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Study on facile method for cellulose degradation from waste paper

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ABSTRACT

The facile method the hydrolysis of cellulose from waste paper material has been worked out. Very mild conditions are used for cellulose breakdown to glucose. The glucose produced in this technique was also estimated qualitatively as well as quantitatively. The production of ethanol from the glucose was also studied qualitatively.

Keywords: Cellulose degradation, Glucose

INTRODUCTION

Literature survey reveals that The basic material for the production of first generation biofuels are often seeds or grains such as wheat, which yields starch that is fermented into bioethanol. There are two common strategies of producing biofuels. One is to grow crops high in sugar like sugar cane, sugar beet, and sweet sorghum and then use yeast fermentation to produce ethyl alcohol. The second is to grow plants that contain high amounts of vegetable oil, such as soybean, jatropha, or pongamia pinnata. When these oils are heated, their viscosity is reduced, and they can be burned directly in a diesel engine,or they can be chemically processed to produce fuels such as biodiesel. Wood and its by products can also be converted into biofuels such as methanol or ethanol fuel [1].

Second-generation biofuel production processes use a variety of non food crops. These include waste biomass, the stalks of wheat, corn, wood, etc. Second generation biofuels use biomass including cellulosic biofuels from non food crops [2]. Many second generation biofuels are under development such as biohydrogen, biomethanol, DMF, biohydrogen diesel, mixed alcohols and wood diesel. Cellulosic ethanol production uses non food crops or inedible waste products and does not divert food away from the animal or human food chain.. This feedstock is abundant and diverse, and in some cases it is a significant disposal problem.

The work on bifuels like butanol and ethanol has tremandous international recognition. There are international organizations such as IEA Bioenergy, established in 1978 by the OECD International Energy Agency (IEA), with the aim of improving cooperation and information exchange between countries that have national programs in bioenergy research, development and deployment. The U.N. International Biofuels Forum is formed by Brazil, China, India, South Africa, the United States and the European Commission[3] .A recent publication by the European Union highlighted the potential for waste-derived bioenergy to contribute to the reduction of global warming. The report concluded that the equivalent of 19 million tons of oil is available from biomass by 2020, 46% from bio-wastes: municipal solid waste (MSW), agricultural residues, farm waste and other biodegradable waste streams [4,5].

It is worth experimenting to devise a facile methodology for the degradation of cellulose from waste paper and to find a way ethanol production.

MATERIALS AND METHODS

Waste paper was collected from the campus of Shankarlal Khandelwal college Akola.

Pre-treatment method and estimation of glucose
01 gram of waste paper was treated with 50 ml of 10 % HCl solution in a round bottom flask and heated for 1 hour at 85°C the reaction was stopped after 1 hour. The reaction mixture was allowed to cool and filtered. The in the sample was neutralized by small volume of concentrated potassium hydroxide solution. The in situ production of glucose was estimated by felhing solution method as below

Chemicals used
0.06 N standard glucose solution, felhing solution A, felhing solution B

Standardization of felhing solution
50 ml of felhing solution A and 50 ml of felhing solution B was mixed in a 250ml beaker out of which 10 ml of the solution was taken in a clean china dish with the help of pipette. The china dish was kept on heating mental and the solution was heated to boiling. To this felhing solution, the standard glucose solution of normality 0.06N was added drop wise through the burette till the colour changes from dark blue to brick red.

Observations

Sr. No.	Volume of Felhing solution	Volume of Std. Glucose	End point
1	10ml	5.3ml	
2	10ml	5.4ml	5.4ml
3	10ml	5.4ml	

Calculation
Normality of felhing solution
Glucose Felhing
N1V1 = N2V2
0.06 x 5.4 = N2 x 10
N2 = 0.06 x 5.4
10
N2= 0.0324 N

For experimental solution

Sr. No.	Volume of Felhing solution	Volume of Experimental Glucose	End point
1	10ml	12.3ml	
2	10ml	12.4ml	12.4ml
3	10ml	12.4ml	

To calculate normality of experimental glucose solution
Felhing Experimental glucose

N2V2 = N3V3
0.032 x 10 = N3 x 12.4

N3 = 0.032 x 10
12.4
N3 = 0.025 N

Normality of experimental glucose = 0.025 N
Wt/lit = Normality x eq. Wt
Wt/lit = 0.025 x 90
Wt/lit = 2.25 g
Per 50 ml
50 x 2.25
1000
= 0.11 g
Result :- 0.11 g glucose (11%)

Scaling up experiment
10 gram of waste paper was treated with 500 ml of 10 % HCl solution in a round bottom flask and heated for 1 hour at 85°C the reaction was stopped after 1 hour. The reaction mixture was allowed to cool and filtered. The in the sample was neutralized by small volume of concentrated potassium hydroxide solution. The in situ production of glucose was estimated by felhing solution method as below

Chemicals used
0.06 N standard glucose solution, felhing solution A, felhing solution B

Standardization of felhing solution
50 ml of felhing solution A and 50 ml of felhing solution B was mixed in a 250ml beaker out of which 10 ml of the solution was taken in a clean china dish with the help of pipette. The china dish was kept on heating mental and the solution was heated to boiling. To this felhing solution, the standard glucose solution of normality 0.06N was added drop wise through the burette till the colour changes from dark blue to brick red.

Observations

Sr. No.	Volume of Felhing solution	Volume of Std. Glucose	End point
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Calculation
To calculate normality of felhing solution
Glucose Felhing
N1V1 = N2V2
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N2 = 0.06 x 5.4
10
N2= 0.0324 N
For experimental solution

Sr. No.	Volume of Felhing solution	Volume of Experimental Glucose	End point
1	10ml	13.3ml	
2	10ml	13.4ml	13.4ml
3	10ml	13.4ml	

To calculate normality of experimental glucose solution

Felhing Experimental glucose
N2V2 = N3V3
0.032 x 10 = N3 x 13.4
N3 = 0.032 x 10
13.4
N3 = 0.023 N

Normality of experimental glucose = 0.023 N
Wt/lit = Normality x eq. Wt
Wt/lit = 0.023 x 90
Wt/lit = 2.07 g
Per 500 ml
500 x 2.07
1000
= 1.035 g

Result :- 1.035 g glucose (i.e 10.35%)

Production of ethanol by fermentation process
The solution obtained from experiment no. 04 was filtered and concentrated up to 100 ml. This solution was labeled as Sample A. Basal growth medium was prepared as below.

Yeast extract 4.5 g, bromothymol blue 30 g, peptone 7.5 g, distilled water 1000 ml, Chloramphenicol 70 mg (added after autoclaving),

A tube containing 10 ml of basal medium was prepared and autoclaved. 5 ml of sample A was added to the tube under aseptic condition. The tube was then inoculated with active culture of yeast. The mixture was then incubated at 28^0C for 12 days. After 12 days, the contents were filtered and 10 ml of the solution was taken in a test tube. To this solution 5 drops of 10% solution NaOH solution was added. With a separate dropper, KI solution was added drop wise till the solution became yellow. The mixture was then allowed to stand for 5 minutes and the pulsated vigorously. Yellow precipitate was obtained which is the indication of ethyl alcohol.

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