EFFECT OF FLYASH ON MECHANICAL PROPERTIES OF GLASS FIBER POLYMER COMPOSITES

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Abstract- The use of polymer fiber reinforced Composite materials is finding applications day by day in engineering fields such as aero-space, automotive, aircrafts constructions, etc. Glass fibre polymer composites are reinforced with flyash in different weight fractions, i.e. (0%, 5%, 10% and 15%) and fabricated by using hand lay-up technique. These fabricated slabs are cut into required dimensions and the tests for mechanical properties like Tension test, Impact test and Hardness test were performed. Tension test was performed on Universal Testing Machine (UTM), Impact test was performed for Izod and Charpy specimens and Hardness test was performed on Brinell's Hardness Testing Machine. From the experimental results obtained, it was noticed that the mechanical properties were enhanced when the flyash percent was increased and also among these percentages of flyash, the specimen having 15% was possessing highest properties.

Keywords- Composite material, Fibre, Mechanical Engineering

I. INTRODUCTION

The word composite material signifies that two or more materials are combined on a macroscopic scale to form a useful third material. The key is the macroscopic examination of a material wherein the components can be identified by the naked eye. Different materials can be combined on a microscopic scale, such as in alloying of metals, but the resulting material is, of all practical purposes, macroscopically homogeneous, i.e., the components cannot be distinguished by the naked eye and essentially act together. The advantage of composite materials, if well designed, they usually exhibit the best qualities of their components or constituents and often some qualities that neither constituent possesses. Some of the properties that can be improved by forming a composite material are, Strength, Stiffness, Corrosion Resistance, Wear Resistance, Fatigue life, Thermal Insulation, Thermal Conductivity, Weight, etc. Anyhow, not all of these properties are improved at the same time or is there usually any requirement to do so.

Composite materials have two constituents.
1. Matrix
2. Fibre

1.1 Matrix (GLASS FIBRE)
Glass fiber also called fiberglass. It is material made from extremely fine fibers of glass. Fiberglass is a lightweight, extremely strong, and robust material. Its bulk strength and weight properties are also very favorable when compared to metals, and it can be easily formed using molding processes.

1.1.1 Properties of Glass Fiber
Glass fibers are useful because of their high ratio of surface area to weight. By trapping air within them, blocks of glass fiber make good thermal insulation, with a thermal conductivity of the order of 0.05 W/(mK).
The freshest, thinnest fibers are the strongest because the thinner fibers are more ductile. The more the surface is scratched, the less the resulting tenacity. Because glass has an amorphous structure, its properties are the same along the fiber and across the fiber. Humidity is an important factor in the tensile strength. Moisture is easily adsorbed, and can worsen microscopic cracks and surface defects, and lessen tenacity.

1.2 Fibre (FLYASH)
Electricity is the key for development of any country. Coal is a major source of fuel for production of electricity in many countries in the world. In the process of electricity generation large quantity of fly ash gets produced and becomes available as a by-product of coal-based power stations. It is a fine powder resulting from the combustion of powdered coal - transported by the flue gases of the boiler and collected in the Electrostatic Precipitators (ESP).

Fly ash that results from burning sub-bituminous coals is referred as ASTM Class C fly ash or high-calcium fly ash, as it typically contains more than 20 percent of CaO. On the other hand, fly ash from the bituminous and anthracite coals is referred as ASTM Class F fly ash or low-calcium fly ash. It consists of mainly an alumino-silicate glass, and has less than 10 percent of CaO.

1.2.1 Properties of Fly Ash
The fly ash particles are generally glassy, solid or hollow and spherical in shape.

The fineness of individual fly ash particle ranges from 1 micron to 1 mm size. The fineness of fly ash particles has a significant influence on its performance in cement concrete. The specific gravity of fly ash varies over a wide range of 1.9 to 2.55

1.3 Introduction to Resin & Hardener

Epoxy Resin System

- Mixture of epoxy resin and a curing agent.
- Curing agent is also called as hardener or catalyst.
- They are often used in jobs where tough, durable coatings or adhesives are needed.

Epoxy resin properties (Araldite ly 556)

- Viscosity – 1350 – 2000 MPa-s
- Specific Gravity – 1.1-1.2 g/cm^3
- Epoxy content – 4.20-4.35 eq/kg
- Appearance – clear liquid
- Flash point – 160^{0}c

HARDENER

Epoxy Hardener properties (Araldite hy 951)

- Viscosity –10-20 MPa-s
- Specific Gravity – 0.98 g/cm^3
- Appearance – clear liquid
- Flash point–110^{0}c

II. FABRICATION

2.1 Composition

The following table shows the composition in which the different constituents are mixed according to the weight fraction for the various composite slabs.

Composition	Weight of Laminated sheets (gr.)	Epoxy Resin (gr.)	Hardener (gr.)	Fly Ash (Wt %)
1st Composition	245 grams	400 grams	60 grams	0%
2nd Composition	245 grams	400 grams	60 grams	5%
3rd Composition	245 grams	400 grams	60 grams	10 %
4th Composition	245 grams	400 grams	60 grams	15 %

2.2 Hand Lay-Up Technique

Hand lay-up is a simple method for composite production. To prepare the slates of our required dimensions we prepared a frame with a mild steel bar of inner length of 16 cm* 40 cm with a thickness of 6 mm. This frame is prepared by cutting at required dimensions using heck saw and joined through welding at edges. For making the frame even all over it grinding process is done. This glass fiber is cut in to 16 pieces with 15cm*38.5cm for a single slab.

For soft finishing we placed tinsmith sheets below during placing process and above after completing the layers. We prepared four slabs using fly ash powder of various percentages i.e. 0%, 5%, 10% and 15%. For first slab preparation fly ash is 0% so only epoxy and hardener mixture is placed in between the two successive layers. Based on the weight of nil (0%) slab, 5% Fly Ash is calculated and added for next slabs.

The basic procedure is first the frame is placed on the tinsmith sheet and epoxy-hardener mixture is brushed smoothly all over the place required and a single sheet is placed on it. place once and another sheet is placed on it and again applied the mixture and rolled over it. Same procedure is repeated for complete 16 sheets.

On the top finishing with that mixture and the tinsmith sheet is placed over it and weight is placed on it. After 24 hrs the slab is removed by chipping over the edges. Similarly procedure is repeated after removing all the slabs it is cut through required dimensions using cutting machine.

III. EXPERIMENTATION

3.1 TENSILE TEST

This test was performed on Universal Testing Machine (UTM). Tensile testing, also known as tension testing, is a fundamental materials science test in which a sample is subjected to a controlled tension until failure. The results from the test are commonly used to select a material for an application, for quality control, and to predict how a material will react under other types of forces. Properties that are directly measured via a tensile test are ultimate tensile strength, maximum elongation and reduction in area.

3.1.1 Specimen Dimensions

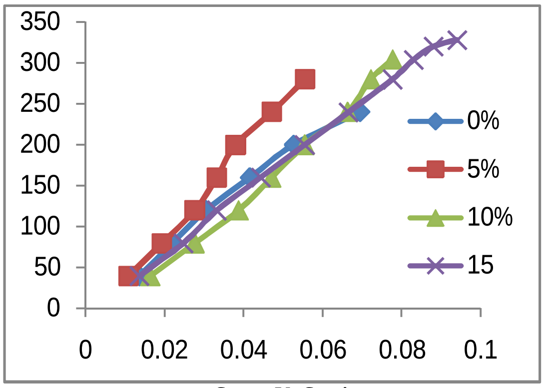
After removing all the slabs, it is cut through required dimensions using cutting machine which is of exactly 10 cm in width and a length of 35 cm.

3.1.2 Result of Tension Test

S.No	Fly Ash (%)	Ultimate Tensile Strength (MPa)
1	0	240
2	5	280

3	10	304
4	15	328

3.1.3 Stress-Strain Curve



Stress Vs Strain

3.2 IMPACT TEST

Standardized impact test on standardized specimens have been developed to provide a basis for comparing the resistance of materials to shock. An impact test gives an indication of the relative toughness of the material. In this test, the specimen is machined or surface ground and usually notched is struck and broken by a single blow and the specimens used are namely Charpy & Izod.

3.2.1 Result of Impact test

S. No	Flyash(%)	Impact Test	
		IZOD	CHARPY
1	0	48	204
2	5	64	228
3	10	82	246
4	15	97	252

3.3 HARDNESS TEST

Brinell's hardness tester is used for testing hardness of the specimen. 60Kg of Load is taken. Test is performed for all the specimens of different weight fractions of fly ash. Brinell Hardness number is found by using the formula

$$BHN=2P/(\pi D(D-\sqrt{(D^2-d^2)}))$$

where:
P = applied force (kgf)
D = diameter of indenter (mm)
d = diameter of indentation (mm)

3.3.1 Result of Hardness Test

S. No	FLY ASH (%)	Indentation (mm)	BHN
1	0	1.5	30.54
2	5	1.133	56.24
3	10	1	73.16
4	15	0.666	169.02

CONCLUSION

After fabricating the composite slabs with different weight fractions of flyash i.e. 0%, 5%, 10% and 15%, they are cut into required dimensions and these specimens were tested for mechanical properties like Tension, Impact and Hardness. Tension test was performed on Universal Testing Machine (UTM), Impact test was performed for Izod and Charpy specimens and Hardness test was performed on Brinell's Hardness Testing Machine. From the results obtained experimentally it can be concluded that the mechanical properties were enhanced when flyash is reinforced with the Glass fibre polymer and also the specimen having 15% (largest constituent of flyash percent among all other specimens) is possessing better Tensile Strength, Impact strength and Hardness.

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