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Mechanical Behavior of Epoxy- Phenol Formaldehyde Hybrid Blend

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***Abstract* - Phenol formaldehyde resin was mixed with epoxy resin in different weight fraction (0-20) wt. % to formation hybrid blend which used as a new part in engine oil tank of the cars. The properties of the new blend were studied and included: Impact strength, tensile strength, compressive strength, Shore D Hardness and bending resistance. Results showed improved properties of epoxy resin after adding phenol formaldehyde.**

Keywords: Hybrid blend, Properties, Phenol formaldehyde resin, Epoxy resin.

I. INTRODUCTION

It is a truism that technological development depends on advances in the field of materials. One does not have to be an expert to realize that the most advanced automotive or aircraft design is of no use if adequate materials to bear the service loads and conditions are not available. Whatever the field may be, the final limitation on advancement depends on materials. The composite material is made by combining two or more materials often ones that have very different properties. The two materials work together to give the composite unique properties [1-3]. Types of composites shown in Fig.1. However, within the composite you can easily tell the different materials apart as they do not dissolve or blend into each other. The properties are used not only for their mechanical properties, but also for electrical, thermal, tribological, and environmental applications. Modern composite materials are typically optimized to achieve a particular balance of properties for a given range of applications. Given the vast range of materials that may be considered as composites and the broad range of uses for which composite materials may be designed, it is difficult to agree upon a single, simple, and useful definition. However, as a common practical definition, composite materials may be restricted to emphasize those materials that contain a continuous matrix constituent that binds together and provides a form of an array of stronger, stiffer reinforcement constituent. The resulting composite material has a balance of structural properties that is superior to either constituent material alone [4-6].

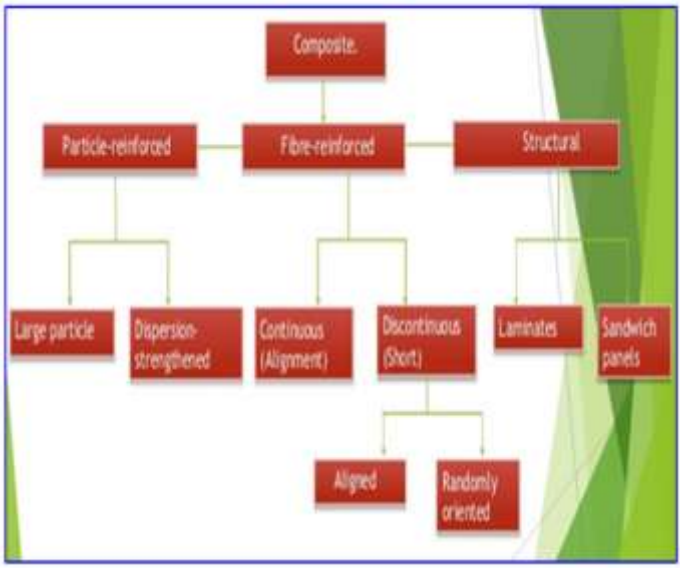

Figure -1: Types of composite

II. THE AIM OF THE RESEARCH

The general use of the composite material depends largely on the mechanical and physical properties of these materials. Therefore, the study of these properties under the influence of forces and loads in different conditions is of great importance for determining the suitability of these properties to the work place of these materials. The mixing of the epoxy material with the phenolic formaldehyde resin, which is called the resole, is used in the use of different mixing ratios for the purpose of making samples for the necessary tests to obtain the mechanical properties and analyze them and compare them with the mechanical properties of the foundry.

III. EXPERIMENTAL PROCEDURE

Materials: Epoxy resin (LEYCO-POX 103), Phenol formaldehyde (resole) resin.

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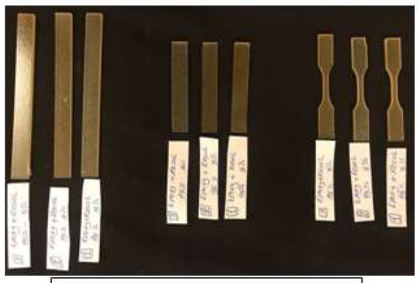
Samples preparation and Calculation properties: epoxy and phenol formaldehyde resin were mixed with different weight fraction as shown in Table.1. Tensile strength samples are fabricating according to the (ASTM D 638) standard suitable for universal testing machine (Fig.2). (ASTM-D790) standard was used to fabricate hardness samples which is (25mm) in diameter and (10mm) thickness suitable for shore D hardness instrument (Fig.3). Impact samples were fabricated according to the (ASTM-E23) standard suitable to Charby Impact Instrument (Fig.4).Notch depth is (0.5mm) and notch base radius is (0.25mm).

Sample No.	Composition
E0	(Epoxy/Resole) (80/20)%
E1	(Epoxy/Resole) (85/15)%
E2	(Epoxy/Resole) (90/10)%
E3	(Epoxy/Resole) (95/5)%
E4	(Epoxy/Resole) (100/0)%

Table-1: Composition of epoxy- phenol formaldehyde hybrid blend

E4 (Epoxy/Resole) (100/0) %



E3 (Epoxy/Resole) (95/5) %

E2 (Epoxy/Resole) (90/10) %

E1 (Epoxy/Resole) (85/15) %

E0 (Epoxy/Resole) (80/20) %

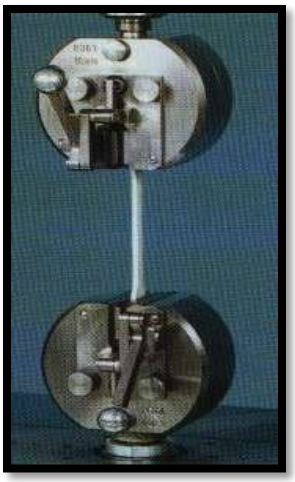


Figure-2: Tensile Test Instrument

Figure-3: Hardness Test

Figure-4: Impact Test Instrument

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Ratio	Tensile Test		Bending Test		Impact Energy (Joule)	Shore D Hardness
	Stress(Map)	Strain	Stress(Map)	Strain		
0%	25.40985	3.378	0.21684	34.31733	0.37	68
5%	26.01369	1.7106	0.2597	33.60467	0.15	70.2
10%	24.26089	3.0093	0.30076	41.04733	0.133	64.6
15%	11.12752	2.168	0.10888	35.772	0	62.8
20%	1.27556	2.0626	0	0	0	42.4

Table.2: Testing of Epoxy with Resole at different ratio

For the purpose of making samples for the necessary tests to obtain the properties and analysis and compare them with the properties of the alloy, which is the part of the original, which was chosen for the purpose of replacement of the alloy composite material used in the search for weight loss and improve properties, and a simulation program was used, where the composite material used in the research is tested and compared to the alloy material from which the part was originally manufactured.

IV. RESULTS AND DISCUSSIONS

Tensile characteristics are the most widely reported mechanical properties of any material. Tensile strength is the maximum load that the sample will carry before breaking under a slowly applied gradually increasing load during a tensile test [7]. As for tensile strength, resin is considered a brittle material. Its resistance to tensile strength is very low. But when adding resole, its tensile strength will improve significantly. The tensile strength of the composite material because it is characterized by its low elasticity. Tensile strength is increased by increasing the added weight ratios as they occupy more space within the resin allowing better load distribution. Bending Test is the main purpose of the bending test is to identify the linear behavior or so-called "Hooken Behavior" of the material under the influence of the vertical-mounted bearing at the surface level. That the deflection is directly proportional to the updated pregnancy when the elimination of the effect of the load of the material recover the first case, and concludes that the article is subject to the law (Hook's Law) [8]. In the light of the results of this test, it is noted that the bending test occurs in two types of stress, compression in the first face (front) and tension or Tension (Tension) in the face (back). It is known that brittle materials have a small plastic deformation area that is not non-existent. The elasticity coefficient values increase with the increase in the ratio of the hardened material due to the increase in the density of cross-link density, which significantly affects the elasticity of the chains, so that the material becomes solid with low voltage rates, which increases its elasticity coefficient. The shore D hardness values for the blends, as for the hardness properties, the resins are considered to be non-solid materials, which are low, but when adding the recoil material to it, the hardness characteristic will improve clearly. Hardness of composite material [9]. The hardness is increased by increasing the added weight ratios as they occupy more space within the resin allowing better load distribution. The increase in the percentage of additive leads to a decrease in the hardness of the material due to the generation of pores caused by the increase in proportion, which in turn weakens the properties of the substance. The decrease in the ratio of the base material means weakness in the strength of cohesion. The impact strength is generally low for resins because of its brittleness. After mixing, the value of the impact strength increases. This is due to the fact that the mixing materials will bear the bulk of the impact energy exerted on the composite material which improves this resistance. The failure of the non-reinforced resin material under the shock test results in the breakdown of the bonds or forces in the polymer by the growth of the initial cracks that are created for the effect of the shock stresses. In fact, these cracks grow and multiply rapidly towards the interfaces between the polymer chains because the forces between these polymer chains are Vander (Waal - Vander), which require a small amount of energy to overcome them, and the slits extending in a vertical direction on the direction of the polymer chains to break those chains during the propagation process, and it is worth mentioning that this requires greater energy Overcome those responsible for linking the structural units of Covalent bonds.

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V. CONCLUSIONS

1. Tensile strength is increased by increasing the added weight ratios.
2. The elasticity coefficient values increase with the increase in the ratio of the hardened material due to the increase in the density of cross-link density.
3. The increase in the percentage of additive leads to a decrease in the hardness of the material due to the generation of pores caused by the increase in proportion.
4. Cracks grow and multiply rapidly towards the interfaces between the polymer chains because the forces between these polymer chains are Vander (Waal - Vander).

REFERENCES

[1] Mustafa A. Rajab, Ekhlas I. Kader, Ali A. Hamod, Abdul Hameed I. Hameed, "Mechanical properties of silica, graphite and carbon fiber reinforced composites" , *International Journal of Engineering and Technology (IJET)* , Vol 9 No 5 Oct-Nov 2017.

[2] Dr. Mustafa A. Rajab, Dr. Ali Adwan Hammod, Dr. Ekhlas I. Kader, Abdul Hameed I. Hameed, "Mechanical properties (Tensile, Hardness and Shock resistance) for the phenol formaldehyde resin with Epoxy resin", *Diyala Journal of Engineering Sciences*, 4, 55 – 60, 2018.

[3] Jun Zheng, "Studies of pf resole / isocyanate hybrid adhesives ", Ph.D., Thesis, *Virginia Polytechnic Institute and State University*, 2008.

[4] Ali I.Al-Mosawi "Study of Some Mechanical Properties for Polymeric Composite Material Reinforced by Fibers", *Al-Qadessiyah Journal For Engineering Science*, Vol. 2, No 1, pp.14 – 24, 2009.

[5] Dr. Mustafa A. Rajab, Dr. Ekhlas I. Kader, Abdul Hameed I. Hameed.., ": FLEXURAL AND SHOCK STRENGTH OF SILICA, GRAPHITE AND CARBON FIBER REINFORCED COMPOSITE MATERIALS", *5th International Conference on Innovation Challenges in Multidisciplinary Research Practices* (ICMRP-December 15-16, 2017) Singapore, 2017.

[6] P.K. Mallick "Fiber-Reinforced Composites: Materials, Manufacturing, and Design", *3rd Edition, CRC Press*, 2007.

[7] Dr. Abbas A. Al-Jeebory, Ali I.Al-Mosawi, Sajed A. Abdul Allah "Effect of percentage of Fibers Reinforcement on Thermal and Mechanical Properties for Polymeric Composite Material " , *Iraqi Journal of Mechanical and Materials Engineering* , First Conference of Engineering College , 2009.

[8] E.P.De.Garmo, J.T. Black, and R.A. kohser "Materials and processes in Manufacturing", 10th Edition, *john Wiley & Sons*, 2008.

[9] Halem, Ali Hoby, "Improvement Properties of Reinforced Plastic Materials", MSC Thesis, *Engineering College, Babylon University*, Iraq, 1999.

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