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APEC
Advanced Biohydrogen and Green Growth Newsletter

The food security, climate change, energy security, interlinked challenges, and green growth for the APEC region.

Contents

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APEC Meetings and Events

§ APEC EWG (Energy Working Group) meeting 2012 §

In 1990, the Energy Working Group (EWG) was launched with the motivation of maximization of the energy sector and its contribution to the regions of APEC economic, social well-being, while mitigating the environmental effects of energy supply and use. This group is mainly assisted by four Expert Groups which are as follows,

＊Clean Fossil Energy,
＊Efficiency & Conservation,
＊Energy Data & Analysis,
＊New & Renewable Energy Technologies

Steering Committee on Economic and Technical Cooperation (SCE)
The objectives of the SCE are to:

- Strengthen the implementation of APEC's ECOTECH activities via Leaders and Ministers
- Provide policy guidance on ways to contribute to APEC's ECOTECH goals
- Coordinate ECOTECH objectives and priorities between the APEC Economic Leaders
- Meeting and Ministerial Meetings

The 43rd EWG meeting will be held in Kuala Lumpur, Malaysia on 5-10 March 2012. The main topics will be discussed are,

- Strengthening transportation's role in a clean-energy future
- Developing energy efficient transport systems for livable low-carbon communities
- Powering low-carbon transport
- Greening the supply chain: Energy efficient freight transportation

In 2012, the EWG has undertaken numerous capacity building workshops that are assisting APEC economies towards achieving their energy goals and fostering green growth. These events include:

- The second APEC Cooperative Energy Efficiency Design for Sustainability (CEEDS) Phase 3 workshop that was held in Singapore in January 2012. The first workshop was held in San Francisco, the United States in September 2011.
- The Training Workshop on Analytical Methods to Monitor the Effectiveness of Implementing Energy Efficiency Measures that was held in Hanoi, Viet Nam in February 2012
- The APEC Low Carbon City Workshop: Achieving Sustainability through Low Carbon Cities that will be held in Kuala Lumpur, Malaysia in March 2012.

APEC Public – Private Roundtable on Energy Security

Research Note

§ Dark Fermentative Hydrogen Production with Pilot Scale Fermenters §

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The cheap substrate can improve competitiveness for dark fermentative hydrogen production. In order to develop the pilot technology of hydrogen production from non-grain feedstock, this study explored the hydrogen production from desizing wastewater (DW) and condensed molasses fermentation soluble (CMS) using 60 and 400 L pilot-scale fermentors, respectively. It is expected that experiment results obtain several related parameters for scale up and further connect with commercial processes. In addition, the microbial community structure in systems was analyzed by using molecular biological techniques.

DW was initially conducted the experiments of environmental factors and operation strategies with a lab-scale continuous flow stirred tank reactor (CSTR). The results showed that combination substrate preheating (60℃, 1 h) and HRT (hydraulic retention time) 12 h could inhibit the activity of non-hydrogen-producing bacteria and improve the stability of system operation. The optimum pH value was 5.5, but the CSTR reactor could not be operated steady at a HRT of 8 h. DW via saccharification pretreatment could improve this problem, obtaining a H2 production rate (HPR), H2 yield (HY) and overall H2 production efficiency (HPE) of 15.2 m3/m3/d, 9.77 mmol-H2/g-hexose and 37.5%, respectively, at a HRT of 8 h. If the pretreatment processes combined saccharification with alkali (pH 10.0-10.5) treatment, it could further improve the hydrogen yield.

Unfortunately, the 60 L pilot-scale reactor could not be started up by feeding variously pretreated DW. However, the waste concentrated beverage added 0-10% (total sugar ratio) DW could be successfully operated at HRT 6 h, getting a HPR, HY and HPE of 20.2 m3/m3/d, 8.7 mmol-H2/g-hexose and 37.2%, respectively. The analytical results of microbial community structure showed that hydrogen-producing Clostridium sp. existed in the reactor for three stages of addition of 0-10% DW, and C. butyricum was the predominant H2-producing bacterium in the system. However, hydrogen production decreased to near zero when the addition of DW was increased to 20%. The analytical results of microbial community structure showed that C. butyricum still presented in the reactor. Accordingly, the main cause of stopping hydrogen production should not result from propagation of non-H2- producing bacteria in the fermentor. It is highly probable that chemical substances of hydrogen inhibition existed in desizing water.

The 400 L pilot – scale bioreactor could successfully start up by feeding CMS at HRT 6 h (Cs = 40 g COD/L). However, the performance of hydrogen production became periodic fluctuation situation. This problem could be improved by substrate preheating (60℃, 1 h), obtaining a HPR and HY of 17.8 m3/m3/d and 9.1 mol H2/g-hexose, respectively, at . HRT 4 h and substrate concentration 70 g COD/L (total sugar concentration 17.7 g/L). The analytical results of microbial community structure showed that Corynebacterium glutamicum presented in the system became non-predominant bacterium by substrate preheating, resulting in the shift from lactate fermentation into butyrate fermentation. In addition, the Megasphaera sp., which can decompose carbohydrates and lactate to produce hydrogen, was found that existed in the system of substrate preheating. According to the degrees of lactate content in soluble metabolites, there was speculation that Megasphaera sp. gave some contribution to hydrogen production.

Keywords: fermentative hydrogen production, pilot scale, desizing wastewater, condensed molasses fermentation soluble, PCR-DGGE

Research News

§ Waste to Biogas - Mapping Tool Available §

US - The ***US Environmental Protection Agency's (EPA)*** Pacific Southwest Region has launched an online "waste to biogas mapping tool" to support the use of organic waste for energy projects."This innovative mapping tool, the first of its kind in the nation, helps restaurants, hotels and other food waste generators to connect with large energy producers," said Jared Blumenfeld, EPA's Regional Administrator for the Pacific Southwest. *"Harvesting this energy prevents waste from ending up in landfills or clogging sewer lines."*

The tool is an *interactive map created to link food and other biodegradable waste sources with facilities such as wastewater treatment plants* that can enhance energy production with their existing infrastructure. Wastewater treatment plants and some dairies manage waste with anaerobic digesters, which produce methane-rich biogas as a natural byproduct. By adding food scraps or fats, oils, and grease to an anaerobic digester, facilities can increase biogas production to make money while providing a renewable energy source, *reducing greenhouse gas emissions*. These business and environmental opportunities may present a largely unrealized potential.

The tool is designed for decision-makers with technical expertise in the fields of waste management, wastewater treatment, and renewable energy. This includes *businesses, state and local governments, and non-profits.* The tool allows users to determine the types of facilities in their area, where clusters are located, and the distance between a waste producer and an anaerobic digester. The tool also functions in reverse – allowing generators of organic waste to find partner facilities that will accept it. The use of biogas to displace natural gas would have a climate change abatement potential equal to taking approximately 160,000 cars off the road. A prime example is in Millbrae, California. Grease is collected by a licensed material hauler, transported to the wastewater treatment facility in 3,000 to 5,000 gallon tanker trucks, and added to a FOG-condition system, where it is converted into biogas used to meet 80 percent of the facility's needs. Millbrae has increased biogas production by nearly 100 percent, reducing their utility energy bill by 75 to 80 per cent, preventing some 589 tons of green house gas from being emitted into the atmosphere annually, and *reducing annual dewatered bio-solids hauling by 35 per cent.*

Wastewater treatment plants in the region's four Pacific Southwest states are co-digesting more than FOG. Organic materials – including food waste, yard trimmings, soiled paper, and green waste – comprise two-thirds of the solid waste stream. According to the *East Bay Municipal Utility District (EBMUD),* food waste has up to three times as much energy production potential as bio-solids. An EBMUD demonstration project indicated that 100 tons of food waste digested per day produces enough energy to power up to *1,400 homes*. Financial assistance provided by federal, state, and private sources can make on-site generation affordable and practical. The federal government provides grants, loans, and rebates. State agencies also provide grants, loans, rebates, renewable credits, and stand-by rates for energy generation. Local utility districts provide private sources of funding as do private third-party leasing arrangements and pooled bond financing.

Adapted from: http://www.thebioenergysite.com/news/11145/waste-to-biogas-mapping-tool-available

Special Column

The first Bio-Hydrogen Gas Station in Chinese Taipei and Built up Demonstration System to APEC Members

On November, 2011, Feng Chia University in Taichung, Chinese Taiepi unveiled the first Bio-H2 Gas station in the world that supplies biologically produced hydrogen. Two micro Bio-hydrogen concept cars were using microbial technology to transform agricultural waste biomass into fuel for hydrogen fuel cell vehicles. This micro concept cars completely non-polluting concept was the major step forward to environmental friendly. This technology was developed through collaboration among the Feng Chia University, the National Science Council and the Bureau of Energy under the Ministry of Economic Affairs (MOEA) since 1998.

Dr. Bing-Kuen Tsai, Deputy Mayor of Taichung City tested the micro car and said the micro H2 car produces water and is accordingly 100% environmentally friendly. Bio-H2 gas station can be used to dispense biofuel to future cars that will run on hydrogen energy fuel cells. Biohydrogen energy is a renewable energy created from sources such as wastewater and food waste.

The First Bio-H2 Gas Station Unveiled

FCU Vice-president Bing-Jean Lee, FCU Green Energy Development Center Director Chiu-Yue Lin, Taichung City Deputy Mayor Ping-Kun Tsai, and Ministry of Economic Affairs Bureau of Energy Deputy Director-general Yunn-Ming Wang (left to right)

On November, 2011, the project overseer: Prof. Chiu-Yue Lin presented one multi –stage green energy demonstration (MSGED) to LIPI, Indonesia. After that, many APEC members were interested in this system. In 2012, GEDC will give one (MSGED) to APEC members. It could also promote green technology and academic exchanges among APEC members. That will not only improve the green technology in both countries but also, fortunately, take it to the global level.

Multi –Stage Green Energy Demonstration (MSGED)