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Bioconversion of lignocellulosic biomass to biogas

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Depletion of fossil fuel and increase in environmental pollution at an alarming rate has motivated the researchers to look for the environmentally friendly as well as cost effective alternative sources of energy. Biomass is a renewable energy source developed from living or recently living plant and animal materials, which can be used as fuel. The main components present in biomass are polymers such as carbohydrate, protein, cellulose, lignin and fat. Biogas is produced when the biomass is anaerobically degraded by microorganisms. The process of Anaerobic Digestion (AD) takes place in four steps: hydrolysis, acidogenesis, acetogenesis and methanogens. Biogas production from biomass is getting a lot of attention due to its easy availability and relatively simple biomass to energy conversion technology. Co-digestion of biomass with cattle dung is another promising method of converting biomass to energy through anaerobic digestion. In most developing countries like India, China etc. the principal occupation of the people is crop production and the crop residues remaining after harvesting is a major challenge to deal with. These biomasses are lignocellulosic in nature as they contain cellulose, hemicellulose and lignin. They are not economically used; rather they are disposed of in the open environment or burnt, causing serious health problems and environmental pollution. Lignocellulosic biomasses are assessed for the use of anaerobic digestion with the objective of generating biogas from it and performing kinetic study on the produced biogas. The aim of the present study is to investigate the optimum pretreatment method and performance characteristics of anaerobic digestion of lignocellulosic biomass for biogas production in batch mode. To assess the potentiality towards biogas production, three different types of biomasses were collected and characterized. Based on the results obtained from the characterization, three different lignocellulosic biomasses viz. sugarcane bagasse, wheat straw and rice husk were selected, upon which small scale anaerobic digestion was performed. In this research, therefore, an optimal achievement of the lignocelluloses plant has been evaluated in the pretreatment impact (physical, chemical and biological) and multiple biogas manufacturing parameters. The pretreatment method focused on removal of lignin content by applying different alkaline and acid condition and then anaerobic digestion of pretreated biomass (WS, RH and SB). The parameters considered for the analysis TS of biomass, temperature of substrate, C:N ratio and pH.

Biologically, Lignocellulose biomass gave maximum biogas yield followed by acid and alkaline treatment. Among thermal treatments, best results in the increase of methane formation were observed with the treatment of wheat straw followed by sugar cane bagasse and rice husk at 121°C & 120 minutes (19.8%, 18% and 13%, respectively). Acid pretreatment at optimized condition (30%, (60 minutes) and % increase in methane content is found maximum with anaerobic digestion of wheat straw (25%), sugarcane bagasse (20%) followed by rice husk (17%). Acid pretreatment has maximum impact on biomethanation of wheat straw biomass at optimized condition. Biological pretreatments performed with a fungal strain, improves methane production. The percentage increase in methane content after pretreatment with fungal strain is found maximum for wheat straw (34%), followed by sugarcane bagasse (30.2%) and rice husk (27.7%) respectively. Findings also show that these biomasses have high volatile matter content (above 60%) and high fixed carbon content (above 10%) which make them potent for biogas production. Effect of total solid and particle size of biomass on biogas production was studied and it was found that with 8-9% of total solid and 0.355 mm of particle size, maximum amount of biogas can be produced. Effect of temperature on biogas production from lignocellulosic biomass was also studied at five different temperatures from 35°C to 55°C at a step of 5°C and it was found that with increase in temperature of the digestate from 40°C to 55°C, biogas production from substrates can be increased. It is also observed that in mesophilic condition, biogas generation is the highest at 35°C followed by 40°C. Alongside the biogas delivered, AD additionally changes the additional feedstock into digestate that can be utilized as compost which is high in nitrogen, potassium and phosphorus substance. The N (%) from spent slurry from anaerobic assimilation of biomass (WS, RH, SB) was in the scope of 0.93 to 0.98, most noteworthy P(%) and K(%) found from slurry of anaerobic processing of rice husk.

Biography

Rajan Sharma had done PhD in field of biomass to biofuel from university of petroleum and energy studies, India. He had worked in different project of biogas. He attended various national and international conferences and author of three books. His research area is biomass to biofuels.

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