二零二二年香港學生科學比賽

延伸摘要(研究項目專案設計)

(字數上限:1500字, 頁數上限:2 頁)

隊伍號碼: **SBBC297**

作品名稱:一步一口罩

參賽類別:研究項目專案設計

直至**20220**年**06**月**30**日, 經過仔細的文獻搜索, 就我們所知, 現時有 / ~~沒有~~* 相類似的作品。如有類似的作品, 相關產品或研究的參考的連結如下 :

I. 前言

由於疫情肆虐, 所以全球口罩的消費和棄置數量大大增加, 導致了大量的固體塑膠垃圾, 對環境造成了更大的不良影響。在香港, 每日棄置口罩的數量(https://www.info.gov.hk/gia/general/202005/20/P2020052000560.htm?fontSize=1)也相當龐大, 而這些口罩最終會被運送到堆填區, 除了對環境有不好的影響外, 還加重了香港堆填區的負擔。為了解決這一問題, 專案的目的就是找出如何回收、重用口罩中的塑膠(https://www.adidas.com/us/parley), 以期減少口罩垃圾的數量及減低大量垃圾口罩的影響。

II. 目標

專案的目的在於通過回收口罩、提取口罩中的塑膠、重用口罩中的塑膠來減少口罩垃圾。

III. 假設

假設是口罩含有大量的塑膠, 通過消毒、提取、硫化等過程, 可以從一次性口罩中提取出聚合物, 並可以作為回收原料進一步用於工業過程。

IV. 研究方法

實驗 1 - 選擇哪種溶劑適合從一次性口罩中提取 PE

目的:用氯仿和己烷加熱從消毒過的一次性口罩中提取PE

使用的材料

燒杯, 玻璃棒, 氯仿 , 己烷 , 熱墊 , 夾子 , 剪刀

步驟:

將經過消毒的口罩切成小塊, 以增加它們與溶劑的接觸表面積, 提高溶解速度。準備足以覆蓋面罩的溶劑。然後將口罩完全浸入煮沸的溶劑中, 以通過加熱墊增加溶解度。在此過程中, 不斷攪拌溶液以促進聚合物的溶解。

未溶解的無紡布口罩在此過程中不斷被夾子取出。蒸發掉剩餘的溶劑就可獲得純PE就可獲得仍能流動的熱PE。

實驗 2 - 強化提取的聚合物

目的:通過添加硫磺硫化來增強提取的聚合物

材料:

燒杯，玻璃棒，氯仿，熱墊，夾子，剪刀，黃色硫磺粉，電動天秤

步驟:

用電子天平稱取幾份定量的硫磺。通過加熱墊繼續加熱從實驗 1 中獲得的氯仿和聚合物（尚未蒸發）的混合物，以增加溶液的溶解度並讓硫溶解在其中。在溶液中加入硫磺。每次添加一份並攪拌溶液以溶解添加的硫。當硫過量時停止添加硫（一些硫顆粒出現在玻璃棒的末端）。繼續煮沸溶液以蒸發氯仿，直到只剩下一半的溶液。慢慢冷卻溶液以固化聚合物。

V. 預期結果和研究的影響力

實驗 1 - 通過用氯仿加熱從消毒的一次性口罩中提取 PE。

仍然可以流動的熱PE只能在氯仿中獲得，而在己烷中無法獲得物質。得到的最終物質主要是PE。所得物質易碎。 獲得的物質的厚度受使用的口罩數量的影響。得到的物質是藍色的，因為面具是藍色的。然後發現顏色不影響PE的使用。

實驗 2 - 通過添加硫強化提取的聚合物

形成的產品比不加硫的產品更硬更厚。所得產物為藍綠色。如果添加的硫太少，產品的硬度和稠度會降低。如果添加的硫過多，則產品的底部會被燒黑，過量的硫會留在最終產品的底部。

得出的結論是，準確量的硫可以增強聚合物。

VI. 結論

經研究證實，從一次性口罩中提取聚合物並將提取的聚合物應用於日常生活的方法是有效的。

□ 我們的作品是以我們學校之前的比賽作品為題進行了持續研習，有關改良如下:

Hong Kong Student Science Project Competition 2022

Extended Abstract (Investigation Design Proposal)

Team Number: SBBC297

Project Title: One Step One Mask

Project Type: Investigation Design Proposal

To our best knowledge and after thorough literature research, as at 30/06/2022 , there are / ~~are no~~* similar works.

I. Background

Since the outbreak of COVID-19 epidemic, wearing face masks has become a social normality, particularly single-use masks, creating large amounts of disposable masks. Thus, the vast plastic waste and plastic particle waste produced gives rise to new environmental challenges.

The aim of the project is to investigate how to reuse materials in disposable masks in daily necessities. Literature of the structure and materials of masks, recycling of polymers in industrial processes, the current situation of waste of disposable masks in Hong Kong and successful commercialization of recycling polymers into products is reviewed in the project. The references included : _____, the Secretary for the Environment, the company Adidas.

With reference to the literature review, while there is research concerning the current situation of the use of disposable masks, recycling of polymers and commercialization of recycling polymers into products, there is still no systematic research on effective recycling and reuse of disposable masks. Therefore, the project is trying to fill this gap. In the experiment, extraction of polymers and vulcanization would be focused.

II. Objective(s)

The aim of the project is to investigate how to reuse materials in disposable masks in daily necessities. Method of extracting polymers from masks and vulcanization is focused in the experiment.

III. Hypothesis

The hypothesis is that the recycling of disposable masks can be implemented in our daily applications by using the following process: (1) Sterilization; (2) Extraction; and (3) Vulcanization. The extracted polymer can be used further in industrial processes as a recycled raw material.

Extraction of polymers can be tested in Experiment 1 with different organic solvents used to dissolve the polymers ; effect of vulcanization can be tested in Experiment 2 by adding sulphur and evaluate the strength of the product compared with the product without sulphur.

IV. Methodology

Experiment 1 - To choose which solvent is suitable for extract polypropylene from disposable mask

1. Materials to be used: beaker, glassrod, chloroform, hexane, heat mat, clip, scissors
2. Procedures: The sterilized masks were cut into small pieces in order to increase the contact surface area between them and solvent to increase the rate of dissolving. Then, the masks were immersed totally in boiled solvent to increase the solubility of the solution by heating with a heat mat. During the process, the solution was constantly stirred to facilitate dissolve of polymers and the non-woven fabrics of the undissolved masks

were taken out by clip constantly. The remaining solvent was evaporated out in order to obtain the polymers in the masks. Polymers that have not yet solidified could be obtained.

Experiment 2 - To strengthen the extracted polymer

1. Materials to be used: beaker, glassrod, chloroform, heat mat, clip, scissors, sulphur powder, electric balance
2. Procedure
   - Several servings of sulphur of fixed amount are weighed by electronic balance. The mixture of chloroform and polymers (not yet evaporating) obtained from Experiment 1 were kept heated by a heat mat to increase the solubility of the solution and allow sulphur to dissolve in it. One serving of sulphur powder was added each time and the solution was stirred to dissolve the sulphur added. Adding of sulphur was stopped when sulphur is in excess (some sulphur particles are at the end of the glass rod). The solution was boiled to evaporate chloroform until only half of the solution was left and then slowly cooled down to solidify the polymers.

V. Expected Results and Impact of research

In Experiment 1, polymers that have not solidified yet can be obtained only in chloroform while no substance can be obtained in hexane. The final product was mainly polypropylene. The product was brittle. The thickness of the product depended on the amount of masks used.

In Experiment 2, the product formed is harder and thicker than the one without adding sulphur. If sulphur added is too few, the product is less hard and thick. If sulphur added is too much, the bottom side of the product is burned black and the excess amount of sulphur would remain at the bottom of the final product. It is concluded that an accurate amount of sulphur can strengthen the polymer.

In the laboratory, the test of effectiveness of sterilization cannot be carried out, so research done by the authorities is referenced.

The process is feasible to put in practice. From the experiments, polypropylene can be extracted and strengthened by sulphur, which is common in laboratories, so vulcanisation of polymers by sulphur is feasible.The safety issue can be solved by sterilization in which germs are killed. The extracted polymer can be used in a lot of other production lines, such as shoe soles and plastic bags as mentioned above, so it is cost-effective for companies to carry out this industrial process, encouraging the commercialization of recycling polymers in masks into daily products. This can eventually reduce the amount of disposed masks entering the landfills.

VI. Conclusion

After the research, the method to extract polymers from disposable masks and application of the extracted polymers to daily uses is substantiated to be valid. With reference to the literature review and results of the 2 experiments, it is concluded that the method suggested is feasible and can be applied to industries in practice.

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