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DILIGNIFICATION OF LIGNOCELLULOSIC WASTE BY DIFFERENT PRETREATMENT METHOD

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ABSTRACT

Lignocellulosics are most viable raw materials which can be utilised for the fermentative production of ethanol. However, to convert then for biodegradation /hydrolysis these need to be pretreated by various methods. In the present study biodegradability/digestibility of bagasse has been increased using different physical and chemical methods. The reagents used for pretreatment of lignocellulosic waste are NaOH, H 2 SO 4 and HCl whereas grinding, milling, steam explosion have been used as physical methods. In all the methods used significant removal of lignin has been obtained, which ranged from 32-85%. Alkali treatment and steam explosion gave best results. Sulphuric acid too was effective in removing of lignin and increasing the digestibility of cellulose but hydrochloric acid was comparatively less effective and required more time and drastic experimental condition.

Keywords: *Lignocellulosic Waste, Pretreatment, Delignification, Lignin*.

Introduction

Fossil fuels including crude oil have been major resource to meet global energy demand till now. fossil resources are continuously diminishing and at same time prices are increasing at fast pace. The demand for energy is continuously increasing owing to rapid industrialization along with burgeoning population expression all over world.

At present global annual demand of petroleum products in 1700 million metric tones. Ethanol is viewed as alternate fuel which could partially or fully replace gasoline. Use of bio-ethanol as new able transportation fuel could potentially after many benefit scientist believe that in near future, no other sustainable option for production of transportation flues will be able to match ethanol made from lignocellulosic biomass with respect to its environmental, economic strategic and infra structural advantages.

Compared to fossil fuels bio-ethanol contribution to net emission of CO2 is low blended with gasoline, combustion of ethanol in car engine cover emission of many pollutants such as co, hydrocarbons and volatile organic compounds.

Furthermore, ethanol increases octane numbers. Ethanol can also be mixed with petrol up to 20% for such blends of 5%,10%and 20% country's demands shall be5000,10000 and 20000 million liters annually against annual distilled capacity of distilleries been 3550 million liters with ethanol production of 2000 million litres.

As such there shall be huge gap b/w demand and supply of ethane which can not be met by present capacity of molasses bases distilleries. From time to time in glasses byproducts of Indian sugar indices can been in short supply a result of which capacity utilization or distillers has been only 60% molasses shortage can be compensation only by using other renewable raw materials like sugarcane juice, sweet sorghum juice, burn rice ,millets etc.

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In United States corn is utilized for products of ethanol over 80%. In our country too few distilleries as grain based but owing to government ban on use of coals for ethanol production. These are not likely to be uses for fermentation production of ethane in near future. Under such as condition alternate remains they lignocellulosic wastes which are available in plenty and then utilization for ethanol production can definitely solve energy problem of our country forever.

Objectives

The study was conducted with following objectives in view:

- To investigate commercial process for ethanol production from wheat straw, rice husk, wood chips and bagasse by increasing efficiency of separate steps and reducing processing costs.
- To main emphasis should be on pre-treatment and enzymatic hydrolysis step along with ethanol recovery.

Methodology

For general chemical expression of converting natural glucose base carbohydrates to bioethenol, it may be expressed as following.

(C6H10O5)n + n H2O → nC6H12O6 → 2nC2H5OH +2nCO2

Pretreatment processes will be applied to lignocellulose prior to hydrolysis and fermentation in order to liberate cellulose from surroundings of lignin and hemicelluloses. Physical, chemical, and biological pretreatment methods will be used in pretreating lignocelluloses.

Chemical Pretreatment

These pretreatment using chemicals is most studied technique used for the recovery of sugar from the cellulosic material. Chemicals reagents used for degradation of lignin from cellulosic waste are oxidizing agents alkali, acid and salt. Some powerful oxidizing agent such as O_3 and H_2O_2 can also used for removal of lgnin.

- **Alkaline Pretreatment**: In this method generally bases are used, such as hydroxides of calcium(Ca), sodium(Na) , ammonia(NH_3) and potassium(K). This pretreatment causes the degradation of ester (RCOOR) and glycosidic side chains.
- **Acid Pretreatment**: This process is the most employed technique used to disrupt the lignocellulosic matrix. The most well-studied applications of the acid pretreatment are in bioethanol and biogas production. Furthermore, this pretreatment has been improved using solid catalysts and by increasing the solid loading.
- **Ozonolysis**: ozone(O_3) can be used to degrade lignin and hemicelluloses in many lignocellulosic materials such as wheat straw, bagasse, green hay, peanut, pine, cotton straw and poplar sawdusd. The degradation was essentially limited to lignin and hemicelluloses which were slightly attacked, but cellulose was hardly affected. Ozonolysis pretreatment has the following advantages-

Enzymatic Hydrolysis

Hydrolysis using appropriate enzymes represents the most effective methods to liberate simple sugars from cellulosic materials cellulose hydrolysis is catalyzed by a class of enzymes known as celluloses. These enzymes can be produced by fungi such as Tricoderma reesei and A. niger or bacteria such as clostridium cellulovorans.

Result

Table 1: Physical Properties of Chosen Biomass of Lignocellulose

Lignocellulosic Biomass	Rice Straw	Sugarcane bagasse	Maize stover	Napier grass
MC (%)	10.30%	12.50%	08.60%	09.20%
Bulk Density kg m^{-3}	94 kg m^{-3}	97 kg m^{-3}	89.60 kg m^{-3}	87.20 kg m^{-3}
Ash Value (%)	09.60%	17%	05.20%	05.80%

Observed Moisture content ranges from 08.60% to 12.50% as per lignocellulosic biomass whereas ash value found to be 05.20% to 17% depending on chosen feedstock.

Table 2: Chemical Properties of Chosen Biomass of Lignocellulose

Lignocellulosic Biomass	Rice Straw	Sugarcane bagasse	Maize stover	Napier grass
% Cellulose	33.70 %	35.20%	32.10%	31.80%
% Hemicellulose	25.40%	29.60%	19.70%	20.30%
% Lignin	13.50%	12.40%	14.70%	14.90%

Ranges of cellulose are found to be 31.80% to 35.20%. Likewise, % Hemicellulose and % lignin found to be in ranges 19.70% to 29. 60% and 12.40% to 14.90% respectively that are appropriate for production of ethanol via fermentation.

Pretreatment Techniques for Selected Feedstock

Selected feedstock pretreated with 01, 03 and 05 % acid (H2SO4) levels and in LSR proportion 1:10 feedstock. The diminishing sugar was assessed with various stretches as depicted area 3.3.3.1 from those outcomes, most noteworthy lessening sugar was seen at 3 percent acid level at 24 h. Subsequently ideal pretreatment conditions were upgraded as 3 percent acid (H2SO4), strong to fluid proportion (1:10) with 24 h assimilation at room temperature. The ideal compositional changed blend introduced and other mix results were arranged.

Conclusion

Ethanol from inexhaustible assets like lignocelluloses biomass and horticultural harvests buildup has been interest in late a long time as an elective fuel to the current non-renewable energy sources. Ethanol has pulled in interest as an elective fluid fuel, particularly for transportation, for two reasons. Right off the bat, the oil emergency during the 70s focused on the reliance on the inventory of petrol which can be decreased by the utilization of elective powers from sustainable assets, for example, ethanol created from lignocellulosic materials. Also, if the ethanol creation measure just uses energy from sustainable power sources, no net carbon dioxide is added to the climate, making ethanol an ecologically useful fuel source. Furthermore, the fumes discharges from and harmfulness of ethanol are lower than those of gas. The always expanding interest for the petrol based energizes and alarm accessibility has lead to broad exploration on bioethanol and its creation considers. Hence, this study has been selected to carry out suitable process of lignocellulosic material and production of maximum possible ethanol by optimizing the operational parameters.

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