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Effect of Shells Powder Filler Additives on Hardness and Tensile Strength Properties of Natural Rubber

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Abstract Shells powder filler was added to natural rubber grade SMR L. The filler loading was varied from 60 – 90 pphr. The mechanical properties included hardness and tensile strength were investigated. The results shown increased hardness continuously with shells powder filler loading from shells powder 60 –90 pphr, but tensile strength decreased after adding shells powder filler.

Keywords: *natural rubber, shells powder filler, mechanical properties*

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1. Introduction

As an elastomer, natural rubber is widely used in various applications, due to the fact that elastomers possess unique a properties, such as their abilityto undergo a large elastic deformation and to absorb energy [1]. Natural rubber products have been used in commodityapplications, such as shoes, tires, rubber bands, tubes, etc. Recently, the applications of natural rubber have been expanded into engineering purposes, for example, machine parts, construction parts, automotive parts [2]. For engineering applications, not only mechanical properties, but also dynamic mechanical properties at a sensible range of temperature, must be taken into account. It is of necessary to provide adequate data for engineers in designing rubber products with the required performance at all service temperatures [3]. 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 [4].

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 [5].

2. Experimental Procedure

Natural rubber grade SMR L and shells powder were used. Other compounding ingredients were sulphur, zinc oxide, stearic acid, N-isopropyl-N'-phenyl-p-phenylenediamine (IPPD),N-cyclohexyl-2-benzothiazyl sulphenamide (CBS). The batch was prepared from 100pphr Natural rubber grade SMR L with addition of some of materials (5pphr zinc oxide, 2.5pphr Sulphur, 2pphr IPPD, 1pphr Stearic acid, 0.5pphr CBS), shell powder was added to rubber as a weight percentages (60-90 pphr).

Preparing samples of hardness test was done according to ASTM D1415 specifications which is a disc shape with (40mm) diameter and (4mm) thickness**.** samples of tensile test were prepared according to (ASTM D413) standards as a circular section with (6mm) diameter and (115) length. 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. Tensile strength test was carried out on Monsanto T10 tensometer.

3. Results and Discussion.

Figure 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 [6].

Figure 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.

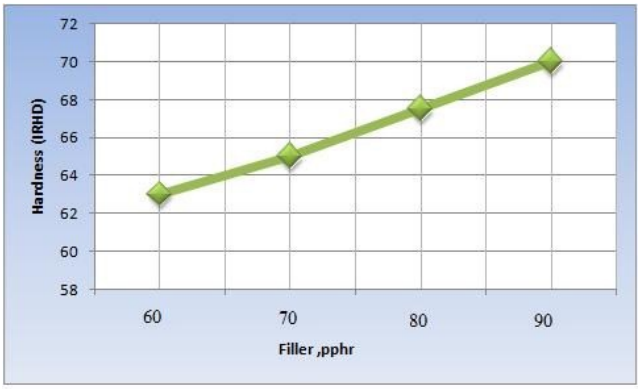

Figure 1. Relation between hardness and shells powder percentage

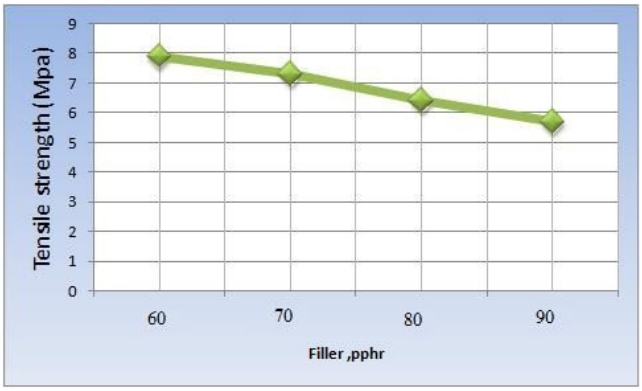

Figure 2. Relation between tensile strength and shells powder percentage

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 [7].

4. Conclusions

Natural rubber is one of the most widely used elastomers for engineering purposes. The investigation of mechanical properties with fillers would provide useful data in designing such materials. It was found that hardness will increase after adding shells powder and this thing will continue with increased powder percentage. And in the same percentages ,the tensile strength will decreased strongly.

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