PATENTS

- "A Continuous process for the production of ethanol from Starchy materials", Indian Patent # 188562.
- "The production of pollution free gaseous fuel", Indian Patent # 212605.

PUBLICATIONS

The lab has been publishing research in peer-reviewed journals since the last decade. Above 115 journal publications, both research and review articles have been recorded hitherto and contributions in several International and National Conferences are in record.

Published a book entitled "Biohydrogen Production: Fundamental & Technology Advances" by D.Das, N.Khanna, C. Nag Dasgupta, CRC Press, New York, Page 408, 2014 (ISBN 9781466517998).

ACTIVITIES

- International Workshop on "Biohydrogen Production Technology" (IWBT 2008), February 7-9, 2008, IIT Kharagpur.
- International Workshop on "Use of solar energy for CO_2 capture, algae technology and hydrogen production, and subsequent use of algal biomass for commercial purposes", October 17-18, 2011, Hyatt Regency, Kolkata.
- International Conference on "Algal Biorefinery" (ICAB 2013), January 10-12, 2013, IIT Kharagpur.

AWARDS AND ACHIEVEMENTS

- H-index of Prof. D. Das is 31 with total citation 5398.
- Prof. Debabrata Das was awarded Fellow of Biotechnology Research Society of India (FBRS) at the NHBT-2011.
- Prof. Debabrata Das was awarded IAHE AKIRA MITSUI AWARD in 2008.
- Dr. Kaushik Nath was awarded INAE Innovative Student Projects Award in 2007.
- Prof. Debabrata Das was awarded Fellow of West Bengal Academy of Science and Technology in 2004.
- Prof. Debabrata Das received best paper award in CHEMCON-2002.
- Prof. Debabrata Das was awarded DBT's Overseas Associateship 2000.

MAJOR ONGOING PROJECTS

- Mission mode project on Hydrogen Production through Biological Routes; 2010 - 2016, MNRE, Govt. of India.
- High rate algal biomass production for food, feed, biochemicals and biofuels; 2010 - 2015, DBT, Indo-Denmark.
- Improvement of Energy recovery from waste water by dark fermentation followed by Microbial Fuel Cell, 2013 - 2016, DRDO, New Delhi.

MAJOR PROJECTS COMPLETED

- "Production of hydrogen as a cleaner fuel through waste recycling" 1999 - 2002, DBT, New Delhi.
- "Studies on the Fe-hydrogenase genes of prokaryotes and eukaryotes for the improvement of hydrogen production", 2004 - 2006, DST-DAAD (Indo-Germany), Germany.
- "Bio CO_2: An integrated multidisciplinary project using solar energy for production of renewable hydrogen combined with CO_2 capture, to address global warming and energy production", 2008-2012, MFA (Indo-Norwegian), Norway.

WORKGROUP

Bioprocess Engineering Lab has produced 13 Ph.Ds. Several M.Tech and B.Tech students completed their project works. Their contributions have been immense; the career profiles of the graduates are briefly detailed below:

- Kakali Bandyopadhyay, Scientist, National Center for Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia, USA.
- Narendra Kumar, Associate Professor, Pharmaceutical Sciences, Texas A & M Health Science Center, Texas, USA.
- David K Daniel, Professor, Vellore Institute of Technology, Tamil Nadu, India.
- Jayashree Mishra, Associate Research Scientist, Texas A&M Health Science Center, Texas, USA.
- Kaushik Nath, Professor & Head, Dept. of Chemical Engineering, GH Patel College of Engg. & Tech., Anand, (Gujarat), India.
- Devrani Mitra, Assistant Professor, Department of Biological Sciences, Presidency University, Kolkata.
- Kaustubha Mohanty, Associate Professor, Department of Chemical Engg., IIT Guwahati, India.
- Shireen Meher Kotay, Post doctorate, Environmental Engg. & Microbial. Lab. University of Utah, Salt Lake City, USA.
- Tumpa Dutta, Research Associate, Endocrinology, Diabetes, Nutrition Mayo clinic, Rochester, USA.
- Mohan Yama, Post doctorate, Bharat Petroleum Corporation Limited, New Delhi, India .
- Namita Khanna, Post doctorate, Uppsala University, Sweden.
- Kanhaiya Kumar, Post doctorate, Advanced Biomass R & D Center, Republic of Korea.
- Jose Gilbert, Reliance Industries Ltd., Navi Mumbai.

Research Personnel

Present Work group

Pallavi Sinha	Balachandar G.
Soumya Pandit	Supratim Ghosh
Raghupati Samanta	Nitai Basak
Debarati Dasgupta	Sinu Kumari
Bikram Nayak	Amrit Lal
Preeti Mishra	Ramya Veerubhotla
Shantonu Roy	Jhansi L. Varanasi

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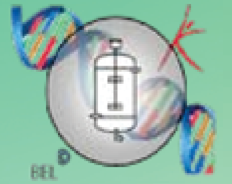
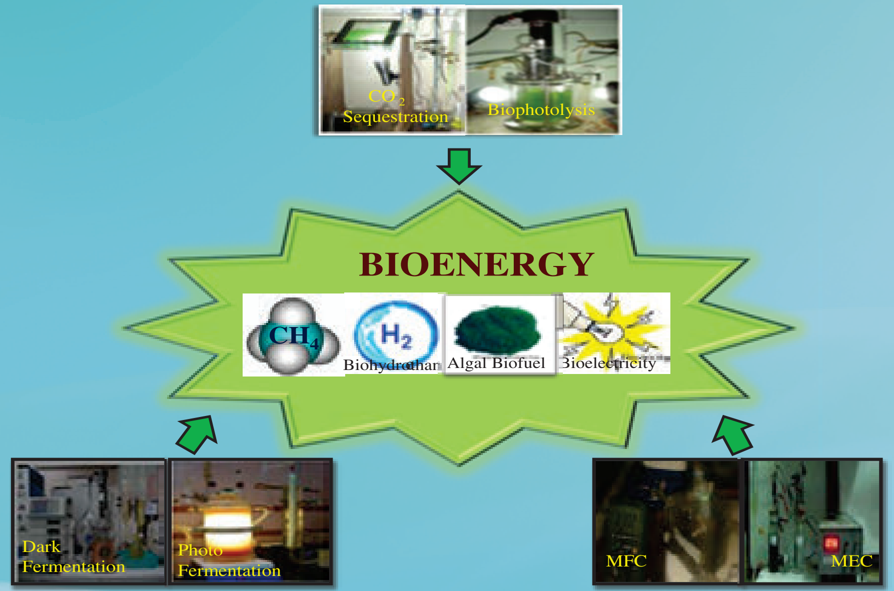
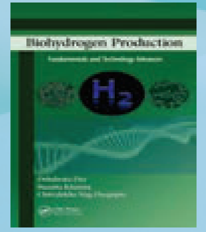


BIOPROCESS ENGINEERING LABORATORY



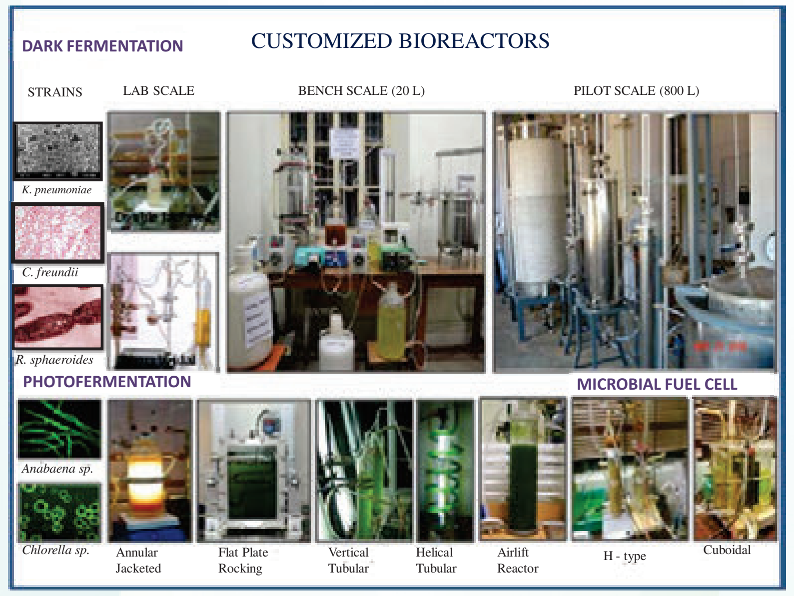


In quest of cleaner energy...

DEPARTMENT OF BIOTECHNOLOGY
INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR,
INDIA, 2014

ABOUT US

Bioprocess Engineering Laboratory is an integral part of Department of Biotechnology, Indian Institute of Technology Kharagpur, a premier research institute of the country. The research work of this laboratory is sponsored by several international and national funding agencies viz. National Science Foundation, USA; DAAD, Germany; Norwegian Ministry of Foreign Affairs, Norway; MNRE, BRNS, DST, DBT-Scout, DRDO and ISIRD of Govt. of India. The work-group has collaborative experience with different industries (World Hydrogen Enterprise LLC, New York, USA and IFB Agro Industries Ltd), India and foreign laboratories (University of Miami, USA; Oslo University, University of Bergen, Norway; Ruhr University, Germany; Denmark Technical University, Denmark; Uppsala University, Sweden etc).



The Principal Investigator (PI), Prof. Debabrata Das has been involved in design, fabrication, installation, commissioning of five pilot plants in India and has more than thirty years research experience on the biological gaseous energy recovery systems. The P.I. has successfully designed and commissioned pilot plant for hydrogen production using different wastes/by-product like sewage sludge, cane molasses etc.

The lab hitherto has generated as many as 13 PhD. Several M.Tech, B.Tech students completed their project works. It has published more than 115 research papers in the peer-reviewed journals, 14 book chapters and one book. It is also involved in organizing several International / National Conferences / Workshops; short-term courses for faculty members of engineering institutions, process engineers, researchers, etc.

LAB VISITORS

Prof. Chris Somerville
Energy Biosciences Institute,
University of California, Berkeley

Prof. T Nejat Veziroglu
Clean Energy Research Institute, University of Miami, Florida

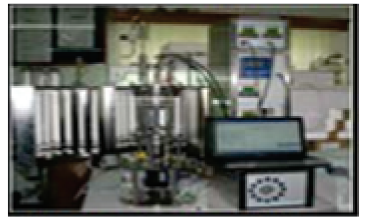
RESEARCH

Biohydrogen production is acknowledged to be environmentally benign and the most promising renewable energy resource and an ideal alternative to fossil fuels that doesn't contribute to the greenhouse. Biohydrogen production has greater prospect not only for the power generation but also for waste recycling. The Bioprocess Engineering Laboratory research activities contribute towards the development of sustainable bioenergy generation in addressing the Nation's energy challenges. Our projects focus on maximization of hydrogen production by dark fermentation using both mesophiles and thermophiles, photofermentation and biophotolysis of water using green algae and cyanobacteria; customized bioreactor designing; scale up studies and microbial fuel cells. Other research areas are given below.

Biohythane production
Alkaline lipase production using *Citrobacter freundii* IIT-BT L139.
Alcohol production from starchy materials.
Glucoamylase production using *Aspergillus awamori* NRRL 3112.
Phenol biodegradation using *Pseudomonas putida* MTCC 1194.
Biomethanation of different agricultural residues.
Landfill gas generation technology.

FACILITIES

Controlled Fermenters



Bioengineering AG KLF 2000

New Brunswick Bio Flo 110

Gas Chromatograph

Agilent 7890A

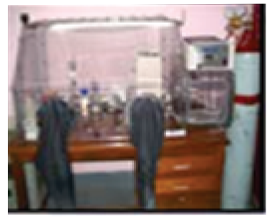
Gel Doc

Bio-Rad

DGGE

Bio-Rad

Anaerobic Glove Box



Coy Lab

HPLC

Agilent 1260

20 L Fermenter

NBS

TECHNOLOGY

- The workgroup has isolated four bacterial strains that produce hydrogen at significant amounts viz. *Klebsiella pneumonia (Enterobacter cloacae), Citrobacter freundii, Bacillus coagulans and Thermoanaerobacterium thermosachharolyticum* IIT BT ST1. These strains have been extensively studied both at microbiological & molecular level. Also mixed consortium (acetogenic and methanogenic) has been devdeloped.
- The lab has designed and developed several bioreactors for immobilized and suspended cell systems for cultivation of algae (both green algae and cyanobacteria) and biohydrogen production. Besides, 8 flat plate rocking reactors have been ingeniously designed and constructed.
- An indigenous pressure control system using IR sensors and logic controller for Biohydrogen reactor has been developed.
- The workgroup has also succeeded in developing efficient scalable process systems such as a pilot plant for hydrogen production using sewage sludge by electrochemical process (sponsored by M/s. Hydrogen Energy Enterprise, California, USA); a 800 L Biohydrogen reactor (sponsored by MNRE) and further under 'Technology Mission Project' with MNRE, a Biohydrogen plant of 10,000 L capacity will be commissioned soon.
- Recently, the group has designed microbial fuel cell (having high power density 20 W/m^3) and a microbial carbon capture cell (MCC) for simultaneous waste water treatment, CO_2 sequestration and electricity generation. Also, MEC for bio electrochemical hydrogen production has been indigenously designed.

COLLABORATORS

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