International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 06 | Jun 2022 www.irjet.net p-ISSN: 2395-0072

Enhancement of mechanical properties of polypropylene extracted from the waste surgical masks by adding glass fiber

Aniket Patil[1], Ravichandra Naik[2], Parashuram Bhilare[3], Ajey Badami[4], Prof. Prashant Shet[5], Dr. Rajendra M Galagali[6]

[1,2,3,4] *Student, Department of Mechanical Engineering, S.G. Balekundri Institute of Technology, Belagavi, Karnataka, India*
[5]*Professor and Project Guide, Department of Mechanical Engineering, S.G. Balekundri Institute of Technology, Belagavi, Karnataka, India*
[6]*Professor and HOD, Department of Mechanical Engineering, S.G. Balekundri Institute of Technology, Belagavi, Karnataka, India*

Abstract - *The main objective of this project is to recycle the used surgical masks to reduce the pollution caused due to a lack of knowledge in people on proper disposal. The surgical masks may look like they are made out of fabric but in reality, they are made out of three layers of polypropylene material which is a type of plastic, this type of plastic material is also used to make bottle caps, food containers, etc. So, we decided to collect the used surgical masks from hospitals and to make the use of the masks to form specimens by melting the masks and analyzing the mechanical properties of the specimens as per American society for testing and materials (ASTM)standards. The mechanical properties of the specimens will be tested on a Universal Testing Machine (UTM). And we will compare the properties with glass fiber-infused polypropylene. And the results which we will obtain after the test will help us to produce products that can be used in day-to-day life.*

Key Words: **Masks, Polypropylene, Glass Fiber, Universal Testing Machine (UTM), American Society for Testing and Materials.**

1. INTRODUCTION

One of the things that saved us from the Covid 19 virus is Mask, we have collectively used around 129 billion masks in 2021. This resulted in the mass disposal of masks in landfills and water bodies, which is harmful to the environment and aquatic life. Each mask takes about 500 years to degrade in the environment. These surgical masks are made out of polypropylene.

Polypropylene (PP) is a synthetic material that is durable, water-resistant, lightweight, Recyclable, and inexpensive. This material is generally considered non-toxic and safe for human contact. It has a wide range of applications and is available in a variety of forms. For example, sheets of plastic (used for food containers, woven fabric (used for clothing), And non-woven fabric (used in the mask). The type of polypropylene used in masks is non-woven propylene (NWPP).

Non-Woven polypropylene is nontoxic, hydrophobic (water-resistant), and provides good filtration. NWPP is widely used in the medical field for masks and PPE kits. Non-woven polypropylene is produced by spinning polypropylene fibers into threads and laying them down in a porous web form that is breathable and provides good filtration of air.

After being used these masks are thrown in dustbins or other disposals this results in wastage of the material and it pollutes the environment. Instead of throwing these masks and wasting them we can recycle these masks and produce useful products by melting the mask and moulding it into desired products. by this we can reduce the pollution caused by the masks.

In this paper, we are conducting mechanical tests like compression tests and bending tests on the specimen made out of polypropylene and glass fiber reinforced polypropylene. The specimen is produced as per ASTM standards. The tests on the specimen will be performed on a Universal testing machine (UTM).

A Universal Testing Machine is used to test the mechanical properties (i.e., tensile test, compression test, bending test, etc.) of a given specimen by exerting tensile, compression, and bending force on the specimen. The machine Is called universal because it can perform various kinds of tests on a variety of materials.

2. OBJECTIVE

1. To reduce pollution created by masks in the environment
2. To improve the physical properties of the material derived from the waste mask.
3. To study the mechanical properties of produced material.
4. To produce useful low-cost products out of the waste mask

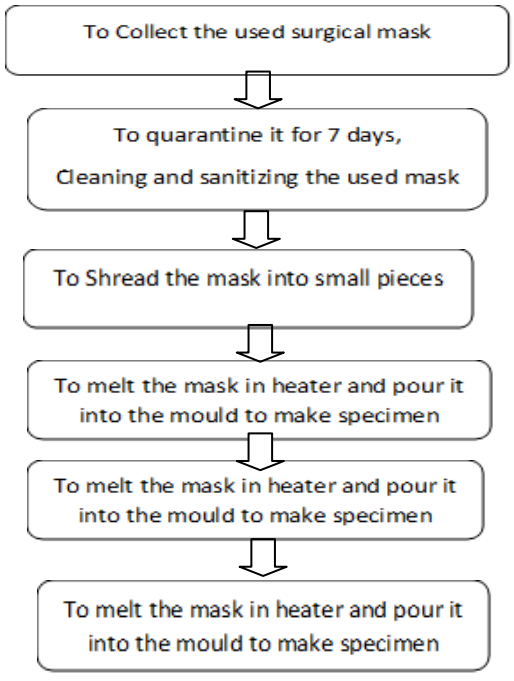
3. LITERATURE REVIEW

- Amzan Alsabri, Furqan Tahir, Sami G. Al-Ghamdi have studied consequences on the Environmental impacts of polypropylene production and the prospects of its recycling in the GCC.
- Francesco Saliua, Maurizio Veronelli b, Clarissa Ragusoa , Davide Baranac , Paolo Galli a , Marina Lasagni have studied The release process of microfibers: from surgical face masks into the marine environment.
- R. Singer, A.M. Ollick, M. Elhadary has conducted experiment on Effect of cross-head speed and temperature on the mechanical properties of polypropylene and glass fiber reinforced polypropylene pipes.
- Mariana Etcheverry and Silvia E. Barbosa has conducted an experiment Glass Fiber Reinforced Polypropylene Mechanical Properties Enhancement by Adhesion Improvement.

4. METHODOLOGY

Used masks from the hospitals are collected and quarantined for 6 to 7 days and then they are sanitized. The nose wire and ear loops are separated from the masks. Then the masks are shredded into small pieces and the pieces of the shredded mask are placed into the heater and melted and then the molten form of the mask is poured into the mould to get the desired shaped specimen and to perform mechanical test i.e., Tensile test, Bending test And Compression Test According to the ASTM Standards.

Flow chart-1: Methodology.



5. PROCEDURE OF MAKEING THE SPECIMEN

5.1. Preparation of mould (as per ASTM Standards):

a. For Tensile Test:

Taking a sheet metal of size 171X25mm and shaping it into a mould of 165X19X3.2mm sized cuboid.

b. For Bending Test:

Taking a Sheet metal of Size 131X25mm and shaping it into a mould of 125X19X3.2mm Sized cuboid.

c. For Compression Test:

Taking a Sheet metal of size 50X50mm and shaping it into a mould of size 25.4X12.7X12.7mm sized cuboid.

5.2. Preparation of Specimen (as per ASTM Standards):

a. For Tensile Test (ASTM D638)

Specimen size:

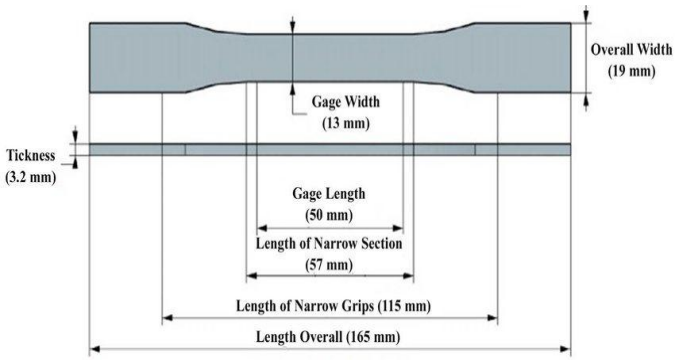


Fig-1: Specimen size for tensile test.

Three types of specimens were made:
T1- Polypropylene
No. of masks used = 10.
Weight of Specimen= 20gm.

T2- Glass fiber infused polypropylene
No. of masks used = 9.
Weight of glass fibre= 2gm.
Weight of Specimen= 21gm.

T3- Glass fiber sheet infused polypropylene
No. of masks used = 9.
Weight of glass fibre= 5gm.
Weight of Specimen= 23gm.

b. For Bending Test (ASTM D790)

Specimen size:

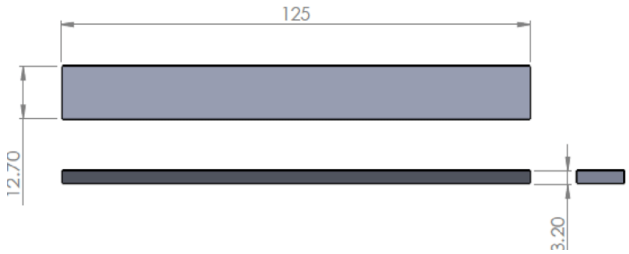


Fig-2: Specimen size for bending test.

Three types of specimens were made:
B1- Polypropylene
No. of masks used = 9.
Weight of Specimen= 18gm.

B2- Glass fiber infused polypropylene.
No. of masks used = 9.
Weight of glass fibre= 2gm.
Weight of Specimen= 20gm.

B3- Glass fiber sheet infused polypropylene.
No. of masks used = 9.
Weight of glass fibre= 5gm.
Weight of Specimen= 23gm.

c. For Compression Test (ASTM D695)

Specimen size:

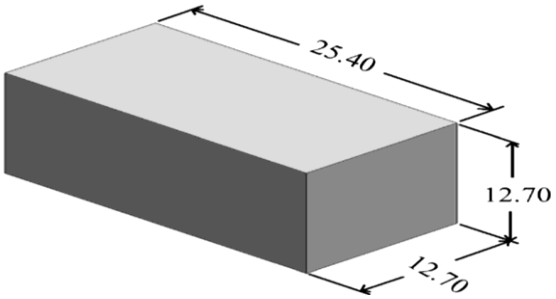


Fig-3: Specimen size for compression test.

Three types of specimens were made:
C1- Polypropylene
No. of masks used = 2.
Weight of Specimen= 4gm.

C2- Glass fiber infused polypropylene
No. of masks used = 2.
Weight of glass fibre= 1gm.
Weight of Specimen= 5gm.

C3- Glass fiber sheet infused polypropylene
No. of masks used = 2.
Weight of glass fibre= 1gm.
Weight of Specimen= 5gm.

Fig-4: Test specimen prepared as per ASTM standards.

6. TEST RESULTS

The Mechanical tests are performed on a Universal testing Machine according to the ASTM standards.

For Tensile Test of T1, T2, and T3:

Specimen No.	Peak Load (KN)	Yield Strength (N/mm^2)	Tensile Strength (N/mm^2)
T1	0.424	4.613	5.779
T2	0.512	5.423	6.408
T3	0.639	6.212	6.908

Table 1: Test results for Tensile Test.

For Bending Test of B1, B2, and B3:

Specimen No.	Angle (in º)
B1	40
B2	42
B3	46

Table 2: Test results for Bending Test.

For Compression Test of C1, C2, and C3:

Specimen No.	Max. Load (KN)	Compressive Strength (N/mm^2)
C1	0.510	1.36
C2	0.623	1.59
C3	0.702	1.77

Table 3: Test Results for Compression Test.

7. CONCLUSION

In this study, the analysis of the effect of adding load to the specimen prepared by the mask material (i.e., Polypropylene), Glass Fibre infused Polypropylene, and Glass Fibre sheet infused Polypropylene shows that:

- In the tensile test, it was observed that the yield strength, peak load, and tensile strength of the Glass Fibre sheet infused Polypropylene was higher than that of the other two i.e., PP and GFPP.
- In the Bending test, it was observed that the bending angle of the Glass Fibre sheet infused Polypropylene was higher than that of the other two i.e., PP and GFPP.
- In the Compression test, it was observed that the max. load and the compressive strength of the Glass Fibre sheet infused Polypropylene was higher than that of the other two i.e., PP and GFPP.

Hence, adding of glass fibre to the material obtained from mask enhances its mechanical properties as show above.

REFERENCES

- Kajanan Selvaranjana, Satheeskumar Navaratnam, Pathmanathan Rajeevc, Nishanthan Ravintherakumarand – "Environmental challenges induced by extensive use of face masks during COVID-19: A review and potential solutions" April 2021
- Saikat Sinha, Raya Hyung, Kae Leea Dao, Thi Thanh Huyena, Shiao-Shing ChenbYoung-NamKwona "Microplastics waste in environment: A perspective on recycling issues from PPE kits and face masks during the COVID-19 pandemic 11th Jan 2022"
- Elise Sales Naïl, Mulatie rLouise Wittmann Antoine Fernandes Beatrice Vacher Jose Penuelas "Effect of dry heat treatment between room temperature and 160 ◦C on surgical masks" Jan 2022
- Maocai Shen Zhuotong Zeng Biao Song Huan YiTong HuYaxin Zhang Guangming Zeng Rong Xiao- "Neglected microplastics pollution in global COVID-19: Disposable surgical masks"29th May 2021
- Francesco Saliua, Maurizio Veronelli b, Clarissa Ragusoa, Davide Baranac, Paolo Galli, Marina Lasagni- "The release process of microfibers: from surgical face masks into the marine environment" 4th March 2021
- John W. Scott a, Andrew Turner b, Andres F. Prada a, Linduo Zhao a- "Heterogeneous weathering of polypropylene in the marine environment" 7th December 2021.
- R. Singer, A.M. Ollick, M. Elhadary- "Effect of cross-head speed and temperature on the mechanical properties of polypropylene and glass fiber reinforced polypropylene pipes" March 2021
- D. Rigona, F. Floriana, M. Ricottaa, G. Ardengob F. Trivillinb and G. Meneghettia – "Fatigue behaviour of 3D printed virgin and recycled short-glass- fiber-reinforced and mineral-filled polypropylene" 29th December 2021
- Idehai O. Ohijeagbona, Adekunle A. Adelekea,c, Vincent T. Mustaphaa , John A. Olorunmaiyea , Imhade P. Okokpujieb , Peter P. Ikubannic- "Development and characterization of wood-polypropylene plastic-cement composite board" 20 April 2020.
- Youmei Du a, Dequan Ma a, Jie Mao a, Jianqi Yao a, Qin Ma a, Jing Lu a, Faliang Luo a, Chunhui Luo b, Lei Li c – "Improving the antistatic and antibacterial properties of polypropylene via tetrapod-shaped ZnO@Ag particles" 18th July 2021.
- Mateusz Barczewski a, Olga Mysiukiewicz a, Jacek Andrzejewski a, Adam Piasecki b, Beata Strzemięcka c, Grzegorz Adamek – "The inhibiting effect of basalt powder on crystallization behavior and the structure-property relationship of α-nucleated polypropylene composites" 22nd September 2021.
- Amzan Alsabri, Furqan Tahir, Sami G. Al-Ghamdi – "Environmental impacts of polypropylene (PP) production and prospects of its recycling in the GCC region" 2021.