

Hong Kong Student Science Project Competition 2022

Template of Extended Abstract (Investigation)
(Word Limit: 1,000 words, Pages: 2 pages only)

Team Number: JBBC280

Project Title: ‘ Enzymatic Hydrolysis of Cellulose — Paper — Glucose’

Project Type: Investigation

To our best knowledge and after thorough literature research, as at 28 / 6 /2022 , there are similar works. If there are, the reference links are as below:

1. Enzymatic hydrolysis of cellulosic biomass (2011). Taylor & Francis Online.
<https://www.tandfonline.com/doi/abs/10.4155/bfs.11.116>
2. Ethanol from biomass by enzymatic hydrolysis: <https://www.osti.gov/biblio/6943966>
3. The nature of lignocellulosics and their pretreatments for enzymatic hydrolysis:
https://link.springer.com/chapter/10.1007/3540116982_4
4. Enzymatic hydrolysis of waste cellulose: <https://onlinelibrary.wiley.com/doi/abs/10.1002/bit.260161105>
5. An overview of the Enzymatic hydrolysis of cellulose:
<https://www.sciencedirect.com/science/article/abs/pii/S0960852491900952>
6. Substrate Pretreatment: The Key to Effective Enzymatic Hydrolysis of Lignocellulosics:
https://link.springer.com/chapter/10.1007/10_2007_064

The enhancement our project has made for the existing related products or research is summarised as below:

1. Investigation of relationship between pH and glucose yield

***Please delete if not applicable. HKSSPC values the originality of works. Students must conduct literature research thoroughly to ensure that their works are unique, and to list relevant reference materials to complement the research or invention.**

I. Background

Environmental pollution is increasing with each passing year. Paper waste is a severe problem in many industries and offices. About 10,000 sheets of paper would be used per office employee in each year. In recent decades, the supply of landfills has not been enough for demand in Hong Kong and our project tries to solve the waste problem. Also, our experiment can recycle polluted papers into glucose. It can save raw materials and promote a sustainable lifestyle for society. The use of glucose is better than cellulose because glucose can be used in biofuels, food and other uses. In addition, the process can recycle used paper, polluted paper and other types. Various types of paper will be tested in our projects.

II. Objectives

To investigate the effects of pH on enzymatic hydrolysis.

III. Hypothesis

- The lower the pH, the higher the glucose yield.

IV.

Methodology

Controlled set-up

Materials

- toilet paper
- Benedict's solution
- sodium citrate
- sodium hydroxide
- strainer
- heating plate
- citric acid
- cellulose

Pretreatment—alkaline hydrolysis

1. Toilet paper is soaked into 3L of distilled water.
2. Sodium hydroxide is added for enzymes to break down cellulose.
3. The solution is heated and stirred with heater until the solution gets yellow.
4. The paper is filtered with a strainer from the polluted yellow water, steps are repeated until all of the impurities are washed away.
5. The paper is squeezed until all the paper is dried.

Enzymatic hydrolysis

1. Enzyme powder is added into 3L of distilled water
2. Citric acid and sodium citrate is added into the solution, the solution is stirred
3. Pretreated toilet paper is put into the solution
4. The solution is put into an oven with 50°C for 48 hours
5. The solution is stirred and is cooled down.

Testing

1. Benedict test are carried out
2. Solution obtained from the enzymatic hydrolysis is poured into a boiling tube contains same amount of Benedict's solution

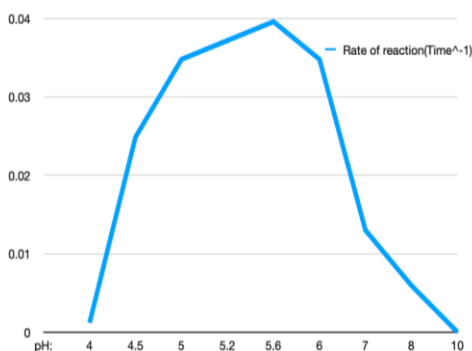
Experiment 1 toilet paper

Repeat the controlled set-up method on a smaller scale with the above materials.

Experiment 2– Investigate the effect of pH value

Repeat the controlled set-up method on a smaller scale with the above materials. The amount of sodium citrate and strainer are varied.

V. Results



The results are evident. In our experiment, cellulose with pH level 5.6 yielded the highest. After a series of experiments and analysis, we found that the optimum pH range for the enzymatic hydrolysis is 4.5 to 6 while under pH 5.6, the enzymatic activity is the highest. It verified our hypothesis that the enzymatic activity of cellulase will increase to highest in a specific pH.

Numerous limitations and errors are found in our experiment, for example, the test of non-reducing sugar. The test carried out to test the presence of glucose and amount of glucose mainly make use of the

reducing property of sugar.

Through our investigation, we suggest that cellulose can be used to convert into biofuel, even if the cellulose is polluted.

Therefore, this is a convincing result to prove that production of biofuel from cellulose is feasible in future time and alleviate the world's shortage of energy.

VI. Conclusion

The optimum pH for the enzymatic hydrolysis is 5.6 and having a better pH range from 4.5 to 6. Ink in printed paper inhibits the process of enzymatic hydrolysis, a hydrolysis of ink should be done before the start of enzymatic hydrolysis.

□ Our project is developed based on our school's previous project and the enhancement is as below:

1. More investigation on the factors on the process