Bio-Ethanol from Ligno-Cellulosic Biomass: An Alternative Transportation Fuel

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Abstract— The fossil fuel-based economy is facing several problems and challenges, such as increasing emissions of CO2, decreasing reserves and increasing energy prices. In this background green biotechnology presents a promising approach to convert most of the solid agricultural wastes particularly lingo-cellulosic materials into liquid bio based energy-fuels. This paper presents study on successful production of Bio-ethanol from Sugarcane bagasse with Dilute Acid Concentration (1-5)% and time duration of (10-30)min. for. The results showed maximum yield of Bio-ethanol at Dilute Acid Concentration of 5% and at time duration of 20 min.

Key words: Bio-Ethanol, Bio-Fuel, GHG (Green House Gas Emission), Ligno-Cellulosic Biomass, Refractive Index Meter

I. INTRODUCTION

Today, the transportation sector worldwide is almost entirely dependent on petroleum-based fuels. It is responsible for 60% of the world oil consumption. With the expansion of human population and increase of industrial prosperity, global energy consumption also has increased gradually. Import of transport fuel is affected by limited reserves of fossil fuel. Annual global oil production will begin to decline within the near future. In this scenario, renewable sources might serve as an alternative. Ligno-cellulosic materials are renewable, low cost and are abundantly available. It includes crop residues, grasses, sawdust, wood chips, etc. Extensive research has been carried out on ethanol production from lingo-cellulosic in the past two decades. Hence bio-ethanol production could be the route to the effective utilization of agricultural wastes. Rice straw, wheat straw, corn straw, and sugarcane bagasse are the major agricultural wastes in terms of quantity of biomass available. This paper aims to utilize Sugarcane bagasse for the successful production of Bio-ethanol.

II. AVAILABILITY OF LIGNO-CELLULOSIC MATERIAL

The price of the raw materials is also highly volatile, which can highly affect the production costs of the bio-ethanol. Ligno-cellulosic materials serve as a cheap and abundant feedstock, which is required to produce fuel bio-ethanol from renewable resources at reasonable costs. Ligno-cellulosic materials can be classified in four groups based on type of resource: (1) forest residues, (2) municipal solid waste, (3) waste paper, and (4) crop residue resources. Literature reports several papers on utilization of various lingo-cellulosic waste materials such as rice straw, corn stover, switchgrass, palm bagasse.

III. EXPERIMENTAL PROCEDURE

Sugarcane bagasse is collected from a Commercial stall. Raw Sugarcane bagasse is washed with tap water to remove dirt. After that it is oven dried for 24 hours at 105°C. Dried sample is again grinded in a mixer for size reduction. Grinded material passed from 40 no. mesh is collected and used for the further process. With 1 gm of Sugarcane bagasse powder Acid Hydrolysis is carried out by varied Acid Concentration of (1-5)% with retention time ranges from (10-30) min. Un dissolved Lignin during acid Hydrolysis is removed by Filtration. For finding out Sugar concentration in the filtered sample Phenol Sulphuric acid method is used. pH is maintained in the acidic range for the successive fermentation process. Fermentation is carried out for 7 days and then sample is centrifuged for the removal of dead yeast. Remaining sample is analysed in Refractive index meter to find out (%) Bio-ethanol in sample. Sugar Concentration is finding out by (Phenol Sulphuric acid method) the graph shown below in figure: 1

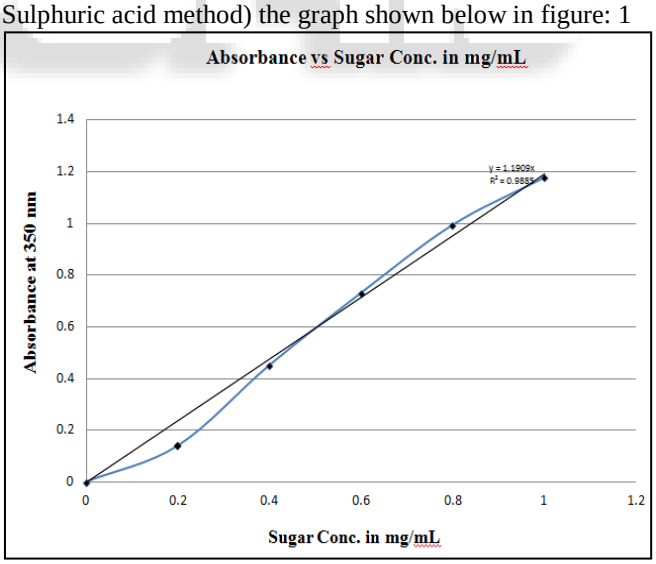

Fig. 1: Absorbance Vs Sugar Concentration in Mg/Ml.

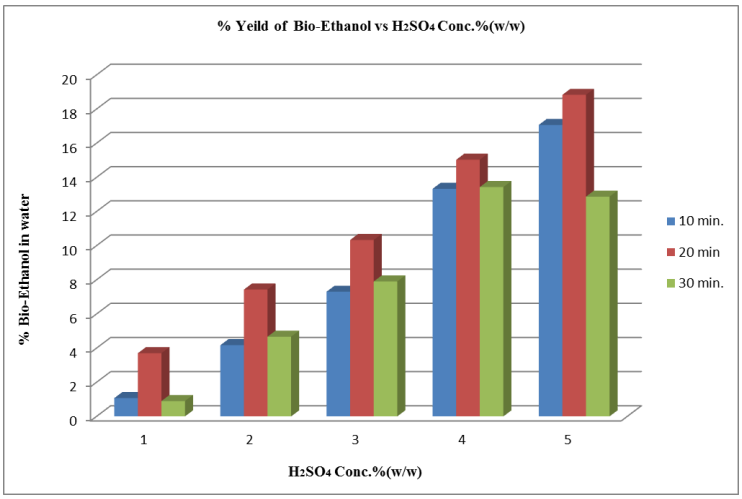

Fig. 2: % Yield of Bio-Ethanol at Different Combination of (Time, Temp. Acid Conc.).

IV. Results and Discussion

It was observed that Bio-ethanol yield was increased with increased in Acid concentration and time duration, but maximum yield was achieved at 5%(w/w) Acid concentration at 150°C for time duration of 20 minute. After that the yield was decreased because yeast can not tolerate high concentration of ethanol. And also there will be a problem of Corrosion in Auto mobile Engines with increase in Acid concentration.

V. Bio-ethanol as a transportation fuel

Bio-fuels include bio-ethanol, bio-methanol, vegetable oils, biodiesel, biogas, biosynthetic gas (bio-syngas), bio-oil, bio-char, Fischer–Tropsch liquids, and bio-hydrogen. The term bio-fuels can refer to fuels for direct combustion for electricity production, but is generally used for liquid fuels for transportation sector. Renewable liquid bio-fuels for transportation have recently attracted huge attention in different countries all over the world because of its renewability, sustainability, common availability, regional development, rural manufacturing jobs, reduction of GHG emissions, and its biodegradability. Bio-ethanol is ethyl alcohol, grain alcohol, or chemically C2H5OH. It has high octane number, both permit the rising of the compression ratio and gives lower emission. Octane number is a measure of the gasoline quality for prevention of early ignition, which leads to cylinder knocking. The fuels with higher octane numbers are preferred in spark-ignition ICEs. An oxygenate fuel such as bio-ethanol is provides a reasonable antiknock value.

VI. Future scope

This batch study can be modified into continuous study where in water sample after distillation which may contain some sugar can be recycled into fermentation unit, So there will be no liquid waste generation after Distillation. Relatively low yields of ethanol can be a major problem in this bioconversion, as yeasts can not tolerate high ethanol concentrations. Once ethanol concentration reaches in between (15 to 20 %) it inhibits the growth of micro-organisms. But in future approaches has to be made for improving yeast metabolic flux and fermentation rate and selection of yeast with higher ethanol tolerance for higher yield of bio-ethanol. One more alternative approach, aiming to enhance ethanol tolerance of the yeast through modification of growth medium composition.

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