ETHANOL PRODUCTION FROM NEWS PAPER WASTE

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Abstract

Newspaper waste, is the one of the impotant problem for disposal in many countries due to its landfill capacity. Removal of paper waste is a challenging task in managing the solid waste. Newspaper is emerging as an attractive option for the production of bio-ethanol because of lower feedstock costs. It also has higher potential for fossil fuel displacement due to which there will be reduction of green house gas emission.. The main objective of the current project is to minimize the newspaper load on municipal solid waste by efficiently utilizing the waste newspaper in the production of bio-ethanol by Pretreatment, hydrolysis and fermentation.

Keywords-; Ethanol, Pretreatment, hydrolysis, fermentation.

Introduction

The population of the country is increasing day by day. So its leads to increase in the consumption of energy (Hanh-Hagerdal B., *et al*., 2006). Crude oil is used as the fuel in order to reduce the energy crisis. Crude oil is prepared from the fossil fuels. Due to the continuous usage, the fossil fuel in the earth is vanishing. So that we need to reduce the petroleum usage and switch to an alternative method. One of the best alternative fuel is the biofuel which beat the energy crisis. Biofuel can be prepared from directly from plants and indirectly from industrial, agricultural and commercial waste. So that it is an environmental friendly fuel. Biofuel can be produced from starchy material such as corn, sugar cane and honey. It can also be produced by means of different sources like waste chicken feathers, cellulosic biomass food, organic waste and paper waste. The various types of biofuels are biodiesal, Biogas, Ethanol. The utilization of renewable carbohydrate sources for the production of bioethanol has stimulated it interesting (Bandaru, V.V.R., et al., 2006). Waste newspaper constitute a large amount of muncipal or industrial waste. In recent years, the recycling is strengthened. But only 66% of the manufactured paper is recycled (dubey et al. 2012). Others are disposed in to the environment. Collecting these type of paper and use it as the raw material for bioethanol production. In the present study waste paper is used for ethanol producton in terms of pretreatment techniques, enzymatic hydrolysis and fermentation conditions based on different paper grades.

METHODOLOGY

Collection of Sample

The waste paper was collected from the paper mill and weighed the paper for 50 g. The paper then made in to small pieces.

Preparation of media

Sugar (dextrose)-2g , yeast extract-1g, urea-1g, peptone-2g and $MgSO_4.7H_2O$-1g was added in to the 100 ml distilled water in a conical flask and stirred well. Capped the conical flask and place it in the sterilizer for 30 min. After cooled in to room temperature, place it in the refrigerator for 24 hr. Inorder to cultivate the yeast, 1.2g of potato dextrose broth is mixed with 50ml distilled water in a separate conical flask. Place the conical flask in the sterilizer for 30 min. After that, the colony from the yeast strain was picked and inoculated in to the PDB. Then close the conical flask using cotton and place it on the fungal incubator for 24hrs. 500µl PDB broth is added in to the media. Then place it in a shaker for 24 hrs at 30^0C and 200 rpm.

Steam Pretreatment

The 50 g of raw material is soaked in the 500 ml of distilled water in a conical flask and capped the flask using aluminium foil. Place it in the room temperature for 24 hrs. then it was placed in the autoclave at 121^0C for 15 min. After finishing the pretreatment process, it allow to cool. Then the soluble and insoluble parts were separated. The insoluble part undergoes acid hydrolysis in the next step.

Acid Hydrolysis

The 3%(v/v)dilute sulphuric acid is prepared. Then it added to the non soluble part and place it on the reactor at a temperature of 140^0C and at a time of 1 hr. After hydrolysis , the waste paper part was separated by vaccum filtration. Then solid part is washed again in the distilled water in order to obtain maximum sugar. Then adjust the p^H by adding 10 m NaOH became in the range 4.9-5.2. Soluble part from the pretreatment process is added to the p^H adjusted solution. Then the solution undergoes fermentation process.

Fermentation

Before fermentation process, place the sample for 30^0C. Then mix the sample with media in 1:10 proportion. Place the sample in the shaking incubator for 72 hrs, 30^0C, and 200 rpm. After each 24 hrs, the sample were taken in to distillation process and spectrophotometric reading was done.

Distillation

Distillation was the final step. Simple distillation was done at a temperature of 85^0C for 2 hrs of 3 days sample. Inorder to obtain high purification, distillation was done for several times.

Quantitative estimation of ethanol using biochemical method

Most of the chemical oxidation methods are based on the complete oxidation of ethanol by dichromate in the presence of sulphuric acid with the formation of acetic acid. The theoretical reaction stoichiometry is shown below:

2Cr2O7-- + 3C2H5OH + 16H+ -----> 4Cr+++ + 3CH3COOH + 11H2O

For the Acid dichromate solution, 125 ml of water was added to a 500 ml conical flask. Then 325 ml of concentrated sulphuric acid was carefully added. The flask was cooled under cold water tap and 34 grams of potassium dichromate was added. Dilute to 500 ml with distilled water and Sodium Hydroxide Solution, 40 grams of NaOH was added in 1000 ml of distilled water. 10-50 microlitres of absolute alcohol was taken in different test tubes and the volume was made up to 500 microliters by adding distilled water in each test tube.30 microlitres of test sample was taken and the volume was made up to 500 microliters by adding distilled water in test tube.1 ml of potassium dichromate reagent was added in each test tube. Then 2 ml of sodium hydroxide solution was added in each test tube. The test tubes were incubated at 500C for 30 minutes. The absorbance was measured at 600 nm by using a spectrophotometer.

Result and discussion

Collection of sample

R. Maceiras, V. Alfonsín et al., (2016) produce the ethanol from waste office paper by acid hydrolysis and fermentation process. Here sufficient amount of paper waste was collected from the paper mill. The paper was prepared in to small pieces.

Pre-treatment

The sample was carried to steam pretreatment process to remove lignin, reduce cellulose crystallinity and increase porosity of the material shown in fig (1, 2).

Acid hydrolysis

The acid hydrolysis was done for breaking long chain cellulose molecule in to small sugar units. Here, the soluble part was seperated from the non-soluble part (paper waste) and performed acid hydrolysis with the non-soluble part fig (3).

Fermentation

Miroslava Zichova, Eva Stratilova et al. (2017) produce the ethanol from waste paper using immobilized yeast and according to Shruti A. Byadi, P. B. Kalburgi *et al*.(2015) the bioethanol production is maximum when pre-treatment was done at 1.5% concentration of H2SO4 at 121ºC and 45 minute. They used Cytophaga Huchnosonni bacteria for hydrolisis which convert cellulose into sugar molecule. Then fermentation was done using Yeast Saccharomyces Cerevisae. The yield of the bioethanol was estimated using specific gravity method and the value obtained is 6. 849% (v/v). yield was also teste using HPLC and the value is 6. 91%. Here in this study the fermented sample with *Sacharomyces cerevisae* was kept for 3 days incubation (72hr) undergone distillation process for every 24 hr and after spectrometric analysis the sample produced 5.356 µl/ml fig.6 (table 1). The density obtained after distillation was 0.9814 g/ml fig (4,5). The concentration (% weight) of ethanol in water was 10.3178%.

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Legends

Figures

1. Paper soaked in distilled water

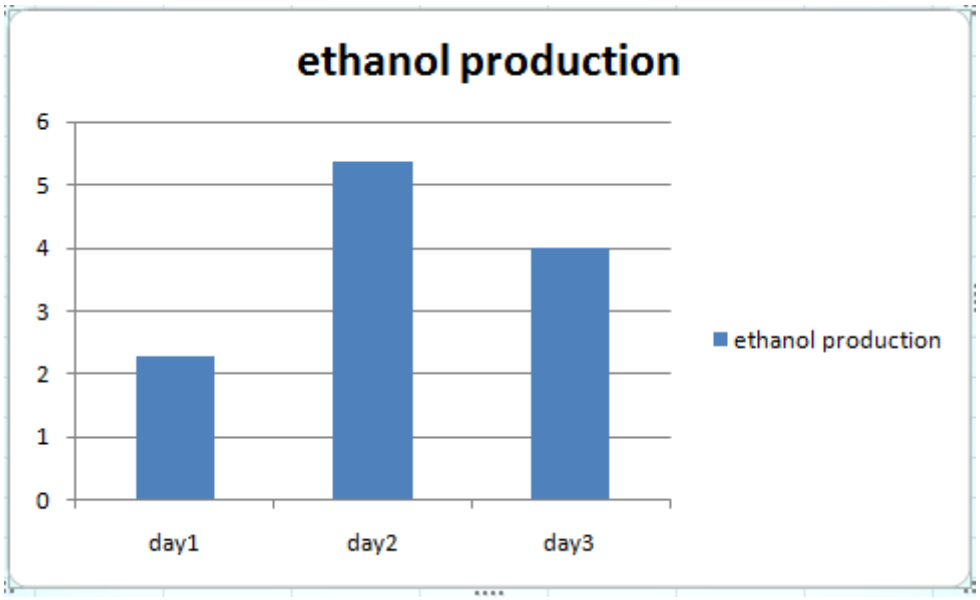
2. After Pretreatment

3. Soluble part after Acid Hydrolysis & Pretreatment

4. Sample before distillation

5. After Distillation

6. Spectrophotometric analysis of Ethanol produced for 3 days after distillation process



2. Table

1. Potassium dichromate test of ethanol

Sl.no.	Sample Name	Day1	Day 2	Day 3	Ethanol
1	Paper waste	2.30µl	5.356 µl	4 µl	5.356 µl