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Fabrication of Composite By Used Surgical Mask

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Abstract— Composites have been found to be the most promising and discerning material available in this century. Presently, composites reinforced with fibers of synthetic or natural materials are gaining more importance as demands for lightweight materials with high strength for specific applications are growing in the market. Fiber-reinforced polymer composite offers not only high strength to weight ratio, but also reveals exceptional properties such as high durability; stiffness; damping property; flexural strength; and resistance to corrosion, wear, impact, and fire. These wide ranges of diverse features have led composite materials to find applications in mechanical, construction, aerospace, automobile, biomedical, marine, and many other manufacturing industries. Performance of composite materials predominantly depends on their constituent elements and manufacturing techniques, therefore, functional properties of various fibers available worldwide, their classifications, and the manufacturing techniques used to fabricate the composite materials need to be studied in order to figure out the optimized characteristic of the material for the desired application.

Keywords— Composite, fibres, reinforced fibres, polymer, polymer composite

I. INTRODUCTION

Another problem after the covid-19 pandemic is waiting at the door, i.e. disposal of used mask. As if now government advised people to use double mask, it means every individual will at least use a single surgical mask. Usually after the use of masks they are dumped in the household waste. Which are then taken to landfills and get mixed with other waste. This can be harmful to cleaners, marine life and many more. The best possible way to get out of this problem is to RECYCLE the used masks.

Research shows that the improper disposal of used surgical masks is leading to waste generation and polluting the water bodies.The surgical masks are made of non woven polypropylene (PP) of 20GSM and 25GSM. (Polymers (Basel). 2021 Jan; 13(2): 233.)shows that PP can be recycled by converting into granules and then reinforcing it with hybrid fibre reinforcement.

The polymer matrix composites have been widely used for many applications. These are light in weight and easy for manufacturing. The hybrid fiber reinforced composites have been prepared to enhance the mechanical, thermal, damping properties compared to single-fiber reinforced composites. The fiber reinforced hybrid composites consist of two or more fiber in a matrix system. The different fibers were reinforced with suitable matrix for preparing the hybrid composites using various manufacturing methodology. The hybrid composites are used for many application and replacing wood, wood fiber composites and conventional materials. The mechanical properties (tensile, flexural and impact), dynamic, tribological and water absorption properties of natural fiber reinforced hybrid polymer composites and natural/ synthetic fiber reinforced hybrid polymer composites were reported.

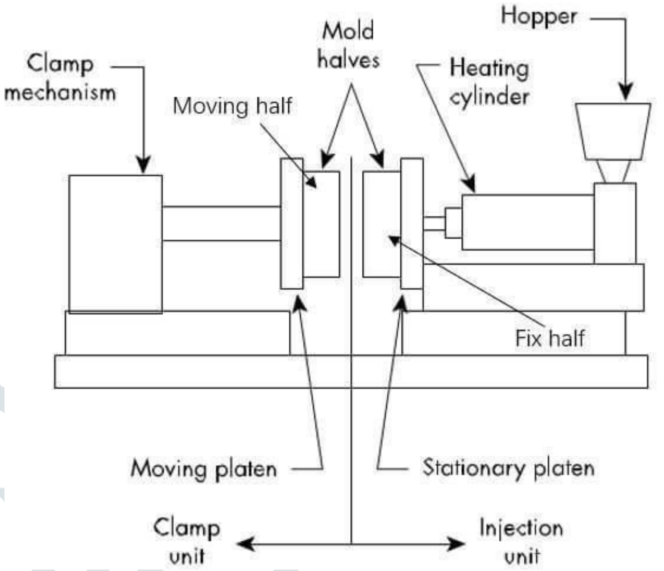
Fiber Reinforced Polymer (FRP) composites are generally used in various applications such as structural members, aerospace, architectural furnitures, sports items etc. because of their lower weight, high stiffness and strength, impact resistance behavior and maximum flexibility in manufacturing. FRP in regular practice are fabricated with synthetic based fibers such as glass and carbon, which are costly and non-ecofriendly. Utilization of natural fibers from plant, leaves and seeds is always an advantage. Different natural fibers such as sisal, banana, coir, flax, jute, hemp, cotton etc. are being used in making of an FRP composite for various types of uses. Rohit and Dixit [1] brought out the future trend of natural fiber reinforced composites through evaluation of various mechanical properties and biocompatibility with upcoming tests for indoor and outdoor uses. Natural fiber has moderated strength, light weight and eco-friendly nature. To increase mechanical strength and other properties of natural fibers, chemical treatment to reduce the hydrophilic nature is must before fabrication as suggested by various researchers [2], [3], [4], and [5]. Harish et al. [6] studied the coir/epoxy composite fabricated by hand lay-up method and characterized for several mechanical properties. Flexural strength of 31.08 MPa and impact strength of 11.49 KJ/m^2 was attained displaying greater interfacial bond strength. Hybrid FRP panel made of synthetic and natural fibers are gaining attention in making different types of products. Pickering

[7] in the review paper, provided the detailed properties such as flexural strength, impact behaviour and strength/stiffness of natural fibers used to make hybrid FRP composite. Alagarraja et al. [8] worked on glass-sisal FRP composite using hand lay-up method. Sanjay [9] studied the FRP composite made of Glass-jute. Tensile strength and flexural strength of 85 MPa and 114 MPa was attained with impact strength 7.12 J.Hoo Tien Kaun [10] demonstrated that volume fraction of fibers made of glass improves impact behaviour. [11] Studied plant fiber FRP composite made of jute, sisal, flax and hemp fibers, traditionally available in rural India. Through extensive research done by researchers, [7], [12], [13] flax and hemp fibers possess better mechanical properties such as tensile strength, young's modulus, % elongation etc. as compared to other available natural fibers. Kevlar as a synthetic fiber provides better static and dynamic property as an outer skin of the composite [14].

Manufacturing Technique

Manufacturing of FRP composite involves manufacturing of fiber preforms and then reinforcing these fibers with the matrix material by various techniques. Fiber preforms involve weaving, knitting, braiding, and stitching of fibers in long sheets or mat structure Preforms are used to achieve a high level of automation with the assistance of robotics, which offers control over the fiber angle and the fiber content on every zone of the part to be molded

It uses preheated molds mounted on a hydraulic or mechanical press. A prepared reinforcement package from prepreg is placed in between the two halves of the mold, which are then pressed against each other to get a desired shape of the mold. Figure 1 represents the stepwise processing of compression molding. It offers short cycle time, a high degree of productivity, and automation with dimensional stability, hence it finds diverse applications in the automobile industry Dispersion of 35% filler elements containing sisal fiber and zirconium dioxide (ZrO_2) particles in the matrix of unsaturated polyester (UP) was obtained by the compression molding technique, which displayed optimum mechanical properties when tested under SEM, X-ray diffraction, and Fourier transform infrared spectrometer (FTIR). Jute fiber-reinforced epoxy polymer matrix-based composite has been fabricated by using hand lay-up followed by the compression molding technique at s curing temperature ranging from 80 ◦C to 130 ◦C. Enhancement in the mechanical properties has been observed with the maximum tensile strength of 32.3 Mpa, flexural strength of 41.8 Mpa, and impact strength of 3.5 joules.



Plastic molding machine diagram(figure 1)

Plastic molding machine display(figure 2)

Methodology

1) NIP ROLLER

Roll of non-woven pp is passed through nip roller.

2)CUTTER COMPACTOR MACHINE

The cutter compactor is specially designed to process with plastic films, which produce frictional heat during the process, it helps to compact the films and increase the density while removing the moisture from the waste films or flakes at the same time. It is also equipped with an overheated water cooling system to cool down when needed.

Non-Woven PP is passed through cutter compactor machine to shred it into cotton.

3) Degass Vent

It is then passed through Degass Vent

4) Die Face Cutting System

The processed PP is then passed through Die Face Cutting System where it is converted into granules.

5) PP is reinforced with glass fibre and hemp fibre

Glass fiber(figure 3)

Flax fiber(figure 4)

PMC IN PERFORMANCE FOOTWEAR

Performance footwear: The optimum utilization of polymers and polymer matrix composites is essential for manufacturing performance footwear of high quality and comfort that can be used for prolonged periods despite the severe demands that may be placed on them during use. Hence polymers and polymer matrix composites find many uses in performance footwear. The following are some examples:

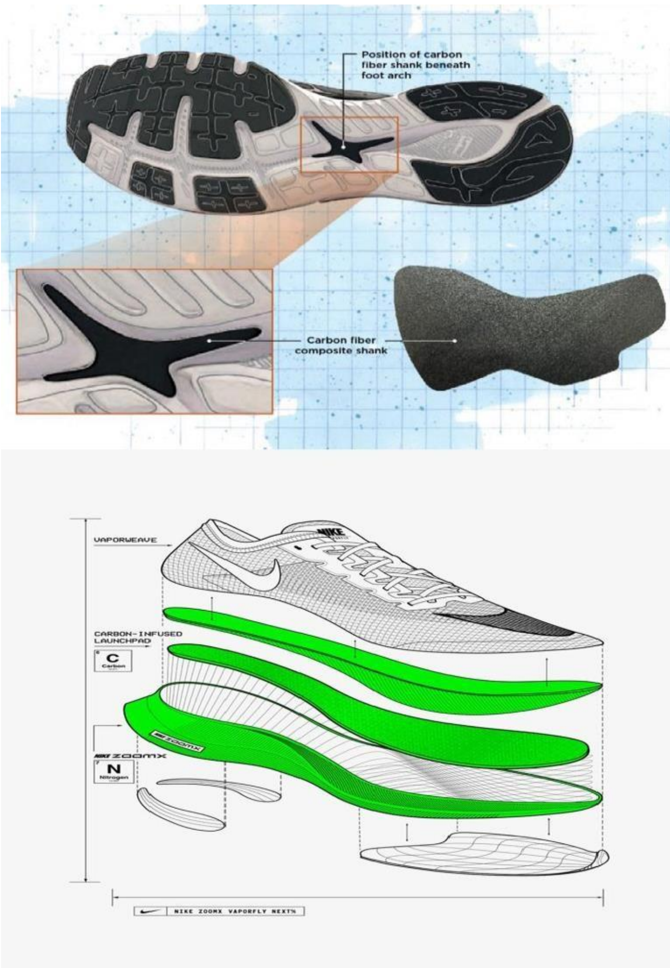
Technical textiles of various types of design, chosen mainly for their technical and performance properties, are among the materials of construction of performance footwear. The fiber types used in such textiles include cotton, wool, nylon, polyester, polypropylene, rayon, Spandex, and many others. Textiles constructed from these different types of fibers and their blends span a broad range of properties and performance characteristics and are used in many different portions of performance footwear.

Synthetic (artificial) leather prepared from polyurethane formulations is often used as an alternative to natural (most often cow) leather in performance footwear. It is available in different designs, at different levels of quality and cost. It is often a composite made of two layers, including a backing layer that is most often made of woven or nonwoven polyester fibers.

Open-cell polyurethane foams of various densities and thicknesses are used in the tongues, collars, and uppers of shoes. Reticulated open-cell foams are used if the maximum possible amount of ventilation is desired.

Midsoles are manufactured from closed-cell foams of materials such as ethylene-vinyl acetate copolymers, polyethylene, styrene-butadiene rubber, polyurethane, natural rubber, and polychloroprene.

The polymers and composites used in performance footwear can be further fine-tuned with the use of additives to provide additional benefits. For example, biologically resistant or reactive composites may be used to counteract the typical drawbacks of conventional shoe textiles, such as odor, bacteria, and fungi.



~ Olesya Gulubeva and Alina Pogorelova

Hybrid Fibres Shoe sole(figure 5)

Table 1

Fiber/fraction (%)	Tensile strength (MPa)	Tensile modulus (GPa)	Flexural strength (MPa)	Flexural Modulus (GPa)	Impact strength (J/m^2)
None	20–40	1.0–1.4	42.1	1.1	16
Hemp/30 (wt)	22.1	10.2			
Hemp/40 (wt)	40.2	3.55	73.3	4.1	29
Hemp/50 (wt)	50	6.5	85	4	53 (kJ/m^2)
Hemp/30 (wt)	32.3	1.53	48.5	1.67	15.1 (kJ/m^2)
Hemp/30–70 (wt)	55	6.7	85	4.7	46 (kJ/m^2)
Hemp/64 (wt)	42		63		152
Hemp	34	2.7	41.5	2.3	3.89 (kJ/m^2)
Glass/22 (vol)	88.6	6.2	60	4.4	54.12 (kJ/m^2)

CONCLUSION

1. The surgical masks are made of non-woven polypropylene(PP) of 20GSM and 25GSM.
2. PP can be recycled by converting into granules.
3. It can be reinforced with hybrid fibres .
4. This composite can be used in sports applications(shoesole).

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