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STUDY THE EFFECT OF ADDITION OF NATURAL AND SYNTHETIC MATERIAL ON SOME OF MECHANICAL PROPERTIES OF UNSATURATED POLYESTER

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ABSTRACT: - In this work unsaturated polyester resin was modified with a Peach waste product of peach (natural) and novolac (synthetic) polymer. With weight percentage (0, 1.5, 3.5, and 5%). Some mechanical properties such as impact, tensile, and hardness conductivity as well as dielectric constant were studied. The results obtained that the best value of impact strength obtained at 5% from peach waste. Hardness Test gave proportional relationship with the peach waste percentage while it increased by 1% for novolac. Tensile strength gave the best value at 3.5% and tensile modulus at 1.5% of peach waste. Dielectric constant increases with the increasing percentage of added materials. The thermal Conductivity decreasing with an increase percentage of novolac particles while it decreased at 1.5% for peach.

Keywords: unsaturated polyester, Peach waste, novolac particle, mechanical, thermal conductivity, dielectric constant.

INTRODUCTION

During Our day life Composites are widely employed. This is Due to their low Weight, rigidity, intensity, high-temperature carrying out, decomposition resistance, solidity, conductivity and capability to be bespoke for definite end employ they have increased a Significant ground in the high execution applications, such as aerospace and automobile industry, that are not possible with the Individual components by themselves (1-2). The structure of the composite material contains of two or more components that are joint at a macroscopic level and are insoluble in each other. The supporting phase and the one in which it is enclosed is called the matrix (3). Numerous kinds of composite materials and a number of approaches of categorizing them, one of its bases on geometry and contains of three clear families bedded composites, particular composites, and fiber-reinforced composites (4). The particles improved are classified into dispersion and Large particle composites, each one of them have special mechanism for example The term “large” is employed to show the contacts between particles and matrix cannot be processed on the atomic or molecular grade instead, continuum technique are employed. The grade of strengthening or enhancement of mechanical conduct count on powerful attachment between the particle and matrix (5).

Many research workers have considered the issue of locally available materials on mechanical properties of polymer

Fadhel, et al. ⁽⁶⁾ studied the Cellulose and ethyl cellulose with reformed unsaturated polyester at ambient state with various mass percentages (5-25 %) of Cellulose or ethyl cellulose. The Cellulose effect showed that the impact test increment, hardness test, and dielectric constant with decrements in bending of the MUPE, while in exist the ECls the dielectric constant is decreasing and the other mechanical tests increase for MUPE.

Naglaa ⁽⁷⁾ studied the unsaturated polyester that was reinforced by hybrid carbon - Kevlar fibers at different reinforcement percentage (20%, 40%, and 60%). The tests show after additional the fibers the mechanical properties increases and the relation between them is positive.

Mohammed ⁽⁸⁾ studied influence of sunflower and water-melon seed shell pulverization on some mechanical properties of unsaturated polyester thermoset. At different percentage from 5 wt% to 25wt%. The tests presented that the relation between the shells percent and the flexural strength, modulus of elasticity, hardness and compressive strength is positive, while The impact test was observed to decrease with increasing of powder percent.

Onuegbu and Umoh ⁽⁹⁾ studied the result of alkali treatment and fibre load on the tensile properties additional to hardness of unsaturated polyester with coconut fibre. The tensile tests include tensile strength, modulus, load at rupture, tensile strain at rupture and extension at rupture. The significant findings of the research showed that alkali treatment improved the tensile properties and hardness of the composite. The tensile properties at 10% fibre load were greatly enhanced while 15% fibre load is best for micro hardness.

The aim from this research study the mechanical properties of unsaturated polyester resin used as a matrix in the polymer composites after the additional particles to determine some parameters, such as, Impact, tensile, hardness, conductivity, and dielectric constant.

2- EXPERIMENTAL

2-1 Materials & Preparation

Unsaturated polyester resin (percentage of styrene 32, viscosity at 25 °C is 1000 cp, appearance transparent, pH solid basis 22, specific gravity 1.15) was used for moulding sheets with methylethylketone peroxide (MEKP), 100g of UP was combined with 2g hardener (Methyl Ethyl Ketone peroxide). Two types of particles were synthesized with various percentages, one of them from novolac and another from a peach. The particles size in this paper was (100 µm). The particles powder was used (1.5, 3.5, and 5) wt. %. Before add the hardener to UP the two particle powder combined with UP at various particle percent at room temperature and then add the hardener to the mixture at the same temperature. The composite was cast to the forge depending on the test and left 48 to complete solidification.

2-2 Tests

2-2-1 Impact strength test

Instrument of type Izod was employed for this test which include a pendulum swiping downing from a special height to hit the piece. Each sample was prepared according to the ISO-179 with fixed dimensions (55 × 10 × 5) mm. Impact test is estimated by the relationship:

$$Impact = Uc/A \quad 1$$

Uc is the fracture energy and A is the cross sectional area of the specimen.

2-2-2 Hardness Test

Shore D instrument was employed for this test with fixed dimensions (40 mm diameter and 5mm thickness).

2-2-3 Tensile test

This test was rendered according ASTM-D638 with dimensions (150 x 6 x 5) mm.

2-2-4 Dielectric constant test

The Victor ASTM-D150 instrument was used for this test with fixed dimensions (40 mm diameter and 5mm thickness). Dielectric constant (ϵ_r) was calculated from the equation

$$\epsilon_r = \epsilon / \epsilon_0 \quad (2)$$

ϵ and ϵ_0 are the permittivity of the medium and the free space.

2-2-5 Conductivity test.

Lee's disk was used for this test with fixed dimensions (40 mm diameter and 5mm thickness). Conductivity was calculated from the equation

$$\lambda \left(\frac{T_2 - T_1}{d} \right) = e \left[T_1 + \frac{2}{r} \left(d_1 + \frac{1}{2} d \right) T_1 + \frac{1}{r} d \cdot T_2 \right] \quad 3$$

$$i * v = \pi \cdot r^2 \cdot e (T_1 + T_3) + 2\pi \cdot r \cdot e \cdot \left[d_1 T_1 + d \cdot \frac{T_1 + T_2}{2} + d_2 T_2 + d_3 T_3 \dots \right] \quad 4$$

Where

λ thermal conductivity, i my current amount, V provided voltage, r radius of the disc, T_1 , T_2 and T_3 are the temperature of the reference discs A, B and C respectively, d_1 , d_2 and d_3 are the thickness of the reference discs A, B and C respectively, d is the thickness of the sample. e present the rate of heat transfer through the area of the sample .

3-Result & discussion

3-1 Impact test

Fig (1) shown the relationship between impact test and particles content of novolac and peach addition to unsaturated polyester, influence the particles of novolac caused decreases in impact strength when it increased; this is because reduced the capability of matrix to absorb energy (10), while the particles of peach caused increasing in impact test at 5% percent.

3-2 Hardness Test

Fig (2) represents the influence of particles content for novolac and peach added on unsaturated polyester. It shows that hardness increase with the increasing in novolac particles content and this is due to decreasing the motility of polymer molecular which lead to scratch, while the hardness decrease with the increase the particles of peach.

3-3 Tensile test

Fig (3a) depicted the effect of reinforcing particles added on unsaturated polyester with calculated tensile strength and fig (3b) with tensile modulus. It shows that the calculated tensile strength decreased with increasing novolac particle content, but maximum value of tensile strength increases with the peach particle content at 3.5% that it's showing the enhanced ability and increased adhesion of particles, while The maximum value of tensile modulus with the peach particle content at 1.5%, then particles are more rigid than the matrix resin ⁽¹¹⁾ .

3-4 Dielectric constant test

The effect of particles content for novolac and peach added on unsaturated polyester is shown in fig (4), It recognizable that increased dielectric constant with the increase in particles content for novolac and peach and this is ascribed mainly to the interaction between surface particles and unsaturated polyester is poor, the polarizability is also effected on dielectric constant, If polarizability is higher the dielectric constant will be high ⁽¹²⁾ .

3-5 Conductivity test

From fig (5), it is shown the behavior of thermal conductivity with the particles content for novolac and peach added on unsaturated polyester. Thermal conductivity can be decreased by increase in particles content of novolac, while the thermal conductivity can

be decreased with increase in particles content of peach at 1.5% and return to increase. This low thermal conductivity attributable to no free electrons for these fabrics. This leads that these materials can be employed as thermal insulators⁽¹³⁾.

4-Conclusion

The results of parameters after reinforcement unsaturated polyester by novolac and peach particles showed the impact test at 5% particles percent of peach gave the Best value. Hardness Test gave proportional relationship between peach particles percent and hardness, and best value for novolac at 1%. Tensile test gave the best value at 3.5% for peach while the tensile modulus gave the best value at 1.5%. Dielectric constant increasing with an increase percentage of materials. Conductivity gave the value of thermal conductivity of novolac particles decreasing with increase percentage while it decreases at 1.5% of the peach.

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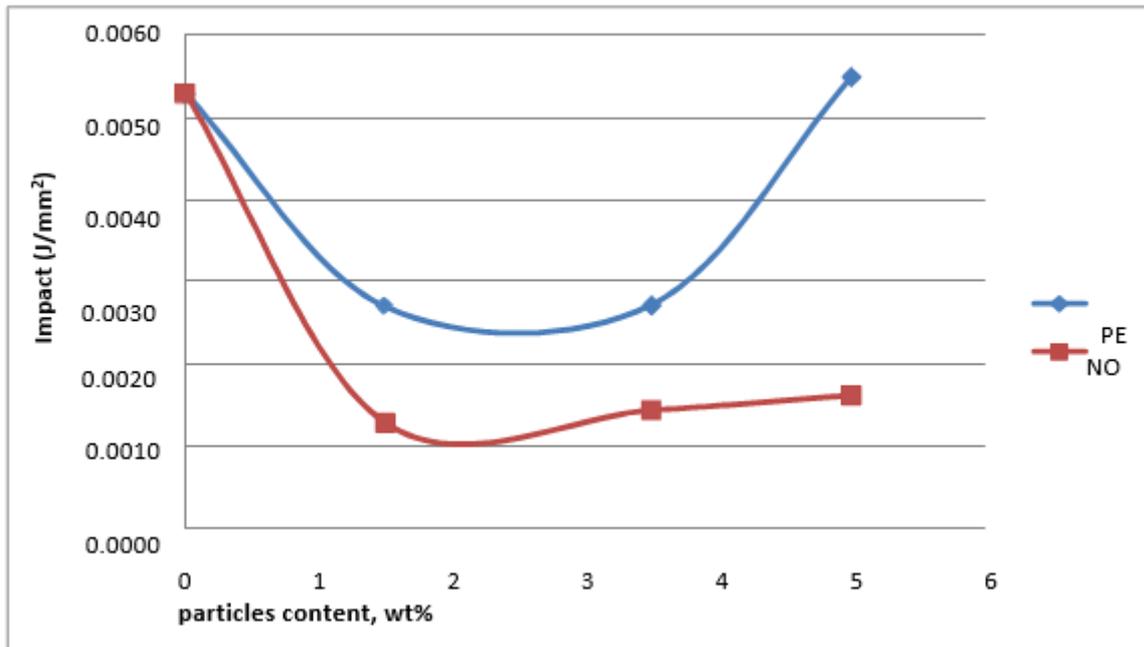


Fig. (1): impact strength of polyester vs. peach and novolac particles content

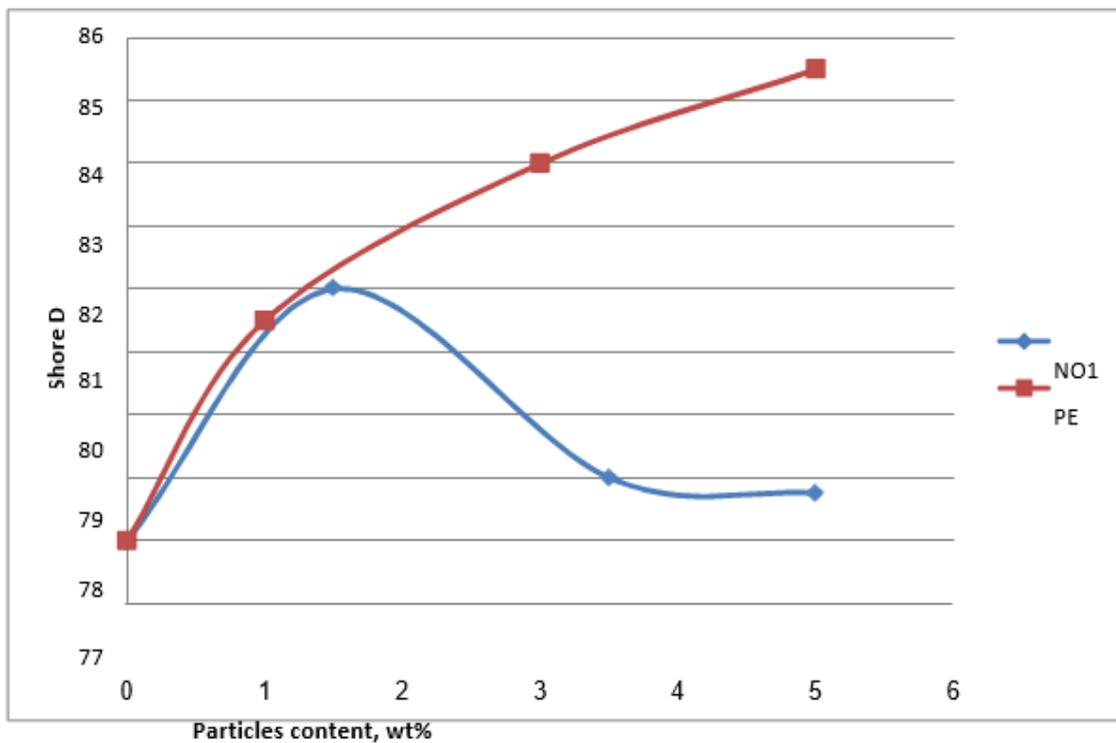


Fig. (2): hardness vs. peach and novolac particles content

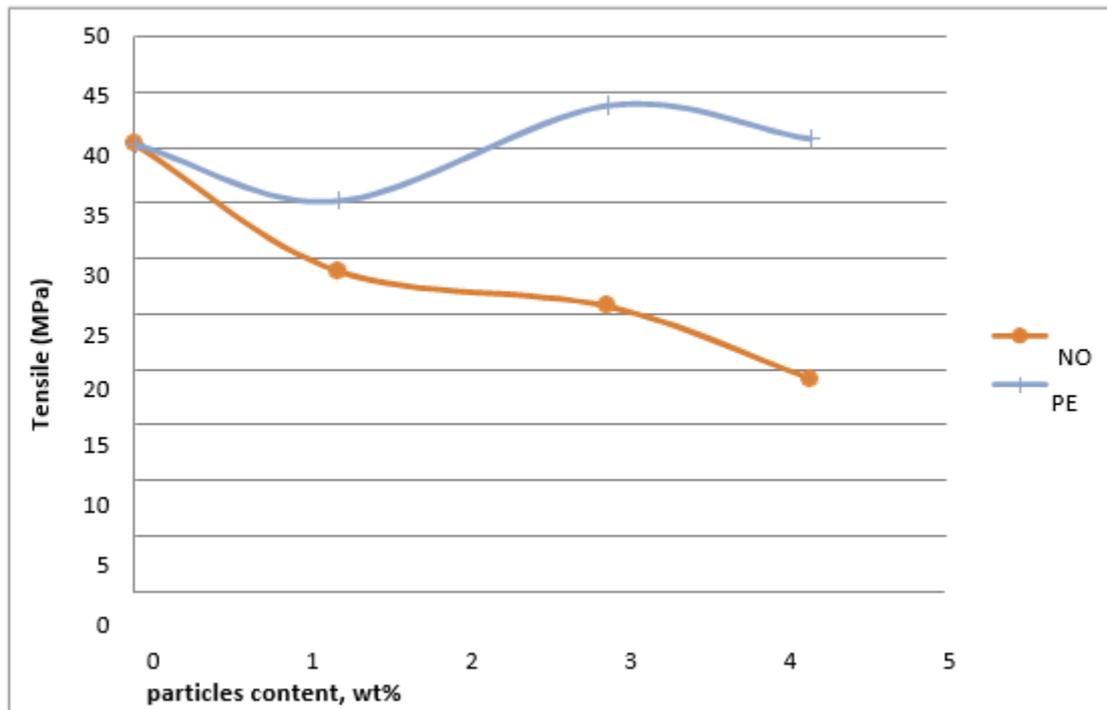


Fig. (3a): tensile strength vs. peach and novolac particles content

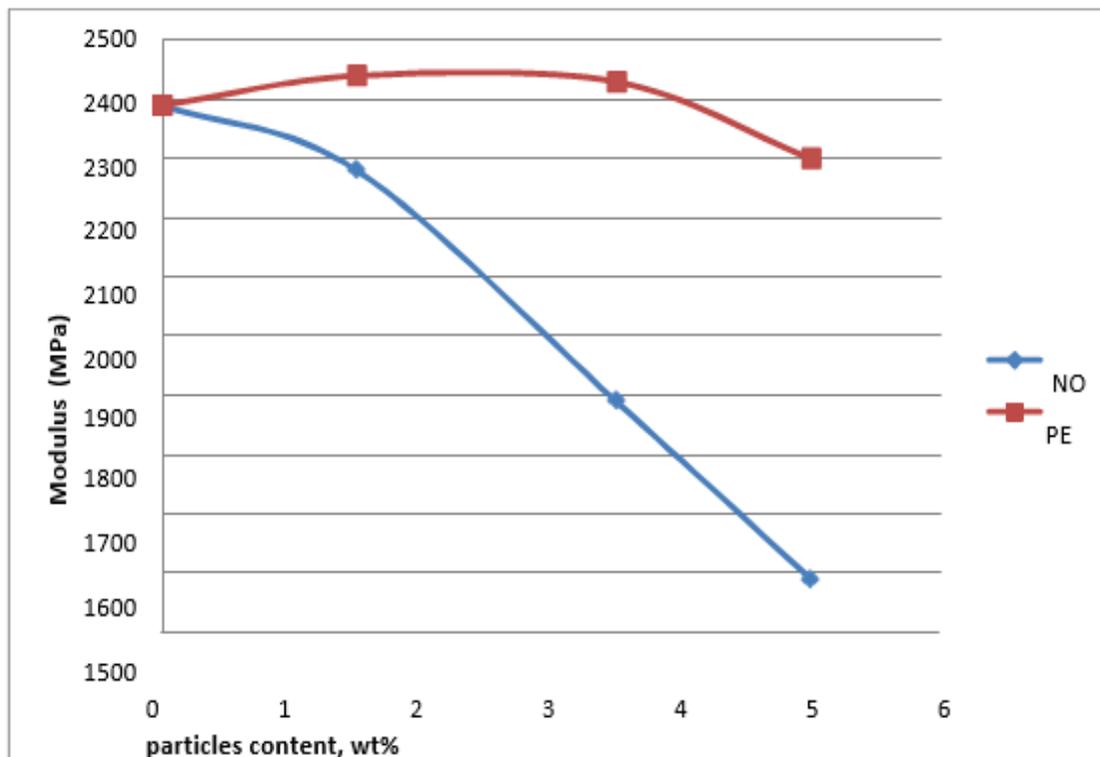


Fig. (3b): tensile modulus vs. peach and novolac particles content

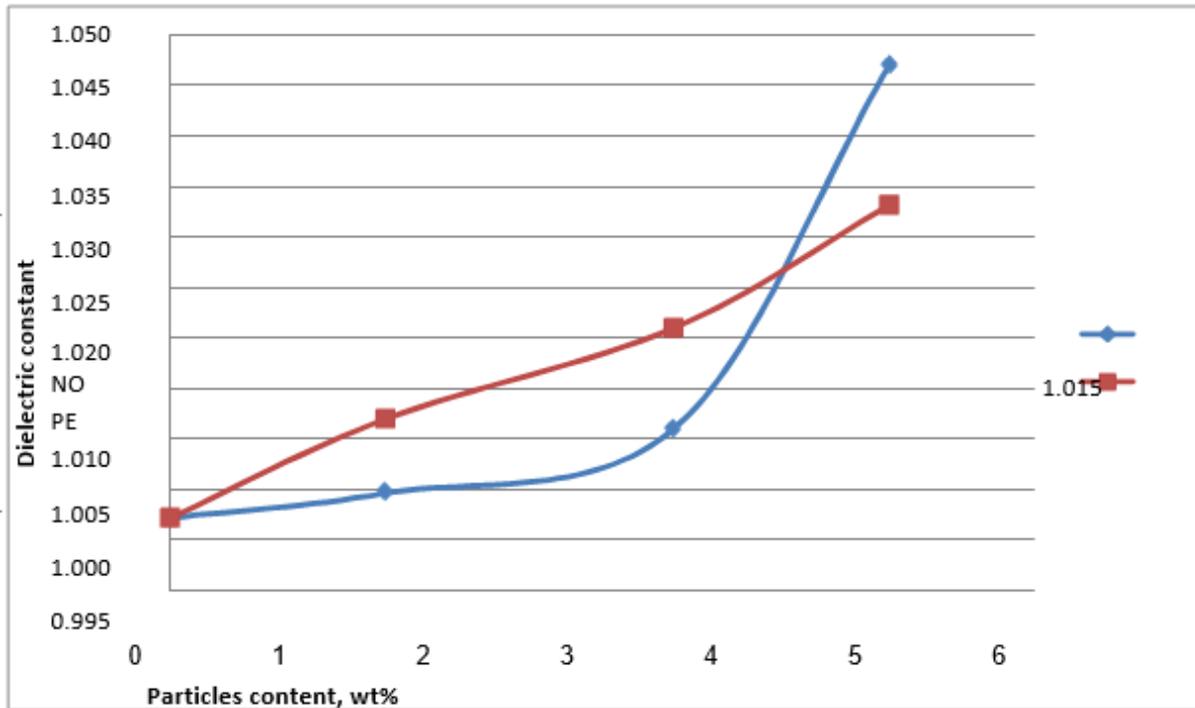


Fig. (4): dielectric constant vs. peach and novolac particles content

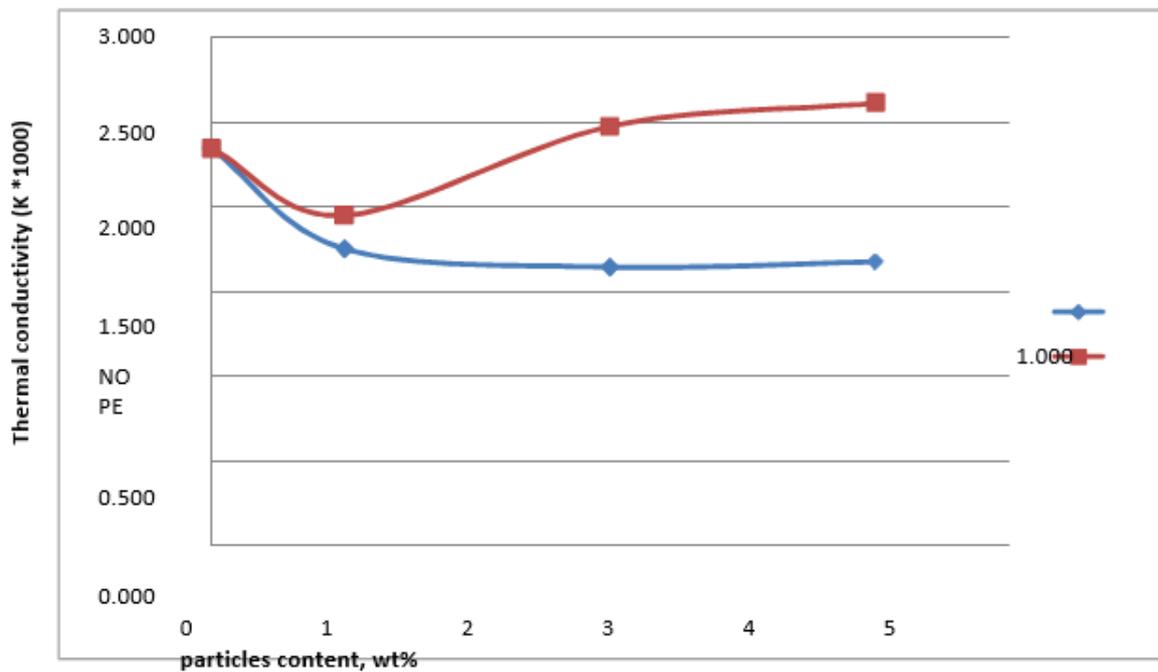


Fig. (5): Thermal conductivity vs. peach and novolac particles content

دراسة تأثير إضافة المواد الطبيعية والاصطناعية على بعض الخواص الميكانيكية للبوليستر غير المشبع

الخلاصة

في هذا العمل تم تعديل راتنج البوليستر غير المشبعة مع منتج النفايات الخوخ (الطبيعية) والبوليمر نوفولاك (الاصطناعية). مع النسبة المئوية (0، 1.5، 3.5، و 5%). ودرست بعض الخواص الميكانيكية مثل، الشد، الصدمة، صلابة والموصلية، فضلا عن ثابت العزل الكهربائي. النتائج اظهرت على أفضل قيمة لقوة الصدمة عند 5% من النفايات الخوخ. وأعطى اختبار الصلابة علاقة متناسبة مع نسبة نفايات الخوخ في حين أنها زادت في 1% للنوفولاك. وأعطى قوة الشد أفضل قيمة عند 3.5% ومعامل الشد عند 1.5% لنفايات الخوخ. ثابت العزل الكهربائي يزيد مع زيادة النسبة المئوية للمواد المضافة. الموصلية الحرارية تتناقص مع زيادة النسبة المئوية لدقائق النوفولاك في حين أنه انخفض عند 1.5% لنفايات الخوخ.