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Effect of TiO_2 on the mechanical properties of natural rubber (SMR 30) and X-Ray penetration resistance

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Abstract

The natural rubber (SMR 30) was reinforced with micro particle powder TiO_2 with different ratio of (20 – 100) pphr also study the effect of TiO_2 on mechanical properties in different ratio. The tensile, modulus and hardness was increasing while elongation was decreasing. X-Ray penetration resistance for the sample of rubber composite with TiO_2 at (100) pphr was week at 20 KV so the TiO_2 was giving the composite rubber white color.
Keywords : rubber composites , TiO_2 particles , Attenuation , X- ray

1. Theoretical

Since the year 1960, there has been an increase in the need for a material that possesses high resistance, stiffness and light weight characteristics at the same time as in the field of space and transportation to obtain such materials as this requires an effort to research extensively in the field of composite materials by studying the properties of materials and knowing the extent of their interconnectedness. With some and the proportions of their addition, this in turn led to the emergence of types of composite materials, as polymeric composite materials are considered the best types due to their high mechanical properties relative to their density as well as the ease of their manufacture [1-2].

Rubber is a natural or synthetic polymeric material that is distinguished from other engineering materials such as its high elongation, good damping characteristics and its ability to change its external shape when under the influence of a certain pressure,[1-3] then return to its original state after the effect of the effect has disappeared removed, as well as the degree of Its glass transition Tg , which is often less than the use temperature of use. Rubber has a high coefficient of friction when it is dry, but it quickly decreases when, of use. Rubber has a high coefficient of friction when dry, but it quickly decreases when wet with water. It is a poor conductor of electricity because its bonds are of the covalent type and the absence of charge carriers, it was also a poor conductor of heat. One of the new qualities of it, including: [4].

Increase the stiffness, strength and durability of the polymer. [4-8]

1 - Increase the stiffness, strength and durability of the polymer.
2 - Improving tensile and elastic properties.
3 - Increase the distortion temperature.
4 - Reducing the permeability of the polymer to gases and liquids.
5- Reducing the polymer cost.

2. Experimental

2.1. Master Batch

The master batch consists of natural rubber (SMR 30) with some additives that have been approved on the basis of international standards. Table (1) shows the contents of the used dough.

Chlorophyll was added by extracting it from the plant (Alfalfa) by acetone in several proportions (10 - 20 - 40 - 60 - 80 - 105) pphr as batch No 1

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Table (1) the components of the rubber batch used without addition

Compounding ingredients	pphr
natural rubber (SMR 30)	100
Satiric acid	1.75
Zinc Oxide	0.6
TMTD	0.6
matches	2.5

The effect of chlorophyll on the mechanical properties of batch No. (1) was studied. The ratio of 20 pphr was approved as the best sample of mechanical properties. Then added TiO_2 to the batch No. (1) in several proportions (10 - 20 - 40 - 60 - 80 - 100) pphr. The effect of TiO_2 on the mechanical properties of batch No. (2) was studied. X-ray penetration tests were performed at Al - Diwaniyah Teaching Hospital.

3. Results and Dissections

3.1. Tensile Strength and Modulus of Elasticity

The tests for mechanical properties of rubber batch with different ratio of TiO_2 and (20 pphr Cll + Master Batch)

3.2. Tensile strength and elastic modulus

for Fig. (1) and Fig. (2), the tensile strength and elastic modulus are slightly increased due to interconnection between the rubber chains and TiO_2 and their grain size increase in the large surface area, as well as the irregular shape of the grain containing the curvatures helps to increase its surface area and the overlap between the rubber chains and filler.

3.3. Hardness

From fig. (4) we notice an increase in the amount of hardness with the increase in ratios of the TiO_2, where the small grain size means that it has a large surface area, which increases the ability of its bonding to the rubber chains with strong bonds that are responsible for resisting the force of force and thus increasing the hardness.

3.4. Elongation

Fig. (3), we notice a gradual decrease in the elongation values due to the cross-linkage between TiO_2 and rubber and due to the TiO_2 possessing the grain size that increases the surface area of bonding with the rubber chains, which leads to a decrease in the elongation.

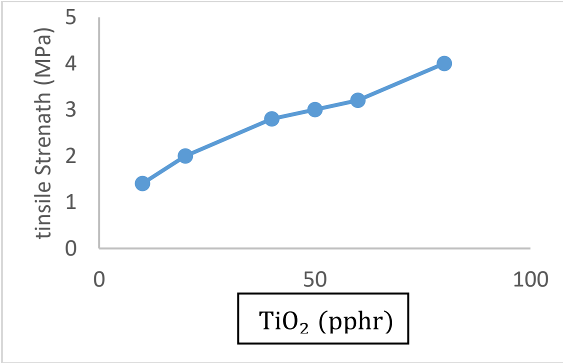

Fig. (1) the effect of adding TiO_2 on tensile strength

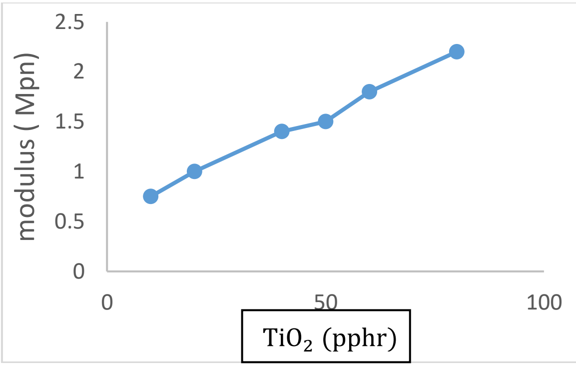

Fig. (2) Effect of addition of TiO_2 on elastic modulus

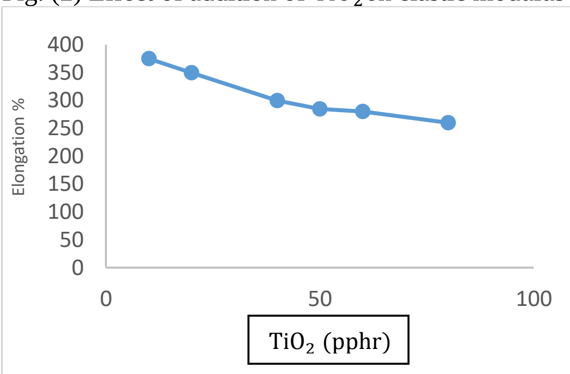

Fig. (3) Effect of addition of TiO_2 on elongation

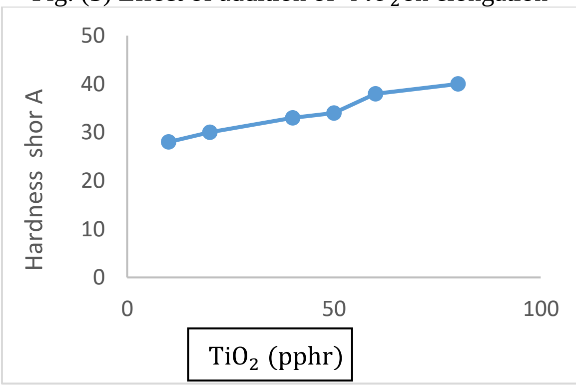

Fig. (4) Effect of addition of TiO_2 on hardness

3.5. X-ray penetration

Fig (5) Show the X-ray penetration resistance tests were performed for samples (rubber 100 pphr + chlorophyll 20 pphr + $\mathrm{TiO_2}$ $100\ pphr$), weak results in penetration resistance to radiation were not reliable, as radiation penetration was done at 20 KV

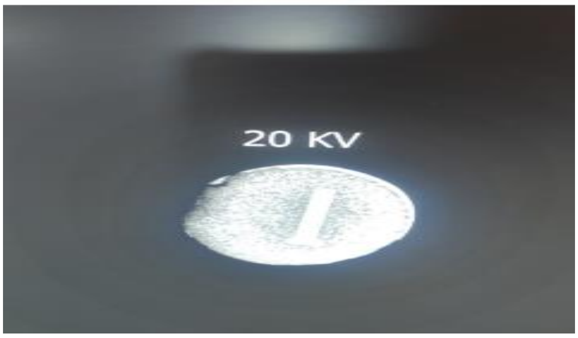

Fig. (5) Show penetration of X-ray for sample rubber composite with 100 pphr $\mathrm{TiO_2}$.

4. Conclusion

We conclude from the results that $\mathrm{TiO_2}$ increases the mechanical properties, tensile, elasticity, and hardness, and leads to a decrease in elongation. However, when adding 100 pphr of $\mathrm{TiO_2}$, it is inefficient in preventing the penetration of x-rays.

5. References

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