Experimental Studies on Generation of Ethanol from Paper Waste

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ABSTRACT— At this time India is witnessing a new phase in development with rapid economic growth and high rate of urbanization. Construction provides the direct means for the development, expansion, improvement and maintenance of human settlements is particular and economic growth in general. Construction activity accounts for more than 50% of the development outlays in India. For a developing nation like India, the current energy portfolio is dominated by fossil fuels such as oil, coal, and petroleum products. Due to the rapid depletion and limited available resources, the price of fossil fuel increases. Also, fossil fuel induces climate change, environmental pollution, and rising global temperature. There is urgent need to shift from conventional energy to renewable energy source for sustainable and economic growth and to enhance a country's energy security. Bio-fuel offers an attractive source of energy for the substitution of fossil fuels, and looking at the huge demand for diesel in all sectors of the economy, the biodiesel is being viewed as the best substitute for diesel. The other advantage for bio-fuel promotion in India is climate change mitigation through reduced greenhouse gas (GHG) emission. This article provides the current status of biodiesel development in India and discusses the role played by the Centre and state government in promoting second-generation feedstock (non-edible seeds) and third-generation feedstock (algae) for biodiesel production.

Keywords: Ethanol, Bio-fuel, Bio-diesel, Renewable Energy

I. INTRODUCTION

Ethanol is an alcohol fuel that's distilled from plant materials, such as corn, sugar, rice paddy. Alcohol fuels have been around for years, typically mixed with gasoline in a blend also known as gasohol. E10, with a ratio of 10% ethanol to 90% gasoline, can be used in any internal combustion engine, and many oil companies already blend their fuels that way. Methanol, mostly used in race cars, isn't popular for other vehicles because it isn't as clean and it also relies on fossil fuels. The use of these fuels in higher proportions requires modification to the fuel storage and delivery systems on cars and trucks. E85, a mixture of 85% ethanol to 15% gasoline, can be used in flex-fuel vehicles, and car enthusiasts have modified their vehicles to run on ethanol or methanol alone, with mixed results. One point that's commonly overlooked is that alcohol is about half as energy-dense as gasoline, so you can only go half as far on a tank, because ethanol is biodegradable, nontoxic, and dissolves in water, E85 has been praised by the U.S. Department of Energy (DOE) as producing emissions that contain less carbon dioxide and carbon monoxide than emissions from vehicles that run on gasoline. As the supply of gasoline diminishes, the current E85 standards that require the mix to contain 15 percent gasoline are being challenged to allow a greater proportion of ethanol.

Ethanol has become a very important agricultural product over the past two decades. In 2005, more than 13% of U.S. corn production went toward making this fuel additive/fuel extender, which lessens U.S. dependence on foreign oil imports, is cleaner for the environment, and has substantial impact on the rural economy and agriculture production. Ethanol is an alcohol produced by yeast from sugars. It is the same alcohol produced by yeast in beer, wine, and spirits. Fuel ethanol is ethanol that has been highly concentrated to remove water and blended with other compounds to render the alcohol undrinkable. Fuel ethanol can be used alone as a fuel, such as in Indy Racing League cars, or can be blended with gasoline and used as fuel. All ethanol production is based upon the activity of yeast (Saccharomyces cerevisae), an important microorganism to humans. Through a process called "fermentation," yeast eats simple sugars and produce carbon dioxide (CO2) and ethanol as waste products. For each pound of simple sugars, yeast can produce approximately ½ pound (0.15 gallons) of ethanol and an equivalent amount of carbon dioxide.

In India Ethanol is produced mainly produced from Sugarcane molasses which is a byproduct obtained from the sugar industry .Since it is rich in glucose it is easily converted into ethanol by yeast. They are known as First generation fuels as they are made from seeds, grains,

sugars. While corn is the most widely used feedstock in the western countries like Brazil and the USA. Petrol and diesel are the most widely used fuels for automobiles in India with exception of a very few places using Natural gas. Bioethanol can be blended with gasoline/petrol known as gasohol for use in vehicles. The amount of environmental pollution caused by the fossil fuels by means of its products of combustion like Carbon dioxide, carbon monoxide, nitrogen oxide and sulphur is more when compared to natural gas, Bioethanol and biodiesel.

Apart from the known usage of ethanol as a fuel, about 45% of the produced ethanol is being used as potable alcohol, 40% in the industrial sectors and only the remaining is available for blending with petrol. In the industrial sectors ethanol is used by chemical, pharmaceutical industries etc. It is also used to produce Ethyl Tertiary-Butyl Ether (ETBE).

There are three methods of pretreatment of the biomass namely; physical, chemical and Biological. At an industrial level biological process is the preferred since it does not produce any unnecessary byproducts. The targeted reactions are only carried out which is required for the product formation thus the remaining biomass after product extraction could be used for any other purposes like animal feed. Since all the biological reactions happens at optimum conditions, the production cost is also less when compared to other methods. Starch is made up of amylase and amyl pectin. It is made up of alpha 1.6 and alpha 1.4 linkages. When Starch is cooked at a high pressure and temperature, it is gelatinized, enabling the enzymes to access and digest the polymers. Dry grind method was used in this project for the production of ethanol, mainly because it is economical, gives high yield and also because the whole corn kernel could be used unlike the wet milling process that involves the separation of starch, germ, fiber etc. When it comes to the fermentation process yeast is the most widely used organism. Simultaneous saccharification and Fermentation (SSF) process was used. In a single reactor, yeast is added along with the saccharifying enzymes which produces the glucose units and they were immediately converted into ethanol. In this way there are no chances of glucose accumulation and also the produced ethanol prevents the microbial contamination. The selection of microorganism is one of the important factors for the production as it should be able to with stand the osmotic pressure and tolerance to ethanol. Yeast has been a commonly used organism since several decades and hence the same was used.

II. METHODOLOGY

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A. Materials

Corn starch extract, waste paper(100g/sample), yeast(75g), Diammonium phosphate(9g), Distilled water (pH 7.0), Water (pH 8.2), N/10 H_2SO_4, N/10 HNO_3, N/10 HCL , Diammonium Phosphate , Corn, Paper Waste, Baker Yeast.

2.2 GENERATION OF ETHANOL FROM WASTE PAPER

The present study deals with the study of producing Bioethanol from the waste tissue papers by the process of fermentation. Samples were collected from the three different markets located in Raipur. Regular visits done for the sampling purposes and regular laboratory work were also done. Samples were collected manually according to the sampling plan in the plastic bags. Every time three samples were collected from the three market to make one composite sample. Hence, random samples were collected to make 09 composite samples.

Each sample contains 100gm of the paper waste. Samples were taken in the clean plastic bags. Plastic bags were capped properly and preserved at the room temperature.

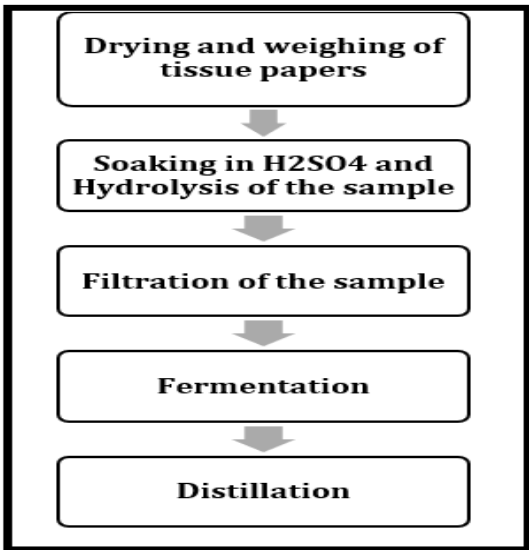

Figure:1 Process for generation of ethanol

1. Drying and weighing of tissue papers:

The drying of tissue paper waste was done at first. The papers were placed in an oven at 800C for about 40 minutes until all the moisture content was removed from the papers. After drying the paper waste was weighed. For this purpose the weighing balance was used. Different samples were prepared in which nine samples with 100 g paper waste. To produce ethanol from the paper waste, one sample was prepared with 100 g of paper. For this purpose the weighing balance was turned on. The samples in a tray were placed on it and the reading of desired weight was noted in grams on weighing balance.

2. Soaking in H2SO4 and hydrolysis of the samples:

Next the tissue papers were soaked in H2SO4 (5 % by weight of H2SO4) similarly, NAOH and HCL. The H2SO4, NAOH and HCL was taken in the different variations i.e. 300ml, 400ml, 500ml, 600ml, 700ml, 500ml, 500ml for the tissue papers, papers and mixture of both (50g tissue papers and 50g papers) respectively. Afterwards the samples were placed in the autoclave for the hydrolysis. Acid hydrolysis was done due to its economic importance. The autoclave was maintained at 1200C for about 3 hours.

3. Filtration of the samples:

The filtration of all the samples was done in the filtration assembly. The filtration was done twice in order to get the pure filtrate without any residue. The second time, filtration was done by the help of filter paper. Different quantity of the filtrate can be obtained from the different samples.

4. Fermentation:

The fermentation of all the samples was done at the room temperature. The fermentation can be done by adding Yeast (Sacchromyces cerevisiae) in each sample. The Yeast can be added in the different concentration i.e. 2.5g, 5g, 10g, 15g, 20g, 10g and 10g respectively. The samples were placed at 300C for the fermentation for about 48hours.

5. Distillation:

After fermentation all the samples were ready for the distillation. The distillation was done in the distillation assembly for about 8hours. The distillation can be held twice in order to optimize the production of Bioethanol in the final product. In order to get the large quantity of Bioethanol, another sample was prepared with the different concentrations of all things in it. In that sample 900g of tissue papers were soaked in 3500ml H2SO4, NAOH, HCL.The amount of 400ml of Diammonium sulphate solution (1g Diammonium sulphate dissolved in 300ml distilled water) was added in order to neutralize and the amount of Yeast added was 150g for fermentation and after fermentation the sample was left for the distillation (twice).

III. RESULTS AND DISCUSSION

Table-1: Ethanol Obtained (in percentage)

Sample no.	Samples	Ethanol Obtained (in percentage)
1	300 ml HNO_3 + 100 gm of paper	16%
2	500 ml HNO_3 + 100 gm of paper	40%
3	700 ml HNO_3 + 100 gm of paper	57%
4	300 ml H_2SO_4 + 100 gm of paper	12%

5	500 ml H_2SO_4 + 100 gm of paper	35%
6	700 ml H_2SO_4 + 100 gm of paper	49%
7	300 ml HCl + 100 gm of paper	9%
8	500 ml HCl + 100 gm of paper	29%
9	700 ml HCl + 100 gm of paper	41%

The given table has the values of ethanol percentage(v/v) of ethanol and the acid which is used for acid hydrolysis are as mention in the table as well .The distillation process which is carried out is a single distillation all acid has which is carried out is a single distillation. From above table, different ethanol percentages are obtained by using different solutions of varying quantities. When 300ml of HNO3 was mixed with 100 gm of paper then the percentage of ethanol obtained was 16, when mixed with 500ml of HNO3 the percentage of ethanol increased to 40 on further increment of solution of HNO3 it became 57.

Similarly, with the other two solutions of H2SO4 and HCL, that when their quantities were increased the percentage of ethanol obtained was also increased, when 300ml of H2SO4 was mixed with 100 gm of paper then the percentage of ethanol obtained was 12, when mixed with 500ml of H2SO4 the percentage of ethanol increased to 35 on further increment of solution of H2SO4 it became 49 and that with HCL the percentage obtained were, when 300ml of HCL was mixed with 100 gm of paper then the percentage of ethanol obtained was 9, when mixed with 500ml of HCL the percentage of ethanol increased to 29 on further increment of solution of HCL it became 41. The maximum percentage was obtained from was HN03, that the minimum quantity gave the maximum percentage, when compared to other samples.

IV. CONCLUSION

Although there is currently a well-known glut of certain grades of wastepaper such as ONP, the demand for wastepaper from the domestic and foreign pulp and paper industries is predicted to increase dramatically.

2. This industry represents the largest competitive demand for wastepaper and can outbid ethanol production for the wastepaper it wants. Because it wants mostly well-sorted and uncontaminated wastepaper, wastepaper in the mixed paper category collected before and after its introduction into MSW represents the largest potential source of wastepaper.

3. Even if the aggressive wastepaper utilization rates predicted for the domestic and foreign paper and paperboard industries are achieved, there exists the possibility of producing 1-2 billion gallons of ethanol from wastepaper collected prior to MSW-mostly from mixed papers and from smaller contributions from OCC and ONP, mostly as feedstocks with mixed papers and perhaps from wood and herbaceous crops.

4. A techno economic analysis was performed of a hypothetical wastepaper-to-ethanol process based on current laboratory scale data. From this analysis it was found that a 2,000-tpd wastepaper-to-ethanol plant could produce ethanol at prices competitive in today's ethanol market, which allows tax credits for ethanol blended with gasoline. The competitiveness of ethanol in this case could be maintained for wastepaper priced as high as Rs 4424/ton. Wit110ut the tax credits, current technology could be competitive in the current oxygenated octane enl1ancer market using wastepaper priced at about Rs 700/tonne.

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