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MECHANICAL PROPERTIES OF COMPOSITE MATERIAL REINFORCING BY NATURAL-SYNTHETIC FIBERS

Ali I. Al-Mosawi*
Technical Institute-Babylon, IRAQ.

Mohammad H.Al-Maamori
Babylon University, Babylon, IRAQ.

Zaynab A.Wetwet
Babylon University, Babylon, IRAQ.

ABSTRACT

The mechanical properties of araldite matrix composites reinforced with hybrid palms - kevlar fibers were evaluated. There are indications that the incorporation of both fibers into a single matrix which is araldite resin will stabilize mechanical properties and lowering manufacturing costs. In this research the impact strength, tensile strength, flexural strength, and hardness were studied for composite material reinforced with hybrid fibers for palms and Kevlar .These fibers were mixed with araldite resin in different reinforcement percentage (20%, 40%, and 60%) and the effect on the above mechanical properties were studied. It has shown an improvement in these mechanical properties after reinforcement by fibers the value of mechanical properties will increase with increasing percentage of reinforcement.

Keywords: Hybrid fibers, Composite material, Mechanical properties.

INTRODUCTION

Composite material is a material consisting of two or more physically and (or) chemically distinct phase, suitably arranged or distributed. A composite material usually has characteristics that are not depicted by any of its components in isolation (Al-Mosawi *et al.,* 2012). Using this definition, it can be determined that a wide range of engineering materials fall into this category. For example, concrete is a composite because it is a mixture of Portland cement and aggregate. Fiberglass sheet is a composite since it is made of glass fibers imbedded in a polymer (Miller,1998).

The incorporation of several different types of fibres into a single matrix has led to the development of hybrid bio-composites. The behavior of hybrid composites is a weighed sum of the individual components in which there is a more favorable balance between the inherent advantages and disadvantages. Also, using a hybrid composite that contains two or more types of fiber, the advantages of one type of fiber could complement with what are lacking in the other. As a consequence, a balance in cost and performance can be achieved through proper material design (Idicula *et al.,* 2006). The properties of a hybrid composite mainly depend upon the fiber content, length of individual fibres, orientation, extent of intermingling of fibres, fiber to matrix bonding and arrangement of both the fibres. The strength of the hybrid composite is also dependent on the failure strain of individual fibres. Maximum hybrid results are obtained when the fibres are highly strain compatible (Cristiane *et al.,* 2009) .

EXPERIMENTAL PROCEDURE

Materials

Araldite resin (GY 250) , Palms fibers, and Kevlar fibers (0º - 90º) .

* Author's email: aaliibrahim76@yahoo.com

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These types of fibers used as consecutive layers in same matrix with 50% palms fibers and 50% Kevlar fibers. Four samples were manufactured for each test which different by the resin and reinforcement percentage as shown in Table.1 . Hand molding was used to manufacture the samples. Some resin spread in the mould and the fiber layer put on it and this process repeated to obtain the desired thickness.

Table 1. Structure of samples

Samples number	1	2	3	4
Resin (weight %)	100	80	60	40
Fibers (weight %)	0	20	40	60

Mechanical Tests

(1) Impact Test: Impact samples fabricated according to the (ASTM-E23) standard suitable to Charpy Impact Instrument .Notch depth is (0.5mm) and notch base radius is (0.25mm). (2) Tensile test : Tensile Strength Samples :these samples manufactured according to the (ISO-R-527) standard .The universal test instrument manufactured by (ZheJinang TuGong Instrument Co., Ltd) used to measure this property with a (20KN) load. (3) Hardness test: In this test the "Brinell method" was used to measure hardness , this test made with a steel ball (5mm) diameter and (10kg) exposition load, loaded into samples for (15sec) , and the hardness number represents the diameter of impression after the load removal, which left on surface by the ball. universal test instrument manufactured by (Uali Test Company) used for this test. Hardness samples are a disc shape with (25mm) diameter and (10mm) thickness. (4) Flexural Strength Test: Flexural strength can be measured by three point test by using universal hydraulic press (ZheJinang TuGong Instrument Co., Ltd) to calculate the maximum load exposed on middle of the sample. Flexural samples fabricated according to (ASTM-D790) standard as a rectangular shape(10mm×135mm) .

RESULTS & DISCUSSION

Fig.1 shows the value of impact strength with fibers reinforcing percentage .Generally ,the impact resistance considered low to the resins due to brittleness of these materials ,but after reinforcing it by fibers the impact resistance will be increased because the fibers will carry the maximum part of the impact energy which exposition on the composite material . The impact resistance will continue to increase with increased of the fibers reinforcing percentage (Al-Mosawi ,2009).

The resin considered as brittle materials where its tensile strength is very low as shown in Fig.2 ,but after reinforcing by fibers this property will be improved greatly ,where the fibers will withstand the maximum part of loads and by consequence will raise the strength of composite material .The tensile strength will be increased as the fibers percentage addition increased , where these fibers will be distributed on large area in the resin (Al-Jeebory *et al.,* 2009).

As mentioned above ,the resin is brittle ,therefore its flexural strength will be low before reinforcement as shown in Fig.3 .But after added the fibers to this resin the flexural strength will be raised to the producing material because the high modulus of elasticity of these fibers will helps to carry a large amount of loads and raise this strength (Azhdar, 1992).

Polymers have low hardness, which appears in Fig.4 the lowest value for araldite resin before reinforcement .But this hardness value will greatly increased when the resin reinforced by hybrid fibers, due to distribution the test load on fibers which decrease the penetration of test ball to the

surface of composite material and by consequence raise the hardness of this material .The hardness will be increased with increasing the percentage of fibers reinforcement (Al-Mosawi, 2009).

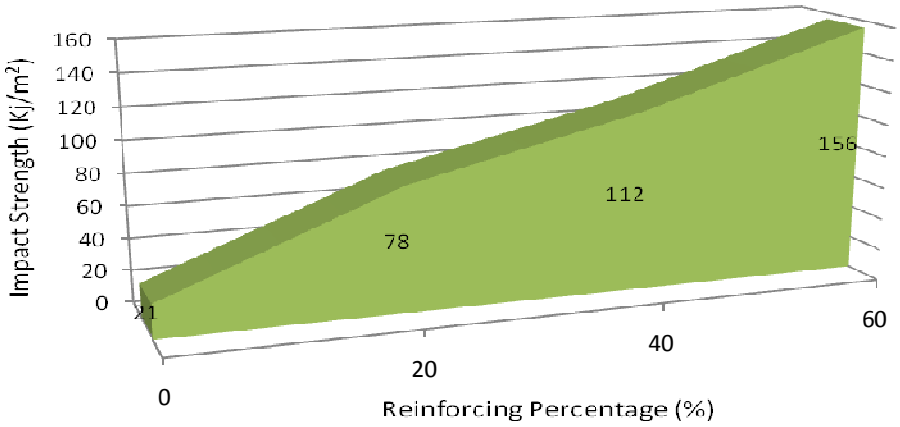

Fig 1. Impact Strength

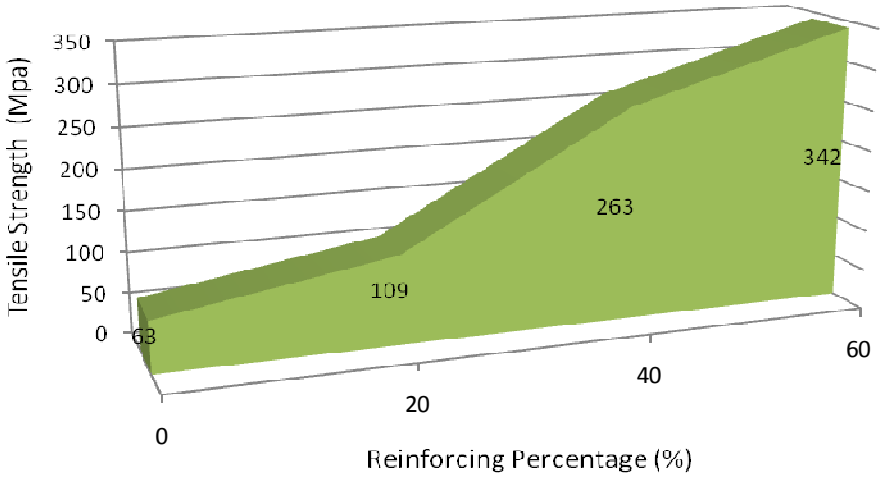

Fig 2. Tensile Strength

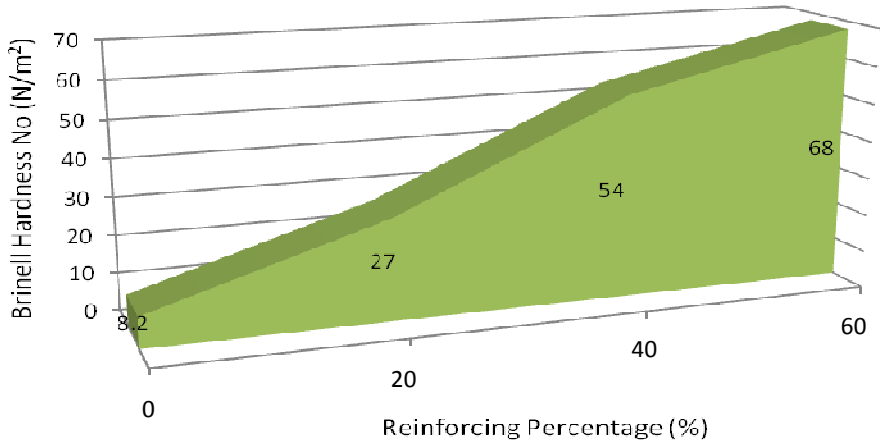

Fig 3. Hardness

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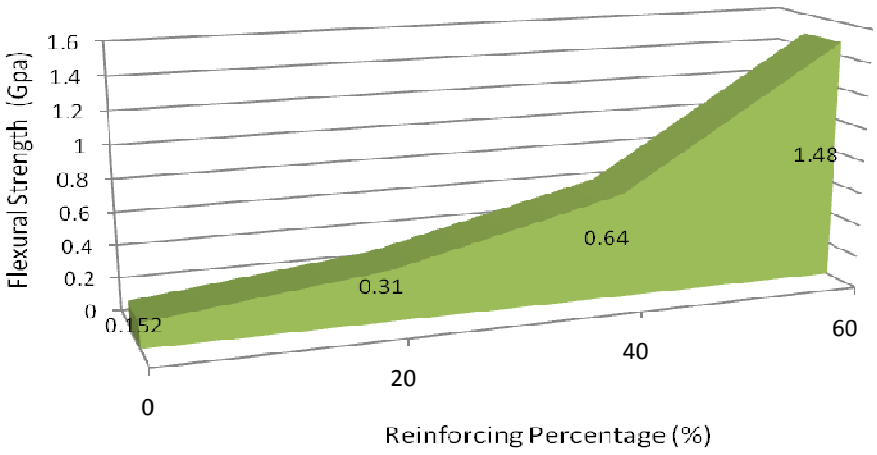

Fig 4. Flexural Strength

CONCLUSIONS

Low mechanical properties (Impact, Tensile, Flexural Strength, and hardness) of the araldite resin . Improvement of mechanical properties after reinforcement by palms and kevlar fibers .

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