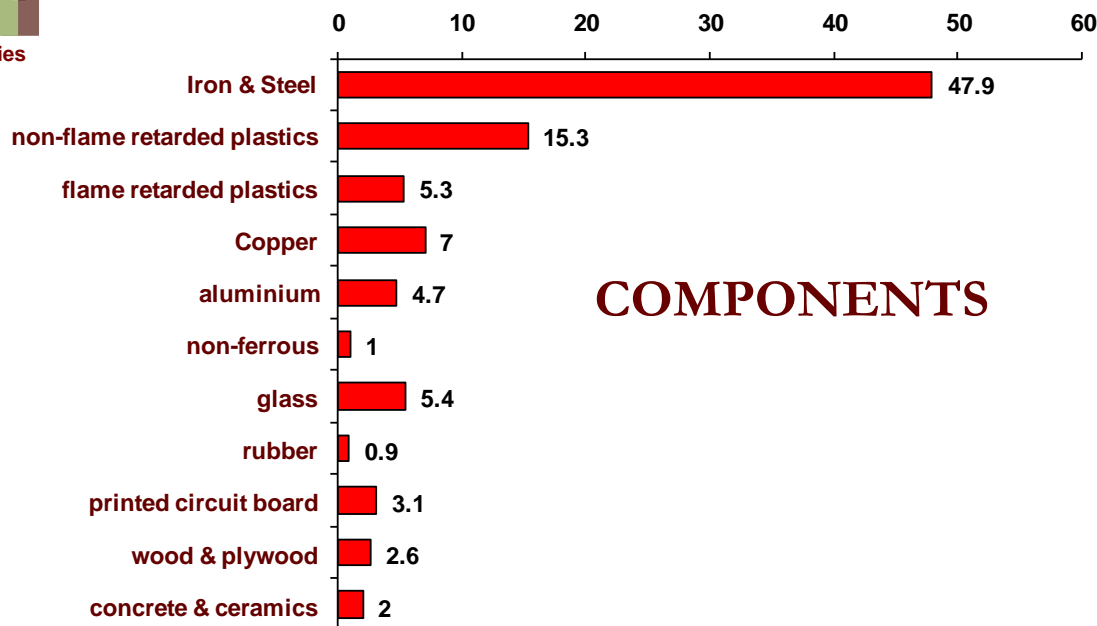
## Research Directions: *Lysimeter Study on Co-disposal of E-waste with municipal solid waste*

### Sources and Components of E-Waste



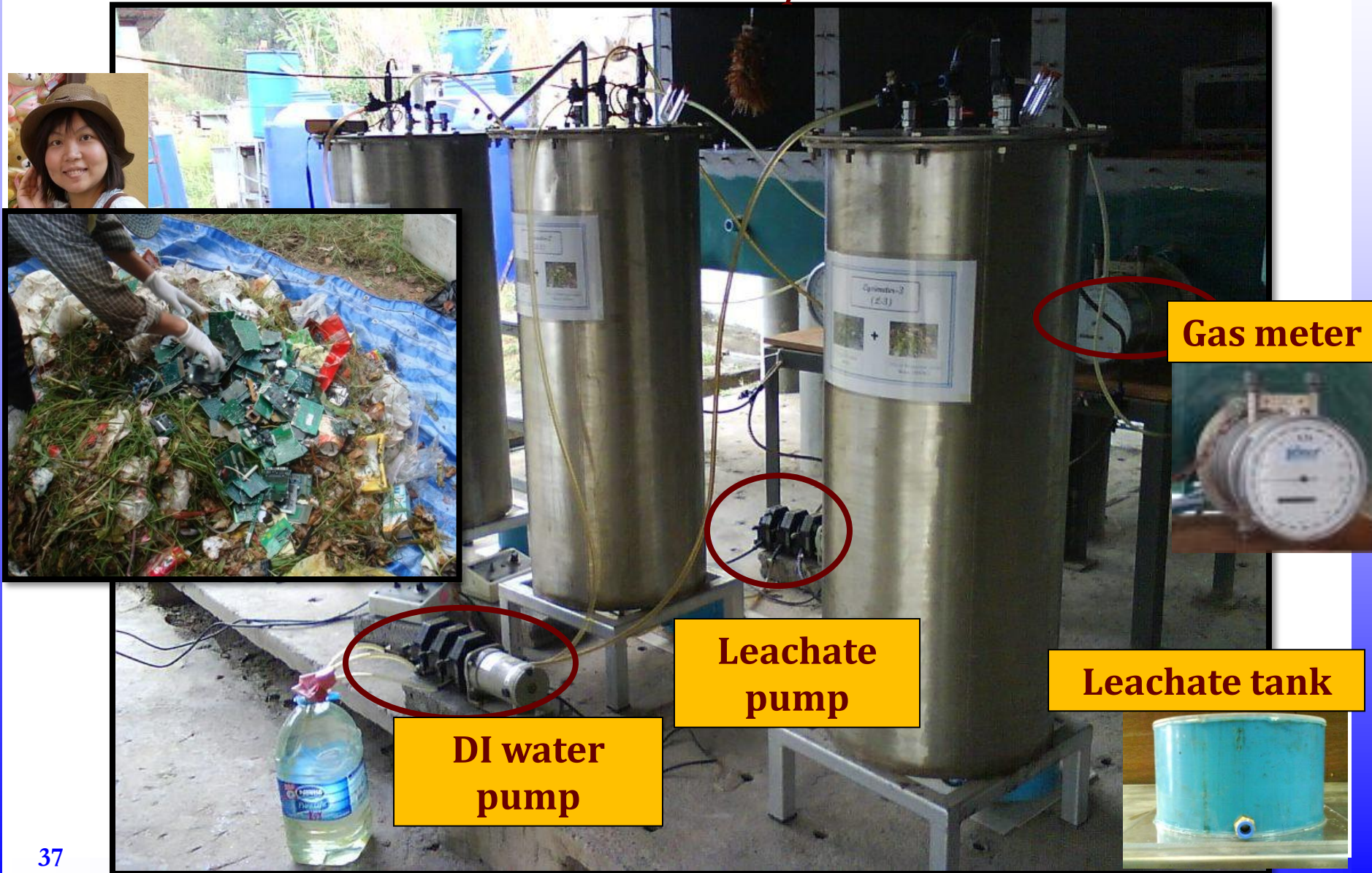
**Business centers, Universities, Government institutes and Industries are the major E-Waste generating sources**

**Iron and Steel are the major component in E-waste**



# Solid Waste Management

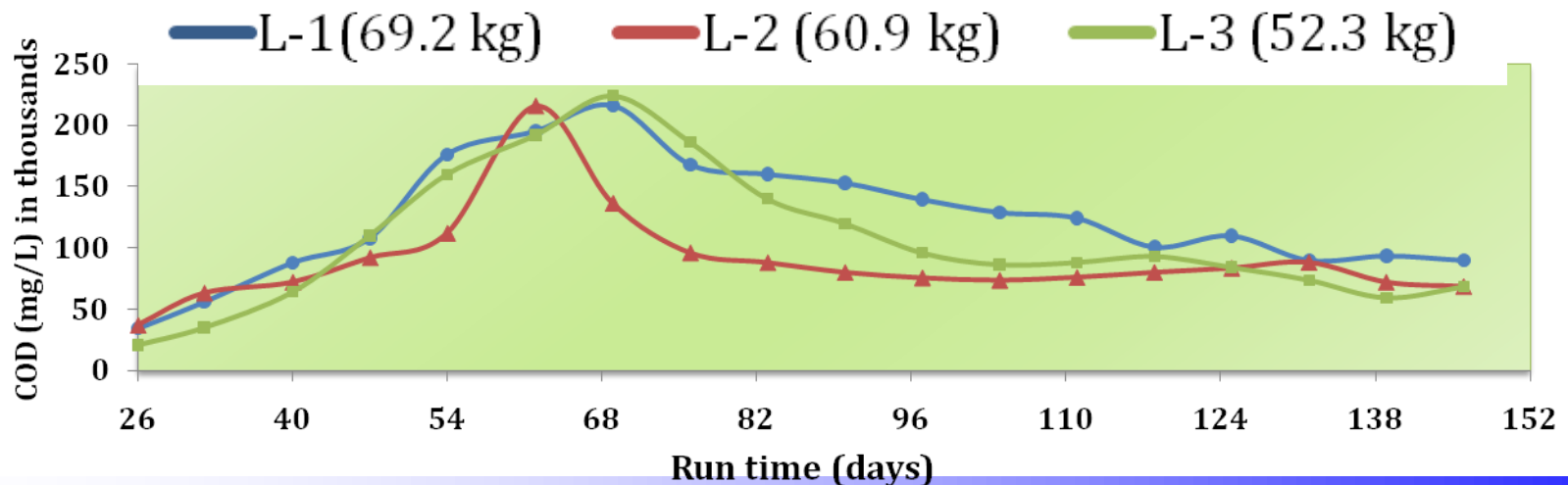
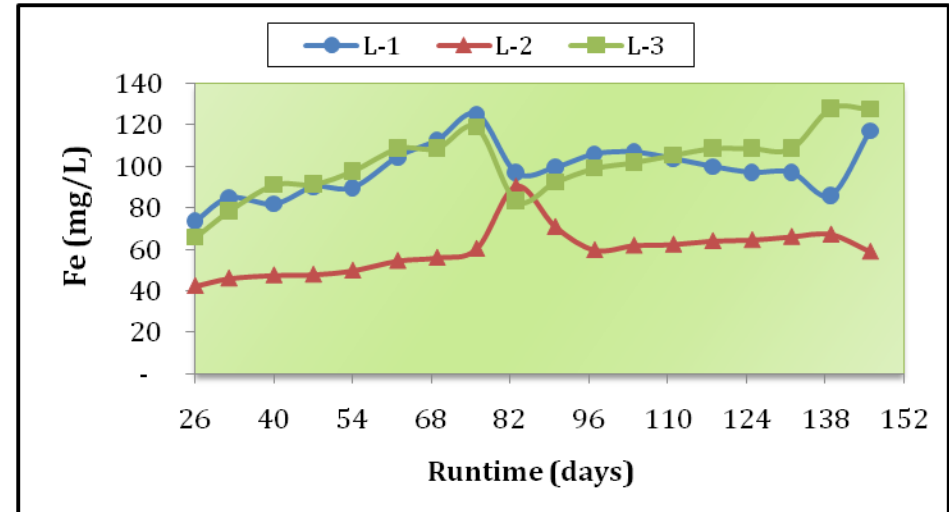
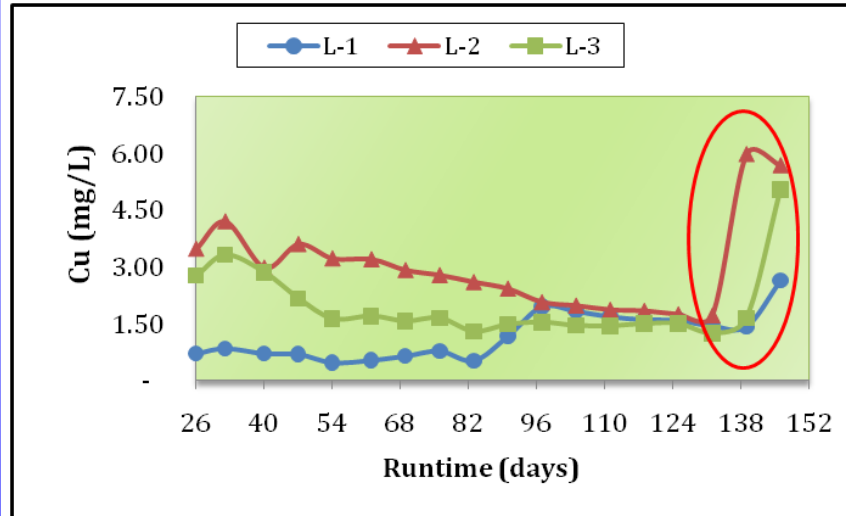
## Research Directions: *Lysimeter Study on Co-disposal of E-waste with municipal solid waste*



# Solid Waste Management

## Research Directions: *Lysimeter Study on Co-disposal of E-waste with municipal solid waste*

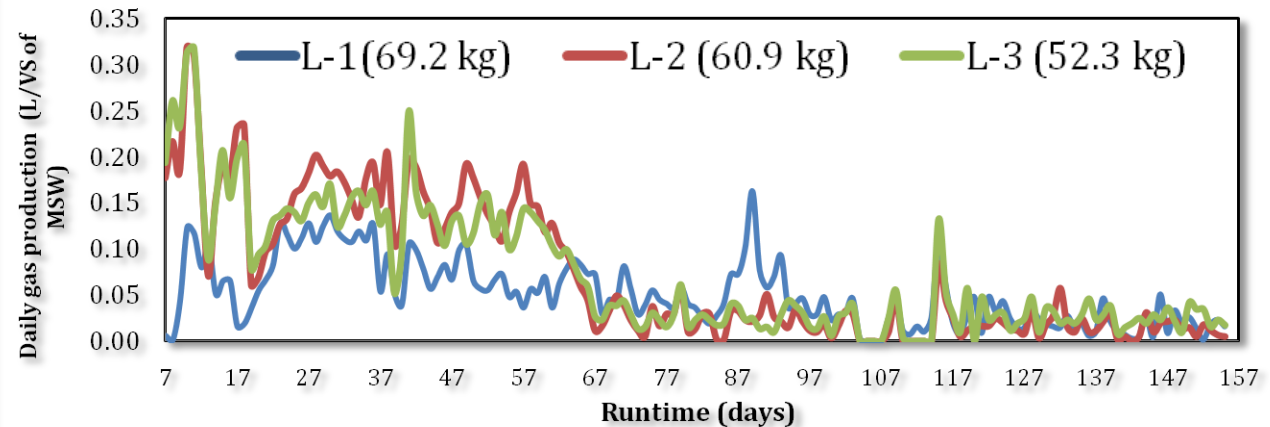
Observations : *Heavy metal and organic leaching*



# Solid Waste Management

## Research Directions: *Lysimeter Study on Co-disposal of E-waste with municipal solid waste*

Observations : *Heavy metal and organic leaching*



Heavy metal leaching is not a problem as % of leached out in leachate is low

Retaining of heavy metal is high

Leachate recirculation is useful in retaining heavy metals with the waste

Anaerobic conditions beneficial on sulphide precipitation of heavy metals

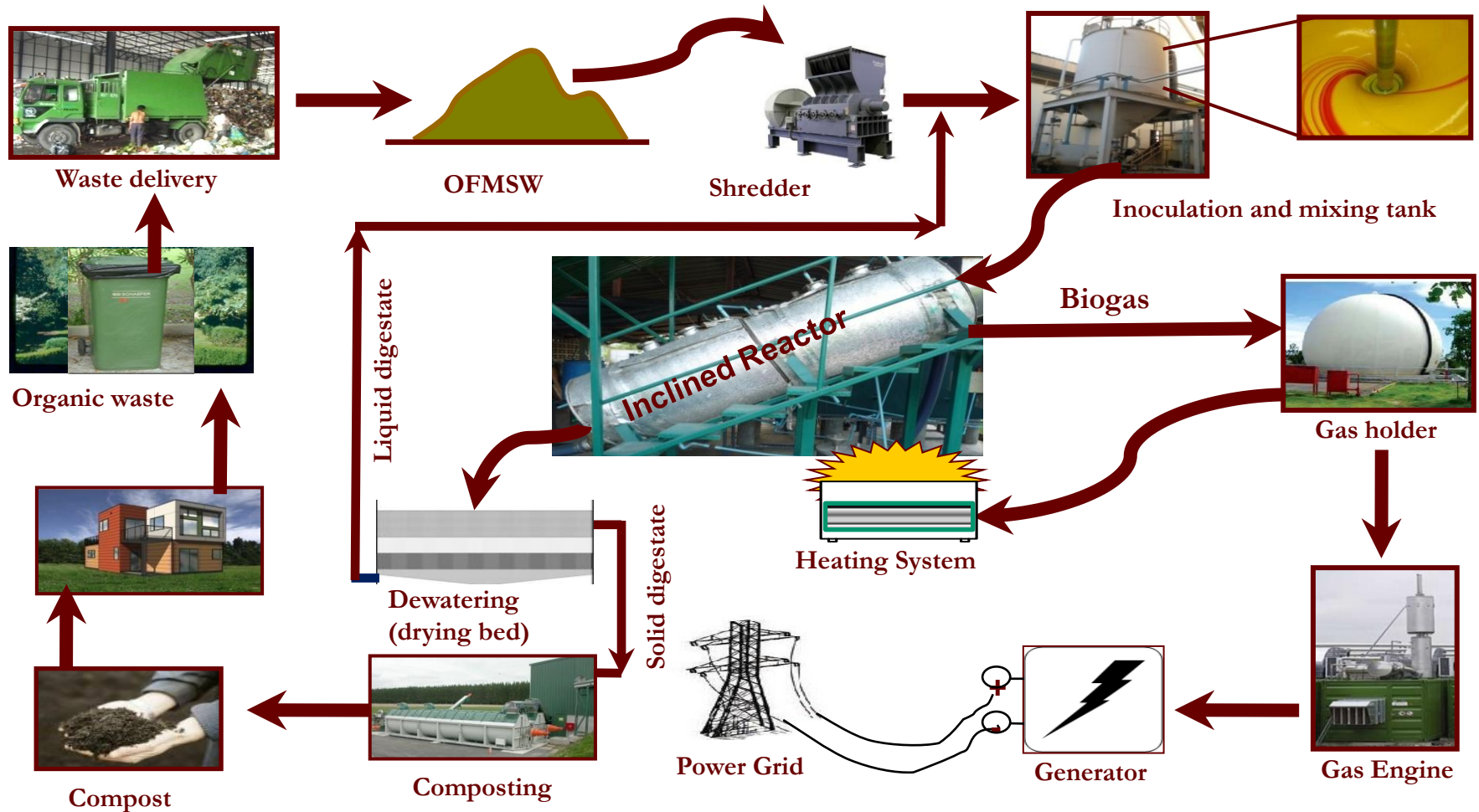
Pb has the highest adsorption capacity

Species or chemical forms of heavy metals should be studied as mobility and toxicity depends on different chemical forms.

Different precipitations mechanisms of heavy metals (sulphide forms, reduction, hydroxide forms, etc.) can be studied further.

# Solid Waste Management

## Research Directions: *Decentralized Integrated Anaerobic-Aerobic Treatment of OFMSW*





# Solid Waste Management

*Pilot unit operated at the research station, AIT*



# Solid Waste Management

## *Dry anaerobic digestion at 55 °C under different organic loading rates*

### Phase I

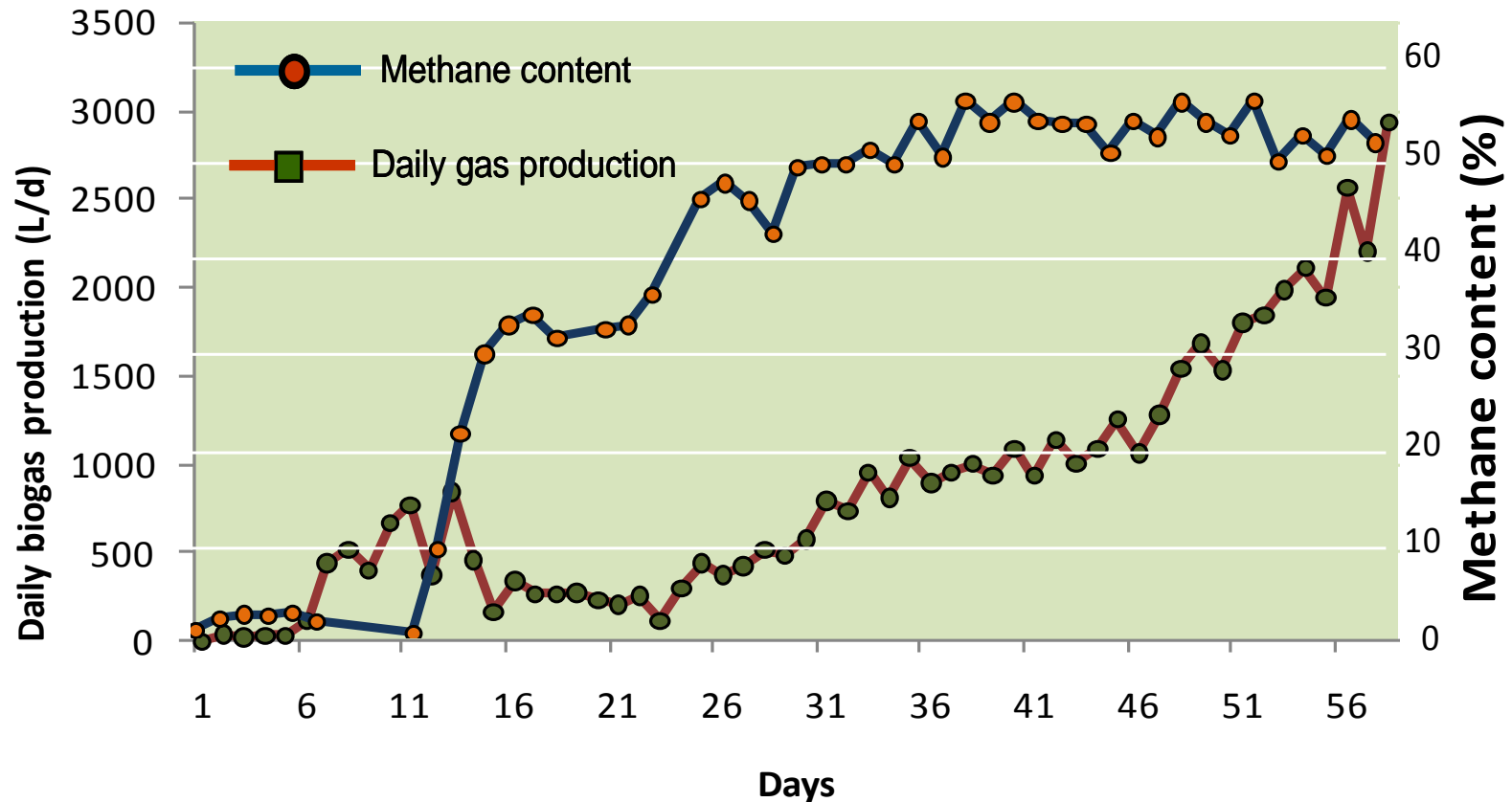
Process optimization under various organic loading rate of MSW in Inclined Thermophilic Reactor

### Phase II

Management of Digestate from Dry AD by dewatering and aerobic composting. Optimization of conditions for end use

### Phase III

Estimation of theoretical and practical GHG emissions under optimized conditions with integrating Dry AD with composting.



## **Research Directions:** Sustainable Solid Waste landfill Management in Asia

**Project Mission:** *Enhancement of solid waste disposal practices and landfill technology for efficient solid waste landfill management in the Asian region*

**Research Objectives:** *Identification and development of sustainable, environmentally sound and cost effective solid waste treatment and disposal technologies*

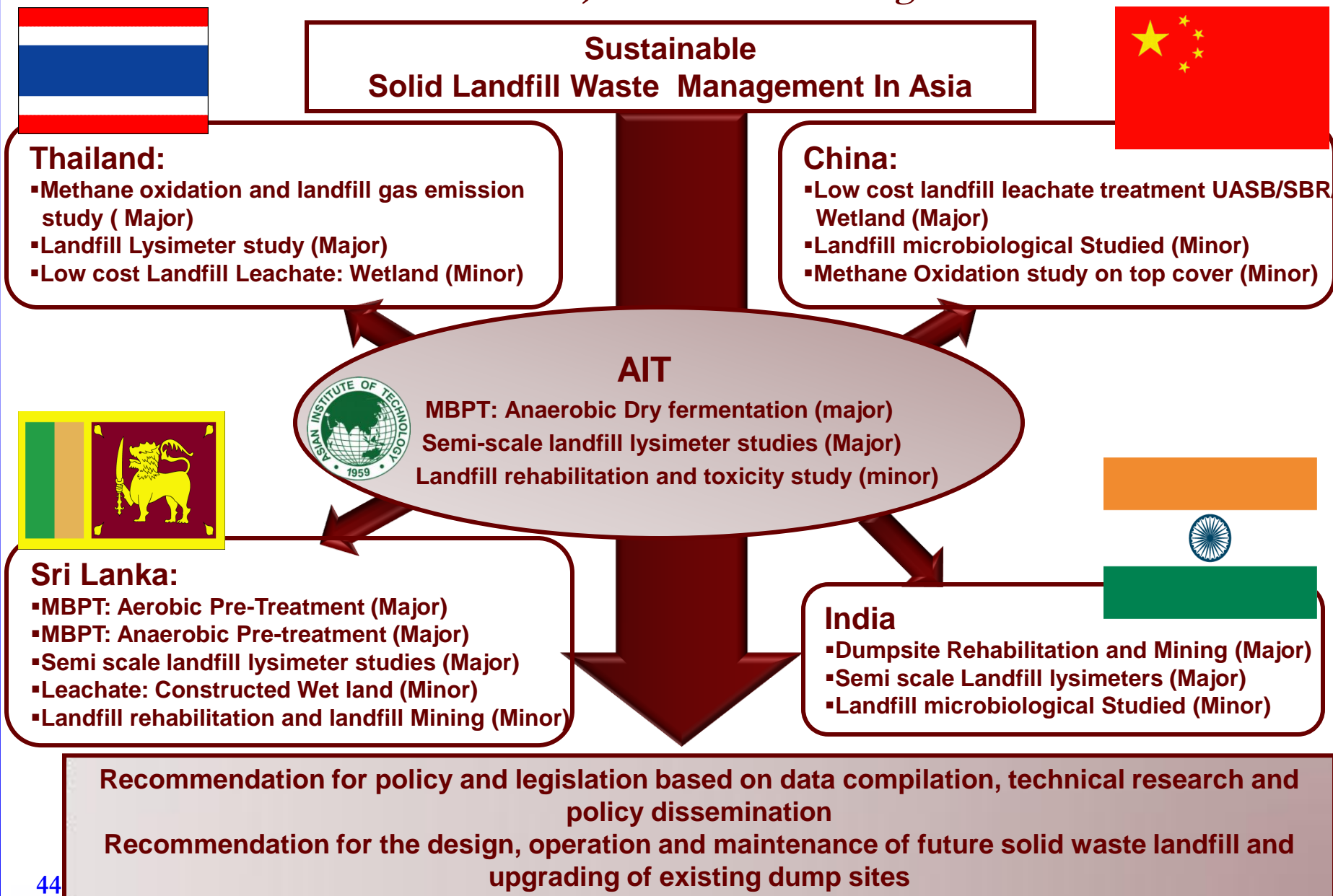
**Technology Aspects:** *Compilation of existing practices of solid waste management and basic information about solid waste organization (case Studies), preparation of training materials, lecture notes, workshop and training programs, workshops and policy dissemination*

**Policy and Institutional Aspects:** *Identification of gaps and recommendation in policy and legislation based on data compilation, technical research and policy dissemination.*



# Solid Waste Management

## Research Directions: *Project Network among NRIs and AIT*



## Research Directions: 3RKH Spin-off Projects

### AIT

#### China



- Shanghai Chengtong Corporation (PCB recycling)
- RDF production (cooperating with Zhejiang and Tianjing University)



#### 3R (Knowledge Hub)

Three major objectives/ functions:

- ✓ To create, collect and capture 3R knowledge;
- ✓ To share and enrich 3R knowledge; and
- ✓ To disseminate 3R knowledge for the benefit of DMC & research networks in the region



#### EU – Asia Pro Eco II Programme

Shortly named as 'WasteSafe-II' (Period 2006 -2009)  
Research Partner

1. AIT - Thailand
2. Bauhaus University Weimar - Germany
3. Lublin University of Technology – Poland
4. KUET, Bangladesh (Applicant)

AIT- Related activities: (Due to success of Sida Solid waste lysimeter studies)

#### Blackwood Ventures (Thailand) Co. Ltd

- Technical support to. for the characterization (determine suitability of MSW for co-processing in Cement Kilns) from various dumpsites in Thailand

#### Southeast Asia Urban Environmental Management Application project

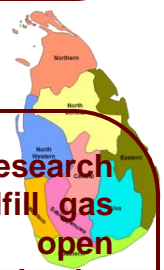
- Dumpsite rehabilitation & resources recovery from mined waste at Nonthaburi dumpsite, Thailand

#### India



- (GTZ) project proposal to EU focusing on “Network on Waste Technologies Adapted for Asia”.

#### Sri Lanka



- A collaborative research to quantify landfill gas emissions from open dumpsites in Colombo District with University of Sri Jayawardanapura, Sri Lanka; Calgary University, Canada.
- Kandy municipality has contracted the research team to rehabilitate the dumpsite & establish a sustainable disposal facility

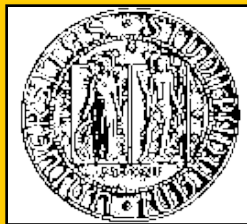
#### Thailand



- Leachate treatment system for Nonthaburi provincial administrative organization
- Odor pollution at On-nuch solid waste transfer station, BMA
- Bioreactor landfill cell construction in Leanchagang municipality

### Private Sector Interactions

## Industrial and Research Partners:

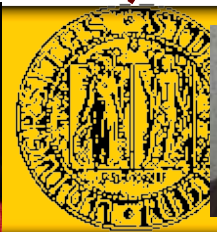


# Solid Waste Management

## Research Partners:



UNIVERSITY  
of HAWAII®



# Solid Waste Management

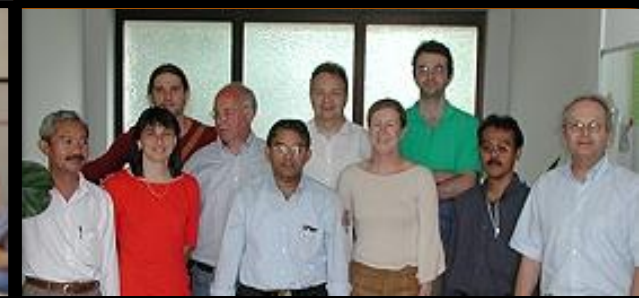
## Consultancy (7) & Training (14):

### *Consultancies and training programs in the region*

Treatment and Disposal of Mercury Contaminated Waste, TOTAL Exploration Thailand Ltd. (January 1997 - September 1997)

International Senior Training Consultant – Solid Waste Management - UN- HABITAT - for Banda Ache and North Sumatra, Indonesia, 3 weeks in July, 2010

Course Director, Toxic and Hazardous Waste Management, Continuing Education Center- AIT, Bangkok, Thailand (19 April - 14 May 1993).



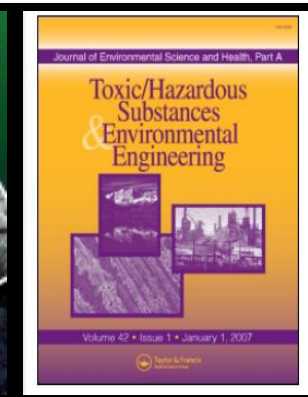
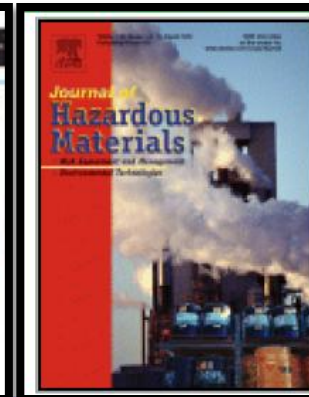


# Solid Waste Management

Journal Publications (42) :

Citations in Refereed Journals: 184

 *h-index: 10*

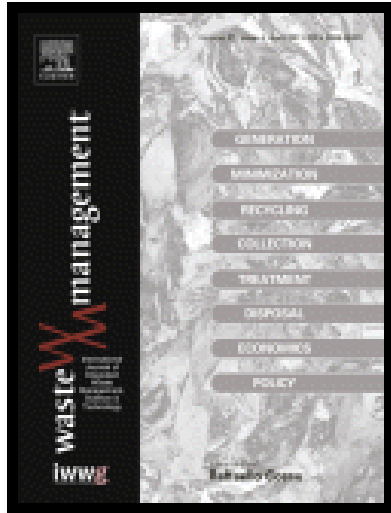


C. Visvanathan, O.P. Karthikeyan and K.H. Park, “Sustainable landfilling in tropical conditions: Comparison between open and closed cell approach”, *Waste Management & Research*, 30, 2608-2614, 2010

C. Visvanathan, D. Pokherl, W. Cheimchaisri, J.P.A. Hettiaratchi and J.S. Wu. Methanotrophic Activities in Tropical Landfill Cover Soils: Effects of Temperature, Moisture Content and Methane Concentration. *Waste Management & Research*, 17, 313-323, 1999.

A. Prem Ananth, V. Prashanthini, C. Visvanathan, “Healthcare Waste Management in Asia”, *Waste Management*, 30, 154–161, 2010

## Member of Journal Editorial Board:



Associate Editor – Asia. Journal of Waste Management, Elsevier Publishers, from Jan 2009

Member of Board of Advisors – Canadian Journal of Pure and Applied Sciences, from 2009



Member of Board of Advisors – Asian Journal of Microbiology, Biotechnology and Environmental Sciences, from 2007

Member of Editorial Board of the Journal of the Agricultural Engineering Society of Sri Lanka (ISBN: 1391-0671), from 2009



# Teaching at AIT:

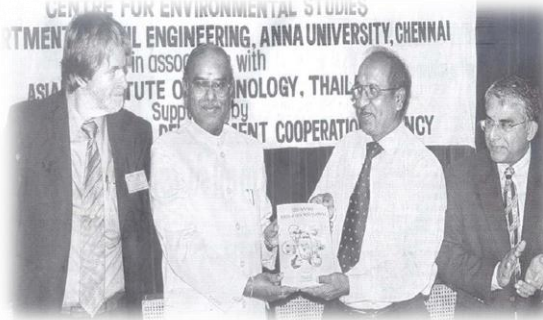
- **Water Treatment (Former Physico Chemical Unit Processes)**
- **Advanced Water and Wastewater Treatment**
- **Environmental Services in Emergency Situation (for DPMM program)**
- **Membrane Technology in Water and Wastewater Treatment**
  
- **Industrial Waste Abatement and Control - <http://www.albuw.ait.ac.th/>**
- **Environmental Quality Management**
- **Principles of Cleaner Production**
  
- **Hazardous Waste Treatment and Management**
  
- **Environmental Science and Technology for Decision Makers (for UEM)**
- **Applied Environmental Management ( for SOM)**
- **Cooperate Environmental Management**
- **Environment in the GMS Regions: Core issues and their management**



# Media and Publicity



As a guest panelist on the Pakistani TV show "Guest in Town" Prof. Visvanathan explains AIT's instrumental role in promoting membrane technology as a bioreactor



Best Speaker: "Review International Symposium MBT and Automatic Waste Sorting" Germany, 2007"

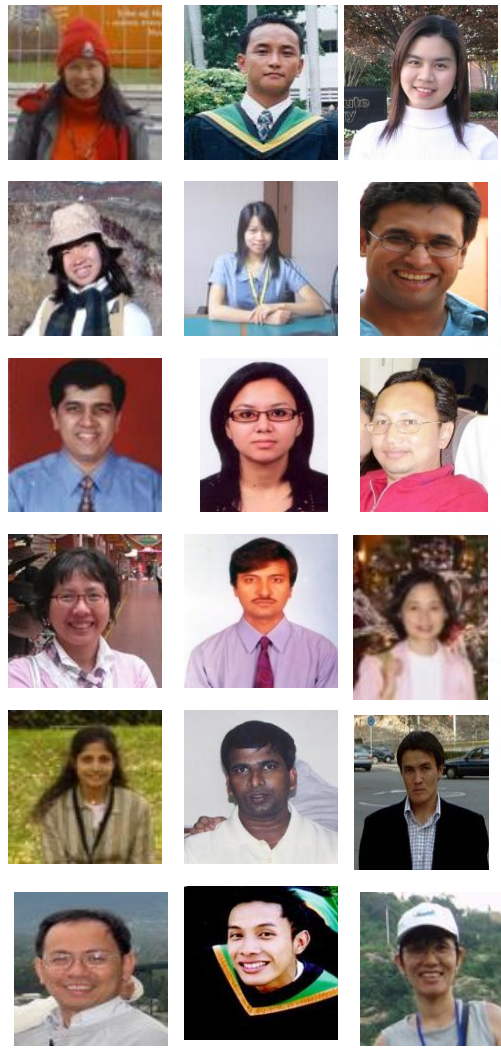
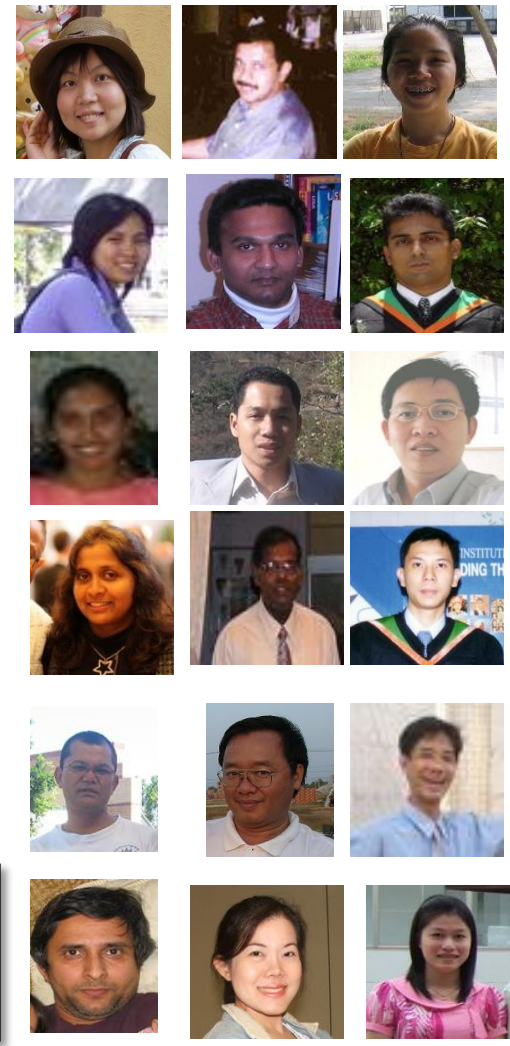
For the latest updates, please visit:

<http://www.faculty.ait.asia/visu/index.php/activities/news-a-events>



# Research Team

*Every drop counts...*





**Thank You**

**If you would like to highlight your research activities do send in your inputs to**

**[scpo@ait.ac.th](mailto:scpo@ait.ac.th)**

