Excellent Center of Waste Utilization and Management 2

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ECoWaste

History - ECoWaste in Brief

Excellent Center of Waste Utilization and Management (ECoWaste) is a collaborative research center between Pilot Plant Development and Training Institute (PDTI), King Mongkut's University of Technology Thonburi (KMUTT), School of Bioresources and Technology (SBT), KMUTT, and National Center for Genetic Engineering and Biotechnology (BIOTEC), National Science and Technology Development Agency (NSTDA). ECoWaste has particularly strong expertise in waste water treatment for over 20 years, with an emphasis on high rate anaerobic digestion system to develop technology and gain a deeper insight into the fundamental aspects of waste treatment systems. It has been initiated in the year 1980 by academic professors, researchers, and engineers who were interested and specialized in wastewater treatment. The center then emphasized in the anaerobic technology for the treatment of agro-industrial wastewaters, such as wastewater from cassava starch, rice starch, palm oil mill, food, and canned fruit industries.

Two important founders of the center are Professor Dr. Morakot Tanticharoen and Associate Professor Dr. Sakarindr Bhumiratana. The first research project was funded by ASEAN Economic Cooperation Programme (AAECP) under the ASEAN Working Group on Food Waste Materials to utilize wastewater from food industry to produce biogas as a source of renewable energy.

Further, the biogas technology research group was established under Biotechnology Department, School of Bioresources and Technology (SBT) in the year 1993. In the year 1996, the research group was expanded its horizon to conduct R&D in waste utilization and waste management along with biogas technology and, thus, changed its name to be “Waste Utilization and Management Laboratory.” The center has moved its research facilities to the Bangkhuntien campus of KMUTT in the year 2000. Last but not least, the center alleviated its position to become an excellent center in the year 2005 in the name of “Excellent Center of Waste Utilization and Management' or ECoWaste.

Over the past 20 years, our continuous research and development has a major impact on our country's knowledge-based science and technology development specifically in biogas technology and put us up front in this region. The utilization from the wastewater treatment process and biogas production from various agro-industrial wastes have been increasing a great deal.

Vision

ECoWaste is one of leading regional excellent centers for utilization and management of agro-industrial wastes and wastewaters with the aims to minimize resource utilization, protect the environment, and promote the use of renewable energy.

Mission Statement

ECoWaste is committed to conduct R&D on utilization and management of agro-industrial sectors to increase its production efficiency, optimize its resource utilization, and manage its wastes and wastewaters to produce biogas as a source of renewable energy. Additionally, ECoWaste is committed to create a foundation of basic and applied knowledge and technology on biogas and other aspects of waste utilization and management along with the development of human resources, technology transfer and demonstration in this country and in the region.

Target

ECoWaste is active in carrying out research programmes to improve biological waste treatment technology especially an anaerobic process in science and engineering skill, including fundamental and applied research on microbial study, the kinetics of anaerobic digestion, overall treatment efficiency improvement, increasing energy recovery efficiency, and minimizing waste and applying clean technology in agro-industries. ECoWaste also provides a consulting service on the design and implementation of full-scale anaerobic systems for interested agro-industries, and organizes workshops and seminars to disseminate information and knowledge in this area to strengthen Thailand 's competitiveness on renewable energy and related areas.

Key Research Areas

Four main research groups are as follows.

1. Microbiological and Biochemical Aspect

The group conducts R&D on basic knowledge of microbiological and biochemical mechanisms of anaerobic digestion. Researchers in this group further develop novel microbial techniques to quantify and qualify microorganisms in the anaerobic digestion process as well as study their interrelationship between different groups of anaerobic microorganisms.

2. Reactor and Process Development

The reactor and process development group conducts R&D on anaerobic reactor design and development. Researchers optimize the start-up period and increase treatment efficiency for biogas reactors along with biogas purification and technology transfer to industries.

3. Computational Aids and Process Optimization

The group conducts R&D on mathematical models to predict biochemical pathway and hydrodynamic mechanisms in a biogas reactor to control its treatment efficiency. The group further develops on-line measurement for the control of the biogas reactor.

4. Environmental Research and Management

The group conducts R&D on the feasibility study of biogas technology transfer to industries. The team is currently conducting a water and energy audit for increasing efficiency and optimize the utilization of natural resources, water, and energy in the tapioca starch industry to a near-zero discharge starch factory, with the aim of determining the capacity and limitations of production.

Technology Transfer and Technical Services

Objectives

The Excellent Center of Waste Utilization and Management (ECoWaste) include technical service section. The work focus on

• The obtained scientific knowledge of anaerobic technology for waste treatment and biogas production as alternative energy would then be implemented to industrial level via industrial services and technology transfer in order to create a continuous development in agro-industries and knowledge suitable for our economy, society and ways of life.

• To design and build anaerobic wastewater treatment based on our developed technology that would treat the wastewater from agro-industry and generate the biogas. This would include the utilization of biogas as energy substitution inside of factory.

• To consult and solve technical problems in environmental management and existing waste treatment systems.

• To test and analysis waste samples for anaerobic digestion and carry out to solve the problem based by the contract research with the private sector.

• To organize workshop and seminar in ECoWaste's experiences for the users

Design

- Evaluate and perform feasibility study on the construction of a biogas or wastewater treatment system
- Consult on the design and construction of a wastewater treatment system
- Consult on biogas utilization

Consulting Services

- Consult on control and operating a wastewater treatment system
- Manage and monitor a wastewater treatment system
- Evaluate and improve a failed wastewater treatment system
- Consult on start up of a wastewater treatment system
- Consult on reduction of chemical use for a wastewater treatment system

Testing and Analysis

- Test and evaluate biogas potential from different raw materials or wastes
- Test toxicity of compounds on biogas system
- Test Bio-Methane Potential of different wastes in the laboratory
- Test and analyze efficiency of wastewater treatment system
- Audit resource and energy utilization in any system
- Improve and minimize waste production

- Consult on the improvement of production process

- Consult on waste minimization and management

Training Course/Workshop

- Organize training course and/or workshop on waste utilization and management

- Organize training course and/or workshop on control and monitoring a biogas system

- Organize a workshop on microbial aspect of anaerobic wastewater treatment system

Awards

National Awards

• “High Rate Anaerobic Fixed Bed Reactor for Agro-Industrial Wastewater Treatment”, Research Award in Industrial Research and Engineering Field in Year 2002 from the National Research Council of Thailand .

• “Thai Biogas Plants – High Rate Anaerobic Fixed Film Technology for Agro-industrial Wastewater”, The Best Program on New and Renewable Sources of Energy (Off-grid) in Year 2003 from the Department of Alternative Energy Development and Efficiency, Ministry of Energy.

• “Initial Biofilm Development during Start-up Period of Anaerobic Hybrid Reactor”, by Dr. Benjaphon Suraraksa – Advisee of Prof. Dr. Morakot Tanticharoen and Assoc. Prof. Dr. Pawinee Chaiprasert, Thesis Award

in Physical Science and Mathematic Field in Year 2004 from the National Research Council of Thailand.

International Award

• Seed Awards 2005, the “Cows to Kilowatts” Partnership is a Winner of the Prestigious 2005 SEED International Environmental Award. The partnership was honored on April 20, 2005 at the 13th United Nations Summit on Sustainable Development, New York , USA . The project has received financial support from UNDP Nigeria through the Nigerian Federal Ministry of Environment to implement the project. Plans are also underway to incorporate the project concept into the National Environmental Sanitation Policy. The Partnership has also received funding from Partners of SEED Awards for Business Plan Development using World Class Consultants. The “Cows to Kilowatts” project is a partnership between a local NGO, the Global Network for Environment and Economic Development Research, a CBO, the Centre for Youth, Family and the Law (Nigeria) and the Excellent Center of Waste Utilization and Management (ECoWaste) of KMUTT and BIOTEC (Thailand). The project aims at constructing a biogas pilot plant using the anaerobic fixed film (AFF) biogas technology which has been developed by the ECoWaste's research team.

Selected Publications

International Level

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Cleaner Production in Thailand Tapioca Starch Industry (2001), Wastewater Treatment Technology Transfer and Cleaner Production Demonstration Project under ASEAN-Australia Economic Cooperation Program (AAECP) Phase III

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Best Practice Environmental Management Guidelines for the Tapioca Processing Industry , Wastewater Treatment Technology Transfer and Cleaner Production Demonstration Project under ASEAN-Australia Economic Cooperation Program (AAECP) Phase III

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Suraraksa, B., Nopharatana, A., Chaiprasert, P., Tanticharoen, M. and Bhumiratana, S. (2003) “ Microbial Activity of Biofilm During Start-Up Period of Anaerobic Hybrid Reactor at Low and High Upflow Feeding Velocity ”, Water Science and Technology, 48(8): 79-87.

-

Chaiprasert, P., Suvajittanont, W., Suraraksa, B., Tanticharoen, M., and Bhumiratana, S. (2003) “ Nylon Fiber as Supporting Media in Anaerobic Hybrid Reactors: Its Effects on System's Performance and Microbial Distribution ,”

Water Research, 37: 4605-4612.

-

Suvajittanont, W. and Chaiprasert, P. (2003) “ Potential of Biogas Recirculation to Enhance Biomass Accumulation on Supporting Media ,” Bioresource Technology, 88 (2003), 157-162.

-

Suraraksa, B., Nopharatana, A., Chaiprasert, P., Tanticharoen, M. and Bhumiratana, S. (2003) “ Effect of Substrate Feeding Concentration on Initial Biofilm Development in Anaerobic Hybrid Reactor ,” ASEAN Journal on Science and Technology for Development, 20(3-4): 361-372.

-

Sanpoti, N., Towprayoon, S., CHAIPRASERT, P., and Nopharatana, A. (2006) “ Enhancing Waste Decomposition and Methane Production in Simulated Landfill Using Combined Anaerobic Reactors,” Water Science and Technology ”, 53 (8): 243-251.

-

Sanpoti, N., Towprayoon, S., CHAIPRASERT, P., and Nopharatana, A. (2006) “ The Effects of Leachate Recirculation with Supplemental Water Addition on Methane Production and Waste Decomposition in a Simulated Tropical Landfill ,” Journal of Environmental Management, 81: 27-35 .

-

Boonapatcharoen, N., Meepian, K., Juproputtasri, W., Chaiprasert, P. and Sechkarnjanarak, S. (2006) “ Microbial Population During Operation Periods of Anaerobic Hybrid Reactor Treating Cassava Starch Wastewater ”, IWA World Water Congress Beijing , China , 10-14 September.

-

Boonapatcharoen, N., Wanichpongpan, P., Ruenglertpanyakul, W., and Techkarnjanaruk, S. (2006) “ Effect of Natural Sunlight on Microbial Population in Shrimp Farming Sediment ”, In Proc. International Conference on Environmental and Public Health Management, Hong Kong, People Republic China, 7 December.

-

Suraraksa, B., Meepian, K. and Chaiprasert, P. (2007) “ Microbial Population and Microbial Activity as Indicating Factor for Controlling Anaerobic Hybrid Reactor (AHR) ”, The Conference Water Micro 2007, Japan, 9-15 Sep, 2007.

-

Boonapatcharoen, N., Meepian, K., Chaiprasert, P. and Techkarnjanaruk, S. (2007) “ Molecular Monitoring of Microbial Population During Operation Periods of Anaerobic Hybrid Reactor Treating Cassava Starch Wastewater ” , Journal of Microbial Ecology. Vol.54: 21-30.

-

Saengchan, K., Wisitrungruang, W., Sasadoor, W., Nopharatana, A. and Songkasiri, W (2007) “ Reducing Sulfur Residue in Tapioca Starch Product ”, Tapioca Eco-Industrial Cluster in Vietnam, Ho Chi Minh City, Vietnam, August 28-29.

-

Sura raksa, B., Kullavanijaya, P., and CHAIPRASERT, P. (2008) “ Accelerating Biofilm Formation on Supporting Media for Reducing Start-up Period of Anaerobic Hybrid (AH) Reacto r,” Biofilm Technologies Conference, January 8-10, Nanyang Executive Centre , Nanyang Technological University (NTU) campus , Singapore .

-

Sura raksa, B., Nopharatana, A., CHAIPRASERT, P., and Tanticharoen, M. (2008) “ Aspect of Initial Biofilm Development of Mixed Culture in Anaerobic Hybrid (AH) Reactor at Low and High Upflow Feeding Velocities ,” Biofilm Technologies Conference, January 8-10, Nanyang Executive Centre , Nanyang Technological University (NTU) campus , Singapore.

-

Laowansiri, S., Vinitnantharat, S., Chaiprasert, P. and Ha, S.R., 2008, “ Anaerobic Degradation Kinetics of Reactive Dye with Different Carbon Sources ,” Journal of Environmental Biology , 29(3), 309-314.

National Level

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Chaiprasert, P., S. Bhumiratana and M. Tanticharoen (2001) “ Mesophilic and Thermophilic Anaerobic Digestion of Pineapple Cannery Wastes ,” Thammasat International Journal of Science and Technology, Vol. 6 (2): p. 1-9.

-

Saengchan, K.; Nopharatana, A.; Songkasiri, W. ” Enhancement of Tapioca Starch Separation with a Hydrocyclone: Effects of Apex Diameter, Feed Concentration, and Pressure Drop on Tapioca Starch Separation with a Hydrocyclone. ” Chemical Engineering and Processing: Process Intensification. In Press. Available online April 2008.

-

Somboonchai W., Songkasiri, W., Nopharatana, M. “ Kinetics of Cyanide Oxidation by Ozone in Cassava Starch Production Process. ” Journal of Food Engineering. 84(4), 2008, 563-568.

-

Phalakornkule, C.; Wongnoi, R.; Songkasiri, W. “ Influence of a Three-Phase Separator Configuration on the Performance of a UASB Reactor Treating Wastewater from a Fruit Canning Factory. ” Wat. Env. Res. 79 (2), 2007, 199-207.

-

Pantamas, P., Chaiprasert, P. and Tanticharoen, M. (2003) “ Anaerobic Digestion of Glucose by Bacillus Licheniformis and Bacillus coagulans at Low and High Alkalinity ”, Asian Journal of Energy and Environment, 4(1-2): 1-17.

-

Tran, T.T., Nopharatana, A. and Chaiprasert, P. (2003) “ Performance of Anaerobic Hybrid and Mixing Reactors in Treating Domestic Wastewater ,” Asian Journal of Energy and Environment, 4(1-2): 19-39.

-

Deddoung, M., Suraraksa, B., and CHAIPRASERT, P. (2007) “Enhancement of Biofilm Development at Initial Strat-up Period of Various Feeding Velocities and Substrate Concentrations,” NSTDA Annual Conference (NAC 2007): Science and Technology for National Productivity and Happiness, 28-30 March, Science Park, Phatumthani, Thailand .

-

Petchsri, P., Towprayoon, S., CHAIPRASERT, P., and Nopharatana, A. (2006) “ The Effect of Precipitation on Municipal Solid Waste Decomposition and Methane Production in Simulated Landfill Bioreactor with Leachate Recirculation ”, Songklanakarin Journal Science and Technology, 28(3): 615-631.

-

Chaiprasert, P. (2006) “Technology Transfer on Biogas Technology: Wastewater to Energy by Anaerobic Fixed Film System” Proceeding The 18 th Annual Meeting of the Thai Society for Biotechnology “Biotechnology: Benefits & Bioethics” November 2-3, The Montien Riverside Hotel Bangkok , Thailand .

-

Kullavanijaya, P., Paepatung, Loapitinan, O., N., Songkasiri, W., Nopharatana, A., and CHAIPRASERT, P. (2007) “ An Overview of Status and Potential of Biomethanation Technology in Thailand ,” KMUTT Research and Development Journal, Special Issue 30(4), 693-700.

-

Songkasiri, W., Sasadoor, W., Wisitrungruang, W., Tipwong, S. and Nopharatana, A. (2007) “ Increase of Dewatering Efficiency and Starch Recovery using Extractors in Pulp Management for a Native Cassava Starch Production Factory ”, International Symposium on Air Quality and Waste Management for Agriculture, Broomfield, CO, USA, September 15-19.

-

Tipwong, S.; Saengchan, K.; Nopharatana, A.; Songkasiri, W. “ Study of Hydrocyclone with Solid Core for a Tapioca Starch Separation Unit .” Oral Presentation at the 2 nd International South East Asian Technical University Consortium (SEATUC) Symphosium, Bandung , Indonesia , February 26-27, 2008 .

-

Boonya, S.; Ruenglertpanyakul, W.; Songkasiri, W. “ Effects of Liquid Upflow Velocity and Reactor Configuration on Solid Flow Pattern inside UASB Reactors Using Computational Fluid Dynamics (CFD). ” Oral Presentation at the International Conference on Engineering, Applied Sciences, and Technology, Bangkok , Thailand , November 21-23, 2007 .

-

Rungrueng, N.; Sangchan, K,; Nopharatana, A.; Songkasiri, W. “ Water Minimization in the Tapioca Starch Production Industry: A Dicision Support System .” The Oral Presentation at the International Conference on Starch Update 2005, November 4-5, 2005 . Bangkok , Thailand .

-

Petchrungchruang, U., Songkasiri, W., and CHAIPRASERT, P., 2008, “ Water Quality Classification for Rasper, Extractor and Separator as a Key Indicator Index for Water Consumption in Tapioca Starch Factory ,” The Proceedings of 4 th Naresuan Environmental Annual Conference, May 26-27, Naresuan University , Payao , Thailand .

-

Phutarak, P., Songkasiri, W., and CHAIPRASERT, P., 2008, “ Secondary Wastewater Treatment of Cassava Starch Factory Using Horizontal Subsurface Flow Constructed Wetland ,” The Proceedings of 4 th Naresuan Environmental Annual Conference, May 26-27, Naresuan University , Payao , Thailand .

-

Eksomthramate, T., Songkasiri, W., and CHAIPRASERT, P., 2008, “ Hydrolysis of Cassava Peels and Pulps from Cassava Starch Processing for Ethanol Production ,” The Proceedings of 4 th Naresuan Environmental Annual Conference, May 26-27, Naresuan University , Payao , Thailand .

Research Projects on Year 2006-2008

- The Promotion of Biogas Production as an Alternative Energy in Cassava Starch Industry

- Enhancement of Biofilm Development in Startup Period of Anaerobic Hybrid Reactor

- Molecular Monitoring of Syntrophic Acetogenic Bacteria in Anaerobic Reactor by 16S rDNA Oligonucleotide Probe Hybridization

- Computational Fluid Dynamics (CFD) Model for the Scale-up of the Biogas Reactors

- Application of a Hybrid Reactor Combining an Upflow Sludge Bed and a Fixed Bed on Treating and Producing Biogas

from Palm Oil Mill Effluent

- Startup Conditions on Trophic Microbial Group for Enhancing Performance of Anaerobic Hybrid Reactor

- Enhancement of Tapioca Starch Collection by Post Cyclone

- Development of Hydrocyclone for enhance starch recovery in the Tapioca Starch Separation Unit

- Effects of Angles and Velocities of Injected Water on the Extraction Process in the Native Cassava Starch Production

- Predictive controlling model for the tapioca starch drying process

- Research and Development on the Tapioca Starch Production Process to Increase Efficiency and Optimize the Utilization of Natural Resources, Water, and Energy: A Near-Zero Discharge Starch Factory

- Assessment of Biomass Potential for the Biogas Production in Thailand

- Assessment of Biogas Technology in Thailand

- Study of Microbial Population in an Intensive Shrimp Cultivation Pond

- Kinetic Modeling of Anaerobic Digestion from Cellulosic Waste for Methane Production

- Detection of Viable Microorganism Using Carboxyfluorescein Diacetate (cFDA) for Determining Characteristic of Inoculum Seed in Anaerobic Wastewater Treatment

- Assessment of Energy Crops Potential and Technology for the Biogas Production as Alternative Energy in Thailand

- Application of an Industrial Scale Treatment of Hybrid Reactor for Recycling Water in Cassava Starch Processes

- Study of Microbial Community Associated to Corroded Gas Pipelines Using Molecular Techniques

- Biogas Cleaning by Removing Hydrogen Sulfide Using Biofilter

- Etc.

Personnels

Advisors

- Professor Dr. Morakot Tanticharoen

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