World Applied Sciences Journal 21 (Mathematical Applications in Engineering): 143-147, 2013
ISSN 1818-4952

DOI: 10.5829/idosi.wasj.2013.21.mae.99941

A Study of Some Rheologyical and Mechanical Properties for Natural Rubber Reinforced with Black Carbon from Apricot Stones by Ultrasonic Technique

Shaymaa Hadi Khudhair

Babylon University, College of Education for Pure Sciences, Department of Physics, Iraq

Abstract: A study of the effect of preparation conditions on of black carbon produced from Apricot stones was made using zinc chloride as an activator In the present work, the study of some Rheological and Mechanical Natural Rubber (Polyisoprene) dissolved in Toluene concentrations of 0.2% gm / ml to 2%gm / ml reinforcement black carbon from Apricot stones by 0.04 wt% using activated physical when the temperature (900) °C Where was measured density and viscosity solutions of Natural rubber and account average molecular weight of the rubber at the same degree heat. Were also measured speed of ultrasonic wave of different concentrations of rubber technology using ultrasonic wave with frequency (45kHz) before and after the addition of activated carbon from Apricot stones. we calculate theoretically, absorption coefficient, relaxation time, relaxation amplitude, compressibility, bulk modulus and specific acoustic impedance of Natural rubber. The results of measurements of improvement in the properties of Rheological and mechanical Natural Rubber reinforcement activated carbon significantly increase the temperature, moreover, that the existence of reciprocal influences between each of the rubber particles and the solvent is reflected in a linear increase in the values of properties of Rheological and mechanical with increasing concentration of rubber, on the contrary decreasing values of the compressibility increase of concentration of Natural rubber.

Key words: Rheological properties · Ultrasonic wave · Reciprocal influence · Compressibility

INTRODUCTION

Natural rubber (Polyisoprene) The history of the discovery of natural rubber-century atheist tenth is that the name of rubber (Rubber) launched the world (Priestley) in 1770 as it noted that they are able to survey the effects of writing a pencil and some trees are able to configure this Article rubber, but the most important a source of rubber is a tree (Brasiliensis Heva) which indicate call to home Brazilian who discovered it the first time [1,2] and after his discovery has been the spread of cultivation in various parts of the world At present Malaysia is one of the most countries of the world in terms of production of rubber as it produces almost a million and a half million tons per year where he gets to natural rubber from the wringer secreted by the bark of a tree Haifa (Heva Tree) when the cut be wringer is an aqueous solution is stuck to the rubber contains (25% to 40%) of the rubber Alheidrocarbona and be installed there small amounts of protein and fatty acids and combines juices and curd and wash and dry and there are two ways to convert these juices to the rubber [3,4].

Comes carbon black in the second place after the rubber in terms of importance in the industries of rubber, because he is working to strengthen good and appropriate, helps to improve the properties Rheologyical and mechanical properties of composite rubber inside the rubber industries producing carbon black in several ways [3,4]., but the type used to strengthen the rubber product is the only way gas furnace and the amount of potentiation achieved depends on several factors to use as the size of the molecule (surface area) and compositional structure [6,7]. It uses natural rubber in many industrial applications such as industry, mechanical devices, shoes, adhesives, tires and the preparation of some adhesives for belts conveyor rubber textile. And mix of natural rubber (Polyisoprene)with rubber (styrene butadiene) and black carbon for the work samples lateral part of the frames.

Corresponding Author: Shaymaa Hadi Khudhair, Department of Physics, College of Education for Pure Sciences, Babylon University, Iraq.

Practical Part

Materials: Use Natural rubber, a transparent rubber material and use the solvent Toluene with purity 97% as a solvent to dissolve the rubber in question, were prepared solutions of different concentrations of polymer and dissolving it in a certain weight (100 ml) of Toluene To speed up the process of dissolving the engine used a magnetic rotor (Magnetic Stirrer).

Apricot Stones: Been used apricot nuclei after washing and drying were milled using a ball mill Ball Milling of pure alumina balls Type CROSCHOPP German-made and continued for the grinding process (7hr) for the degree of smoothness required. Conducted a palmSieving Process in order to make classification volumetric her has to make classification volumetric her has been used for this purpose sieves German-made Type Micro-Prazisossieb size of opened lessthan 50 µm with a vibrator German type Retsch. Were activated physically temperature°C 900 using zincchloride and that the requirements of the research.

Measurement the Density: Measured density of Rubber solutions and for various polymer concentrations using a density bottle with a capacity of 25 ml and the balance of a digital type (Sartorious) is very sensitive to 0.0001 gm and appoint the cluster size of 25 ml in the sensitive balance.

Measurements of Viscosity: Were measured for the viscosity of all Rubber solutions using a measure of the type of viscosity (Oswald Viscometer) and a stopwatch with a resolution (0.001sec) and to maintain the temperature used the water bath has a temperature regulator.

Measurements of Ultrasound: Were measured speed of ultrasound scattered through liquids using a technology pulse, consisting of a device manufactured by a company (PHYWE) German works V (220) volts and generates waves of ultrasound frequency constant (45kHz), where filling the sender and the recipient device in the solution is make them opposite and move the recipient distances consistent with the recording pulse delay times.

To control the temperature using a thermostat manufactured by a company (PHYWE) works V (220) volts and consists of a basin-coated with a layer of cork to protect it from external vibrations is equipped with heating and cooling and a mixer. Measurements were at a temperature of (25°C).

Theoretical Calculations: Reduced viscosity was calculated and a time to relax and unwind capacity and compressibility and modulus of elasticity and resistance audio quality and the absorption coefficient of ultrasound using the following relations

$$\eta_{red} = (\frac{\rho t}{\rho_o t_o} - 1)/c \quad (1)$$

$$[\eta] = KM^a \quad (2)$$

$$\frac{\alpha}{f^2} = \frac{8\pi\eta}{3\rho v^3} \quad (3)$$

$$\tau = \frac{4\eta}{3\rho v^2} \quad (4)$$

$$Z = \rho\, v \quad (5)$$

$$\beta = \left(\rho v^2\right)^{-1} \quad (6)$$

$$K = \rho\, v^2 \quad (7)$$

$$v = \frac{X}{T} \quad (8)$$

RESULTS AND DISCUSSION

Figure (1) shows the value of density increased with increasing the concentration of Natural rubber before adding the carbon black is due to the increased mass of the solution per unit volume and increased more after the addition of carbon black due to the swelling made in the polymer particles in the solution as a result of overlapping of molecules the solvent with the polymer particles.

Reduced viscosity was calculated using the relationship (1) and figure (2) illustrates the changing is exponential with a focus before and after the addition and due to the increase in the number and size of the particles and thus increase [7,8]. the forces of internal friction [9,10]. Then calculated the self-viscosity (Intrinsic viscosity).

Figure (3) shows the increasing in the ultrasound velocity of the Natural rubber before adding carbon black increased due to the increasing overlap, as shown from the curve of density and viscosity resulting from the union of two types of molecules of polymer and solvent, leading to the formation of large molecules (Macromolecular) within the solution polymer compatible carbon black, which is working on the transfer of mechanical waves from a source of disorder on the board of beams, which lead to increase speed in contrast to simple liquids or pure [11,12].

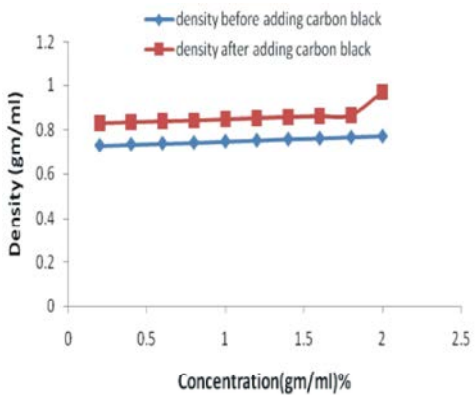

Fig. 1: Shows density and concentration

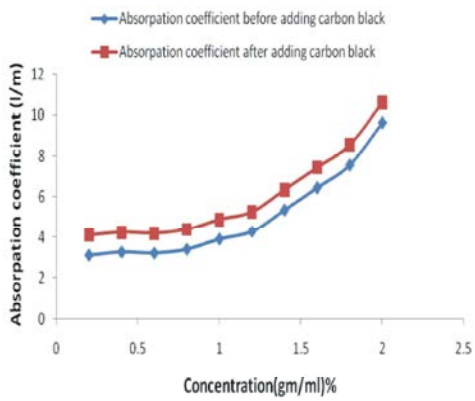

Fig. 4: Shows absorption coefficient and concentration

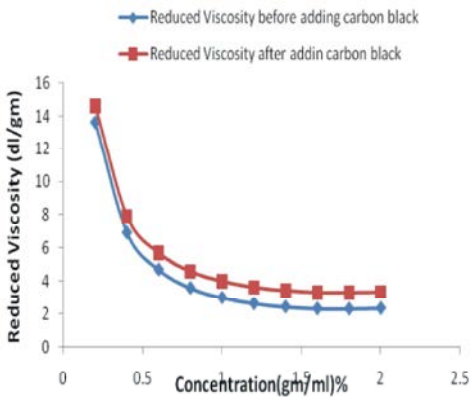

Fig. 2: Shows reduced viscosity and concentration

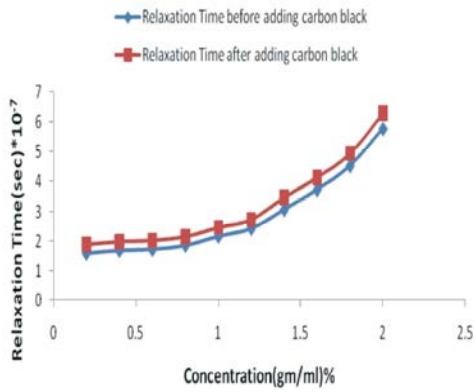

Fig. 5: Shows relaxation time and concentration

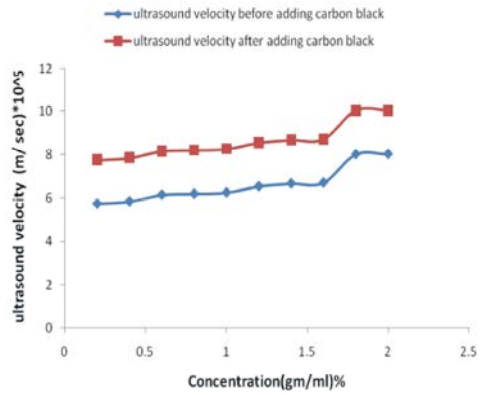

Fig. 3: Shows ultrasound velocity and concentration

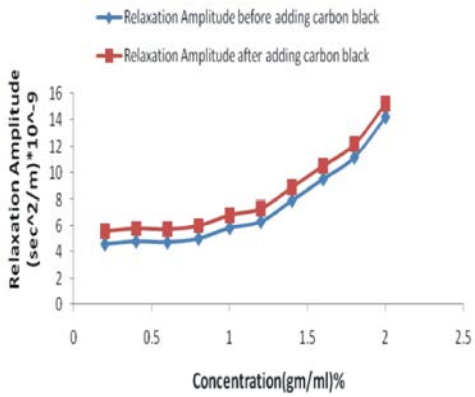

Fig. 6: Shows relaxation amplitude and concentration

Using the relationship (3) to calculate the absorption coefficient of of ultrasound waves at different concentrations and the figure (4) shows the increasing in values of absorption coefficient with increasing of Natural rubber concentration. Dispersion impact is small so it can be neglected so viscosity is responsible for the increased absorption of ultrasound [10, 11].

Values of the relaxation time was calculated by using the relation (4) and figure (5) shows the increasing in the values of the relaxation time with greater emphasis, by the addition of carbon black from Apricot stones and explains that the increased size of the chains of polymeric lead to increased internal friction among the layers of the liquid resulting from the mistake is dislocations and the effect of ultrasound, thus increasing the time required to re-excited molecule to its original [12,13].

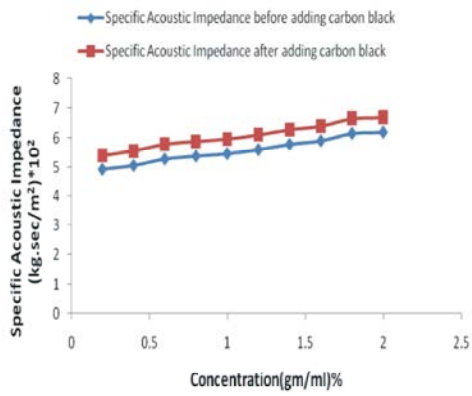

Fig. 7: Shows specific acoustic impedance and concentration

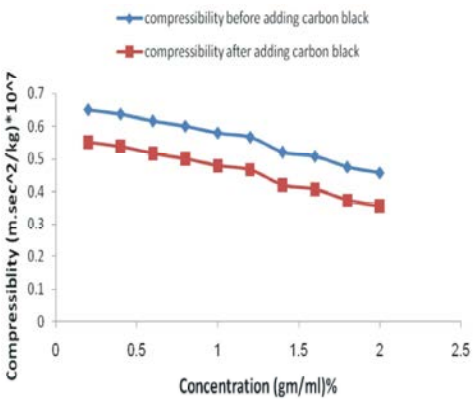

Fig. 8: Shows compressibility and concentration

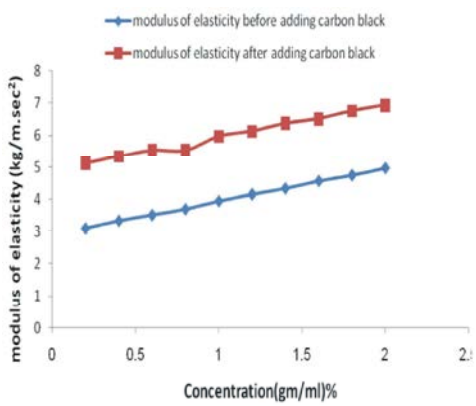

Fig. 9: Shows modulus of elasticity and concentration

Figure (6) shows the capacity of relaxation was calculated using the relationship (3) which increased with the increasing of Natural rubber concentration and the increase added black carbon is due to the large distance traveled by the molecules during the process of stimulation [15].

As obtained on the values of specific acoustic impedance using the relation [5], which describes the relation between the speed of ultrasound and specific acoustic impedance and we note from figure [7] increasing the values of impedance with increasing concentration of Natural rubber due to the increasing of density of the center carrier with increasing the speed of ultrasound [14,15].

Using the relation [6] was obtained on the values of compressibility and notes from the relationship that the compressibility is inversely proportional to the square of speed, the speed increase will lead to a decrease in the value of compressibility [11] as the pass-band of ultrasound is working to urge the particles to move from the natural state of balanced to the high energy state, which then become the structural composition of the liquid tight (compressed) and lead the process of rearrangement of molecules adjacent to the building part of the absorption of energy, causing rapid decay of the wave and this is evident in Figure (8).

Finally, modulus of elasticity was calculated using the relationship (7) and figure (9) shows the modulus of elasticity increased with increasing the natural rubber concentration after adding carbon black due to the adoption of the modulus of elasticity on the speed of ultrasound is mainly [13,15].

CONCLUSIONS

From the results of the research was reached the following conclusions:

- show that the Natural rubber reinforced by carbon black from Apricot stones continuous change in physical properties with increasing concentration and various temperatures.
- increasing in values of the physical properties of Natural rubber reinforced by carbon black from Apricot stones significantly with the increasing of temperature because of the increased of kinetic energy of the ions in solution, in that way increasing the kinetic energy.
- The mixing of Natural rubber with carbon black as a phase of reinforcement lead to improve the physical properties of a compound of rubber used in the rubber industries. This back to the reason of additive nature which considered a good strengthen factor and appropriate for the homogeneity of the Natural rubber, which makes it cheap, colorless,.
- Knowing the extent to which the Natural rubber to survive external influences, which work to select the most appropriate concentration utilized in the industrial and engineering applications.

REFERENCES

1. Georgis Abd al-Adam, Hussein detector cap, 1983. Technology and Polymer Chemistry, University of Basra - Faculty of Science.
2. Akram Aziz, Mohammed, 1993. the chemistry of plastics, University of Mosul - College of Science.
3. Choi, S., 2000. Bull. Korean Chem. Soci., 21: 628.
4. Bell, W. and N. Daly, Trans., 2: 75,1452. A.M. Orth, RA. Pethrick and P.B. Teik, 1979, Chem., Faraday.
5. AL-Ammar, K., 2001. Iraqi J. for Mach and Mate. Engi, 21: 1.
6. France, M. and K. Nijenhuis, 2000, J. mole. Stru., 554: 1.
7. Abood, S.H. and K.H. Habeb, 2006. Al-Kufa J., 14(1): 76.
8. Massoumeh, F., 2006, Acta Chim. Slov., 53: 219-222.
9. Maffezzoli, A. Tazia and D. Cannoletta, 1999. Macromol. Symp., 138: 149.
10. Serin, M., O. ankurtaran and F. yi maz, 2003. optoelect ronics and Advanced Materials. J., 5: 3.
11. Khalida, H.H., 2004. Journal of Al-Qadisiya of Pure Sciences, 9(3): 118-122.
12. Hassan, K., N.A. Hassan and F.A. mustafa, 1993. Engineering Technology J., 12(10): 89.
13. Hiroyasu, N., M. Tatsuro and K. Shinobu, 2004. Pure Appl. Chem., 76(1): 97-104.
14. Masoudi, 2004. the success of Kazem Alian, study the effect of environmental conditions in the complexes high-density polyethylene-supported carbon lions, Master Thesis, Faculty of Science-University of Babylon.
15. Shaghayegh, J. and M. Hamid, 2005. Iranian Polymer Journal, 14(10): 863-873.