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Effect of Shells Powder on Scorch and Cure Time of Elastomer Material

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Abstract The effect of shells powder additive (60,90,120 pphr) on scorch and cure time of natural rubber was studied in this paper. Oscillating Disk Rheometer was used to measuring the above times by specified the behavior of master batch through scorch time. The obtained results shown that the shells powder don't have negative effect on rubber properties during vulcanization, where the properties was enhanced after added this powder and the best percentage of addition was (120 pphr).

Keywords: *natural rubber, shells powder, scorch, cure time*

1. Introduction

Rubber composite materials with different type of rubber are used in dampers and supports application [1]. Therefore it is occupied a wide field studies, because rubber has good characterization in the high elastic strain damping which is obtained from the suddenly impact loading because of different acceleration of the system, therefore a different modification of new type of rubber composite for loading resistance in addition to the interference of the usages conditions with the mechanical loads such as environment effects at high temperatures in the presence of oils and friction result in creation of blended polymers such as (NBR, SBR, NR, CR, ... etc) [2]. Also a new type of polymers which is supported by thermosetting polymers type is developed for heat resistance purposes, also different types of blended rubbers ate improved by supporting methods such as by using particles and fibers for dynamic properties improvement for high loads purposes [3].

2. Rubbers

Rubbers can be divided broadly into two types: thermosets and thermoplastics. Thermosets are three-dimensional molecular networks, with the long molecules held together by chemical bonds. They absorb solvent and swell, but do not dissolve; furthermore, they cannot be reprocessed simply by heating. The molecules of thermoplastic rubbers, on the other hand, are not connected by primary chemical bonds. Instead, they are joined by the physical aggregation of parts of the molecules into hard domains [4]. Hence, thermoplastic rubbers dissolve in suitable solvents and soften on heating, so that they can be processed repeatedly. In many cases thermoplastic and thermoset rubbers may be used interchangeably. However, in demanding uses, such as in tires, engine mounts, and springs, thermoset elastomers are used exclusively because of their better elasticity, resistance to set, and durability. The addition of various chemicals to raw rubber to impart desirable properties is termed rubber compounding or formulation [5].

Typical ingredients include crosslinking agents (also called curatives), reinforcements, anti-degradants, process aids, extenders, and specialty additives, such as tackifiers, blowing agents, and colorants. 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 [6]. Natural rubber (NR) Natural rubber is produced from the latex of the Hevea brasiliensis tree. Before coagulation, the latex is stabilized with preservatives (e.g., ammonia, formaldehyde, sodium sulflte) and hydroxylamine may be added to produce technically-specified, constant-viscosity grades of NR [7]. Figure 1 shows the Isoprene units.

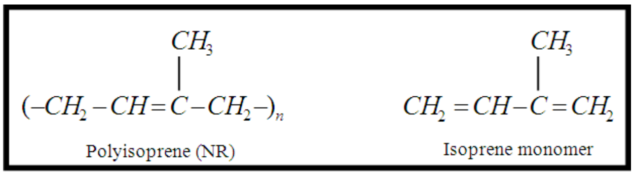

Figure 1. Isoprene units

Fillers not only reduce the cost of composites, but also frequently impart performance improvements that might not otherwise be achieved by the reinforcement and resin ingredients alone. Fillers can improve mechanical properties including fire and smoke performance by reducing organic content in composite laminates. Also, filled resins shrink less than unfilled resins, thereby improving the dimensional control of molded parts [8].

Important properties, including water resistance, weathering, surface smoothness, stiffness, dimensional stability and temperature resistance, can all be improved through the proper use of fillers. The thermosetting resin segment of the composite industry has taken advantage of the properties of fillers for many years. More recently, the thermoplastic industry has begun to make widespread use of inorganic fillers. Breakthroughs in chemical treatment of fillers that can provide higher filler loadings and improved laminate performance are accelerating this trend [9].

3. Experiments

a-Materials: Natural rubber, Shells powder containing (82.4%) calcium carbonate.

b- The Batch: The batch was prepared from Natural rubber 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 (60,90,120 pphr).

c- Samples Preparing: Samples were prepared as slices of 6 mm in thickness and were divided as discs of 40mm in diameter and 6mm in thickness by using hydraulic mould in order to vulcanize them and study their cure time and scorch time.

d- Measuring of cure and scorch time: The test is carried out according to (ASTM D1646-68) by using oscillating disc Rheometer (ODR).The sample was held upper and lower jaws clutch under 3.5 bar pressure and 185 ℃ for 6min.

The weight percentages of materials in master batch are shown in Table 1.

Table 1. Weight percentages of materials in master batch

Material	pphr
NR	100
ZnO	5
St.A	2
(N-330)	35
S	2.25
MBS	1.2
DPPD	1
RFR	1
Shells powder	60-120

4. Results and Discussion

Relation between the scorch time (This period of time before vulcanization starts is generally referred to as scorch time) vs. shell powder percentage was shown in Figure 2 We notice that the scorch time reduces with the increase in shell powder percent, this is due to the interference of the shell powder between the rubber chains which inhibit vulcanization by sulfur, until reached to (120pphr) percentage from shell powder which will increased scorch time [10].

3 Figure shows the relation between the cure time vs. shell powder percentage, it is noticed that increase in shell powder percent causes decrease in cure time, this is due to the increasing of scorch time and this decreased the vulcanization time which will improved rate of the product [11].

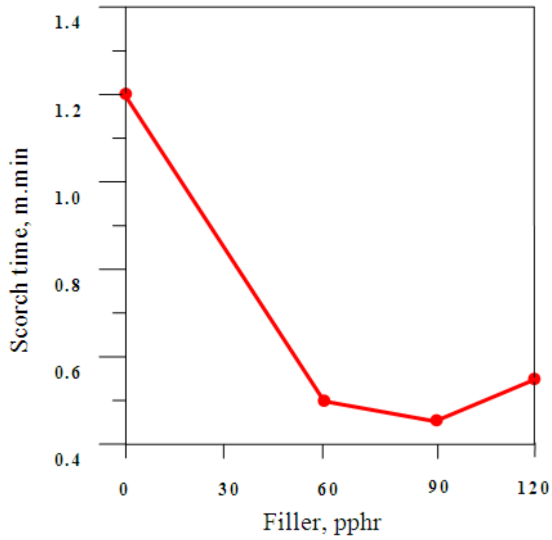

Figure 2. scorch time vs. shell powder percentage

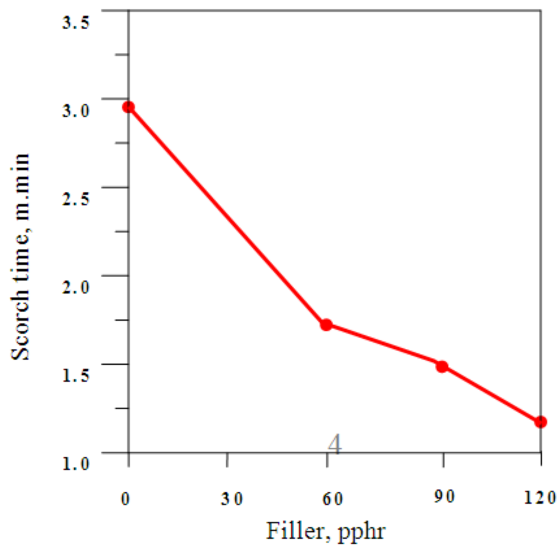

Figure 3. cure time vs. shell powder percentage

5. Conclusions

Reducing scorch time as shell powder percentage increases in the range of 0-90 pphr, until reached to (120pphr) percentage. Decreasing cure time as shell powder percentage increases in all ranges due to the increasing of scorch time.

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