

دراسة الخواص الميكانيكية لمواد متراكبة ذات اساس بوليميري

مدعمة باللياف القطن

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مدرس

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الخلاصة

تم في هذا البحث تحضير مواد متراكبة ذات اساس بوليميري بطريقة الصب اليدوي (Hand Lay-up) وقد حضرت المواد من راتنج البولي استر غير المشبع كمادة اساس مدعمة بتركيزات مختلفة من اليف القطن (Cotton) وبكسور حجمية (40% ، 30% ، 20% ، 15% ، 10% ، 5% ، 0%) و تتضمن الدراسة زيادة تراكيز الاليف و تأثيرها على الخواص الميكانيكية وقد اجريت مجموعة من الاختبارات الميكانيكية عند درجة حرارة الغرفة و شملت (اختبار الشد tensile strength) و خواص المتانة (Flexural properties) و مقاومة الصدمة (Impact Strength) و قد اظهرت نتائج البحث ان هناك تحسن واضح في الخواص الميكانيكية للمتانة (Flexural) مع زيادة تركيز الليف .

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Abstract

Because of the increasing importance in recent years of using composite material generally, and polymeric composite material in particular in different advanced industrial applications, an experiment work was carried out to investigate the most important characteristics which are related to the polymeric composite materials.

In this research unsaturated polyester resin (UP) was used as a (matrix) for composite material while the reinforcement used was Cotton fiber.

The specimens of composite material were prepared by hand lay-up from fiber with volume fraction of (0%, 5%, 15%, 20%, 30%, 40%) the mechanical tests included (Flexural strength, tensile strength, and Impact). Flexural strength and modulus were found to increase with cotton concentration, whereas tensile strength and Impact were found to decrease at higher concentrations.

1- Introduction

The performance of filled polymers is generally determined on the basis of the interface attraction of filler and polymers. Incorporating inorganic mineral fillers [1] into plastic resin improves various physical properties of the materials such as mechanical strength, modulus, etc. In general, the mechanical properties [2] of particulate filled polymer composites depend strongly on size, shape, and distribution of filler particles in the polymer matrix and extent of interfacial adhesion between filler and matrix. Thermoplastic elastomers [3] are one such type of filler and are particularly abundant. Cotton is the important natural fiber

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through out the world , It's a fiber that was used fairly extensively during the early [4] , Each cotton fiber is composed of concentric Layer , The cuticle layer on the fiber and consist of wax and pectin material [5] The mechanical properties classification depended of the type of forced to statically mechanical properties and dynamic mechanical properties

[6, 7]

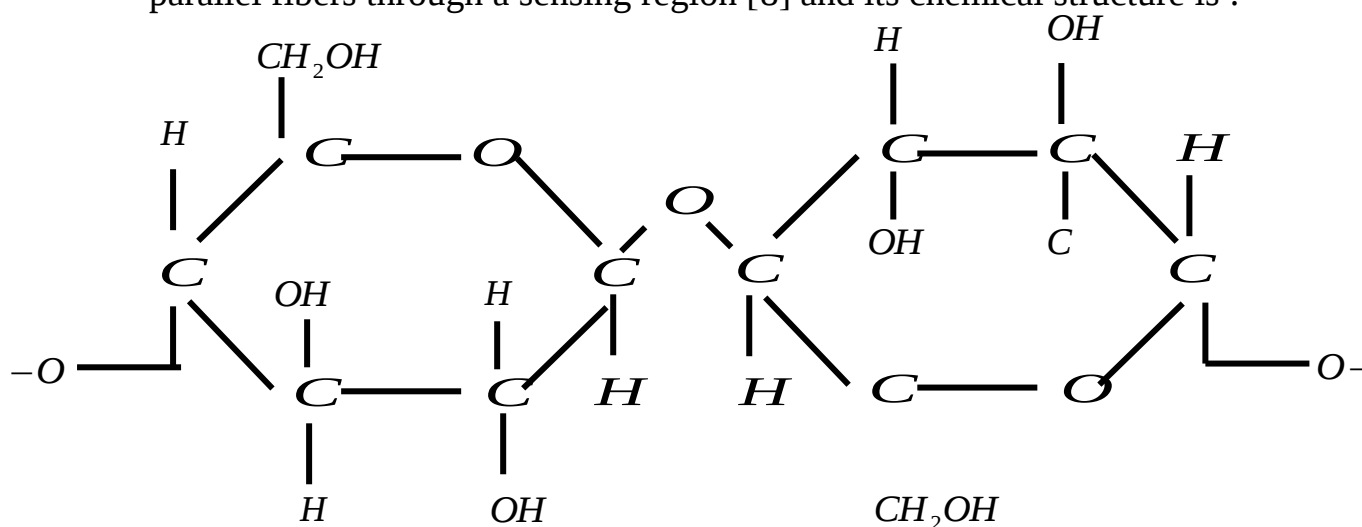
2- Experimental

2 – 1 Compounding

The matrix and filler were predried prior to the compounding , unsaturated polyester resin as matrix reinforced by Cotton fiber .

The unsaturated polyester , which is manufactured by Saudi company (SIR) , is as a form of a transparent glutinous liquid in room temperature , It is mixed by adding the hander (2gm) from the hander of each (100gm)from the resin and it is one of the thermosetting polymers .

The strengthening material are Cotton fiber and fiber length is described as the average length of the longer one – half of the fibers (Upper half mean length) this measure is taken by scanning "abeard" of parallel fibers through a sensing region [8] and its chemical structure is :



Figure(1) Chemical structure of cotton

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in polar polymers formulation to increase the strength of epoxies, nylons , and polyester [9]

2 – 2 Mechanical properties

Tensile strength per ASTM D638 was evaluated using Instron 1195 tensile testing machine LR 5KN form Liloyd instruments Ltd . at a cross head speed of 10µm/min .

Flexural properties according to ASTM D790 were tested using LR 50K from Liloyd instruments Ltd , Charpy Impact test carried out using an every Denison Impact tester (ASTM ISO -179) the striking velocity was (70m/sec) for charpy Impact test specimen , the notch was cut using Notch machine Instrument (ceast) , the unit of expression is J/m^2

3- Results and discussion

3 – 1 Tensile properties

Fig.2 Show the variation of tensile strength as a function of Cotton in wt% , After a moderate increment in the initial concentration of Cotton, the tensile strength decrease at higher filler concentration , The increment [5] may be due to the platy structure of Cotton providing good reinforcement , As the filler concentration increases Cotton plates test and aggregate and the tensile strength decreases . Elongation properties as seen from fig.3 decrease with the addition of filler indicating interface by the filler in the mobility or deformability of the matrix this interference is created through the physical interaction and immobilization of the polymer matrix by the presence of mechanical restraints so as the filler concentration increase the elongation at break get reduced .

3 – 2 Flexural properties

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Fig.4 shows the variation in flexural strength with varying concentration of Cotton, the flexural strength of composites increases with increase in concentration of Cotton , there is a significant increase in the flexural strength with increasing concentration of Cotton as shown in the figure , It is worth pointing out the total area for deformation stress also has an important role in flexural modulus [10] as shown in the figure 4 is found to increase with increase in concentration of Cotton.

3 – 3 Impact Strength

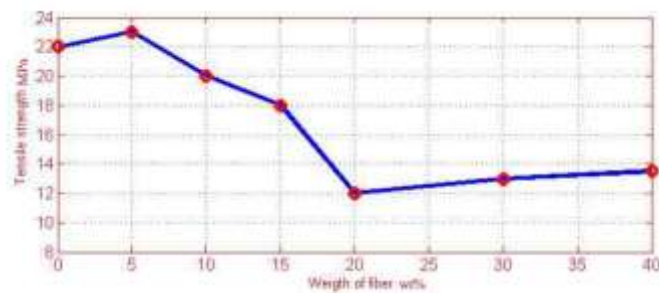
Fig.6 illustrates the variation of impact strength with Cotton loading , It is clear from the figure that the impact strength decrease with filler addition , this is mainly due to the reduction of elasticity [5] of material due to filler addition and there by reducing the deformability of matrixes and in turn the ductility in the skin area , so that the composite tend to form a weak structure .

An increase in concentration of filler reduces the ability of matrix to absorb energy and there by reducing the toughness so impact strength decreases .

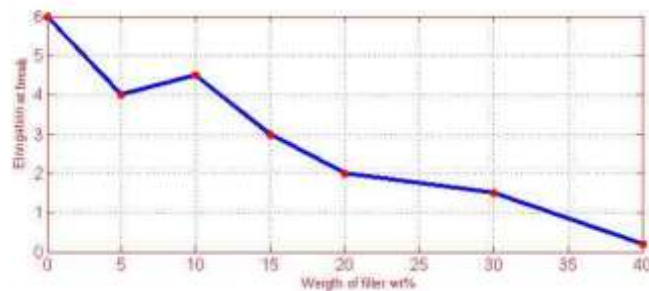
4- conclusion

The mechanical properties of the composite were found to be a function of the fiber aspect ratio the dispersion , the fiber orientation , the interfacial interaction between the minerals and the polymer matrix , Platy structured filler such as Cotton gave significant important in stiffness , It is concluded that the composite showed improved mechanical (Flexural)

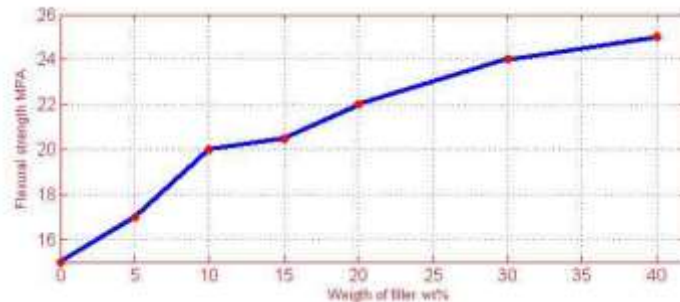
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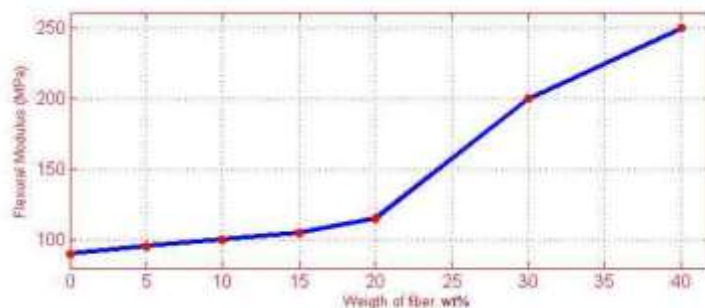
Figure(2) variation of the Tensile Strength of unsaturated polyester with Cotton concentration



figure(3) variation of the Elongation break of unsaturated polyester with Cotton concentration

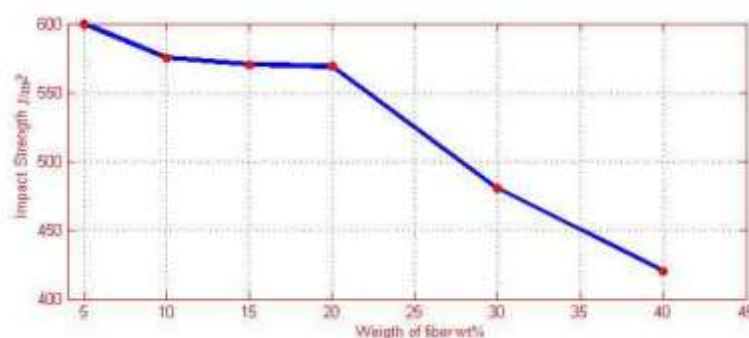


figure(4) variation of the flexural Strength of unsaturated polyester with Cotton concentration



Figure(5)variation of the flexural modulus of unsaturated polyester with Cotton concentration

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Figure(6) variation of the Impact Strength of unsaturated polyester with Cotton concentration

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