



Effect of adding filler rubber pieces powder on the bending resistance and Compression stress for polymer (unsaturated polyester).

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Abstract:

The Study of the effect of rubber pieces powder on the bending resistance properties and flam for unsaturated polyester which is manufactured in the Turkey, a function of the percentages of Copper powder (5%, 10%, 15%, 20%, 25%), a particular size (250 μm). Were investigated through the experimental work for some variables, such as a flame retardant and the bending resistance, Compression stress. Also, the samples of the base material pure unsaturated polyester were measured and measured polyester reinforced with rubber pieces powder . The obtained results appeared that the added rubber pieces powder to led to reducing the spaces between the polymer chains which reflects the high ability of the polymer against the applied stress, the degree of homogeneity is high between polymer and additives, also the results indicate a lowered in bending resistance at percentage (20%) is (70Mpa), and observe from experimental result the average time of burning starts strong impact when (0%) is (189 Sec), and then decreasing behavior values to (121 Sec) when percentage (5%), while the maximum value for percentages when (25%) is (133 Sec.).

Keywords: unsaturated polyester, Additives, Polymer composites, bending resistance, Compression stress, rubber pieces powder, flame resistance, fire retardant, waste tires

1. Introduction

Polymers consisting of a wide range of materials derived in part of organic materials which have its bases of raw materials (oil) [1]. Normal polymers are found in many forms such as horns of animals, tortoise shell, rosin from pine trees, rubber, and asphalt. Rubber was one of the most useful of the natural polymers [2]. The addition of the fillers to polymer materials is a speedy and low-cost way to improve the properties of the base materials. For this cause, particulate filled polymers have been a subject of increasing interest in science researches and industries. By this way, stiffness, strength, dimensional stability, hardness, thermal conductivity, and electrical properties can be obtained [3]. The addition of fillers to polymers is a fast and cheap method to modify the properties of the base materials. For this reason, particulate filled polymers have been, and are, a subject of increasing interest in both industry and research. In this way, strength, stiffness, electrical and thermal conductivity, hardness and dimensional stability, among other properties, can be tailored to the required values. Fillers are solids added to the polymers to develop their properties and decrease the price and have the opposite effect of plasticizers as decrease the flexibility or increasing the volume of plastic material, which decrease the cost and improve some mechanical properties for the polymer materials [4-6]. They are hetero chain macromolecules that possess carboxyl ate ester groups as an integral component of their polymer backbones. Polyesters have received a great deal of attention since the early work of Carothers, who initiated study on many step-growth polymerizations [7]. Polyesters are one of the most versatile synthetic copolymers, and the polyesters are produced in high volume that exceeds 30 billion pounds a year worldwide [8-10]. Rubber tires can also be used in civil and non-civil engineering applications such as in road construction, in geotechnical works, as a fuel in cement kilns and incineration for production of electricity or as an aggregate in cement-based products or in geotechnical field [11-12]. The Mechanical properties depend strongly on the molecular structure and chemical for the polymeric material [13]. Mechanical properties of polymer materials are important for almost all applications in technology, household, and the industry. Especially, strength, toughness, and stiffness are decisive properties in many uses [14]. Researcher Watan I. W. [15], Studied mechanical

Thermal properties of polyester reinforced with ceramic particles, the obtained results of impact and hardness showed an increase with the increase of the weight fraction as non-linear relationships, whereas the thermal conductivity increased with the increment of the weight fraction of ceramic particles which has reached the maximum value of (0.319 w/m. N) for the composite material, reinforced with alumina particles at weight fraction of (20%) which has been at the maximum value. Studied researchers Ahmed and et al [16], the effect of Copper powder on the Mechanical properties of unsaturated polyester. The obtained results showed that the strength at both breaks will be affected little till the percentage (0.8%), and lowered after that by increasing the percentage also indicate a lowered in young's modulus at the percentage (0.8%). The proportional limit was (1046 N) for (1%). The aim of this study is to find the bending resistance properties and fire retardant for unsaturated polyester reinforced with rubber pieces powder.

2. Experimental

2.1. Material basis and Fillers:

In this experimental study, polyester was used as a base material, this material of Turkish origin, and supplied by the company (Henkel A.S Turkish), the polymer density is about (1.5 g/cm³), the polymer polyester is used in various industries, and is a viscous liquid, the color of Brown with special effect. It has a viscosity of 1000 (p) at 25 °C. The solid state is transformed after the addition of the crucifixion, which is also a transparent viscous liquid (ketone, ethyl peroxide) and added a percentage (2%) and supplied by the same company. The rubber piece powder extracted from the car tires (waste), used in this research as the fillers, were cut into small pieces and then grind these small parts by machine grinding electric origin French to the powder, and then were treated oyster shells powder by candidate wired equal to or less than (250 μm). Table (1) shows the chemical composition of oyster shells powder. chemical composition of the used rubber powder is presented. Figure (1) shows the shape of the used rubber piece powder. The quantity of steel is generally about 15%, and it's more important for the heavy trucks tires. For this study steel and one part of textile were removed by magnetic separation and density.

Material/element	Rubber	Carbon black	Textile	Oxidize zinc	Sulfur	Additives
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Mass percentage	54 %	29 %	2 %	1 %	1 %	13 %
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Table (1) The chemical composition of rubber piece powder[17].



Figure (1): Photograph shows of rubber piece powder.

2.2. Preparation of composites.

In this research, a Hand-lay-out is used in the Preparation of models (polymer with fillings), where we start the blending process. As function of the percentages of rubber piece powder (5%, 10%, 15%, 20%, 25%), The base material is mixed with the crucifixion at room temperature, rotation of the mixture continuously and slowly and continue mixing for (5-8) minutes until the mixture homogenizes well, then we flow the liquid mixture in the shape (template) from one side of the mold so that it flows continuously, and regularly to the other side of the template and then put the shape(template) on a manual mechanical vibrator, then start with the process of shaking the shape for a period of (1-2) minutes to remove of the air molecules. Figure (2) shows a photograph of the sample of the polyester added the rubber pieces powder. The Shape

(template) has been manufactured from transparent glass with a thickness (4 mm), and the sides are moving and attached to the base of silicon rubber that is easy to move. These aspects are variable depending on the size of the sample to be manufactured. The Shape (mold) used is rectangular and the dimensions are (length 11 cm, width 1.5 cm, height 4 mm).

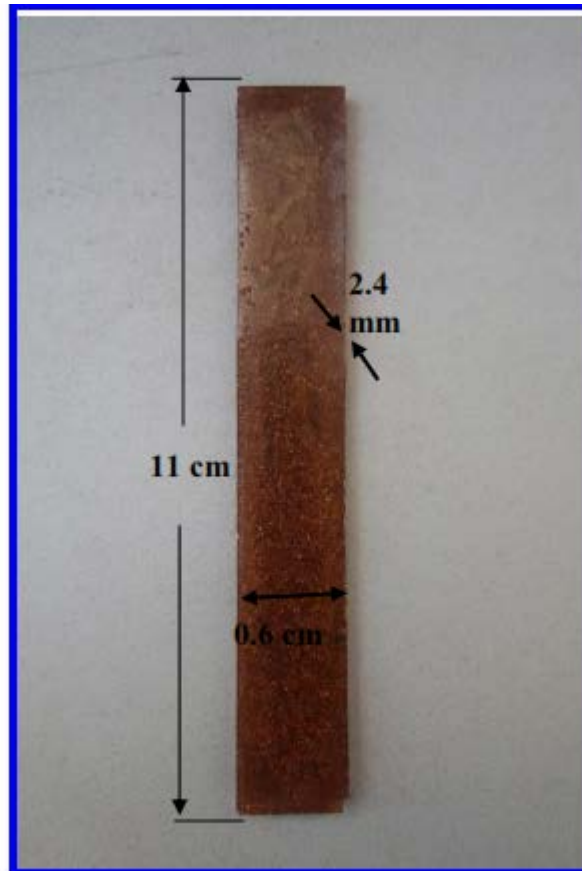


Figure (2) Photograph of the tensile specimen coupon dimensions centimeters.

2.4. Mechanical testing.

The tensile properties were tested according to the ASTM Standard D-638: Standard Test Method for Tensile Properties of Plastics [18]. A photograph showing a mechanical measuring device (Tensile) shown in Figure (3). A universal testing machine (Zwick Rell) was used, this device origin (Germany), from type (BTI-FR2.5TN.D14), power operating card (100-129 V / 4,4-3,7A). The tensile modulus was calculated as the bending resistance for percentages of unsaturated polyester with Copper powder.



Figure (3) a photograph showing a mechanical measuring device (Tensile).

Results and Discussion:

The relation between the resistance of bending and the weight ratios for the unsaturated polyester with the rubber pieces powder is shown in Figure (4). Figure (4) shows that the bending resistance behavior starts with a strong effect (0%) value is (163 Mpa), when the polymer is pure without any addition (the sample elasticity is high and has a low hardness compared to the other samples when adding the fillers), and then the bending resistance behavior of the measurement model decreases with the increase of the weight ratio of the fillers(20%), value is (70 Mpa), and then the behavior of the increases with the increase of the weight ratio of the fillers(25%), value is (39 Mpa), this is because the polymer (unsaturated polyester) and fillers (rubber pieces powder) most of the pressures (the distribution of the additive to the base material is unhomogeneous). Thus, the distribution and pressures on all sides of the sample, which leads to the no concentration of pressure in one area, the result is a failure and less resistance, also, the sample at this ratio is very flexible and low hardness. There may be a strong linkage between the (rubber pieces powder) and (the unsaturated polyester) which creates a good surface so that failure to a resistance to bending requires maximum stress. □

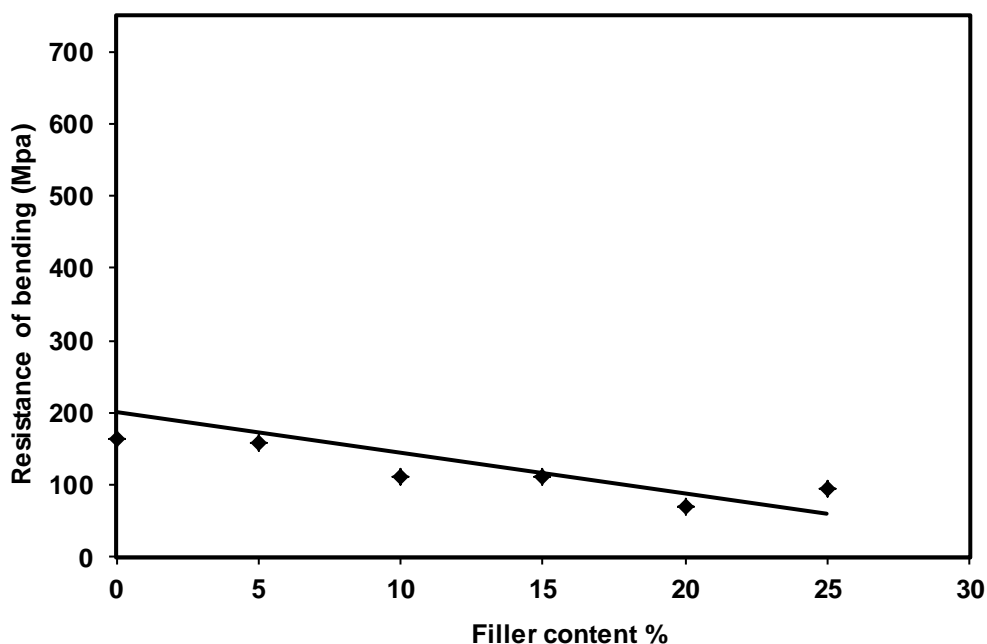


Figure (4) resistance of bending for Polyester reinforced with rubber pieces powder with different percentage of additives. □

It is well known that many polymers emit heat when they are burning, which reduces the ability to use, especially in places where large contingent of flame and the best way to take problem by using additives that increase the flame resistance of polymer. In this research rubber pieces powder was used as additives to unsaturated polyester to see the possibility of these additives to resist flame and spread heat through the polymer matrix. The behavior of (ATB) starts rapidly when the percentage (0%), about (189Sec), and then begins to decrease gradually when increasing percentages which illustrate in Figure (5).

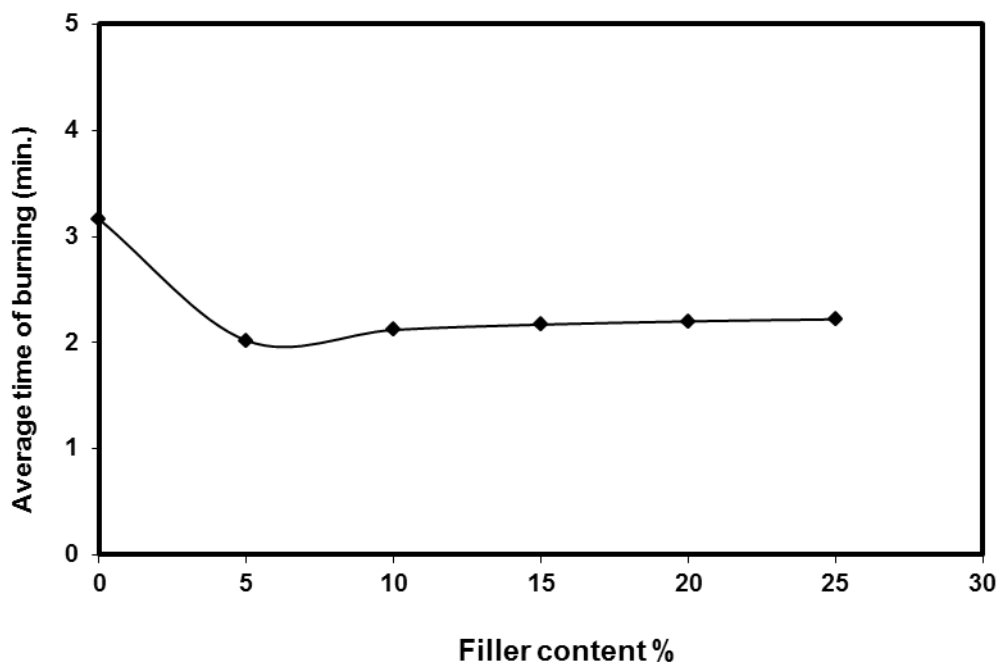


Figure (5) relation between the average time of burning and rubber pieces powder unsaturated polyester composites.

The relation between the Stress and with percentages added to the polymer shows in figure(6). The behavior of stress begins the high effect when the percentage of (5%) of the additive, and then to increase it to (25 Mpa) when the percentage is (10%) , and we note that Stress (strength is the stress at which a material begins to distort plastically. Prior to the yield point the material will distort elastically and will return to its original shape when the applied stress is removed), and Stress decreases when you increase the percentage of adding the rubber pieces powder when the percentage is (25%). This shows that the rubber pieces powder works to improve the elastic property at a percentage when the polymer hardness extends at this rate of the effect of the distribution of homogeneous material nature solid.

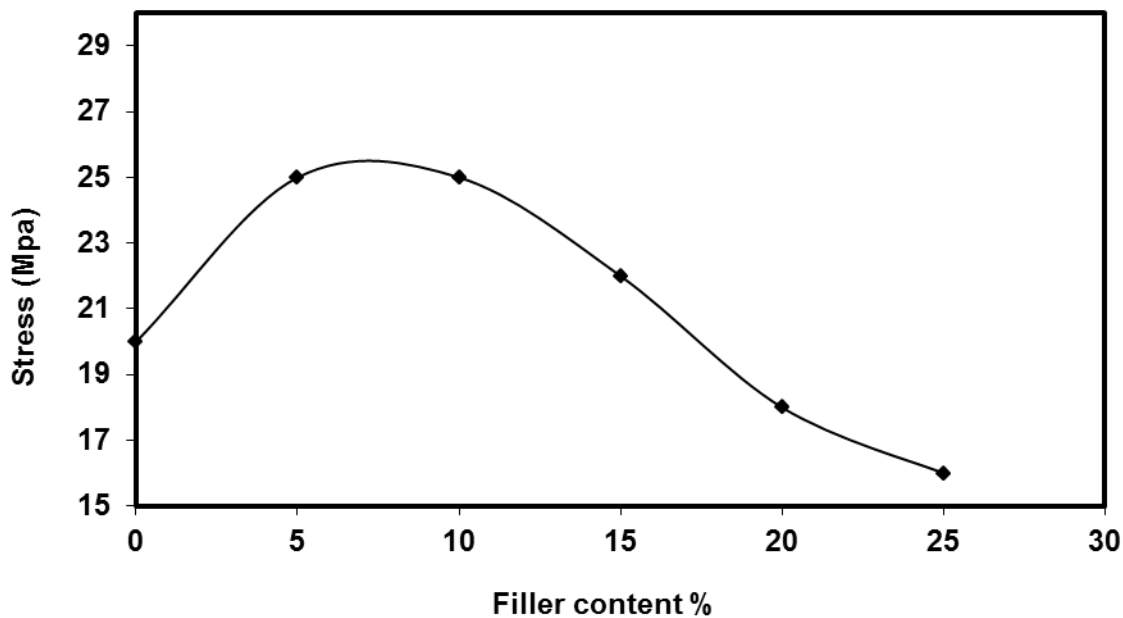


Figure (6) relation between the Stress and rubber pieces powder unsaturated polyester composites.

CONCLUSION:

The results lead to that the strength at bending resistance is (158 Mpa) at the percentage (5%). The obtained results appeared that the added rubber pieces powder to reduce the spaces between the polymer chains, which reflects the high ability of the polymer against the applied stress, The degree of homogeneity is high between polymer and additives, also the results indicate a lowered in bending resistance at the percentage (20%) is (70Mpa), obtained the results showed that rubber pieces powder extracted from the waste tires as a suitable additive to the unsaturated polyester, and observe the increase of fillers ratios to the unsaturated polyester leads to decrease in average of burning time at fillers ratio (10 %), the rate of burning of the prepared composite with the percentage added to rubber pieces powder is continuously increasing with increasing the weight percentage of additives direct proportionality (not inversely proportional), we confirm that the behavior starts strongly when the percentage (0%), about (189 Sec).

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