EXPERIMENTAL RESEARCH ON HARDNESS & FLEXURAL PROPERTIES OF TEAK WOOD POWDER AND FLY ASH REINFORCEMENT WITH EPOXY

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Abstract— This paper highlights the experimental investigations on the effect of wood powder filled polymer composites which has been considerably studied from a scientific and a commercial point of view over the last decades. These materials are particularly attractive for their reduced environmental impact and the globally pleasant aesthetical properties. Wood powder is attractive fillers for thermoplastic polymers, mainly because of their low cost, low density and high-specific properties. They are biodegradable and non-abrasive during processing etc. Although there has been a considerable work reported in the literature which discuss the mechanical behavior of wood/polymer composites, however, very limited work has been done on effect of wood powder on mechanical behavior of polymer composites. Against this background, the present research work has been undertaken, with an objective to explore the potential of wood powder and fly ash as a reinforcing material in polymer composites and to investigate its effect on the mechanical behavior of the resulting composites. The present work thus aims to develop this new class of natural fiber based polymer composites with wood powder and fly ash to analyze their mechanical behavior and technological application.

KEYWORDS- Wood powder, Fly ash, Mechanical behaviour, ASTM standard.

I. INTRODUCTION

Following the technological advancements, industries are constantly searching for a higher strength, lightweight materials to replace the conventional materials used.

Particulate reinforced composites achieve gains in stiffness primarily, but also can achieve increase in strength and toughness. Particulate reinforced composites find applications where high levels of wear resistance are required. The principal advantage of particle reinforced composites is their low cost and ease of production and forming.

.Fly ash is one of the residues generated by coal combustion, and is composed of the fine particles that are driven out of the boiler with the flue gases. Fly ash material solidifies while suspended in the exhaust gases and is collected by electrostatic precipitators or filter bags. Since the particles solidify rapidly while suspended in the exhaust gases, fly ash particles are generally spherical in shape and range in size from 0.5 µm to 300 µm. The recycling of fly ash has become an increasing concern in recent years due to increasing landfill costs and current interest in sustainable development. Thus fly ash is currently being used in cement, bricks, metal matrix composites etc.

Wood powder is finely pulverized wood that has a consistency fairly equal to sand or sawdust, but can vary considerably, with particle size. All high quality wood powder is made from hardwoods because of its durability and strength. Wood powder is commonly used as filler in thermosetting resins such as Bakelite, and in linoleum floor coverings. Wood powder is also the main ingredient in wood/plastic composite building products such as decks and roofs.

Epoxy resins, also known as polyepoxides are a class of reactive prepolymers and polymers which contain epoxide groups. Epoxy has a wide range of applications, including metal coatings, use in electronics / electrical components, high tension electrical insulators, fibre-reinforced plastic materials and structural adhesives.

II. MATERIALS AND METHOD

The composite being prepared is a particulate matrix composite. Thus the reinforcement used is teak wood powder and BHS-05 fly ash powder. Both teak wood powder and fly ash are sieved and particles within 150 micron size are collected. To increase the wettability of the reinforcement to epoxy resin LY556, the reinforcement materials are dipped in 1N sodium hydroxide solution for a period of 24 hours.

Based on the calculations, the required quantity of wood powder, fly ash and epoxy are weighed and introduced to the epoxy resin in a beaker. Acetone of suitable quantity is used to increase wettability of the fly ash- teak wood powder mixture. The contents are then mixed thoroughly using a magnetic stirrer. Hardener HY951 of calculated quantity is introduced.

The mixture is then poured into a mould cavity. The laminate is allowed to dry for a period of 48 hours. The laminate is then removed from the mould and inspected for air bubbles and cavities. The specimens are cut according to ASTM standards and later tested for their flexural and hardness properties using Tensometer and Rockwell and Brinell hardness testing machine.

Fig (a)

Fig (b)

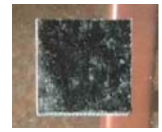


Fig (c)

Fig (d)

Fig(e)

Fig (a): Composite Laminate
Fig (b): Bending Test Specimen
Fig (c): Hardness Test Specimen
Fig (d): Tensometer
Fig (e): Rockwell and Brinell Hardness testing Machine

III. CALCULATION

- Let V_C be volume of mould cavity in cm^3
- Let the density of Epoxy resin be ρ_{re} in g/cm^3
- Let the density of Wood powder be ρ_w in g/cm^3
- Let the density of Fly ash be ρ_f in g/cm^3
- Let the density of Hardener be ρ_h in g/cm^3
- Let V_m be volume of matrix in composite in cm^3
- Let V_w be volume of wood in composite in cm^3
- Let V_f be volume of flyash in composite in cm^3
- Let ρ_c be density of composite in g/cm^3
- Let ρ_M be density of matrix in g/cm^3

- Let V_C be volume of composite in cm^3
- Let mass of Composite be M in g

TABLE 1:-

MATERIAL	DENSITY (g/cm^3)
EPOXY RESIN (LY556)	1.2
HARDNER (HY951)	1.19
WOOD POWDER	0.4
FLY ASH (BHS05)	0.8

$V_C * \rho_c = \rho_M * V_m + \rho_f * V_f + \rho_w * V_w$

From the above formula, ρ_c is calculated as all other parameters are known.

Ex:-

Volume of Fly ash = % of fly ash in composite * V_C

$\rho_c * V_C = M$ (in g)

On Mass basis, mass of each components is found out.

Ex:- Mass of wood powder = % of wood in composite * M

IV. RESULTS

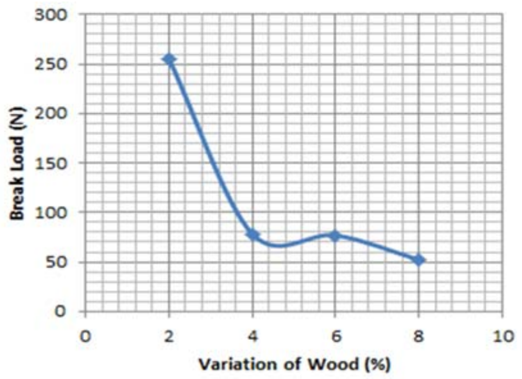
TABLE 2:-

Average Bending Strength in Newton(N)	
Pure Epoxy Composite	238.61
4% Fly ash + Epoxy	251.71
4% Wood + Epoxy	131.55
2%Wood+2%Flyash+matrix	254.98
4%Wood+2%Flyash+matrix	78.45
6%Wood+2%Flyash+matrix	77
8%Wood+2%Flyash+matrix	52.3

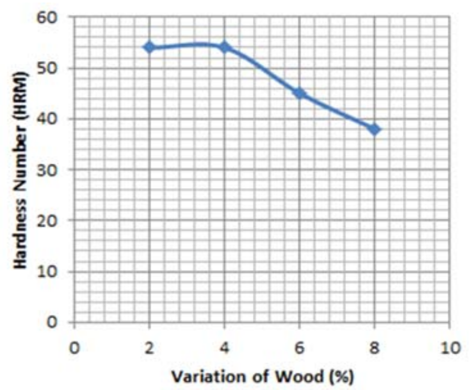
TABLE 3:-

Hardness(HRM) Number	
Pure Epoxy Composite	64
4% Fly ash + Epoxy	62
4% Wood + Epoxy	64
2%Wood+2%Flyash+matrix	54
4%Wood+2%Flyash+matrix	54
6%Wood+2%Flyash+matrix	45
8%Wood+2%Flyash+matrix	38

GRAPH 1:-



GRAPH 2:-



V. CONCLUSION

- Based on the experimental data the composite of (2% Fly ash, 2% Wood and 96% Matrix) has showed Highest Bending strength by comparison with pure Epoxy. The Hardness number is higher compared with other wood-fly ash composite laminate.
- As increasing the percentage amount of wood powder in the composite with constant amount of fly ash, the break load /bending strength decreases.
- From the experimental evidence and the data indicates the addition of more amount of wood powder in the composite leads to decrease in bending strength and **hardness.**

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