

# Exploring The Feasibility of Repurposing Wasted Disposable Face Masks into Sustainable Food Trays in The Food and Restaurant Industry

Justin Jaime R. Viray<sup>1</sup>, Kyla Mae S.M. Artiaga<sup>1</sup>, Margaret Pearl M. Garcia<sup>1</sup>, Patricia Gayle F. Cardeño<sup>1</sup>, Elaine Joyce Y. Dizon<sup>2</sup>, June C. Musngi<sup>2</sup>

<sup>1</sup>Student, College of Engineering and Architecture – Industrial Engineering Department, University of the Assumption, City of San Fernando, Pampanga, Philippines

<sup>2</sup>Professor, College of Engineering and Architecture – Industrial Engineering Department, University of the Assumption, City of San Fernando, Pampanga, Philippines

Corresponding Author: [patricia.gayle.cardeno@gmail.com](mailto:patricia.gayle.cardeno@gmail.com)

**Abstract**— Continuously since the COVID-19 pandemic started, the need and demand for disposable face masks increased. As demand increases, the production of disposable masks also increases, producing both quality products and rejects. Disposable masks, made mostly of polypropylene, serve as an effective means of protection for individuals to fight against the spread of respiratory infections, including the previously unidentified COVID-19 virus. These masks, which are lightweight and effective at catching respiratory droplets, quickly became an essential part of millions of people's daily lives around the world. However, due to their ease of use and extensive use, an unexpected volume of discarded masks has resulted, raising environmental problems due to their non-biodegradable nature. In response to the global challenge of plastic pollution, this study aims to integrate sustainability by exploring the feasibility of repurposing wasted disposable facemasks into a sustainable food tray in the food and restaurant industry. 600 grams of rejected facemasks has been used in the process of creating a food tray with a dimensions of 34.29 cm x 22.86 cm x 0.77 cm. The repurposing of facemasks into a tray represents a unique and innovative approach to sustainability and creativity.

**Index Terms**— Sustainability, disposable face masks, COVID-19 pandemic, repurposing, environmental problems, innovation.

## 1. Introduction

A new case of coronavirus infection has been confirmed in Wuhan, China by the World Health Organization in January 2020.

Manuscript revised May 02, 2024; accepted May 03, 2024. Date of publication May 05, 2024.

This paper available online at [www.ijprse.com](http://www.ijprse.com)

ISSN (Online): 2582-7898; SJIF: 5.59

The world has experienced a pandemic, similar to the Spanish flu of 1918, in the past two years as SARSCoV2 spread around the globe. As of May 2022, the WHO says there have been over 521 million confirmed coronavirus infections and over 6.2 million confirmed deaths due to the pandemic [1].

The pandemic, which has never been seen before, is causing problems for the global economy, supply chain systems, public health, and everyday life. To stop the virus' spread, several precautionary and preventive measures have been put in place at national and regional level. There were multiple stages of lockdown and legislative changes to ensure social distancing and adoption of personal protective equipment (PPE). To raise awareness about the importance of hygiene in everyday life, a series of publicity campaigns have been carried out worldwide.[2]

Continuously since the COVID-19 pandemic started, the need and demand for disposable face masks increased. As demand increases, the production of disposable masks also increases, producing both quality products and rejects. The manufacture of facemasks involves raw materials and production processes. Disposable masks, made mostly of polypropylene, serve as an effective means of protection for individuals to fight against the spread of respiratory infections, including the previously unidentified COVID-19 virus. [3]

However, due to their ease of use and extensive use, an unexpected volume of discarded masks has resulted, raising environmental problems due to their non-biodegradable nature. Wasted disposable masks (WDM) are negligently left as litter in different natural settings, including waterways, public roads and highways, and mountainous regions, where it is improper to dispose of plastic and plastic particle wastes.

In the Philippines, which also reported a high frequency of COVID-19 cases starting February 2020.

With this, the government and LGUs imposed rules for public health protection, one of which is the use of face masks. Due to the rising demand for disposable masks, producers generated a lot of this product. Online marketplace was used by both small and large businesses to sell disposable masks. [4]. This occurrence generated an excessive number of disposable masks in landfill, waterways, public streets, and highways led to different environmental problems due to improper behavior of the consumers. Fortunately, the use of disposable masks is no longer required, but the counting of disposable masks thrown every day is continuous. In hospitals and healthcare industries, disposable masks are essential as their personal protective equipment (PPE).

Therefore, the increase in demand for disposable masks resulted in an alarming increase in plastic waste in the country. [5]

The study focuses on recycling Wasted Disposable Masks (WDM) into new products, emphasizing sustainability benefits. Recycling masks extends their lifecycle, reduces environmental impact, and conserves resources by repurposing materials. This innovative approach explores using rejected face masks as materials for sustainable alternatives to single-use plastics, contributing to waste reduction and promoting a circular economy. Overall, repurposing masks into new products addresses environmental concerns and aligns with goals for a resilient and eco-friendly future.



Fig.1. Company Logo

The name of the company is Repromask Manufacturing. The word 'Repro-Mask' came from the word reprocessed disposable mask. The company name reflects the idea of recycling masks into a new product while emphasizing environmental sustainability. The company came up with the concept of recycling the single-use mask since other waste plastics, such as plastic bottles, already have recycling processes by different businesses and manufacturers, but the disposable face mask appeared to be thrown around after use, causing negative environmental impact.

To attain the safety and minimize the health risk, since used disposable face masks from landfills and medical facilities are highly contaminated, the company processed rejected face masks from the scrap of manufacturing of face masks and turned it into a food serving tray. Serving trays, which are usually used to carry plates of food and dishes to a fast-food, are very important functional items. This is why it must be able to cope with relatively heavy weight, remain flat and include a lip or ledge to keep the items in place.

#### A. Product Information

The company's product is made of rejected face masks sourced from Yokoisada (Phils.) Corporation considering the safety and hygiene of the product.



Fig.2. Raw Material Used to Create the Product

Their face mask is mostly made from polypropylene plastic. Mainly the company used polypropylene plastic (PP) from rejected face masks as the raw materials of the product.



Fig.3. Yokoisada (Phils.) Corporation at Clark Freeport Zone, Pampanga

In every manufacturing process, there is often a possibility of producing defective or substandard products, leading to rejects or waste. Just like in the medical equipment manufacturing of facemasks there will always be rejects or defects. At the same time the large amounts of facemasks that have been produced have negatively affected the environment.

The four industrial engineering students of the Repromask Manufacturer visited the Yokoisada (Phils. Corporation) at Clark, Pampanga last November 21, 2023 as they have made a request to be able to obtain 5 kilograms of rejected facemasks from them. Gladly they have approved their request for scraps and have their support in their feasibility study. Additional information about their production of facemasks is that they have been producing for about 10,000 rejected facemasks in each day of their manufacturing. The rejected facemasks are being collected by the Clark Development Corporation (CDC) the one who is in charge of collecting and disposing of wastes from manufacturers [6].



Fig.4. Repromask Food Tray

Introducing the Repromask Food Tray – where sustainability meets practicality! Crafted from recycled facemasks, this revolutionary tray symbolizes responsible innovation in a world embracing both environmental consciousness and everyday utility. As billions of facemasks have been produced which resulted in plastic pollution. Why not recycle facemasks by making them into a tray. Since facemasks are made from nonwoven polypropylene plastics which is a recyclable material.

### B. Specifications and Features of the Product

#### 1) Material

- The Repromask Food Tray is crafted from recycled white rejected face masks; it is made of quality polypropylene plastic that contributes to sustainable and eco-friendly practices.

#### 2) Dimensions

- Length: 34.29 cm
- Width: 22.86 cm
- Thickness: 0.77 cm

#### 3) Color

- The Repromask Food Tray retains the color of the recycled white face masks, giving it a unique and distinctive appearance.

#### 4) Texture

- Smooth Texture

#### 5) Temperature Required

- Keep the product in an environment where the temperature is below 25 degrees Celsius.

#### 6) Sustainability Features

- Contributes to waste reduction by repurposing rejected face masks.
- Supports circular economy principles by utilizing recycled materials.

#### 7) Durability

- The tray can hold up to 5 kg.

### C. Usage and Application

Repurposing facemasks into a tray represents a unique and innovative approach to sustainability and creativity. The process involves transforming single-use items into a

functional, durable, and visually striking product, giving a new purpose to materials that would otherwise contribute to environmental waste. The resulting tray becomes a tangible symbol of responsible innovation, showcasing the possibilities of upcycling in everyday items.

## 2. Methodology

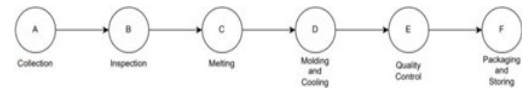


Fig.5. Process Flowchart

### A. Manufacturing Process of Repromask Food Tray

The manufacturing process is a crucial part of industrial production. It determines the technical soundness of a business. It gives all the details necessary for the business to operate. What are the technical specifications of the product? What is the main product? What is it made of? The company aims to achieve a sustainable process to reduce the environmental impact of industrial production while improving and maintaining the overall efficiency and quality of the product. These processes prioritize resource efficiency, waste reduction, energy conservation, and the use of environmentally friendly materials. Repurposing face masks involves transforming used or disposable masks for alternative uses while ensuring safety and hygiene.

### B. Collection Process

This process involves receiving and claiming the reject and waste disposable masks from the supplier.



Fig.6. Collection of Face Masks

### C. Inspection

In this process, the person responsible will inspect the masks and remove the unnecessary part of the mask like ear loop, nose wire, and foam. Only non-woven is needed.





Fig.7. Inspection and Removal of Excess Part of Face Masks

#### D. Repurposing the excess part of the face mask:

**Nose wire** – the nose wire can be used as a folder fastener for office files.

**Ear loop and Foam** – collecting all the foam from the face mask and stuff into the pillowcases to sustainable pillows. Use the repurposed foam pillows in your own home or consider donating them to shelters, charities, or organizations that can distribute them to those in need.

#### E. Melting Process

The mask will pass through a machine that applies heat and pressure. The heat will cause the polypropylene fibers to melt. In this process, different methods and tools are being used to compare what method is the best.

Methods and tools used:

- Flatiron
- Heat Gun
- Grilling or Broiling Method
- Stove



Fig.8. Different Types of Heating Methods Used

It turns out that using a stove is the most effective method.

#### F. Molding Process

Pour the melted or liquified masks into the molder. In molding the melted disposable face mask, the researchers will use a specific molder depending on the material to be made.



Fig.9. Pouring of melted/liquified Face Masks

#### G. Cooling Process

Let the mask dry and cool at room temperature to solidify. It takes 20 minutes to solidify the melted face masks.



Fig.10. Solidification Process: Cooling the Melted Face Masks

#### H. Storing

The product will be kept in an environment where the temperature remains below 25 degrees Celsius to prevent any distortion of the product. Given that the product is crafted from polypropylene plastic, which is susceptible to high temperatures and undergoes slow melting when exposed to elevated temperatures over an extended period. This means the trays are resistant to indirect heat but require ventilation in storage to avoid direct exposure to intense heat sources, such as the sun.

### 3. Results And Discussions

This study aims to address the growing concerns surrounding the environmental impact of single-use face masks. These masks, often constructed from non-biodegradable materials, contribute to solid waste accumulation and environmental pollution upon disposal.

The face mask industry faces numerous challenges, notably in waste management and the increase of microplastics. As such, this research seeks to explore innovative and sustainable approaches to mitigate these issues. Specifically, the study will

investigate the feasibility of repurposing surgical face masks into new products as a potential solution to this pressing environmental problem. The corresponding chart results that is shown afterwards is based on the conducted survey of the researchers to the fast foods and restaurants in the mall established near their area.

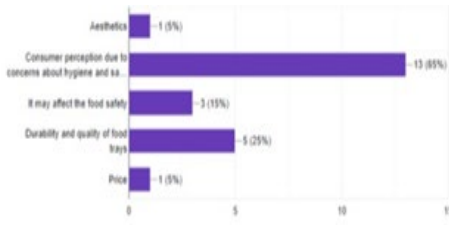


Fig.11. Concerns regarding the use of facemask material for food trays in business

This concern will probably reflect the importance placed on businesses to maintain a good image in order to deal with customers' concerns about their food safety when a Repromask Food Tray is being used. In addition, concerns about durability and the quality of trays made from facemask material were raised by 25 % of respondents. It follows that, emphasizing the importance of trays holding food and retaining their quality, a quarter of companies are considering how they can take advantage of this material.

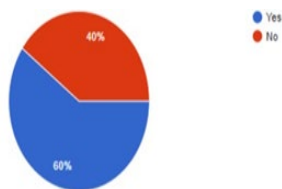


Fig.12. Willingness to Pay for Environmentally Friendly Food Trays

According to the results of the survey, if this leads to reduced waste, 60% of respondents would be open to paying a little more for food trays made from reused or rejected facemasks. This majority suggests a significant level of consumer willingness to support environmentally friendly initiatives, even if it entails a modest increase in cost. 40% of respondents who said "no" appear less interested in prioritizing environmental concerns over cost. They may prioritize economic factors and see less value in paying extra for food trays made from recycled masks.

The Repromask Manufacturing recognizes the importance of reducing environmental impact and promoting sustainability in the company's manufacturing operations. The company is committed to implementing environmentally friendly practices, eliminating waste, conserving resources, and continuously improving environmental performance. Collaboration with vendors is encouraged to source environmentally friendly raw

materials and packaging. Efforts will be made to reduce, reuse, and recycle waste materials, establish waste segregation systems, and ensure proper disposal of potentially hazardous waste. Selection of environmentally responsible suppliers for materials and supplies is prioritized, with a focus on products with minimal environmental impact.

#### 4. Estimated Costs in The Repromask Tray Production

##### A. Computation for Product Cost

The computation of product cost of Repromask Food Tray per piece of Repromask Manufacturing. was derived from the price of raw materials divided by the amount of raw materials per kilogram needed for each shape.

The ratio used in the production is based on Repromask Manufacturing's own mixture during the prototyping stage due to lack of resources about the standard measurements of raw materials needed.

Product	Price of Raw Materials	Needed each	Cost per Repromask Food
Rejected Facemask	₱30/kg	600 grams	₱ 35.83
Butane gas	₱65	50 grams	
<b>Total Cost:</b>			<b>₱ 35.83</b>

Fig.13. Price of Repromask Tray per piece

The following next sections discuss the projected expenses if Repromask Manufacturing chooses to initiate large-scale production of Repromask trays.

##### B. Production Supplies



Items	Supplier	Unit Cost	Quantity	Total Cost
Reject/ Scrap Face masks 	Yokoisada (Phils.) Corporation Location: Phase 1 Lot C-2&D (B) Clark Premiere Industrial Park, M/A Manuel A. Roxas Hwy, Clark Freeport, 2023 Pampanga	P 30 per kilo	960 kg	P 28,800.00
LPG 	South Pacific Inc.	P 850.00	1	P 850.00
<b>Total Cost</b>				<b>P 29,650.00</b>

Fig.14. Projected Production Supplies Cost

Note: This production supplies are for 1 month only

##### C. Polypropylene Plastic from Rejected Face Masks

Scrap or reject disposable face masks from the manufacturer as raw materials for creating the product is the company's desired supply of raw materials, since this material is no longer needed for the cleaning and sanitizing process. The disposable mask is made from polypropylene plastic. Since it is plastic, it can create more products that use plastics. This rejected mask as a raw material enhances efficiency, contributing to a faster, and more economical production cycle.

D. Equipment Cost





Items	Supplier	Unit Cost	Quantity	Total Cost
 Electric Stove	1Stop Minimart Location: McArthur Highway, Tulaco Bridge Apalit, 2007 Pampanga	P 550.00	1	P 550.00
 Molder Tray	Daniel Jr. Sebaria Enterprise Location: Sampaloc Apalit, Pampanga	P 1000 (Customized)	20	P 20,000.00
 Scissor	Pandayan Bookshop Apalit, Branch	P 10.00	2	P 20.00
 Wooden Box	Shopee	P 420	10	P 4,200
<b>Total Cost</b>				<b>P 20,570.00</b>

Fig.14. Projected Equipment Cost

The following equipment listed above are the equipment used in the production of Repromasks Tray. Here is the list of prices per equipment if there is a need for purchase or as a start-up of the business.

Position	Rate	Quantity	Days	Amount
Owner/ Production Manager	Php. 1,501.00	1	12	P 18,012.00
Production Worker	Php. 493.00	4	20	P 39,440.00
<b>Total Cost</b>				<b>P 57,452</b>

Fig.14. Projected Labor Cost

The following table above is the estimated salaries of the five (5) employees in the production. Specifically, the owner or Production manager has an estimated salary of 1,500 pesos. Then the four (4) Production workers have an estimated salary which amounts to 493 pesos which is also based on the announcement of the Department of Labor and Employment (DOLE) about the wages in the particular region.[7]. This sums up the salary they may receive every month.

5. Conclusion

In conclusion, Repromask Manufacturing's initiative to recycle discarded face masks into functional food trays addresses urgent environmental challenges arising from the COVID-19 pandemic. With the increase in face mask usage worldwide, improper disposal has led to significant environmental pollution. This study seeks innovative solutions to repurpose wasted disposable masks (WDM) into valuable commodities, notably the Repromask Food Tray. By prioritizing sustainability, the company contributes to a circular economy model while mitigating environmental harm caused by disposable mask waste. Additionally, charitable campaigns further demonstrate Repromask Manufacturing's dedication to giving back to the community.

The Repromask Food Tray appears to be a highly feasible product. Its innovative use of recycled face masks addresses pressing environmental concerns, such as plastic pollution, while promoting a circular economy. The technical study ensures its structural integrity, functionality, and safety, meeting quality standards for everyday use. The manufacturing

process, including material collection, melting, molding, and quality testing, demonstrates a systematic approach to product development and ensures durability and performance.

This research aims to tackle challenges in the face mask industry, particularly waste management and the multiplication of microplastics, by exploring innovative and sustainable solutions such as repurposing surgical face masks into new products. Findings from a survey conducted by the researchers among fast food restaurants in a nearby mall reveal that approximately 25% of respondents have concerns regarding the use of face mask material for food trays, particularly regarding food safety, durability, and quality. Despite these concerns, a quarter of the companies are considering leveraging this material.

Moreover, another survey results indicate a significant level of consumer willingness to support environmentally friendly initiatives, with 60% of respondents open to paying a slightly higher price for food trays made from reused or rejected face masks if it leads to reduced waste. However, 40% of respondents prioritize economic factors over environmental concerns and are less inclined to pay extra for trays made from recycled masks. In response, Repromask Manufacturing reaffirms its commitment to reducing environmental impact and promoting sustainability in its operations through the implementation of eco-friendly practices, collaboration with vendors, and waste reduction initiatives.

The journey undertaken by the researchers in developing the Repromask Tray has been marked by perseverance and innovation. Through meticulous experimentation and rigorous testing, they have explored a multitude of methods for melting face masks, with the stove emerging as the most effective approach. Despite encountering numerous obstacles and setbacks along the way, their unwavering determination has ultimately borne fruit in the form of the Repromask Tray, a tangible manifestation of their dedication to sustainability. While the researchers acknowledge that their exploration of the capabilities and conduction of various tests on the Repromask Tray has been somewhat limited due to time constraints, they remain optimistic about its potential. They recognize the importance of further research and development to unlock the full extent of its capabilities and ensure its efficacy in real-world applications.

This recommendation for future directives underscores their commitment to continuous improvement and refinement, paving the way for the Repromask Tray to reach its maximum potential. Despite the constraints imposed by time limitations, the creation of the Repromask Tray stands as a testament to the ingenuity and resourcefulness of the researchers. By transforming discarded face masks into a valuable and functional product, they have not only mitigated waste but also contributed to the advancement of sustainability initiatives.

The Repromask Tray represents more than just a solution to environmental challenges—it embodies a paradigm shift towards a more meticulous and responsible approach to waste management and resource utilization. In essence, the

Repromask Tray is not merely a product of the study; it is a symbol of possibility and progress. Its creation underscores the transformative power of innovation and serves as a beacon of hope for a more sustainable future. Through their endeavors, the researchers have demonstrated that even in the face of adversity, ingenuity and determination can pave the way for meaningful change. The Repromask Tray stands as a testament to their vision and dedication, offering a glimpse into a world where waste is repurposed into opportunity, and sustainability reigns supreme.

### References

- [1]. (Pitlik SD) COVID-19 Compared to other pandemic diseases. *Rambam Maimonides Med J.* 2020;11: e0027.
- [2]. Dharmaraj, S., Ashokkumar, V., Hariharan, S., Manibharathi, A., Show, P. L., Chong, C. T., & Ngamcharussrivichai, C. (2021). The COVID-19 pandemic face mask waste: A blooming threat to the marine environment. *Chemosphere*, 272, 129601.
- [3]. Rahman, Z., Hoque, E., Alam, M. R., Rouf, A., Khan, S. I., Xu, H., & Ramakrishna, S. (2022). Face masks to Combat coronavirus (COVID-19)—Processing, roles, requirements, efficacy, risk and sustainability. *Polymers*, 14(7), 1296.
- [4]. Bamber J.H., Christmas T, 2020 Unmasking emerging issues in solid waste management: Knowledge and self-reported practices on the discarded disposable masks during the COVID-19 pandemic in the Philippines. *Environ Chall (Amst)*. 2022 Jan; 6: 100435.
- [5]. Talabis, D. a. S. J., Babierra, A. L., Buhat, C. a. H., Lutero, D. S., Quindala, K. M., & Rabajante, J. F. (2021). Local government responses for COVID-19 management in the Philippines. *BMC Public Health*, 21(1).
- [6]. Yokoisada (Phils.) Corporation Desiderio, L. (2020, April 6). Yokoisada Philippines to produce more face masks. *The Philippine Star*.
- [7]. Production Worker Salaries: Minimum wage per day in Pampanga as of October 16, 2023.