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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.

1- INTRODUCTION

During Our day life Composites are widely employed. This is Due to their low Weight, stiffness, strength, high-temperature performance, corrosion resistance, hardness, conductivity and ability to be tailored for specific end use they have gained a Considerable ground in the high performance 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 consists of two or more constituents that are combined at a macroscopic level and are not soluble in each other. The reinforcing phase and the one in which it is embedded is called the matrix [3]. Many types of composite materials and a number of methods of categorizing them, one of its bases on geometry and consists of three distinct families laminar composites, particular composites, and fiber-reinforced composites [4]. Large-particle and dispersion-strengthened composites are the two sub classifications of particle-reinforced composites. The distinction between these is based upon reinforcement or strengthening mechanism. The term "large" is used to indicate that particle–matrix interactions cannot be treated on the atomic or molecular level; rather, continuum mechanics are used. For most of these composites, the particulate phase is harder and stiffer than the matrix. These reinforcing particles tend to restrain movement of the matrix phase in the vicinity of each particle. In essence, the matrix transfers some of the applied stress to the particles, which bear a fraction of the load. The degree of reinforcement or improvement of mechanical behavior depends on strong bonding at the matrix–particle interface [5].

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

Fadhel, et al. [6] Studied modified unsaturated polyester (MUPE) with Cellulose

(Cls) and with ethyl cellulose (ECls) at ambient conditions with different weight percentages (5-25 %) of Cls or ECls. The results observed that Cls increases the impact strength, hardness, and dielectric constant and decreases the bending of the MUPE, while ECls causes an increase in the three mechanical behaviors and a decrease in the dielectric constant of the MUPE.

Naglaa [7] studied the mechanical properties of unsaturated polyester resin reinforced with hybrid carbon - Kevlar fibers at different reinforcement percentage (20%, 40%, and 60%). These mechanical properties improved after reinforcement by fibers and the value of mechanical properties will increase with increasing percentage of reinforcement

Mohammed [8] studied effect of sunflower and water-melon seed shell powder on some mechanical properties of unsaturated polyester thermoset. At different percentage from 5 wt% to 25wt%. The results showed that the flexural strength, modulus of elasticity, hardness and compressive strength increased with the increasing of the shells powder percent. The impact strength was observed to decrease with increasing of powder percent.

Onuegbu and Umoh [9] studied the effect of alkali treatment and fibre load on the tensile properties and hardness of coconut fibre-ortho unsaturated polyester composites. The tensile tests include tensile strength, modulus, load at break ،tensile strain at break and extension at break. 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 where 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

2-1Materials & Preparation

Unsaturated polyester resin (percentage of styrene 32, viscosity at 25 ºC is 1000 cp, appearance transparent, pH solid basis 22, specific gravity 1.15) was used for moulding sheets with methylethylketone peroxide (MEKP), The mixing ratio used was 100g of UPE resin and 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. %. The samples were prepared by mixing unsaturated polyester with novolac and peach powder using different particle content. The two particle powder was supplementary to polyester and hardener and then they were homogeneously mixed at room temperature. The composite was cast into the mold according to the test and left 48 to complete solidification.

2-2Tests

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 strength (I.S.) is calculated by applying the relationship:

$$I.S. = UC / A \qquad (1)$$

Where: UC is the fracture energy (Joule) and A is the cross – sectional area of the specimen.

2-2-2 Hardness Test

The 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 (εr) was calculated from the equation

$$\varepsilon_r = \varepsilon/\varepsilon_0 \qquad (2)$$

ε and ε0 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

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

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

Where

λ thermal conductivity, I is the current value through the electrical circuit, V is the supplied voltage, r is the radius of disc, T1, T2 and T3 are the temperature of the brass discs A, B and C respectively, d1, d2 and d3 are the thickness of the brass discs A, B and C respectively, d is the thickness of the sample. e quantity of heat that flows through the cross sectional area of the sample per unit time.

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 ability 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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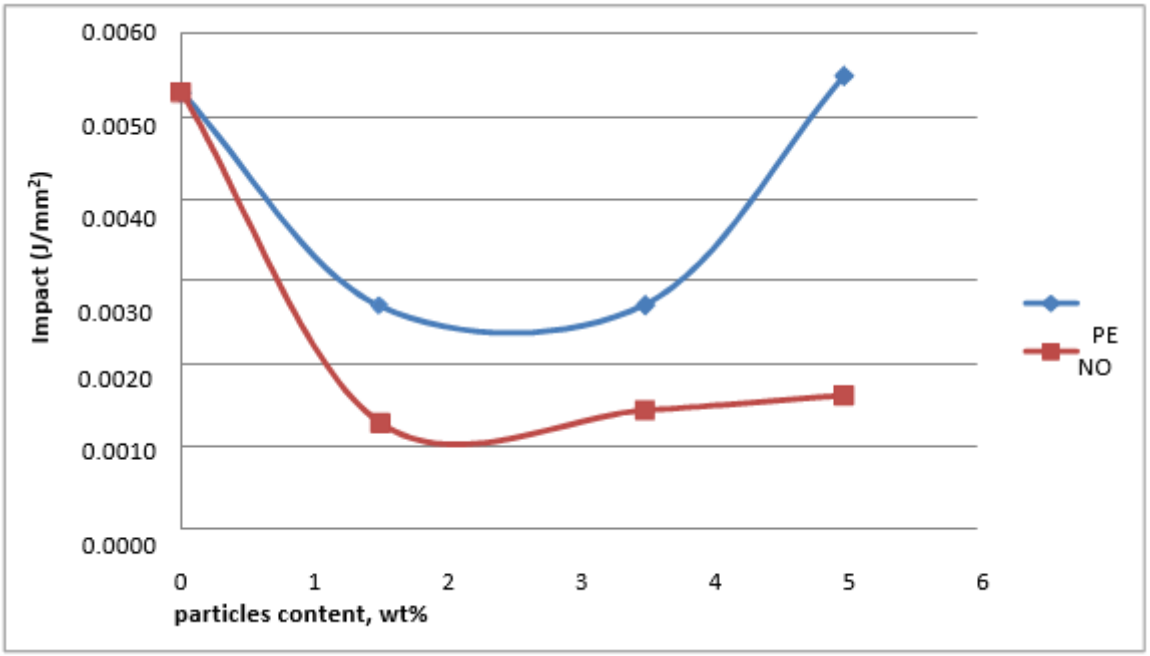

Fig. (1): impact strength of polyester vs. peach and novolac particles content

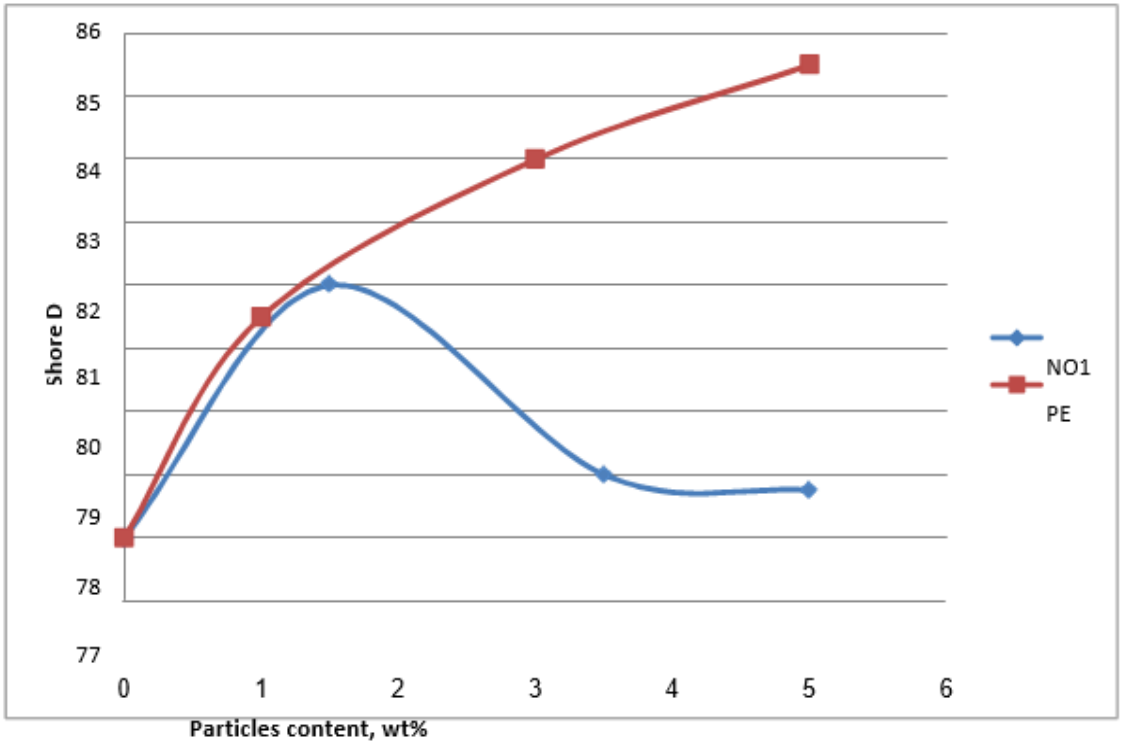

Fig. (2): hardness vs. peach and novolac particles content

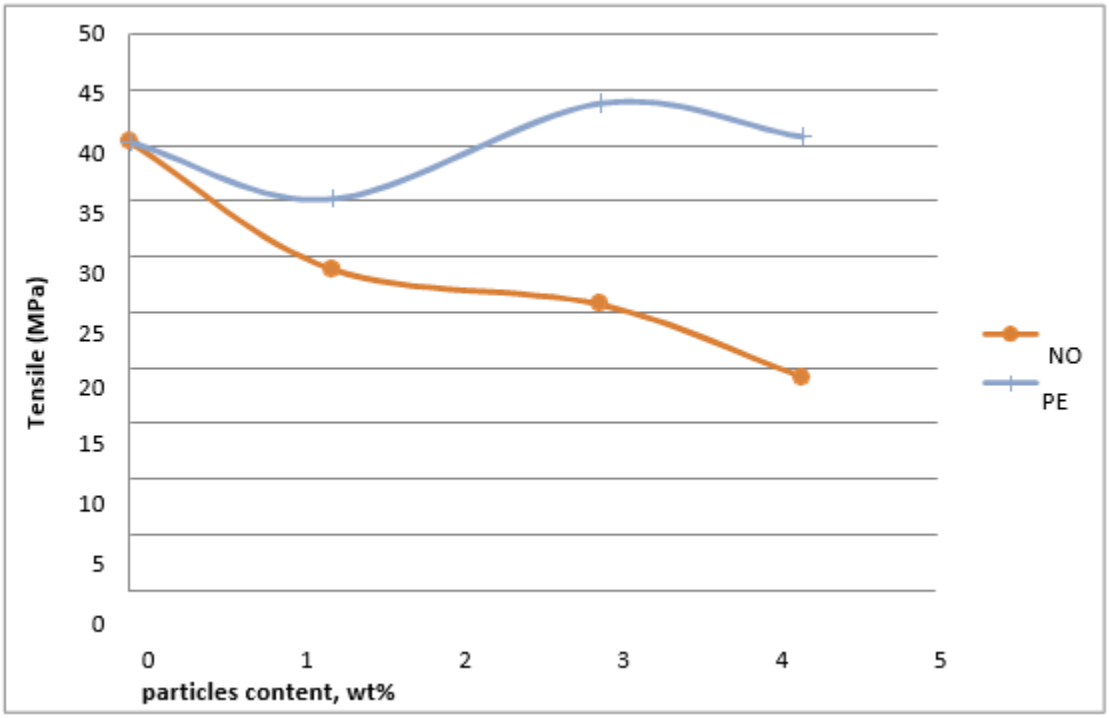

Fig. (3a): tensile strength vs. peach and novolac particles content

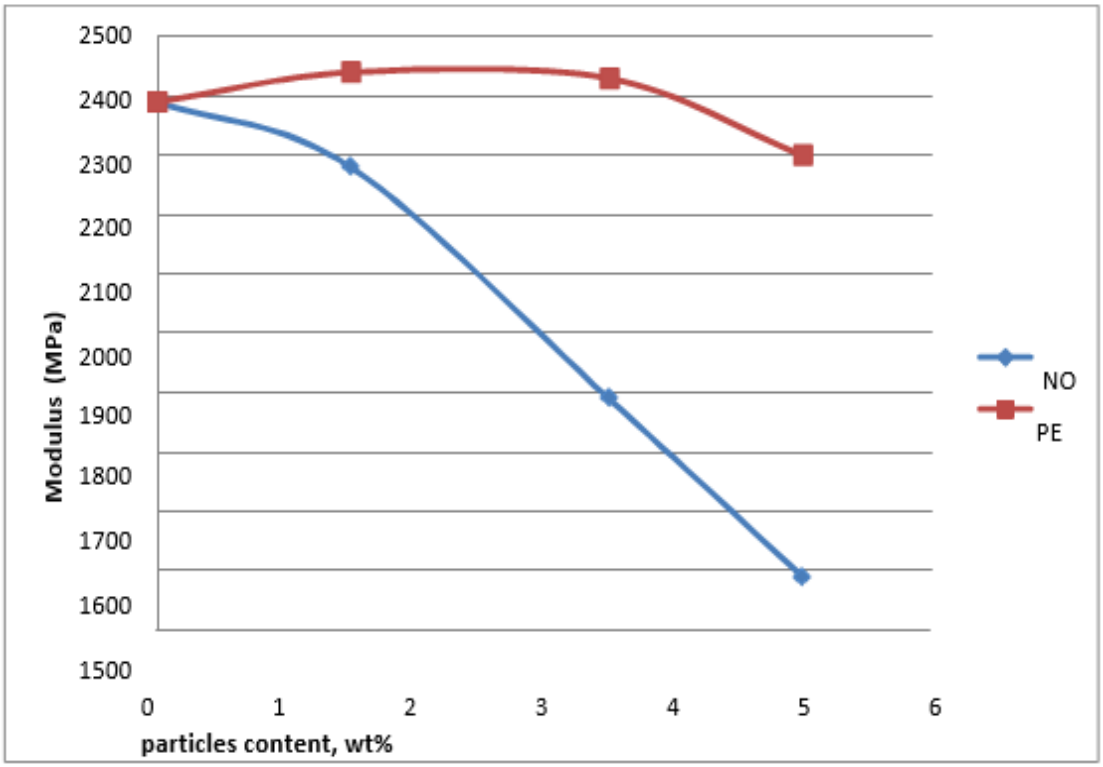

Fig. (3b): tensile modulus vs. peach and novolac particles content

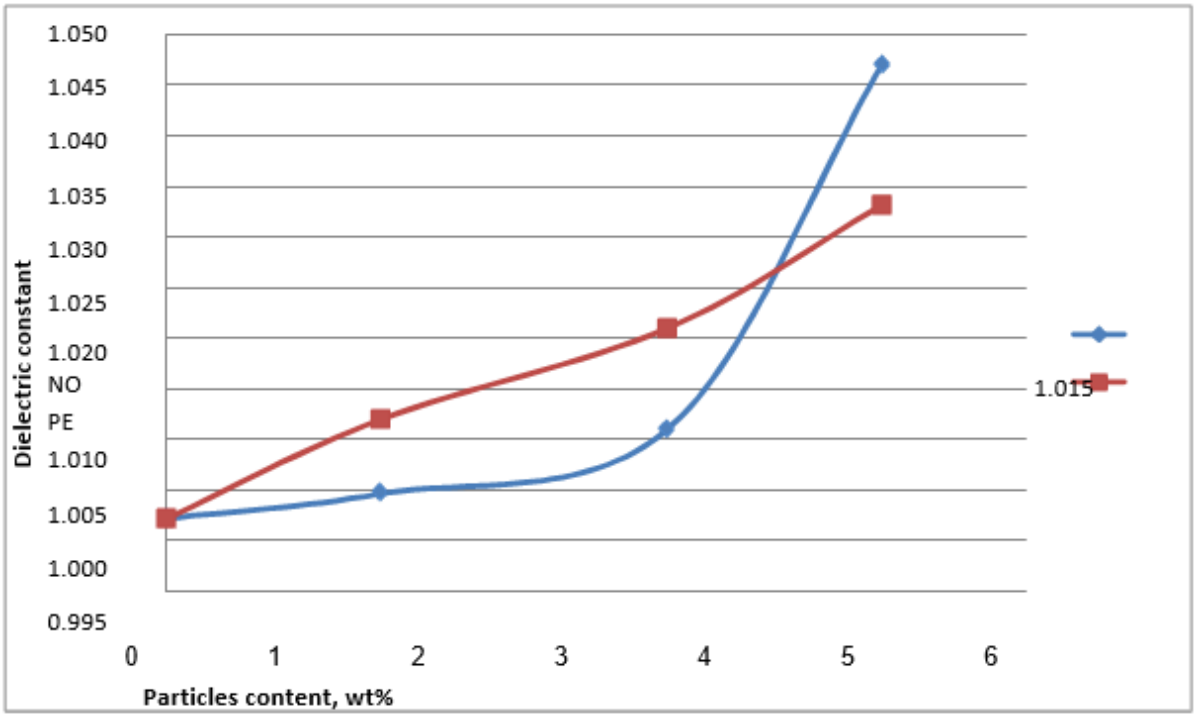

Fig. (4): dielectric constant vs. peach and novolac particles content

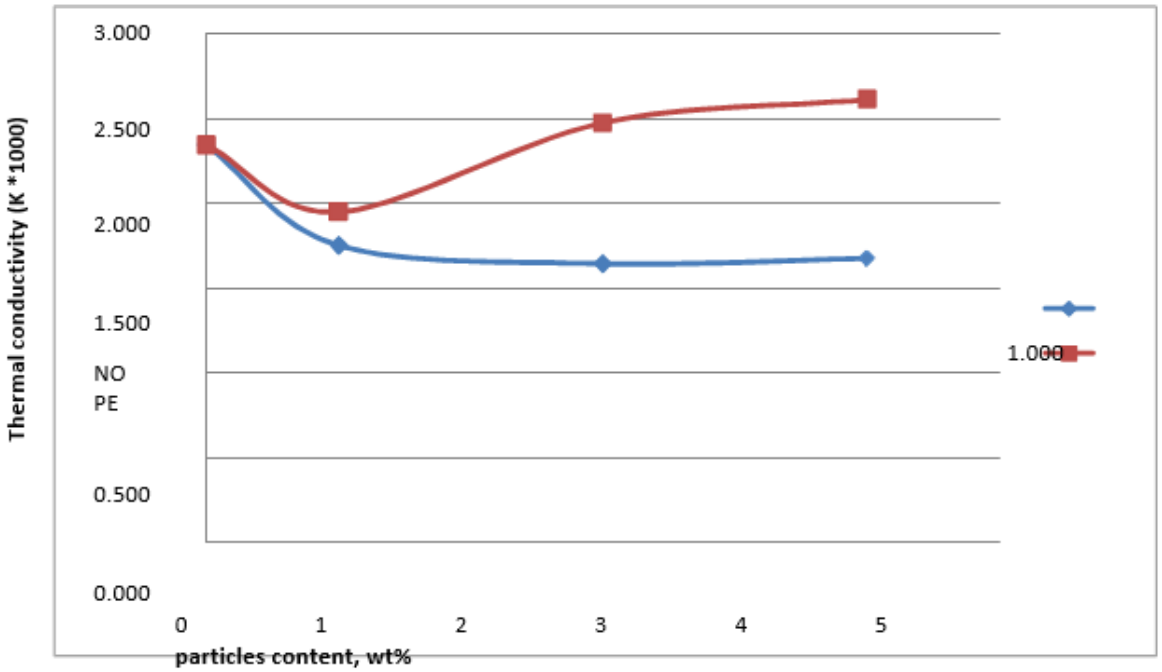

Fig. (5): Thermal conductivity vs. peach and novolac particles content

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.