

# EFFECT OF PHYSICAL ADDITIVES OF SHELLS POWDER ON MECHANICAL PROPERTIES OF NATURAL RUBBER

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**Abstract**— The research aims to use shells powder as a filler adding to natural rubber with different amount (20,30,50,100,120,150 pphr) and observe its effect on mechanical properties of rubber which includes hardness and tensile strength. The obtained results from mechanical tests shown improved in rubber hardness after adding shells powder and increasing this property with increased percentage of powder, but tensile strength increased to (20 pphr) and then strongly decreased after this percentage as shown in figures.

**Index Terms**— Natural rubber, Shells powder, Mechanical properties. (*key words*)

## I. INTRODUCTION

Elastomers are essentially supercondensed gases because most precursor monomers are gases. Their density is greater by approximately 3 orders of magnitude, and viscosity by 14 orders, than the gaseous state. Through polymerization, a long-chain molecule is created (the primary structure of any polymeric material) [1]. The molecules can be arranged in an amorphous (rubbery), glassy, or crystalline phase. Elastomers are typically categorized as amorphous (single-phase) polymers having a random-coil molecular arrangement [2].

The addition of various chemicals to raw rubber to impart desirable properties is termed rubber compounding or formulation. Typical ingredients include crosslinking agents (also called curatives), reinforcements, anti-degradants, process aids, extenders, and specialty additives, such as tackifiers, blowing agents, and colorants [3].

Because thermoplastic rubbers contain hard domains that interconnect the molecules and impart strength and elasticity, they do not require crosslinking agents or reinforcing fillers. However, the selection of appropriate curatives and fillers is critical to the performance of thermoset elastomers [4].

## II. LITERATURE REVIEW

Mohammad, Ali and Nabel were studied the effect of shells powder additive on scorch time, cure time of natural rubber [5]. Al-Mosawi A. I., Ali M. M. and Mohammed J. H.

were studied the Mechanical properties of natural rubber (NR) and calcium carbonate as additive filler with amounts of 5, 10, 15, 20, and 25 parts per hundred (pphr) [6]. Sedigheh Soltani, Ghasem Naderi, and Mir Hamid Reza Ghoreishy were investigated the effect of bonding agent content on the microstructure, mechanical and morphological properties of the composites. Nylon short fibres were incorporated in NR/SBR rubber matrix with and without a bonding system on a two-roll mill mixer [7]. Mohammed Razzaq Mohammed, Ahmed Namah Hadi were studied the effect of egg shells powder on some mechanical and physical properties of natural rubber, that comprised each of tensile strength, modulus of elasticity, elongation, hardness, resilience and specific gravity [8]. Hussain J. M. Alalkawi, Zainab K. Hantoosh, and Raad H. Majid were studied mechanical properties of natural rubber and fatigue life (constant amplitude stresses) were carried out experimentally at room temperature and 40°C [9]. Dr. Hani Aziz Ameen was studied mechanical properties of three types of composite materials using natural rubber vulcanized, unvulcanized and reinforced rubber. The composite material using natural rubber and epoxy resin is manufactured by three methods, first method is mixing the natural rubber with epoxy resin by special mixer without any additional materials, the second method is to make a layer of rubber then coating it with a layer of epoxy resin and bonding using the rolling process. The third one is use in the natural rubber as a matrix material and using additional materials like carbon black in specific ratio and mix with them the epoxy resin in five ratios (20%, 40%, 60%, 80%, and 100%) [10].

## III. MATERIALS AND METHOD.

- A. **Materials:** Natural rubber, Shells powder containing (82.4%) calcium carbonate.
- B. **The Batch:** The batch was prepared from Natural rubber (NR) with addition of some of materials (such as zinc oxide, stearic acid, sulfur, Antioxidant, Carbon black, etc), shell powder was

added to rubber as a weight percentages (20,30,50,100,120,150 pphr).

- C. **Preparation of hardness test samples:** preparing samples of hardness test was done according to ASTM D1415 specifications which is a disc shape with (40mm) diameter and (4mm) thickness .
- D. **Preparation of tensile test samples:** samples were prepared according to (ASTM D413) standards as a circular section with (6mm) diameter and (115) length .
- E. **Measuring of hardness:** The International Hardness test is used in measurement of the penetration of rigid ball into the rubber specimen under specified conditions .The measured penetration is converted to the International Rubber Hardness Degrees (IRHD) .The scale of degrees is so chosen that zero represents a material having elastic modulus equal to zero and 100 represents a material of infinite elastic modulus .
- F. **Measuring of tensile strength:** Test was carried out on Monsanto T10 tensometer

#### IV. RESULT & DISCUSSION

Fig. 1 shows the relation between the hardness and shells powder weight added to NR . We noticed there is increases in the hardness with increase in the shells powder percent in the

rubber and the increment is continue as a curve which may be attributed to the extra cross linking with the rubber besides HMTA which results in increasing the surface tension of the recipe i.e. the recipe surface resists penetration which means increasing hardness. This results agrees with other the at of workers [11] .

Fig. 2 shows the relation between the tensile strength and the weight percent of the shells powder in NR . At first tensile strength increased when adding (20pphr) from shells powder ,but after this percentage the strength will decrease with the increase in the shells powder percent. This is due to the cross-linking of the shells powder with rubber .

Also shells powder is a ceramic material which will raise the hardness of rubber and reduced tensile strength, and these particles of powder will be as a defect in rubber structure which will cause finally to failure .This results agrees with work of [12] .

#### V. CONCLUSION

1- Increasing hardness after adding shells powder and this thing will continue with increased powder percentage.

2- Increasing tensile strength after adding (20pphr) from shells powder but after this percentage will decreased strongly.

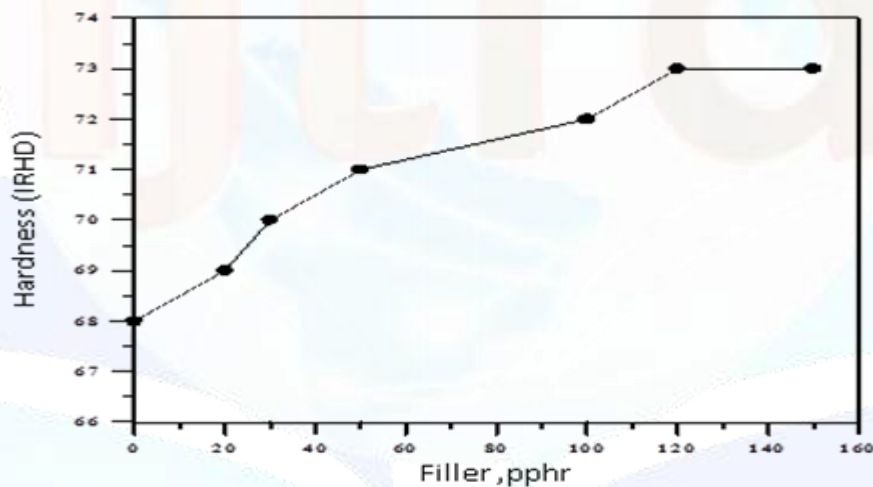
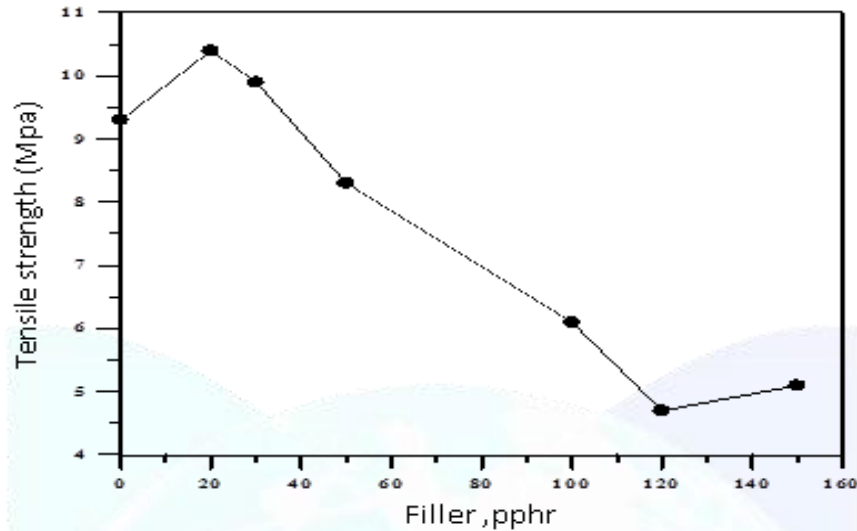


Fig. 1 : Relation between hardness and shells powder percentage



**Fig. 2 : Relation between tensile strength and shells powder percentage**

#### REFERENCES

- [1] 1- R-K Mattham " Rubber Engineering " ,Tata McGraw —Hill publishing company, Delhi 1998 .
- [2] Andrew Ciesielski " An introduction to rubber technology " , 1st edition ,Rapra technology limited ,2000 .
- [3] Jatuporn Sridee "Rheological properties of natural rubber latex" ,M.Sc thesis , Suranaree University of Technology ,2006 .
- [4] C.A. Harper "Handbook of plastics, Elastomer and composite" ,McGraw-Hill, Handbook 2004
- [5] Mohammad H. Al-Maamori, Ali I. Al-Mosawi, Nabel S. Othman "Effect of Shells Powder on Scorch and Cure Time of Elastomer Material" , International Journal of Engineering and Technology ,3(4), April, 2013 ,494-496
- [6] Al-Mosawi A. I., Ali M. M.and Mohmmmed J. H "Experimental approach to mechanical properties of natural rubber mixing with Calcium carbonate powder" , International Journal of Physical Sciences , 7(49), December, 2012 , 6280-6282
- [7] Sedigheh Soltani, Ghasem Naderi, and Mir Hamid Reza Ghoreishy "Mechanical and Morphological Properties of Short Nylon Fibre Reinforced NR/SBR Composites: Optimization of Interfacial Bonding Agent" , Iranian Polymer Journal ,19(11), 2010, 853-861
- [8] Mohammed Razzaq Mohammed , Ahmed Namah Hadi "Effect of egg shells powder on some mechanical and physical properties of natural rubber (NR)" , The Iraqi Journal For Mechanical And Material Engineering, 12(3), 2012 ,446-458
- [9] Hussain J. M. Alalkawi, Zainab K. Hantoosh, and Raad H. Majid "The tensile and fatigue properties of vulcanized natural rubber under ambient temperatures", Diyala Journal of Engineering Sciences, 3(2), December 2010 , 16-24
- [10] Dr. Hani Aziz Ameen "Mechanical Properties of Composite Material Using Natural Rubber with Epoxy Resin", Eng.&Tech. 26(2) ,2008 ,254-264
- [11] Azizan Ahmad , Dahlan Hj. Mohd, and Ibrahim Abdullah "Mechanical Properties of Filled NR/LLDPE Blends " , Iranian Polymer Journal,13 (3), 2004, 173-178
- [12] J. H. Kim, etal, J. International Journal of fatigue, 27,263, 2005