

Hong Kong Student Science Project Competition 2023

Template of Extended Abstract (Investigation)
(Word Limit: 1,600 words, Pages: 3 pages only)

Team Number: SBBC053

Project Title: Renewable Cotton

Project Type: Investigation

*To our best knowledge, there are no * similar works in the field.*

I. Background

Textile waste has been a rising problem in recent years, this was caused by the increasing trend of fast fashion. In light of the problem, we wish to create renewable cotton products to ease the worsening of the problem.

We experimented on creating recycled paper and the effect of Schweizer's reagent on dissolving cellulose in cotton fibre and making renewable products. We found out that these chemicals can dissolve and extract cellulose to change the structure of cotton. Paper making tools can aid us in the making process of renewable cotton at the last step.

To sum up our experiment stage, we had conducted two experiments in total. The first stage is making recycled paper out of used paper. Although our final aim of our investigation and research is to create renewable cotton, this experiment stage not only allows us to familiarize ourselves with the procedures of making renewable cotton, but also acts as a guide for us to investigate the rationale behind the breakdown of cellulose. In our second stage, making renewable cotton, we conducted several trials with a diverse array of cotton samples.

II. Objectives

Our aim is to transform used cotton into renewable cotton in order to reduce the amount of cotton waste.

III. Hypothesis

Acids can extract and break down cotton cellulose in cotton, allowing cotton cellulose to reform into a new cotton like fiber. Hence, renewable cotton can be made.

IV. Methodology

Materials used

Ingredients:	For paper making	For renewable cotton making
- Recycled Paper	- paper making tools	- Balance
- Warm water	- Newspaper	- Filter paper
- Baking soda	- Drying rack	- Filter funnel
- Cotton ball	- Blender	- Conical flask
- 100% cotton towel strip	- Boiling kettle	- Meatie(100mL, 500mL)
- 100% cotton T-shirt	- Large spoon	- Magnetic stirrer
- Ammonia solution	- Teaspoon	- Syringe
- Copper(II) sulphate	- Plastic cup	- Glassrod
- Sodium hydroxide		- pH paper
- 10% sulphuric acid		- sieve (300nm, 500nm)

Experimental protocol

A. Making recycled paper

1. Prepare a pile of shredded paper and a large box.
2. Soak shredded paper with excess water overnight to soften paper.
3. Separate mixture into two portions after soaking.
4. Pour one of the portions into the blender with warm water, blend until smooth.
5. Pour mixture into a large plastic box, scoop mixture using paper making tools to obtain a thin sheet of renewable paper.
6. Place a piece of newspaper under the drying rack.
7. Allow the mold to sit on the drying rack until the mixture is dried.
8. Use a towel to blot dry the product to facilitate the drying process.
9. Take the paper out of the mold after drying.
10. Repeat step 4-9 but add 2 teaspoon baking soda when blending the mixture




B. Making renewable cotton

1. Add distilled water into copper (II) sulphate until completely dissolved.
2. Precipitate copper (II) hydroxide by adding sodium hydroxide solution.
3. Filter copper (II) hydroxide precipitate and wash excess sodium hydroxide solution on the surface of the precipitate using distilled water.
4. Add ammonia solution to copper (II) hydroxide, resultant solution is dark blue in colour.
5. Slowly add cotton and stir until fully dissolved.
6. Introduce the viscous solution into sulphuric acid using a syringe.
7. Measure pH of resultant product, add sodium hydroxide solution to neutralize until neutral solution obtained.
8. Dissolve the resultant rayon into water.
9. Pour the rayon solution into the sieve to separate cotton fibre.
10. Allow the renewable cotton to dry overnight.

V. Results

Results:

The following table demonstrates the results of the extraction of cotton cellulose.

Sieve with a larger opening (300 mesh)	Sieve with a smaller opening (500 mesh)	Sieve with a smallest opening (600 mesh)
		
It creates a thicker product with a stronger strength which is suitable to be our final product of the renewable cotton.	It creates a thinner, sheet-like product which is not suitable to be our final product of the renewable cotton.	It creates a rigid and fragile product. It is also broken into pieces after drying.

In conclusion, a sieve with a larger opening can produce a better final product.

Limitations

As the source of renewable cotton can vary, some may be contaminated and contain harmful chemicals or germs. Further improvements should be made to ensure products may be clean and safe to use. Large amount of chemicals are used in the production of renewable cotton, time required is also high. It may not be cost-effective to produce renewable cotton in a large scale. Lastly, only pure cotton apples can be dissolved. Our experiment shows that dyed clothings cannot dissolve in the solution.

Importance and impact of research

Renewable cotton can be used and altered for various applications, just like regular cotton. Creating cotton products with renewable cotton can create a virtuous cycle for cotton products. When the used cotton products are depreciated, they can be transformed into renewable cotton and used for various purposes and applications. Therefore, it can lessen the amount of cotton waste and reduce the occurrence of other pollutants in multiple aspects such as home furnishing, wearable products and cleaning products.

We are sure the amount of cotton waste can be reduced significantly while the occurrence of deforestation can be lessened if our investigation and research is implied to the society in the future. As a result, less waste will be produced by various industries.

VI. Conclusion

- Make a **data-driven** conclusion of the project and the way forward of the research
- Justify if the proposed project meets the objective(s)

According to our results, using a purer cotton sample and a sieve with larger openings can be possible and feasible to convert used cotton products such as clothings and towels into renewable cotton and use them in daily lives. Therefore our research can transform used cotton into renewable cotton in order to reduce the amount of cotton waste, which meets our aim.