

# Studies on Mechanical and Tribological Properties of Polymer Matrix Composites Reinforced with Titanium Carbide and Natural Fiber

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**Abstract** - This paper describes in detail about the studies of mechanical and tribological of polymer composites materials which are reinforced with titanium carbide and natural fibre. Titanium is a significant transition metal. Its carbide exhibits some superior comprehensive characteristics. Titanium carbide is an extremely hard metal. Natural fibers are naturally occurring fibers that are produced by plants, animals, or geological process. Simple natural fibers have low strength and stiffness. The mechanical properties of the polymer composite of natural fiber and titanium carbide varies depending upon the type of natural fiber used. Thus, the polymer composite can be used in various fields depending upon the strength.

**Key Words:** Polymer Matrix Composites, Epoxy Resin, Titanium Carbide, Cow Dung Ash, Natural fibre, Mechanical properties

## 1. INTRODUCTION

Materials are the reason for improving human creation and expectations for everyday comforts. They give achievements in human advancement. People have been getting to and utilizing materials for a few thousand years. Polymer is first started in 1830s, polymer is any class of regular or engineered substances made out of enormous atoms, macromolecules that are more straightforward synthetic units called monomers. They comprise the premise of such minerals as jewel, quartz and feldspar and such man-made materials as solid, glass, plastic, and rubbers.

Polymer composite material is a multi-stage mix material of at least two segment materials with various properties and various structures through intensifying cycles, it not just keeps up the fundamental qualities of the first segment, yet additionally shows new character which are not controlled by any of the first parts.

The fundamental justification picking polymer grid composites is because of their expense proficiency and simple creation strategies and furthermore the support of PMCs has high strength, high effect opposition, low water retention limit, high elasticity, and so forth In this composite

material epoxy tar alongside hardener is utilized and the support material is Titanium Carbide (TiC) alongside Cow Dung Ash is utilized.

## 1.1 Objectives

The objective of the polymer which we are developing our own polymer with titanium carbide and natural fibres with epoxy resin. The polymer which as high strength, high durability and sustain in corrosive resistance. Moreover, hybrid is named as adding natural fibres such as bagasse, megasse, angora, jute, cotton, bamboo rayon and in geo fibre. The process is done using simple hand lay-up process.

## 1.2 Polymer Matrix Composite

Polymer network composites (PMCs) are contained an assortment of short or consistent strands bound together by a natural polymer grid. The PMCs is planned with the goal that the mechanical burdens to which the construction is oppressed in assistance are upheld by the support. The limit of the structure is to bond the strands together and to move loads between them. Polymer grid composites are regularly separated into two classes: built up plastics, and progressed composites. Boss among the upsides of PMCs is their light weight combined with high firmness and strength along the course of the support. The properties of the PMC rely upon the lattice, and the support materials.

## 1.3 Characteristics of PMCs

- High explicit strength
- High explicit firmness
- High break opposition
- Good, scraped spot opposition.
- Good sway opposition
- Good consumption opposition
- Good exhaustion opposition
- Low cost

### 1.4 Fabrication of PMCs

There are various methods for the fabrication of polymer matrix composite materials. Some of the methods are Compression molding, Injection molding, Press molding, Hand lay-up process and Spray-up process, Etc. Several curing methods are available. The most basic is simply to allow cure initiated by a catalyst or hardener additive premixed into the resin to occur at room temperature. This polymer composite material is fabricated using Hand lay-up process. Hand lay-up is the most basic method for the fabrication of polymer composites. The process is simple and very cost efficient.

The composite is fabricated by mixing 94% of resin along with hardener as a catalyst and 6% of reinforcement material is mixed in different ratios of titanium carbide (TiC) along with cow dung ash is mixed and poured into an open mold and allowed to cure for 8 to 10 hours.

Table - 1: Ratio Test

Samples	Epoxy Resin & Hardener	Reinforcement (TiC)	Fiber (CWD)
1	94%	1%	5%
2	94%	2%	4%
3	94%	3%	3%



Fig - 1: Reinforced Polymer Composite (Sample 1)



Fig -2: Reinforced Polymer Composite (Sample 2)



Fig -3: Reinforced Polymer Composite (Sample 3)

### 1.4 Applications

- **Aerospace structures:** The military airplane industry has primarily driven the utilization of polymer composites. In business carriers, the utilization of composites is continuously expanding. Space transport and satellite frameworks use graphite/epoxy for some underlying parts.
- **Marine:** Boat bodies, kayaks, kayaks, etc.
- **Automotive:** Body boards, leaf springs, drive shaft, guards, entryways, hustling vehicle bodies, etc.
- **Sports products:** Golf clubs, skis, casting poles, tennis rackets, etc.
- **Biomedical applications:** Medical inserts, muscular gadgets, X-beam tables.
- Scaffolds made of polymer composite materials are gaining wide affirmation on account of their lower

weight, utilization check, longer life cycle, and limited shudder hurt.

- Electrical Panels, lodging, switchgear, separators, and connectors. Also, some more.
- Bulletproof vests and other covering parts.
- Chemical stockpiling tanks, pressure vessels, funneling, siphon body, valves, etc.

### 1.5 Selection Of Materials

- **Epoxy Resin** – high performance adhesives are used in various structure such as plastics, paints, coatings, primers, and sealers.
- **Hardener** – the hardener which will act as catalyst and reactant for certain chemical reaction. The main naphthalene’s are used for hardener.
- **Carbide** - the carbide is used as reinforcement in the product. The Titanium carbide powder (TiC) is used as reinforcement in this product.
- **Natural Fiber** - the fiber which is taken from naturally prepared and generated as the natural fiber gives strength, stiffness, and good tensile strength. Various natural fiber is available such as Banana fiber, Bagasse, Maize, Egg shell and agriculture waste. The natural fiber used in this polymer is Cow Dung Ash.

## 2. MECHANICAL PROPERTIES

Various mechanical tests have been performed on the polymer composite material reinforced with titanium carbide along with cow dung ash. The results of the various tests have been shown in the table below.

Table - 2: Impact Test

S. No	Impact Test [J]
Sample 1	0.125
Sample 2	0.125
Sample 3	0.225

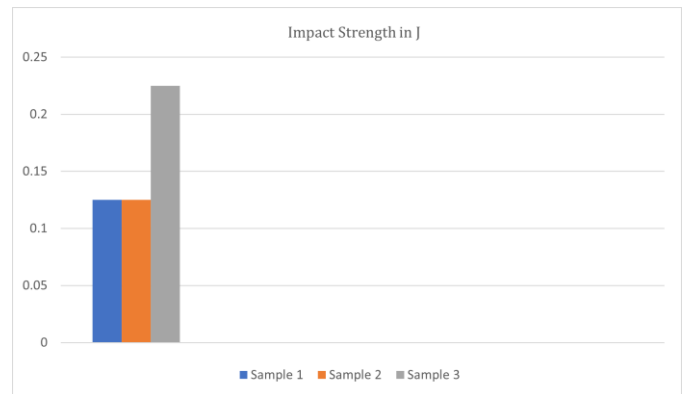


Chart - 1 Impact Strength

Table - 3: Tensile Test

S. No	CS Area [mm <sup>2</sup> ]	Peak Load [N]	%Elongation	UTS [N/mm <sup>2</sup> ]
Sample 1	60.000	897.360	2.430	14.960
Sample 2	60.000	561.711	4.370	9.359
Sample 3	60.000	1083.858	5.730	18.060

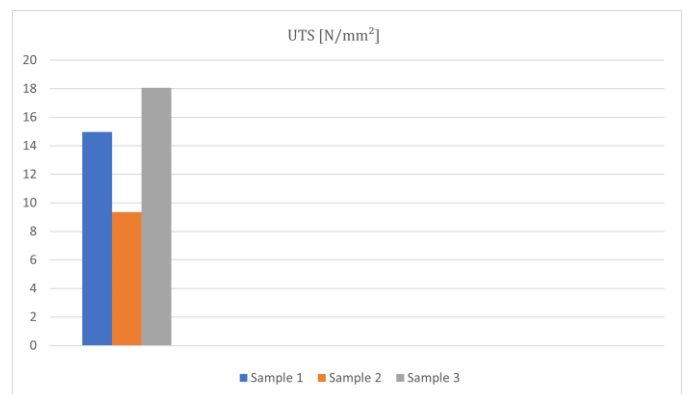


Chart -2 Tensile Strength

Table - 4: Flexural Test

S. No	CS Area [mm <sup>2</sup> ]	Peak Load [N]	Flexural Strength (MPa)	Flexural Modulus (GPa)
Sample 1	39.000	120.153	77.021	9517.450
Sample 2	39.000	67.287	43.133	9597.578
Sample 3	39.000	90.841	58.231	7211.093

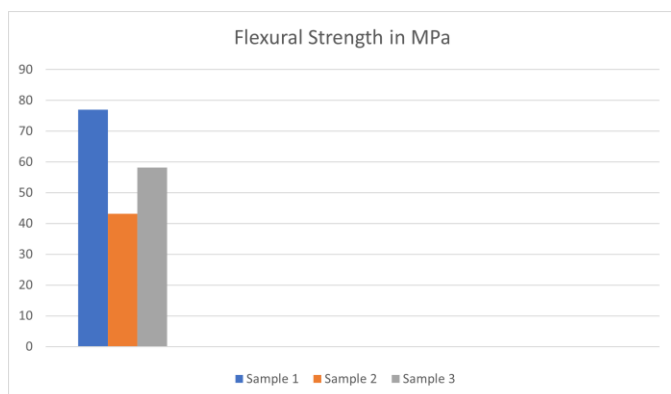


Chart -3 Flexural Strength

Table - 5: Micro Hardness Test:

S. No	Micro Hardness (Vickers) HV (H)	Average HV (H)
Sample 1	21.3	21.4
	21.5	
	21.4	
Sample 2	21.0	21
	21.2	
	20.8	
Sample 3	20.8	20.7
	20.9	
	20.6	

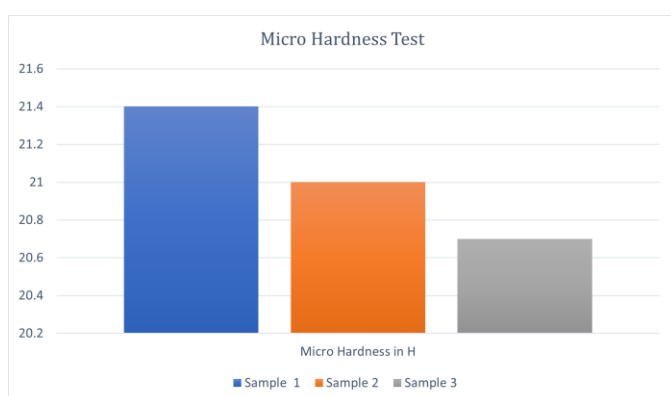


Chart - 4 Micro Hardness

From the above results we can see that the mechanical tests on various ratios of the polymer composite reinforced with

titanium carbide and cow dung ash. A chart is given below to show the graphical representation of the mechanical properties of the results.

#### 4. TRIBOLOGICAL PROPERTIES

Tribological testing is the tests performed on the surface of the polymer composite in which the surface interact with each other in a relative motion.

Table - 6: Water absorption Test

S. No	Weight before test in gms	Weight after test in gms (24 hrs.)	% of water absorption
Sample 1	1.51	1.51	0%
Sample 2	3.67	3.67	0%
Sample 3	3.49	3.49	0%
Sample 4	3.11	3.11	0%

#### 5. CONCLUSION

There are numerous polymers accessible in everyday life except all things considered, we will build up another polymer utilizing "Cow Dung Ash" and we anticipate that if might be utilized to for any required regions in future. Since the support utilized is titanium carbide the polymer shows high strength, and the adaptability of the polymer is diminished and furthermore since just fired material is utilized the water assimilation of the polymer is decreased extraordinarily. In view of the mechanical test aftereffects of the polymer composite there are different enterprises like vehicle, airplane, guard industry, and so on this particular polymer can be utilized. The expense of assembling this polymer is additionally low and this polymer is likewise harmless to the ecosystem contrasted for certain polymers.

#### 6. REFERENCES

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