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Production of Biofuel from Wastepaper: A Review

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Abstract — *India is the world's fifth largest energy consumer and it is expected to become the third largest by 2030. India has only 0.4% of the world's proven oil reserves. India's domestic natural gas reserves are also limited. Fossil fuels are also be used as energy source in future. Ii is important to take steps towards renewable energy sources for preserving fossil fuel sources for future. Biofuels are helpful to solve the energy security problems in India. It is important to proceed towards non-edible feedstock for energy production and use of non-agricultural lands for the production of feedstock for biofuel. This will solve the problem of food v/s energy security.*

Keywords-*Energy Source, Fossil Fuel, Biofuels, non-edible feedstock*

I. INTRODUCTION

With increase in population demand for motor-vehicles is increasing day by day. India is the second largest country in population after China. Automobiles are the lifeline to the day to day life at the same it is responsible for the air pollution also. India's fuel consumption surged 10.9% to 183.5% million tonnes in 2015/16 which is likely to hit 200 million tonnes in 2016/17. As conventional fuels are limited it is required to focus on alternative fuels. Biofuels are the best alternatives to the conventional fuels as they emit less pollutants and helps in reducing air pollution. It is a prime need to switch on renewable fuels because of non-renewable fuels are depleting day by day. Moreover they are the main source of Green House Gases (GHG). India is 4th largest country in GHG emissions. So biofuels can be one of the solution to the conventional non-renewable fossile fuels. Biofuels are renewable source of energy. Biofuels are helpful to replace petroleum products like diesel, oil, coal or addition of biofuels in such petroleum products will help in reducing conventional fuel consumptions as well as reduces GHG emissions. Liquid biofuels are the only alternatives to the current transport fuels. Biofuels can be produced from the edible and non-edible crops as well as agricultural waste. At the initial stage biofuels are blended with petroleum up to 3 to 4% for checking efficiency of biofuels. Biofules are of 1st, 2nd, 3rd and 4th generation. First generation biofuels are made from food crops like sugar, starch, vegetable oil are converted into biodiesel or ethanol with the help of fermentation and transertification process. Second generation biofuels are the one produced from biomass mainly lignocellulosic biomass, agricultural residues, woody crops or waste plant material. Third generation biofuels are made from algae which is rich in oil content up to 50%. The production of algae to obtain biofuel has not been undertaken yet. Fourth generation biofuels are electrofuels and photobiological solar fuels.

II. INDIA'S BIOFUEL POLICY

Biofuels provide a higher degree of energy security nationally, sustainable, cost effective and environment friendly. Biofuels reduces dependency on conventional fossile fuels as vast rural population of india uses fossile fuels in their daily routine. GOI is encouraging and promoting first and second generation biofuels at initial stage. The total power produced from the biomass is estimated up to 40,000 MW of which the power generated through bagasse is estimated to 10,000 MW. GOI approved the National Policy on Biofuels on December 24, 2009 which encourages use of renewable energy sources instead of conventional fuels used in transportation. The target for National Policy is to replace 20 percent of petroleum fuel with biofuel by the end of year 2017. The main focus was on implementation of ethanol blending program (EBP). The GOI recommended 10 % blending of ethanol mandatory with gasoline across all states. Currently ethanol supply for recent year 2016 is meeting 1.9% blending target. Ethanol policy was revised in January 2003, blending 5 percent ethanol in gasoline. Currently 5% blending target is achieved but blending of ethanol up to 10% with p

III. BIOFUEL PRODUCTION FROM WASTE PAPER

Pooja H. et.al. (2016) has conducted an experiment to produce ethanol by the synthesis of waste newspapers. As it contains 40-55 % of cellulose content. In this study bioethanol was obtained by fermentation of various lignocellulosic sources. Collected waste paper was shredded and then soaked in water and oven dried. Deinking of waste paper was performed before hydrolysis of substrate. After hydrolysis fermentation was done by Saccharomyces cerevisiae microorganisms to obtain ethanol. After the ethanol is obtained it was purified by

distillation process. The study concluded that from the 100 ml of liquor 40 ml of methanol can be produced having purity of 68%. Thus the study says that the waste paper can be effectively utilized for bioethanol production.

D. Prema et.al. (2015) has studied on the ability of Pseudomonas aeruginosa to produce biofuel by ferementation of waste paper. The optimum conditions for the process are incubation period of 72 hours, temperature about 35-37°C, pH 8, nitrogen source Yeast extract and carbon source cellulose were found in this study. Yeast Saccharomyces cerevisiae showed maximum ferementability of glucose, mannose and glactose in hydrolysis process of waste paper hydrolysate. In this paper waste paper was collected from Karunya University premises, Coimbatore in polythene bags. The substrate was shredded into small pieces using electric blender. Physical and chemical pretreatment consist of oven drying at 65 °C for 24 hours and pulverization in electric blender. Then substrate was kept for hydrolysis for 6 hours and than again oven dried for 24 hours. After hydrolysis culture of Pseudomonas aeruginosa and yeast for the fermentation of substrate is prepared and after the fermentation of substrate ethanol is produced and ethanol is purified by distillation process.

Michael Ioelovich (2014) has studied that the waste of office paper is best suitable as it contains high percentage of cellulose and negligible content of lignin. In this paper advanced technology is used for the ethanol production which consist of redispersion of waste paper and screening of waste paper to remove mineral fibers from waste paper, acidifcation and washing of fibers to remove $CaCO_3$ and hydrolysis of substrate to get fermentable glucose. After this glucose is fermented to obtain Biofuel. The results shows that 1 ton of office waste paper can produce bout 280 L of bioethanol having calorific value about 1680 kWh.

Giada Franceschin et.al. has studied the treatment of white office paper by LHW(Liquid Hot Water) treatment. Laboratory scale experiment was conducted to examine the sugar yield after enzymatic treatment. The enzyme complex, AccelleraseTM 1000 was derived from modified strain of Trichoderma reesei for hydrolysis of lignocellulosic biomass. The LHW treatment consist of fixed bed reactor in which 28 g of waste paper was treated in each experiment at pressure of 60 bars at reactor temperature 25 to 250 °C. The experiment was conducted to study the pretreatment of lignocellulosic mayerial of office paper. It was observed that at 214 °C the biological material was completely degraded. The treatment of hydrolysate gives the sugers from office paper and after the fermentation ethanol was obtained.

Bibi Zainab et.al. (2014) has conducted an experimental study to check the efficiency of waste tissue paper for the ethanol production by saccharification process of waste tissue paper some other kind of waste papers. For the study samples were collected from the different restaurants. Samples were kept in oven at 100 °C for 40 minutes for drying. After that samples were soaked in sulfuric acid for the hydrolysis and then filtered to remove residue from it. After filtration filtrate was neutralized by adding KOH solution to the different concentrations about 50 ml, 75 ml, 100 ml, 125 ml, 150 ml, 40 ml and 25 ml. Fermentation of waste paper was carried out by adding yeast (Sacchromyces cerevisiae) in different concentrations about 2.5 g, 5 g, 10 g, 15 g and 20 g respectively. After that distillation was carried out to obtain pure ethanol for about 8 hours.

J. M. T. S. Rocha et.al. (2014) has studied the saccharification process of waste office paper for the production of ethanol. Spathaspora passalidarum HMD 14.2 microorganisms were used for the fermentation od glucose, xylose and cellulose content of waste paper. The fermentation efficiency was about 82% and volumetric ethanol production was 0.57 g/L/h.

Dr Reena has conducted study on the various non-edible feedstock for the production of biofuel like biofuel from banana, plantain and pineapple peels, from mango, from orange peels, from orage, apple and tangerine, from plastic and from paper. Food supply chain waste is becoming as a raw material for the biofuel production. Use of such kind of fuel reduces exhaust emissions and thus by reducing the impact of global warming. Biofuels obtained from the various wastes like agricultural waste, food waste, municipal solid waste, paper waste, plastic waste solves the problem of food security. The production of biofuel from waste paper is becoming new trend now a days and one of them is biofuel production from waste paper. This process includes Redispersion and then screening of waste paper to remove mineral fibers from it then Acidification and washing of fibers to remove the $CaCO_3$, Hydrolysis of waste paper by different yeast cultures to obtain fermentable sugar and fermentation of sugar for obtaining bioethanol. The study concluded that about 280 L of ethanol can be produced from 1 ton of waste paper and waste paper can be a promising feedstock for ethanol production from waste paper.

3.1. Common Procedure for making Biofuel from Waste Paper

Raw waste paper collected is finely grinded into small pieces to increase the surface area and then soaked in water for one day. Soaking helps in separating cellulose from wastepaper. After a day wastepaper is filtered out and mechanically crushed and converted into pulp. Dried pulp is mixed with 15% H_2SO_4 for 1 day for the purpose of removing ink from wastepaper as it affects the final yield of ethanol. After this process the mixture is washed with water and dried. After deinking of wastepaper the amount of cellulose is determined using Carboxyl Methyl Cellulose was used as a standard component. Acetolysis is performed in which cellulose gets dissolved to form cellodextrins which gets dissolved and hydrolysed to form glucose molecules when treated with 57% H_2SO_4. This final glucose molecule is dehydrated to form hydroxyl methyl furfural which forms green colour product with anthrone method and the colour intensity is measured at 630nm. After this cellulose molecules are hydrolysed to broken into small particles. After this fermentation of slurry is carried out with the help of *Saccharomyces cerevisiae*

anaerobically for 3 days at pH 4. At the end of fermentation ethanol and other constituents are filtered. The fermented liquor is than distilled at the temperature 85-89% and the pure ethanol is derived at the end with water vapour which can be separated by reflux method. By using this method blending with H_2SO_4 68% pure ethanol can be obtained. For every 100 ml of fermentation 40 ml of ethanol is obtained.

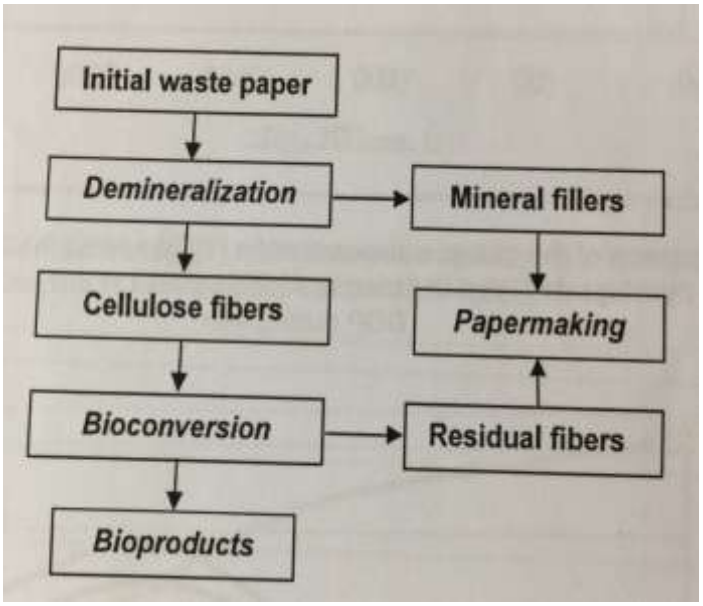

Figure 1 General Procedure for making Biofuel from Wastepaper

IV. CONCLUSION

Waste papers are rich in cellulose content which can be effectively used for the production of bioethanol up to certain level of purity. Studies on production of biofuels from wastepaper shows that Pseudomonas aeruginosa and *Saccharomyces cerevisiae* are effective for producing best quality ethanol which is one of the first generation biofuel used with conventional petroleum fuels.

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