Hong Kong Student Science Project Competition 2023

Template of Extended Abstract (Invention)

(Word Limit: 1,600 words, Pages: 3 pages only)

Team Number: SABC251

Project Title: EcoNappies

Project Type: Invention

***To our best knowledge, there are / ~~are no~~ * similar works in the market*; (if there are,) related product links are as below:**

https://andypandykids.com/products/premium-bamboo-disposable-diapers
https://www.ecoboom.me/collections/plant-based-diapers
https://dyper.com/pages/materials
https://bambonatureusa.com/products/dream-training-pants
https://littletoes.com/collections/bamboo-diapers

The enhancement our project made / the difference with related products are:

Differentiating our product with the related products by substituting all non-biodegradable materials presence in normal diapers to biodegradable materials and making our diapers fully biodegradable.

Please delete if not applicable. The competition values the originality of works. Students must do enough literature research to ensure that their works are unique and list relevant reference materials before starting research or invention.

I. Background

Background:
As diapers are used by babies and people who experience urinary incontinence, mobility impairment, severe dementia or diarrhea, they are estimated to be the largest source of absorbent hygiene product waste. This phenomenon did not only bring a burden on landfill sites, but it also brought pollution issues, which could result in serious health issues. Reusable diapers are an eco-friendlier option to disposable diapers. However, they are not as hygienic as disposable diapers. Reusable diapers are expected to be washed after the user has excreted or egested, mishandling the used reusable diapers during the cleaning process could lead to infection of diseases.

Literature review:
Disposable diapers compose of polypropylene as the top sheet, superabsorbent polymers as the inner core and polyethylene film as the back sheet. These materials allow diapers to perform their function efficiently.
We found materials that are said to be fully biodegradable including linen fabric, beeswax, chia seeds and cornstarch-based bioplastic. Linen has high water-absorption capacity, renewable nature, low environmental impact and comfort when in contact with skin. Cornstarch-based bioplastic has a high biodegradability in the soil. The mucilage in chia seeds can absorb up to 27 times its weight in water. Beeswax with TiO_2 nanoparticles can increase the hydrophobicity and antibacterial properties of the fabric.

II. Objectives

Our objective is to reduce plastic waste and the subsequent issues caused by diapers such as the pollution created during the disposal and decomposition of non-biodegradable plastic materials in diapers, and the waste produced during the manufacturing of non-biodegradable materials. We would also like to promote the use and making of biodegradable materials and products by using biodegradable materials in our product and raising public awareness towards the impact of using disposable diapers.

III. Methodology

This report used a variety of methods to determine the way this research was conducted and the rationale for why specific materials were chosen. Experiments were done to test many of the biodegradable materials and alternative materials for the final product, of which all were planned out in a lab manual with experimental goals, safety precautions, procedures and post-lab questions before the experiment was carried out.
Through these experiments and online research of articles from Google Scholar, the National Center for Biotechnology Information and Hong Kong University Library, many of the possible materials were narrowed down under many conditions. Including cost, water absorbance or repellence, bacteria resistance and breathability.

IV. Design of Invention

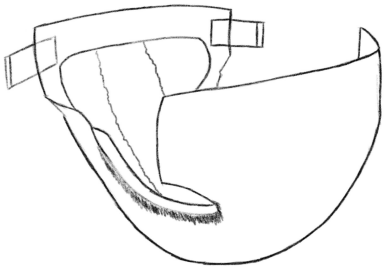

Fig.1 Diaper Design

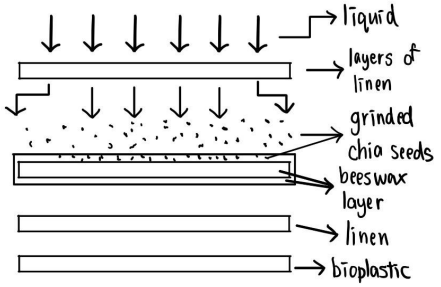

Fig.2 Detailed Layers of our Diapers

The design mainly revolved around a sample of disposable diapers, with the principle of turning it 100% biodegradable. While the development of a full prototype is still in development, a sample-sized version was made using the materials chosen that fit the criteria of fully biodegradable. From several experiments, it was also shown to us that our sample, EcoNappies are actually capable of handling a water absorbance test and could hold water without leaks.

V. Application / Market Need

Our product's target users are babies and elderly people with urinary or excretory issues. There are disposable diapers on the market currently. Still, they are mainly made out of plastics and other non-biodegradable polymers, which can lead to a high amount of pollution issues. With our biodegradable diapers, all the materials can be fully decomposed, minimizing the impact on the environment.
As consumers become increasingly aware of their impact on the environment, demand for biodegradable diapers will increase. Currently, the cost of manufacturing biodegradable diapers is high while the demand is not high enough to lower the cost. Moreover, biodegradable diapers do not absorb as fast as disposable diapers, and there is still a strong smell of bioplastic in the diaper.
It is believed that when our product is put into mass production, the price could be driven down significantly. For the odour of the bioplastic, while it is uncertain at this moment, we strongly suspect that the smell could be reduced by adding components such as essential oil to reduce the strong smell of vinegar. With the above improvement, it is believed that the biodegradable diaper will be appealing to parents and caregivers who wish to build a better future for future generations.

VI. If your team will compete the Sustainable Development Award, please indicate the specific sustainable development goal the project is related to, and provide justification for competing for this award. *(Word limit: 300 words)*

Our project is related to the 12th Sustainable Development Goals. This goal aims to promote the use of sustainable resources and reduce the pollution caused by the production and consumption of these goods. Our product meets the goal by shifting to more sustainable materials. All our materials are fully biodegradable, by fusing materials such as linen cloth with beeswax and chia seed, a layer of

waterproof, antibacterial and water-absorbing cloth is made. While at this moment, the prototype is still not fully developed, it is uncertain how well it actually compares with a disposable diaper. But with a scaled-down sample of our concept, it has proven that our concept will actually allow water to be absorbed efficiently into the layers of chia seeds and water can be retained by the layers of chia seed. It is expected that our diapers can have similar effectiveness as the disposable diapers currently available on the market.

VII. If your team will compete the Social Innovation Award, please list the target group or social issue the project focuses on, and provide justification for competing for this award. *(Word limit: 300 words)*

Our project targets caretakers and parents. They can consider our product over disposable diapers as our product can perform the same function, and provide efficiency and convenience for babies and adults who have inconveniences. As mentioned above, the amount of waste produced by baby and adult diapers brings unfavourable impacts on the environment and public health, and these impacts are irreversible. There is an increasing amount of elders and children who are in need of diapers as Hong Kong faces an aging population, this product will drastically reduce the negative effects that non-biodegradable diapers bring. While biodegradable products in Hong Kong are still not yet common, we hope that our product can influence the general public into switching to a more sustainable lifestyle by providing them with more options for sustainable products. We would also hope that this product could potentially open a path for other biodegradable products to enter the Hong Kong market and form a sustainable cycle of consumers choosing sustainable products and cooperates choosing to sell more sustainable products to suit the new market.

VIII. Conclusion

With a small sample of 5x5 cm, it was tested that the inner layers of our product were able to absorb liquids at a reasonable speed and that it would not leak out at the bottom layer of our product. Accurate data was concluded after multiple experiments and research were done. Our product is able to perform the same function as disposable diapers, ensuring safety and comfort for the users. It also met our objective of reducing plastic waste from diapers, allowing them to be decomposed biologically to reduce pollution.

□ **Our project is developed based on previous project and the enhancement is below:**

N/A