Effect of Filler Content on the Performance of Epoxy/Haritaki Powder Composite

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1 Introduction of Composites

The addition of filler materials into epoxy resin matrix materials greatly influences and improves composite material properties provided that filler particles are bonded to polymer matrix [1]. The advantages of filler material content change material's property of tensile property such as thermal resistance, toughness, color appearance, etc., and the filler material is widely used in manufacturing of polymer composite materials. It saves the raw material cost of the polymer matrix materials. Epoxy resin is a one of the main synthetic thermosetting polymer resin which is used to produce small- or large-scale polymer composite materials [2]. Epoxy resin materials are used in a broad range of structure of building material composites, automobile industries [3]. The matrix material of epoxy resin is one of the mainly used polymer matrices in the composite industry, due to its proper adhesion bonding to many fiber reinforcements [4]. Kadukkai powder could even be a naturally available herbal material which was used as an additive for creating delicious food. From the studies administered on Kadukkai it has been observed that Kadukkai has powerful binding property and desirable hardening properties for creating construction material and concrete [5]. Kadukkai was extracted from Kadukkai tree as a naturally available fruit then it had been dried in sunlight. The dried Kadukkai was made into powder form for effective mixing with binders like cement, lime [6]. The aim of the paper is to report the research works on the results of filler materials of haritaki fine powder mixing with epoxy resin reinforced by E-glass fiber composites.

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2 Raw Materials and Its Method

2.1 Sources of Raw Materials

The E-glass fibers are easily available resources in the market. Glass fibers are stretching in the way of woven mat. The orientations of fibers are perpendicular stands of fiber mats. The matrix materials of Epoxy resin along with Hardener were bought from a private manufacturing company. The filler materials of haritaki powder are brought from organic medical shops.

2.2 Kadukkai Filler Powder (Haritaki Powder)

Kadukkai extract is added in several concentrations of 0%, 5%, 10%, 15% and 20% to the lime and dirt mortar and its effects on workability, compressive strength and porosity are studied. The test results showed that Kadukkai filler materials are improving properties of epoxy resin characteristics to the composite materials. The filler materials of haritaki powder are evenly distributed through the special attachment of the roller spindle by electric motors.

2.3 Hardener and Epoxy Resin Blending Ratio

The matrix material of epoxy resin is blended with hardener in proper mixing in the ratio of 10:1. The 10 ml of resin material is mixed with 1 ml of hardener which induces the curing process of the polymer chains [7].

2.4 Methods of Preparation of Composite Materials

Table 1 shows the E-glass fiber composite materials which are fabricated as per prepared percentage of sample composition. Mostly matrix materials have higher percentage when compared to fiber reinforcement, because of the good wettability of the composites. From Table 1 as shown, 30% of fiber (90 g) and 70% of resin (200 g) are taken. Further filler content of haritaki fine powder is added to resin materials along the ratio of 0, 5, 10, 15, and 20% of Epoxy resin. The mixing ratio of resin with hardener is 10:1 ratio for curing of liquid form to solid form of resin materials. These are primary preparations of composite materials. And next preparation is mold preparation as given required size of samples. The size of the mold is 300 mm of length, 300 mm of breadth and 10 mm of thickness to fabricate rectangular plate of composite materials. Before applying resin, polyvinyl acetate or spray wax are

Table 1 Classification of sample preparation

Samples (%)	Haritaki powder (gms)	E-glass fibers in gms (six laminas)	Epoxy resin + hardener in gms
0	0	90	200
5	14.5	90	185.5
10	29	90	171
15	43.5	90	156.5
20	58	90	142

Fig. 1 **a** Laminas of E-glass fiber, **b** applied Haritaki Epoxy mixing resin, **c** finished fabrication of laminated composites

coated in the outer surface of the mold for easy removal of fabricated composite after curing. After coating of wax, initially the first layer of resin was applied to wettability of fibers. These composites consist of six layers of lamina of Kenaf/E-glass woven mat fibers. Layer by layer resin and fiber are compressed by dead weight above the film sheets of mold. After curing of composite materials, it's removed from mold surface without cracking/damaging fibers. Figure 1 shows the final product of laminated composites.

2.5 Various Testing of Composites

The experimental testing of haritaki filler powder effect in E-glass fiber composite materials involves a wide range of testing types and tests in a variety of different environments. The main objective of the mechanical testing of composite materials is the examination of mechanical parameters such as strength, stiffness and other physical properties. Elasticity, flexural strength and impact strength were resolved in a Universal Testing Machine (UTM), while Universal Pendulum Impact System for Charpy tests. Five specimen samples were tried for every creation and normal outcomes were utilized. Rigidity, flexural strength and impact strength esteems were resolved for different examples and appeared.

3 Results and Conversation

3.1 Longitudinal of Tensile Strength

Longitudinal of tensile strength is the amount of load or stress that can be withstood by a composite material before it stretches and cracks. The longitudinal tensile strength of composite materials is determined mostly by the strength and volume content of the fiber reinforcement. For tensile strength, specimens are prepared as per the ASTM standard of ASTM D3039. Figure 2 shows before and after test of tensile test samples. The results are obtained after carrying out specimen test; the data are plotted in graph as shown in Fig. 3. From these plotted graph data, the obtained results include haritaki filler materials added to the epoxy matrix which can increase the tensile property of epoxy resin matrix composites. The values of tensile strength gradually increase from 0 to 20% of specimen samples of composite materials. The better results values are in 15% and 20% of haritaki filler powder content epoxy matrix composite materials. Haritaki filler materials improve the tensile property of epoxy resin.

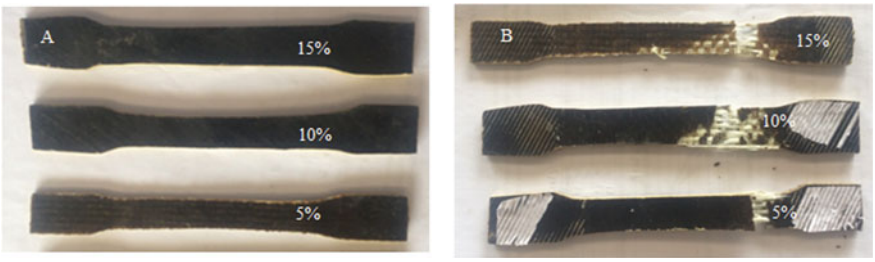

Fig. 2 **a** Three different samples of before tensile test, **b** three different samples of after tensile test

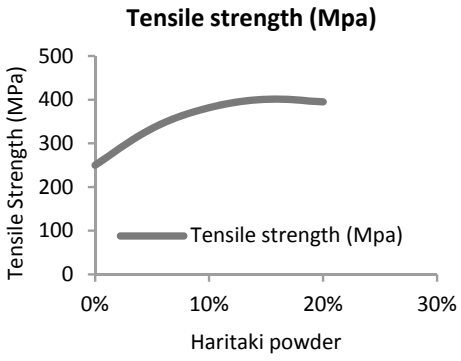

Fig. 3 Different filler content of haritaki/epoxy composite on tensile strength

3.2 Drop Weight Impact Test

The impact resistance of composite materials can be performed with a swinging or a dropping known weight. For impact strength, specimens are prepared as per the ASTM standard of ASTM D7136. Figure 4 shows the impact test samples after load applied. The results are obtained after carrying out an impact specimen test; the values are plotted in graph as shown in Figure 5. From these plotted graph data, the obtained results haritaki filler powder is added to epoxy matrix material which can increase impact strength property of epoxy resin matrix composites. The values of impact strength gradually increase from 0 to 20% of specimen samples of composite materials. The better results values are in 15% and 20% of haritaki filler powder content epoxy matrix composite materials. Haritaki filler materials improve the impact property of epoxy resin because of improving the hardness of epoxy resin materials.

Fig. 4 Sample shows that breakage of after impact test

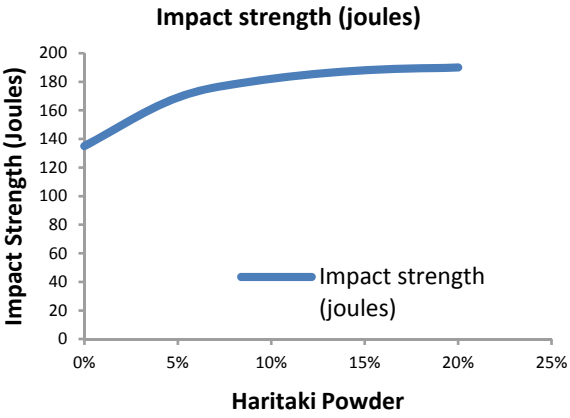

Fig. 5 Different filler content of haritaki/epoxy composite on impact strength

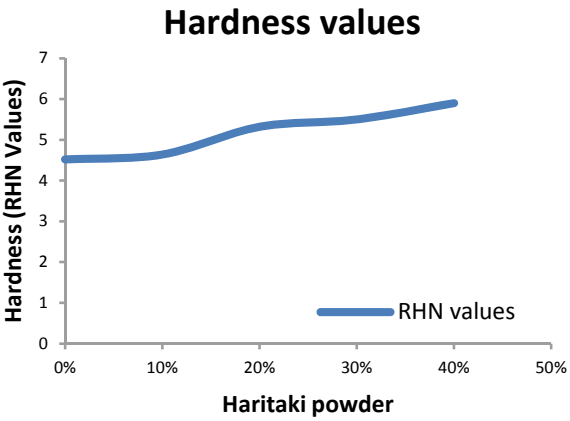

Fig. 6 Different filler content of haritaki/epoxy composite on hardness strength

3.3 Experiment of Hardness Test

The hardness strength of composite materials which can be valued is measured based on the net increase in depth of impression by applied load to specimens. For hardness strength, specimens are prepared as per the ASTM standard of ASTM D785. The specimens were prepared for Rockwell-B hardness test; the preparation of specimen samples is of 25 mm diameter and a length of 20 mm. The results are obtained after hardness specimen test is carried out; the values are plotted in graph as shown in Figure 6. From these plotted graph data, the obtained results of haritaki filler powder are added to epoxy matrix material which can increase hardness strengthen property of epoxy resin matrix composites. The values of impact strength gradually increase from 0 to 20% of specimen samples of composite materials. The better results values are in 15% and 20% of haritaki filler powder content epoxy matrix composite materials. Haritaki filler materials improve the hardness strength of epoxy resin because of improving the toughness and brittle properties of the epoxy resin materials.

4 Conclusion

The haritaki fine powder filler content on the E-glass fiber reinforcement with Epoxy matrix composite has been fabricated. Testing results of various strengths of tensile, flexural and impact strength of natural composite can be examined. From the results, the elongation of tensile property of 20% of filler content of haritaki/epoxy matrix composite is higher than the other filler content of composite materials. The filler material of haritaki powder which increases highly resists impact load on materials due to brittle property of the matrix materials.

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