EFFECT OF DIFFERENT FORMULATION OF NATURAL RUBBER AND STYRENE-BUTADIENE RUBBER BLEND ON PHYSICAL PROPERTIES

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The demand for synthetic rubber is increasing every year. However, this petroleum- based product will have some harmful effects to the environment and air quality. Moreover, it can cause the depletion of petroleum resource. All this contribution has recently created an increase interest in natural base rubber with the use of renewable resources. Because of the problem this research was conduct to prepare the blend of natural rubber and styrene-butadiene rubber sample with different formulation. Then to study the effect of different formulation of natural rubber and styrene-butadiene rubber blend on the physical properties. For the preparation, natural rubber latex was clean and dry completely before going through mastication process to reduce the molecular weight of the rubber to make sure it dissolve easily in solvent. Styrene butadiene rubber was cut into small pieces and then dissolves in toluene and chloroform solution. The rubber was mix with 4 different formulations before been heat and dry overnight in the oven. Then the sample was prepared for testing using tensile tester. The speed was set to 500 mm/min .The speed was constant throughout the test to make sure same force was applied to all sample. The result shows that that blend of 50% of natural rubber with 50 % styrene-butadiene rubber has the highest value of tensile strength which was 1.145 MPa. While the highest tensile modulus for all formulation was sample with 80 % natural rubber and 20 % styrene-butadiene rubber. The value for all 3 tensile modulus was 0.38 MPa , 0.445 MPa and 0.66 MPa for M100 ,M300 and M500 respectively

Keywords— Natural Rubber, Styrene-Butadiene Rubber, Polymer Blend

I. INTRODUCTION

The demand for synthetic rubber is increasing every year. However, this petroleum- based product will have some harmful effects to the environment and air quality. Moreover, it can cause the depletion of petroleum resource. All this contribution has recently created an increase interest in natural base rubber with the use of renewable resources [1]. Considering the present worldwide issue of oil resource depletion, natural rubber is viewed as a sustainable polymer[2]. Natural rubber has been utilized over numerous years and much data has been established regards to formulation of the rubber to get wanted properties[3].

Natural rubber that had been used by industry can be acquire by tapping the Hevea tree. The natural rubber that had been acquire from this activity is known as latex[4]. The rubber is tree is known as Hevea Brasiliensis and earlier found at Brazil but nowadays most of rubber production come from Asia country especially Malaysia, Indonesia and Thailand [5]. At the end of eighteenth century, rubber was known throughout Europe as rubber had greater properties which can give benefit to them[6].

The procedure to create the better properties of polymeric end product which consist more than one element is called blending. . Various type of rubber will show various advantage and special application. This happened because of its chemical properties and configuration. The new type of polymer can be produced when the various type of rubber had been blend. This new polymer has more advantages that can be used for the manufacture of application that had been utilized for daily life. The polymer blend is easier to be produced and less cost compared to chemically creation of a new elastomer [7]

II. METHODOLOGY

A. Materials

For this experiment, natural rubber latex was obtained from local rubber estate in Pulau Pinang. The styrene-butadiene rubber was provided by polymer laboratory and other chemical such as toluene, chloroform and methyl ethyl ketone peroxide(MEKP) was provided by chemical laboratory.

B. Natural rubber preparation

Natural rubber latex was bought from local rubber estate in liquid form but the latex coagulates and hardens. The rubber contained many impurities. In order to clean all the impurities, the latex must be cut into smaller size and washed for several time using tap water. Commercially, the latex will go milling process or crushing process to clean and reduce the moisture content in the rubber. But for this laboratory experiment, the rubber was cut into smaller size and dry in the oven until the weight of the rubber was constant.. After the rubber dried , the rubber was undergo mastication process for 20 minutes to reduce the molecular weight. The masticated rubber was dissolved into solvent by ratio 1:10 which mean 1 g of rubber in 10 ml of toluene.

C. Styrene-Butadiene rubber preparation

Styrene- butadiene rubber was obtained from the laboratory. The rubber was come in large size .The SBR was cut into smaller size to increase the surface area during dilution process. SBR will be dissolved in solvent, which was toluene and a small amount of chloroform to make the SBR dissolve faster. The ratio to dissolved SBR was 1: 9 :1 which were 1g SBR , 9 ml toluene and 1 ml chloroform respectively.

D. *Formulation*

Mixing of Natural Rubber and styrene-butadiene rubber has been fixed to some ratio to make sure the effect of different formulation can be observed. The ratio of Natural Rubber to styrene-butadiene rubber was 50:50 , 60:40, 70:30, 80:20

Table 1: Natural rubber and styrene-butadiene rubber blend formulation

Material	Sample 1	Sample 2	Sample 3	Sample 4
Natural rubber (g)	25	30	35	40
Styrene-Butadiene (g)	25	20	15	10
MEKP (%)	5	5	5	5

E. *Blending*

Solution of natural rubber was weight 25 g and styrene-butadiene rubber solution was weight 25 g The rubber was pour in beaker and the mixture was stirred thoroughly to get homogenous mixture. The mixture was heat using hot plate at temperature 40 ˚C for about 20 minutes. About 5% in amount of Methyl Ethyl Ketone Peroxide (MEKP) that act a curing agent is also added into the mixture to cure the crosslink of the blend[8]. The mixture was stir for 5 minute more. Then the mixture was cold in room temperature for 30 minute. After that , the mixture was placed in the oven for 1 night to make sure all solvent evaporate. The method was repeated for other ratio of mixture.

F. *Testing*

After the mixture was dry, the sample was cut into "dog bone shape" by using specific cutter as show at figure 1 .

Figure 1 : Dog bone shape cutter

After that the sample was test using Instron tensile tester .The speed was set to 500mm/min throughout the experiment. It was to make sure all sample was pull by constant force. The test was end after the sample was break. Repeated this method for all sample.

III. RESULTS AND DISCUSSION

A. *Tensile strength*

Based on the result obtained from this tensile strength test on table 2 it clearly show that blend of 50% of natural rubber with 50 % styrene-butadiene rubber has the highest value which was 1.145 MPa . The second highest tensile strength was 0.82 MPa which gain from 70% natural rubber and 30% styrene-butadiene rubber follow by 0.795 MPa , 80% natural rubber with 20% styrene-butadiene rubber blend. The lowest tensile strength was obtained from 60% natural rubber with 40% styrene-butadiene rubber which was 0.635 MPa. The result shows some inconsistence value. It might happen because the thickness of the sample was not constant and the blend of the rubber was not well mix

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Table 2: Result tensile strength for different formulation.

Material	Sample 1	Sample 2	Sample 3	Sample 4
Natural rubber (%)	50	60	70	80
Styrene-butadiene (%)	50	40	30	20
MEKP (%)	5	5	5	5
Tensile strength (MPa)	1.145	0.635	0.82	0.795

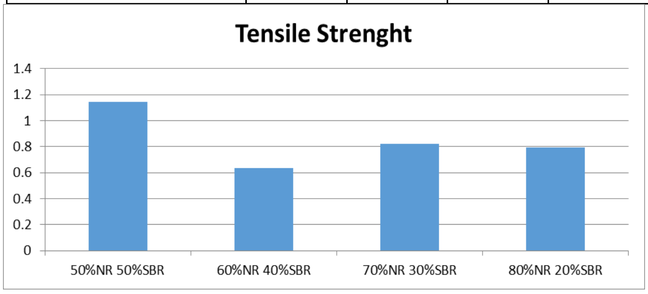

Figure 2 : Graph of tensile strength

B. *Tensile modulus*

Tensile modulus or also known as young's modulus is a mechanical property of linear elastic materials. It determined the elasticity of the sample, which relate between the deformation of the sample and the force needed to deform its. Sample that has higher tensile modulus are more resilient and more resistant to extrusion. Tensile modulus is widely test with different elongation such as 100% , 300% or 500%.Industry usually refer sample that been test with 100% elongation was M100 and same to 300% and 500% which known as M300 and M500 respectively

Table 3: Result for tensile modulus

Sample	Tensile modulus 100% (MPa)	Tensile modulus 300% (MPa)	Tensile modulus 500% (MPa)
50% NR & 50 % SBR	0.28	0.32	0.40
60% NR & 40 % SBR	0.275	0.325	0.45
70% NR & 30 % SBR	0.22	0.29	0.37
80% NR & 20 % SBR	0.38	0.445	0.66

Based on table 3 it shows that, the highest tensile modulus for all formulation was sample with 80 % natural rubber and 20 % styrene-butadiene rubber. The value for all 3 tensile modulus was 0.38 MPa , 0.445 MPa and 0.66 MPa for M100 ,M300 and M500 respectively. Based on this result it can be conclude , this sample has the highest resilient and more resistant to extrusion. The value can be compare through figure 3 .

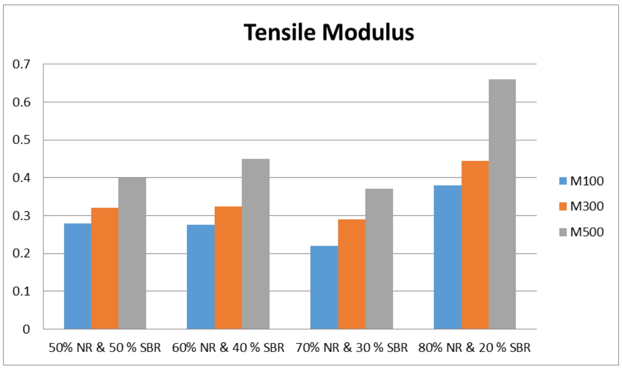

Figure 3 : Graph of tensile modulus

IV. CONCLUSION

Based on the result obtained from the experiment, it can be conclude that, the objective of this experiment was achieved. The first objective was to prepare the sample of natural rubber and styrene-butadiene rubber blend with 4 different ratios. The second objective was to observe the effect of different formulation of the rubber blend on physical properties. There were two physical properties that been tested which were tensile strength and tensile modulus. The result shows that that blend of 50% of natural rubber with 50 % styrene-butadiene rubber has the highest value of tensile strength which was 1.145 MPa. While the highest tensile modulus for all formulation was sample with 80 % natural rubber and 20 % styrene-butadiene rubber. The value for all 3 tensile modulus was 0.38 MPa , 0.445 MPa and 0.66 MPa for M100 ,M300 and M500 respectively. This result show some inconsistency might cause from the sample itself. The sample was to thin and the thickness for all sample was not consistence. It might affect the value obtained from the test

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