

# Hong Kong Student Science Project Competition 2022

Template of Extended Abstract (Invention Design Proposal)

(Word Limit: 1,000 words, Pages: 2 pages only)

**Team Number: SABC213**

**Project Title: The Rebirth of Paper - Paper Making from Food Waste**

**Project Type: Invention**

**To our best knowledge and after thorough literature research, as at 16/6/2022, there are / ~~are no~~ similar works. If there are, the reference links are as below:**

[https://www.researchgate.net/publication/337050659\\_Alternative\\_Raw\\_Materials\\_for\\_Pulp\\_and\\_Paper\\_Production\\_in\\_the\\_Concept\\_of\\_a\\_Lignocellulosic\\_Biorefinery](https://www.researchgate.net/publication/337050659_Alternative_Raw_Materials_for_Pulp_and_Paper_Production_in_the_Concept_of_a_Lignocellulosic_Biorefinery)

## **I. Background**

According to the UN, nearly half of all fruits and vegetables produced globally are wasted every year, while deforestation speeds up climate change as a result of increasing carbon dioxide levels. The environmental issues of food waste and deforestation have come to our attention as we, as students, also contribute greatly to producing solid wastes. This project focuses on production of paper from non-wood raw materials, specifically food waste that contains cellulose. We hope to find an effective way to reduce food and paper waste, maximising the utilisation of such resources. The research gap that could potentially be filled is that Hong Kong currently does not have a comprehensive, organised way of sorting and recycling food waste.

## **II. Objective(s)**

We aim to find a way to improve both situations by discovering an alternative method of making paper: using food materials, thus reusing wasted food and decreasing fresh paper demand. We will be testing different food materials rich in cellulose in production, and investigating their effects on the quality of paper made, hence identifying the food material which works best in paper production.

## **III. Methodology**

To effectively compare and evaluate the best combinations of types and ratios of food waste used, both quantitative and qualitative tests are carried out.

The quantitative tests are as follows:

1. Thickness: A calliper is used to measure the thickness of paper. This method does not account for the uneven thickness of paper.
2. Porosity: 0.5 mm, 0.7 mm pencil leads, HB pencils, 0.4 mm and 0.5 mm gel pens are poked into paper to observe the size of pores of paper.
3. Permeability: The paper is used as filter paper in the filter funnel. 15 mL of distilled water is poured into the funnel and the volume of filtrate is measured.
4. Rigidity and Folding Endurance: Each piece of paper is folded to its greatest extent i.e. cannot be further folded or cracks are shown, number of folds are counted.
5. Curl: Each piece of paper is curled around cylinders of different diameter to observe for any cracks.
6. Strength: Weights of different masses are put onto the paper hung in air to measure the maximum weight that the paper can support.

The qualitative tests are as follows:

7. General Observations: Observations including colour, texture and smoothness when writing are performed to make general comments on the first impressions the paper may give to users.

8. Treatment with Water: The whole sheet of paper is submerged into a tank of water and then dried at room conditions. Observations are made on the effect of water on the strength and durability of paper. Quantitative tests mentioned above are also performed.

#### **IV. Design of Invention**

Recycled paper can be made by mixing blended paper and food waste, followed by screening, pressing and drying. There are 3 parts in the experiment:

Part 1: Determination of optimal ratio of carrot peel to paper waste in production of recycled paper

For this part, carrot peel was chosen to be the food waste used. Blended food waste solution and blended waste paper solution were produced and mixed in different ratios to determine the optimal ratio of food waste to paper waste.

Part 2: Comparison of recycled paper from carrot waste and that from paper waste only

Recycled paper of only A4 paper and newspaper were made, then compared with the recycled paper made using carrot peel.

Part 3: Comparison of recycled paper from different types of food waste

Different types of food waste were used to make the recycled paper, then compared.

#### **V. Application / Market Need**

Through reusing waste paper and food wastes, our modified paper can reduce the impact of food waste and improve the environment.

It can be used for writing, crafting and other creative purposes in real life. Although it may not be suitable for printing and sanitary purposes, it provides a relatively smooth surface and boldness for secretarial purposes.

In comparison to paper made by only A4 paper and newspaper, the texture of our modified paper is less fragile and rigid enough for writing and creasing.

#### **VI. Conclusion**

- Make a conclusion of the design project and the way forward of the invention process

Based on the results of the investigation, it is evident that cellulose from various vegetative food waste is suitable for creating recycled paper. In general, the quality of paper is comparable to recycled paper made from white paper and newspaper, while combining their advantages of being non-porous, less fragile and flexible.

We hope through promoting the recycling of paper with food waste containing rich cellulose, we could provide an alternative approach for the treatment of waste, increasing the popularity of such environmentally friendly practice in households and paper industries.

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