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# EXPERIMENTAL INVESTIGATION AND ANALYSIS OF MECHANICAL PROPERTIES OF CHOPPED STRAND MAT-E GLASS FIBER POLYSTER RESIN & (COAL FLY ASH +GRAPHITE) COMPOSITES.

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**Keywords:** Chopped Strand Mat (CSM) 450 GM-Glass Fibers; (CSA+GRAPHITE) Powder; Polyester Resin; Hand- Lay; Catalyst; Accelerator.

## ABSTRACT

Composite materials play a vital role in many industrial applications. Researchers are working on fabrication of new composite materials worldwide to enhance the applicability of these materials. In view of this the mechanical performance of the composite material is essential. The objective of the present work is to analyze the effect of coal fly ash +graphite powder content on the mechanical behavior of chopped strand mat 450 GM-Glass fiber reinforced. Five different types of composites are fabricated using 0%wt, 5%wt, 10%wt, 15%wt and 20%wt of coal fly ash +graphite powder with Chopped Strand Mat-E glass fiber and polyester resin. The polyester resin, catalyst and accelerator are mixed in 80:6:6 weight ratio in polyester matrix with (csa +graphite)powder. The aim of the project is to investigate the effect of (csa +graphite) powder with chopped strand mat 450GM for making the composite material stronger and tougher. The investigation is carried out by mixing different weight percentages of the powder with the polyester resin and preparing individual samples. After CSM preparation, the materials were properly mixed using the hand-lay techniques and different specimens were prepared with different compositions of the (csa +graphite) powder. After all the samples were prepared, mechanical tests were carried out on the samples to ascertain the changes observed due to the composition of (csa +graphite) powder. The obtained results of various samples specimens were compared and graphically charted to characterize the new composites material

## INTRODUCTION

A composite is a structural material that consists of two or more combined constituents that are combined at a macroscopic level and are not soluble in each other. One constituent is called the reinforcing phase and the one in which it is embedded is called the matrix. The reinforcing phase material may be in the form of fibers, particles, or flakes. The matrix phase materials are generally continuous. Examples of composite systems include concrete reinforced with steel and epoxy reinforced with graphite fibers, etc.

Historical examples of composites are abundant in the literature. Significant examples include the use of reinforcing mud walls in houses with bamboo shoots, glued laminated wood by Egyptians (1500 B.C.), and laminated metals in forging swords (A.D. 1800).

In the 20th century, modern composites were used in the 1930s when glass fibers reinforced resins. Boats and aircraft were built out of these glass composites, commonly called fiberglass. Since the 1970s, application of composites has widely increased due to development of new fibers such as carbon, boron, and aramids and new composite systems with matrices made of metals and ceramics.

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## MATERIALS AND METHODS

*Table 1.1 Technical Specifications -1*

| Material | Specific gravity (Grams/cm$^3$) | Tensile strength (MPa ) | Compressive strength (MPa) |
|---|---|---|---|
| Polyester resin (Not reinforced) | 1.28 | 55 | 140 |
| Polyester and Chopped Strand Mat Laminate 30% E-glass | 1.4 | 100 | 150 |
| Polyester and Woven Roving's Laminate 45% E-glass | 1.6 | 250 | 150 |
| Polyester and Satin Weave Cloth Laminate 55% E-glass | 1.7 | 300 | 250 |
| Polyester and Continuous Roving's Laminate 70% E-glass | 1.9 | 800 | 350 |
| E-Glass Epoxy composite | 1.99 | 1,770 | --- |
| S-Glass Epoxy composite | 1.95 | 2,358 | ---- |

*Table 1.2 Technical Specifications -2*

| Property | Area Weight (%) | Moisture Content (%) | Binder Content (%) | Tensile Strength (N/150mm$^2$) | Width (mm) |
|---|---|---|---|---|---|
| Test Method | ISO 3374 | ISO 3344 | ISO 1887 | ISO 3342 | ISO 5025 |
| EMC 85 | 85 | ≤ 0.20 | 9±5 | ≥50 | ±5 |
| EMC100 | 100 | ≤ 0.20 | 9±5 | ≥ 70 | ±5 |
| EMC120 | 120 | ≤ 0.20 | 9±5 | ≥ 100 | ±5 |
| EMC225 | 225 | ≤ 0.20 | 2-8 | ≥ 80 | ±5 |
| EMC300 | 300 | ≤ 0.20 | 2-8 | ≥ 130 | ±5 |
| EMC450 | 450 | ≤ 0.20 | 2-8 | ≥ 150 | ±5 |
| EMC600 | 600 | ≤ 0.20 | 2-8 | ≥170 | ±5 |
| EMC900 | 900 | ≤ 0.20 | 2-8 | ≥180 | ±5 |

*Table 1.3 Catalyst Mixing Ratio*

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| RESIN WEIGHT | | | | | | |
|---|---|---|---|---|---|---|
| **Addition of Catalyst** (ml) | 50g | 100g | 250g | 500g | 1kg | 5kg |
| 1% | 0.5 | 1 | 2.5 | 5 | 10 | 50 |
| 2% | 1 | 2 | 5 | 10 | 20 | 100 |
| 3% | 2 | 3 | 7.5 | 15 | 20 | 150 |

## DESIGN AND ANALYSIS

***Fig. 1 Earliest composite Mud & Clay***

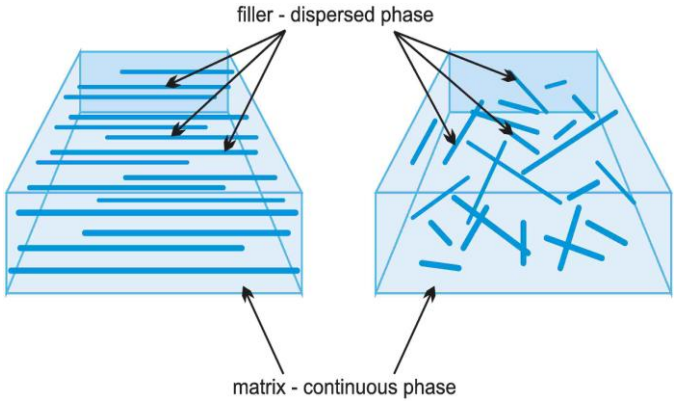


***Fig. 2 Constituents in composites***

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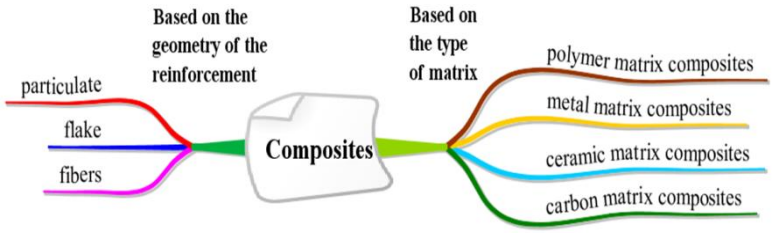


*Fig. 3 Classification of composite materials based on geometry and based on matrix.*

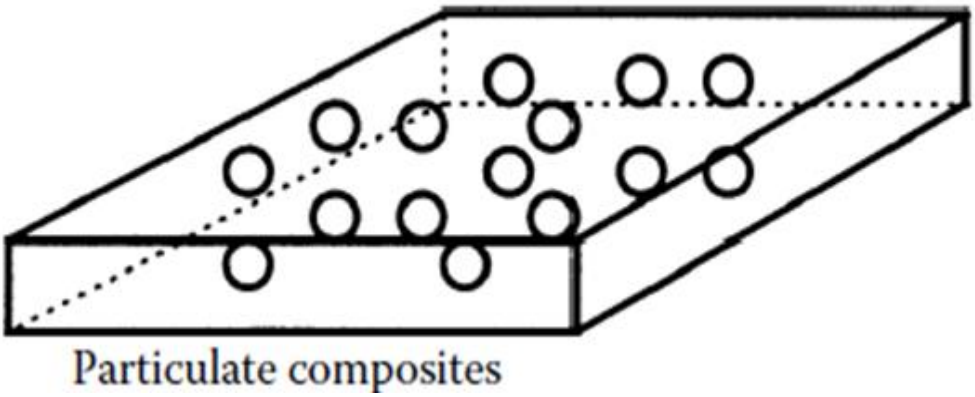


*Fig. 4 Particulate composites*

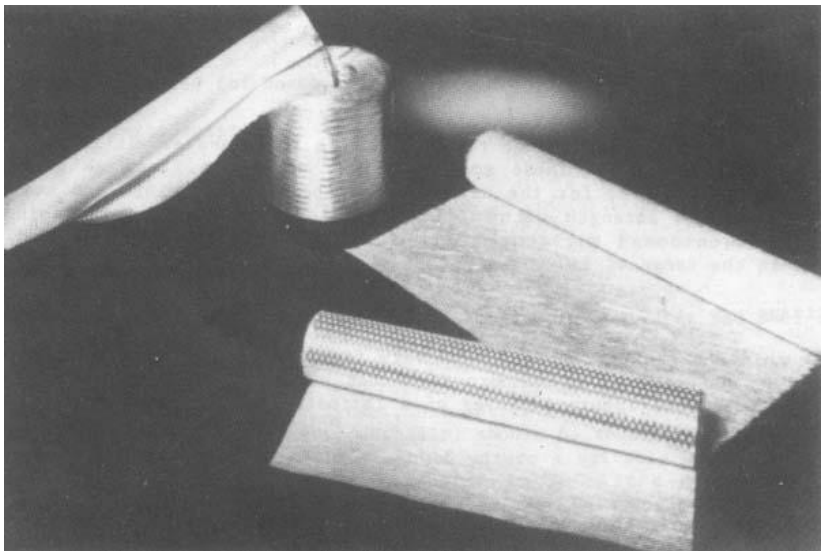

*Figure 5 Glass reinforcements*

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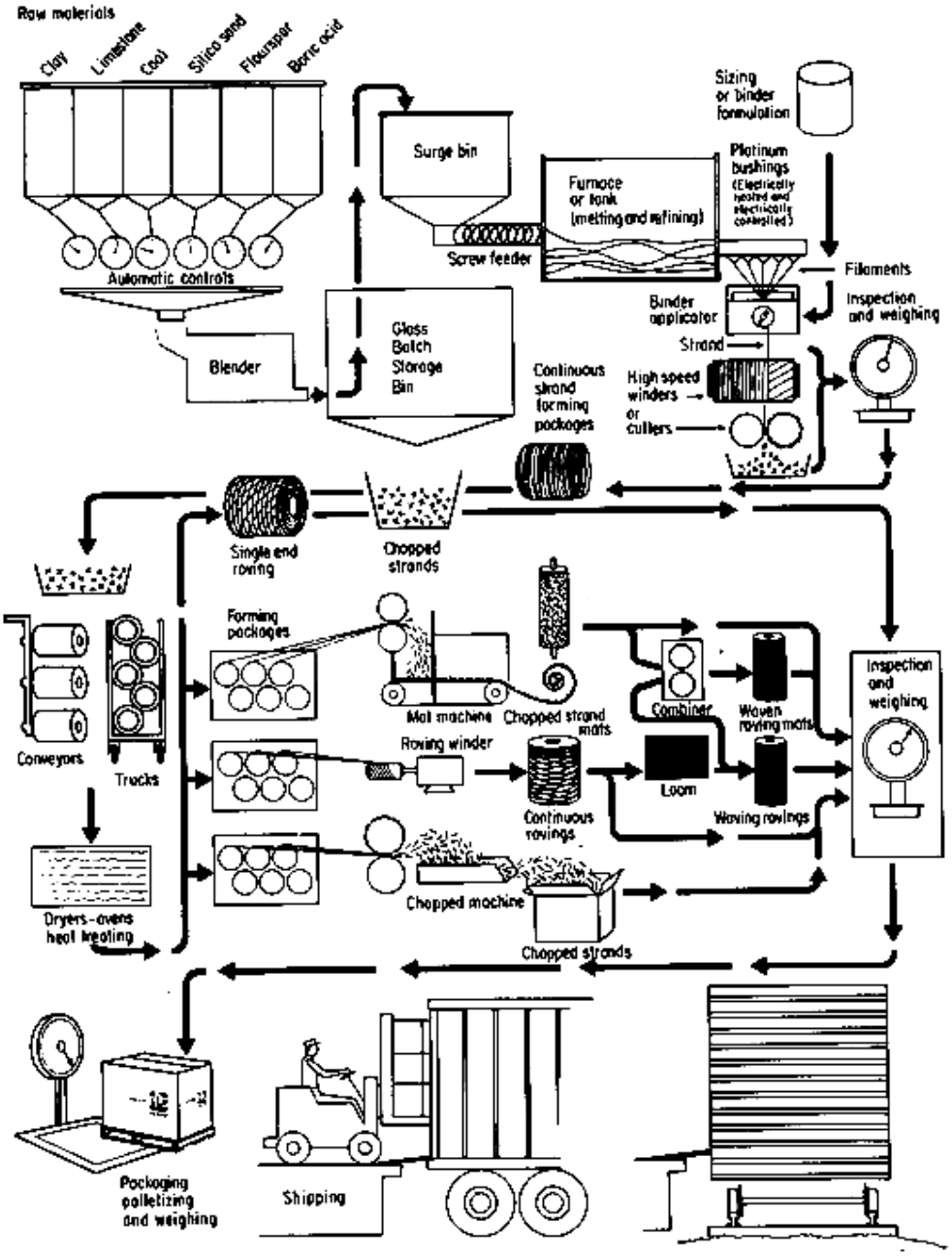


*Fig.6 Reinforcements manufacturing process*

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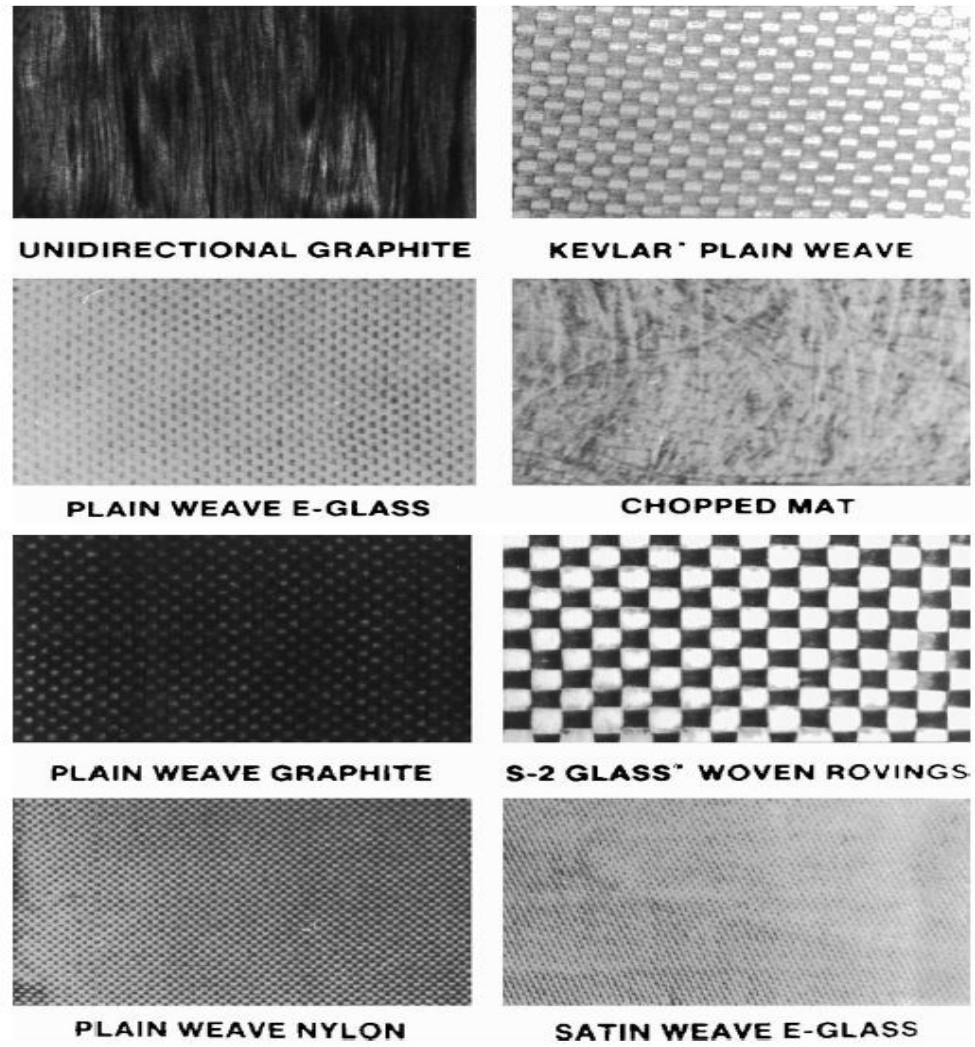


*Fig.7 Different Types of Mats*

## RESULTS AND DISCUSSION

Tensile test was conducted using universal testing machine of 400KN on specimen with different percentages of (CFA+Graphite) powder and the values of the tensile load and elongation are shown in table 4.1

*Table1. 4 Tensile test performance on different percentages of (CFA+ Graphite) powder*

| S.No. | Specimen | Elongation in mm (ΔL) | Tensile load(P) KN | Tensile Stress N/mm$^2$ | Strain (e) (mm) | Young's Modulus N/mm$^2$ |
|---|---|---|---|---|---|---|
| 1 | TSS-0% | 6 | 16.0 | 12.030 | 0.0333 | 364.54 |
| 2 | TSS-5% | 5 | 17.5 | 13.157 | 0.0255 | 515.68 |
| 3 | TSS-10% | 5 | 19.0 | 14.285 | 0.0255 | 560.19 |
| 4 | TSS-15% | 4 | 22.0 | 16.541 | 0.0200 | 827.05 |
| 5 | TSS-20% | 4 | 24.3 | 18.270 | 0.0200 | 913.50 |

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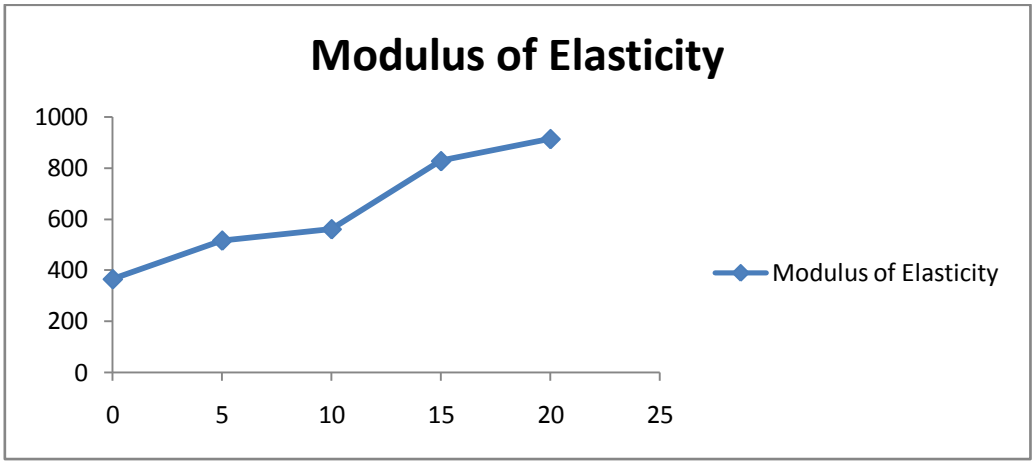
The relation between the Modulus of Elasticity in N/mm$^2$ and CSM-450 Specimens with different percentages of (CFA+ Graphite) powder is shown in Graph 1.

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***Graph 1 Modulus of Elasticity Variations at different weight percentages of graphite under Tensile Test.***

## CONCLUSION

The following conclusions are drawn from the present experimental work:

1. Chopped Strand Mat 450 polyester composite with (CFA+Graphite) powder was successfully prepared as a composite material with five different wt.%, 0%wt, 5%wt, 10%wt, 15%wt and 20%wt.
2. The tensile strength and flexural strength with 0wt% (CFA+Graphite) powder composite is maximum compared with 5wt%, 10wt%, 15wt%, and 20wt%. The hardness at 15wt% graphite composite is maximum compared with 0wt%,5wt%, 10wt%, and 20wt% (CFA+Graphite) composite.
3. The increase of CFA+graphite powder lead to the increase of(0%5wt,10%wt,15%wt,20%) the Izod impact strength of the composite

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