INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	Dipti Yadav
Roll Number	:	136151006
Programme of Study	:	Ph.D.

Thesis Title: **Experimental Investigation of Lignocellulosic Biomass for Biogas Production**

Name of Thesis Supervisor(s)	:	**Prof. Pinakeswar Mahanta and Prof. Latha Rangan**
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SHORT ABSTRACT

Intensifying environmental issues, the rising demand for energy, political apprehensions and the medium-way depletion of fossil fuels has generated the prerequisite for development of sustainable technologies based on renewable economic resources. Biogas is one of the potential alternatives biofuels identified so far and is economically feasible, which might be benefit to meet the future energy supply demands as well as contributing to a reduction of greenhouse gas emissions. Traditionally, livestock dung has been utilized as feedstock for biogas production but due to unavailability, imbalances and failure occurs in large scale biogas plants, lignocellulosic biomass has attained huge attention. Lignocellulosic biomass acknowledged as the most abundant low cost resources for renewable energy generation across the globe. The socio-economic implication is also very prodigious. Energy crops, saw dust, marine weeds, agricultural residues or waste vegetables and woody plants fall under this category. The benefit of using this class of biomass does not compete with the arable land. In the Organisation for Economic Co-operation and Development (OECD) countries lignocellulosic biomass disposed of openly, which origins environmental pollutions as well as root cause for many diseases. Although the complex structure of lignocellulosic biomass is a challenge for its utilization as feedstock in anaerobic digestion system. This work is intended to give an overview about certain aspects of the complex lignocellulosic biomass, providing the characterization, co-digestion, pretreatment and its potentiality for biogas production.

To evaluate the prospective of a variety of lignocellulosic biomass as biogas feedstocks, the characterization of different types of lignocellulosic biomass (bamboo dust, areca nut shell, rice husk, duckweed, saw dust and maize) abundantly found was investigated. The lignocellulosic biomass was

characterized for volatile matter, moisture content, ash content and carbon, hydrogen, and nitrogen (CHN) content. Property analysis of lignocellulosic biomass was also done by Fourier transform spectroscopy, X-ray diffraction and thermogravimetric analysis. To identify the assessment of potential lignocellulosic biomass for biogas production, lignocellulosic biomass has been co-digested with cattle dung in different ratio to optimize the quantity as well as biogas production. Results shows cumulative biogas or methane yields for a set of biomass materials digested separately in different ratio LB and CD. To enhance or exploit lignocellulosic biomass fully a thorough study on pretreatment has been conducted further.

Various physical, chemical and physicochemical methods have been employed for the pretreatment with aim of exposure of cellulose moieties in biomass (rice husk, arecanut shell and saw dust) for breakdown of lignocellulose. A study was conducted to explore and compare its effects against a conventional pretreatment method using sodium hydroxide alone and autoclave with sodium hydroxide, which are well known conventional alkali pretreatment methods. The effects of the pretreatment were investigated by biomass fibre analysis (Van Soest's Method), Fourier transform infrared spectroscopy and thermogravimetric analysis.

Additionally, a novel microbubble-enhanced dielectric barrier discharge (DBD) plasma reactor has been tested to pretreat whole maize plants with the view of improving its digestibility; hence increasing methane-rich biogas production.

The purifying process of methane enrichment from biogas generates many new prospects for its utilization but up gradation may increases the process cost. Therefore, study has been conducted to assess the effect of activated carbon (AC) addition on anaerobic digestion (AD) process for the augmentation of biogas as well as methane production. This study proves that addition of AC in AD system not only improved biogas and methane production alone but it also supports the most recalcitrant LB for faster hydrolysis with higher efficiency.