Egyptian Journal of Chemistry

http://ejchem.journals.ekb.eg/

Manufacture Shield from nano-rubber composite to protection from X-ray radiation

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Abstract

The rubber was reinforced with nanoparticle powder (N Pb) to prepare shields in hospital X-ray units for the purpose of protecting women and workers in X-rays. The addition of chlorophyll extracted from tree leaves and plants as a plasticizer and anti-oxidant with different ratios of (20 – 100) pphr . (20 pphr) was chosen as a ratio that achieves the purpose, but prevented it from penetrating the X-ray radiation is very little even at a high ratio, as well as TiO_2 was added with different ratio (20 – 100) pphr. 20 pphr was chosen as a ratio that achieves the purpose and obtaining good mechanical properties such as tensile strength, elasticity and hardness, but it prevents it from penetrating the X-ray was very few even at high ratios. Then adding nanoparticles lead(N Pb) with different ratio (40 – 350) pphr. Good results in cutting the radiation penetrate the X-ray and the best ratios (100, 200, 300, 350) pphr. As adding (100 pphr) of N Pb to the rubber with a thickness (2 mm) the X- ray were penetrated and cut at (60 KV). Whereas, adding (200 pphr) of N Pb to the rubber with a thickness of (2 mm) prevented the penetration of X-Ray rays and cut them at (80 KV). Whereas, adding (300 pphr) of N Pb to the rubber with a thickness of (3 mm) prevented the penetration of X-ray and cut them at (100KV). Whereas, adding (350 pphr) of N Pb to the rubber with a thickness of (3 mm) prevented the penetration of X-ray and cut them at (110KV). In this way, the purpose of protecting women and their workers from X-ray radiation when using a shield with a thickness of (3 mm) was achieved.

Keywords : rubber composites , nano particles lead , Attenuation , X- ray

1. Introduction

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 from it. It's glass transition T_gWhich is often less than the temperature of use. Rubber has a high coefficient of friction when it is dry, but it quickly decreases when wet with water. It was 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:

Increase the stiffness, strength and durability of the polymer.[4-7]

1. Improving tensile and elastic properties.
2. Increase the distortion temperature.
3. Reducing the permeability of the polymer to gases and liquids.
4. Reducing the polymer cost. [6]

That human exposure to radiation and its results is one of the important matters that must be studied and paid attention to, especially after the tremendous expansion in the use of nuclear techniques in the field of medicine, agriculture and industry. [8-10] There are multiple materials that are used as shields to protect against radiation. The high level of material, in order to diagnose, monitor and treat many medical conditions appropriately, and X-rays have several types according to their energy used for different purposes, there is one type that is used to detect breast cancer. [8] There are X-ray images of the digestive system, and those used to detect bone fractures or blood vessel blockages, and X-rays have some risks to the human body, but the benefits outweigh them for most people. X-rays during pregnancy Most of the imaging procedures are X-ray. Because the radiation levels used are harmful, even if they are low, and in the stage of the embryo-cell division, the cell division may break down, leading to large and small deformities in the woman and her fetus. [11-12].

Ionizing radiation will turn out prejudicious changes in many categories of macromolecules found

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Receive Date: 26 May 2021, Revise Date: 07 June 2021, Accept Date: 08 June 2021

DOI: 10.21608/EJCHEM.2021.77801.3801

in cells [13]. It additionally causes injury to DNA (DNA) and DNA-protein cross-links and induces cellular death [14,15]. there's an instantaneous relationship between the results of radiation and therefore the kind of tissue receiving the radiation and therefore the absorbed radiation dose[16].

2. Experimental Practical

Master Batch was the base paste shall be made of NR rubber with some additives that had been approved on the basis of international standards mentioned in references. Table (1) shows the components of the rubber Master Batch used without addition.

Table No. (1) the components of the rubber Master Batch used without addition [1]

Compounding ingredients	Pphr
NR	100
Satiric acid	1.75
Zinc Oxide	0.6
TMTD	0.6
Sulfide	2.5

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

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. The ratio of 20 pphr was approved the best sample of mechanical properties. Then Nano Pb was added to the best sample (20 pphr TiO_2 + 20 pphr Cll + Master Batch) in several proportions (40-50-100-200-300-350) pphr as in table (2).

Table (2) the components of the rubber batch used with addition Cll , TiO_2 and Nano Pb.

material	pphr
20 pphr TiO_2 + 20 pphr Cll + Master Batch	100
Nano Pb	40
Nano Pb	50
Nano Pb	100
Nano Pb	200
Nano Pb	300
Nano Pb	350

After studying the effect of Nano Pb on the mechanical properties of NR rubber. Then studying the penetration x-ray examinations for all levels of Nano Pb were performed in the X-ray unit at Diwaniyah Teaching Hospital. Then the rubber batch was armed with a (66 N fiber) for the purpose of strengthening and fabricating armor.

3. Results and decoction

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

3.1. Tensile strength and elastic modulus

for Figure (1), the tensile strength and elastic modulus are slightly reduced due to lead ratios because Pb has plasticity property and thus its penetration with rubber chains leads to a decrease in tensile strength and modulus of elasticity slightly.

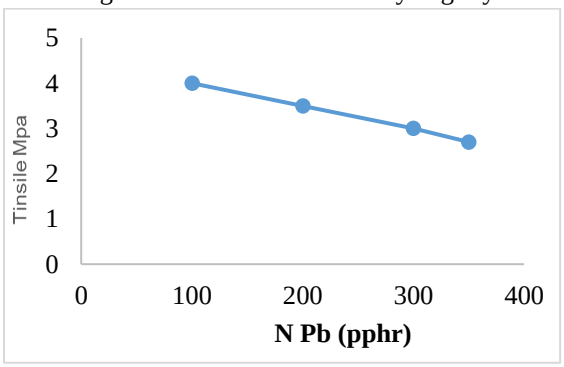


Figure (1) the effect of adding N Pb on tensile strength

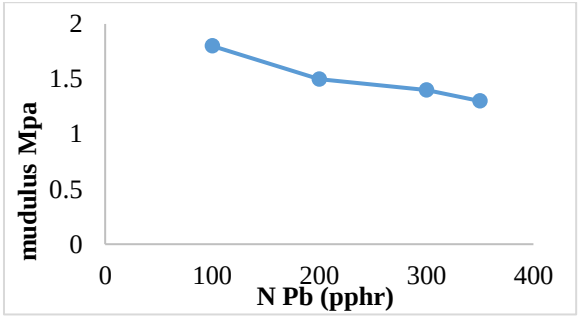
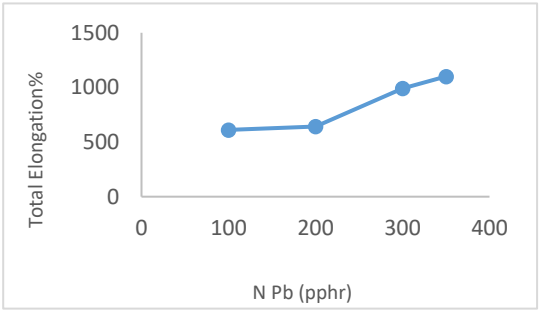


Fig. (2) Effect of addition of N Pb on elastic modulus

3.2. Total Elongation %

As for Figure (3), the Elongation values are slightly increased due to the Pb ratios due to the fact that the Pb material has plasticity, and thus its penetration with the rubber chains leads to an increase in the elongation and Reduction of area% as in Fig. (4).



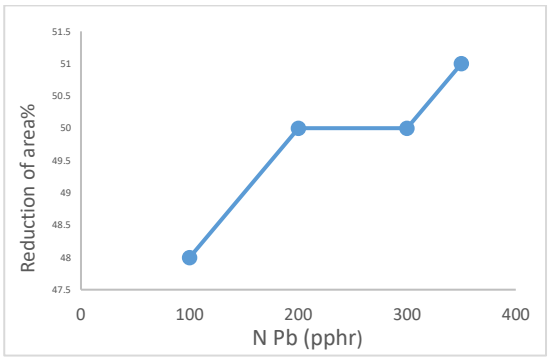


Fig. (4) Effect of addition of N Pb on Reduction of area %

3.3. Hardness

Fig. (5) Shows the hardness increased with the addition of N Pb pphr due to N Pb penetrated between rubber chain and is interconnected by molecular forces, which helps the sample surface on its not to be penetrated and this is meaning hardness.

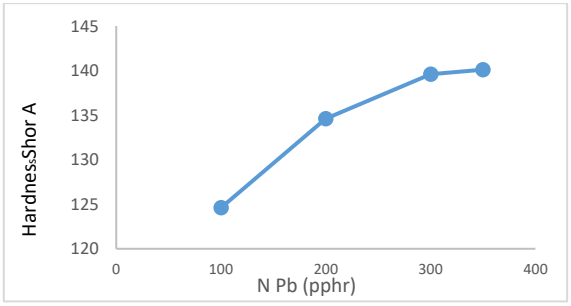


Fig. (5) Effect of addition of N Pb on hardness

3.4. Adhesion

Figure (6), we notice a decrease in adhesion, due to the Pb For being a plasticizer. This agreement with the researcher. [17-18]

3.5. X-ray penetration :

X-ray penetration tests were performed for samples (100, 200, 300, 350) pphr of Pb nanoparticles, and the results were shown in table (3).

the purpose of the aim was achieved to protect the embryos of pregnant women when the shield was of Nano Pb (300 – 350) pphr.

The conclusion is that N Pb causes a decrease in elasticity and tensile strength, an increase in hardness and elongation and that samples with Nano Pb loading (300 – 350) pphr are the best for the manufacture of radiation shields.

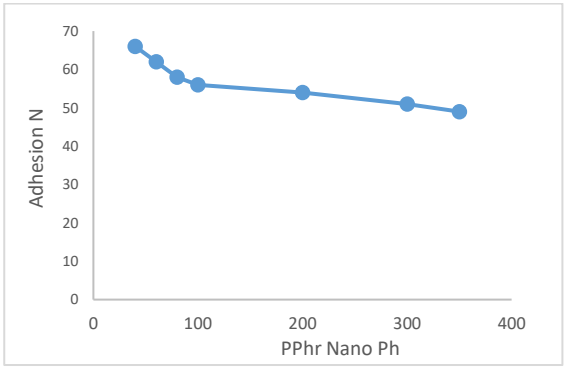


Fig. (6) Effect of addition of N Pb on Adhesion N

3.6. Fatigue Test

Fig.(7), we notice that there is an increase in the number of fatigue cycles due to the fact that Pb is plasticized and thus helps not to break the polymeric bonds.

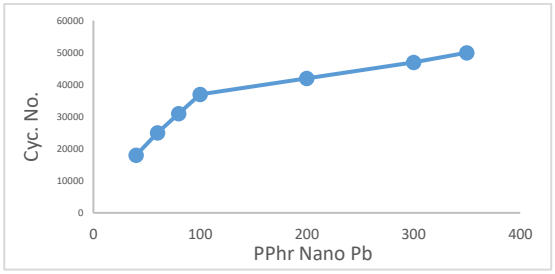


Fig. (7) Effect of addition of N Pb on Fatigue Test

Table (3) Show the results of a X- ray penetration.

Nano particles ratios	Not penetration	Samples
100 pphr	60 KV	Two layers and thickness 2 mm
200 pphr	80 KV	Two layers and thickness 2 mm
300 pphr	100 KV	Two layers and thickness 2 mm
350 pphr	110 KV	one layer and thickness 3 - 3.5 mm

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