International Conference on Innovative Research in Engineering, Management and Sciences
International Journal of Scientific Research in Computer Science, Engineering and Information Technology

Influence of Graphene in Natural Rubber Latex

Kemparaju C R[1], Rachappa C Tambakke[2], Pramod N S[3]
[1]Asst professor Department of mechanical Engineering, New Horizon College of Engineering, Bangalore
[2,3]Asst professor Department of mechanical Engineering, MVJ College of Engineering, Bangalore

ABSTRACT

Rubbers are by and large vital materials, can be custom-made by adding fillers to meet the requests flexible industry applications generally Vehicle (elastic) tires are comprised of carbon black, it will experience more pressure, when its surface interacts with the street for a more drawn out timeframe, it is watched that there will be more wear, so to defeat this issue tires materials are joined or blended with GRAPHENE alongside the CARBON BLACK, this will likewise enhances the wear opposition and furthermore it diminishes the heaviness of the tire by a specific sum, in this manner expanding the fuel effectiveness. Graphene is artificially inactive this keeps it from having connection with elastic when they were combined. Other than that, graphene applications likewise being restricted because of its low solvency. Additionally, since graphene is nano filler, the sum included into the elastic will be less. Keeping in mind the end goal to accomplish the improvement of the properties of elastic, the nano filler should be all around scattered and homogenized with the elastic. In this way, so as to build the interfacial collaborations, subordinates of graphene, graphene oxide (GO) and diminished/ reduced graphene oxide (rGO) were utilized. As both of the GO and rGO bears oxygen- containing practical gatherings, which empower them to scatter well in acetone and furthermore in elastic. Subsequently, the properties of graphene are being held. Presently a days, CB faces a few difficulties since it is gotten from raw petroleum, it produces over the top squanders and the mechanical properties like wear obstruction. Keeping in mind the end goal to enhance the wear opposition, in exhibit work we are utilizing graphene in fortification for regular elastic latex. The utilization of Graphene alongside carbon dark (CB) in Natural elastic latex it indicates changes in mechanical properties like wear opposition

Keywords: Graphene, Carbon black, Natural rubber latex, Wear test, Automobile tire.

I. INTRODUCTION

Graphene is a material made of carbon iotas that are reinforced together in a rehashing example of hexagons. Graphene is thin to the point that it is viewed as two dimensional. Graphene's level honeycomb design gives it numerous unprecedented qualities, for example, being the most grounded material, and in addition one of the lightest material on the planet. The graphene has risen as another layered carbon material with nano estimate impacts and special physical properties.

Rubbers with fillers have been broadly connected in different modern fields because of their extraordinary mechanical properties, warm solidness and oil opposition. One of the businesses that requires enormous measure of filled elastic is the tire business. Tires are the fundamental piece of vehicle enterprises, at whatever point old tires wear off after a separation of mileage was voyage and new tires are required for substitution, there is an interest for it. Because of the popularity of tires, tire industry has turned into the significant customer of regular elastic. The most broadly utilized filler for elastic in tire industry is carbon black.

Countless research contemplates have shown whereby consolidating little measures of particulate fillers, for example, carbon- black can present noteworthy changes in the mechanical and physical properties in elastic. Strengthening with various kinds of fillers is fundamental for rubbers, as unfilled rubbers have extremely limited applications because of their poor mechanical and physical properties. The fuse of filler ready to adjust the mechanical properties of the elastic, for example, modulus, firmness, stress softening effect, wearing and tearing opposition, hardness, rigidity and so on. Throughout the previous two decades, polymer nano composites have much consideration overall scholastically and modernly. The fuse of nano fillers, for example, graphene, graphene oxide and lessened graphene oxide into polymer grid makes materials that show enhanced physical, mechanical, unique mechanical, warm, and so on properties. [1]To enhance the thermo-oxidative maturing obstruction of normal elastic, a sort of functionalized graphene (FGE) was utilized. In contrast with graphene oxide (GO), FGE seemed more twisted surface and achieved the higher water contact edge of 134°. By latex-blending strategy, the consistently scattered FGE blessed NR vulcanizes with clearly enhanced warm solidness. Vitally, the NR/FGE nano-composites showed incredible thermo- oxidative maturing obstruction, which was credited to not just the synergistic antioxidative impact of upset phenol gatherings and bonds, yet additionally the hindrance part of graphene sheets to oxygen. Discoveries give another procedure to plan functionalized graphene as powerful cancer prevention agent for elastic and other polymer materials

Sliding wear test demonstrated that the wear parameters of NBR nanocomposites have essentially progressed. The consolidation of graphene in NBR has diminished coefficient of friction2.3 times more than that of graphite fused NBR.[3] Synthesized sans zinc coupling operators (ZFC)and ZFCs-functionalized graphene (GZFCs), and created GZFCs-implanted SBR with noteworthy improvement in mechanical, warm, and electrical properties. The GZFCs-elastic composite indicated upgraded dry and wet braking and moving obstruction because of improved scattering and solid interfacial association of GZFCs in the silica/elastic matrix.[4] Mechanical quality of nanocomposites were improved with the expansion of oxidation level of GO. This work recommended that GO with higher oxidation degree could adequately enhance the properties of SBR/XNBR blend.[5] The unblemished graphite was first oxidized by Hummers strategy to plan graphene oxide (GO), and afterward graphene was gotten by concoction lessening of GO. The mechanical properties, dynamic properties and inner warmth ascent of GE/NR nanocomposites have been researched in detail. Results demonstrate that GE/NR nanocomposites include the enhanced mechanical properties, dynamic properties and low inside warmth rise. It is watched that when graphene is blended with normal elastic latex there is a change in mechanical property. The capability of rGO as a promising Nano filler in common elastic has been demonstrated.

II. EXPERIMENTAL SET UP

The distinctive Equipment's and materials which are utilized as a part of the present work are said beneath. Equipment's:(a) Stirrer (b) Electric oven (c) Wear testing machine (d) Weighing machine (e) Beaker (f) Dropper

2. Materials:

Figure 1. Materials used

Procedure For Composite Preparation

STEP 1: Legitimate proportion of the got GO colloid containing 0.35% Weight and characteristic elastic latex of 20% weight and acetone are blended by overwhelming mixing by 40 min.

(a) Addition of acetone (b) stirring of mixture

Figure 2. Procedure for composite preparation

STEP 2: The GO/VPR/NATURAL RUBBER emulsion is then co-coagulated by 1% weight by Sulphuric corrosive arrangement

Figure 3. Emulsion is coagulated by Sulphuric acid solution

STEP3: The coagulated composites are washed with water until the ph of the filtered water reached 6-7 and then dried in oven about 50 degree Celsius until dried.

(a) (b)

Figure 4. (a)Pouring colloid into sheet metal model (b) Sheet metal model is placed in oven

STEP4: The dried composites were aggravated with elastic fixings, and they are. Definition

GO/NATURAL RUBBER composites is as per the following

(a) 90 gm of natural rubber (b) 0-5 gm of graphene oxide (c) 5 gm of zinc oxide (d) 2gm of stearic acid

(e) 3 gm. of antioxidant (4010NA) (f) 2.8 gm. of sulfur

Trial No 1:

The elastic (rubber) fixings are blended amid the vulcanization and it is being filled bite the dust for relieving and the shape configuration is given beneath.

Figure 6. Die for curing

The pass on which we outlined had not given the final result (i.e. the normal elastic composite example) as wanted by our measurements so it won't be considered for the following procedure.

Trail No 2:

The kick the bucket was supplanted by utilizing the beneath said figure.

(a) (b)

Figure7. (a)Hallow pipe of dia 8mm (b) Rectangular rubber tire specimen

Utilizing mellow steel empty pipe granulated front bit like cone, play out the punching task on the rectangular elastic tire formed example which we have done through the vulcanization with the goal that the coveted shape is gotten for the testing.

The above strategy likewise not gave the coveted state of the example, so this was additionally not considered.

Trail No 3: In this technique we arranged a sheet metal example which is in the tube shaped shape , so the elastic which has experienced the vulcanization procedure, we simply pour the vulcanized elastic in the empty sheet, at that point we got the correct shape required for testing.

Figure8. GI Sheet metal of cylindrical shape

Figure 9 demonstrates that the elastic latex is being filled a few number of the sheet metal to get examples and it is subjected to normal cooling.

Figure 9.Rubber latex is poured in to cylindrical shape sheet metal.

Preparation of the specimen

Elastic example acquired from vehicle tire and in addition characteristic elastic blended with the graphene examples should be set up with the ASTM measures which assistant tried in the wear testing machine.

Step1: Natural rubber latex is taken with a weight of 90ml in the beaker, here the latex means suspension of a microscopic natural rubber particles in an aqueous medium.

Step2: Graphene is added to the natural rubber along with the carbon black, the color of carbon black is similar to that of the graphene which gives the strength to the rubber material. It should be subjected to stirring. Graphene is added about 0.5 to 2.5gm.

Step3: The blending is the most vital factor in this procedure in light of the fact that the graphene material ought to be totally broken down in the elastic latex which gives the coveted quality and so as to make the graphene material all around scattered in normal elastic, acetone will be included.

The blend will be subjected to mixing under the stirrer for around 20-30 min by keeping up the speed of 40rpm.

Stage 4: The mixed blend is included with a 2-3 drops of sulfuric corrosive to coagulate the blend, and it brings about the colloid here the colloid implies arrangement which has a molecule extending between 1nm to 1000nm in breadth these substances stay scattered and don't settle down at base. Impact of Graphene in Natural elastic latex

Stage 5: Then the blend is subjected to warming in the broiler, and up to 150 degree Celsius it is warmed and later it is blended with the elastic fixings, for example,

Sulfur-2.8gm, Zinc oxide-5gm,Stearic corrosive 2gm, Acetone of 5ml,Accelerator CBS - 1.4gm.

The expansion of the sulfur is called vulcanization, something imperative is that if the vulcanization specialist introduce before beginning of blending it will brings about the untimely vulcanization.

Stage 6: The acquired item is taken out from the oven and it is subjected to characteristic room temperature cool until the point that it is totally dried.

Example arranged according to that is ASTM D412 principles, for the wear testing, the item will be gotten

(a) (b) (c)

Figure 10. (a) Rubber specimen without graphene added. (b) Rubber specimen with graphene added (c) Actual dimension of specimen.

C. Pin and Disc Experimental Set Up For Wear Test

Figure 10. Wear testing apparatus

Emery paper / sheet is used on a disc to provide more friction between disc and specimen. Used emery paper which is having a coarseness size of 120 grit.

III. RESULTS AND DISCUSSION

specimen	Time in min	Wear Rate in microns	Friction in (N)	Weight in gm (self + in 1500 gm)	Speed in RPM	Initial Weight In gms	Final Weight In gms	Difference (Ini-fin) in gms
1	10 15 20	10 9 9	0.5 0.7 0.7	2000	480	1.060	0.748	0.312
2	10 15 20	12 12 13	0.4 0.7 0.9	2000	480	1.157	0.856	0.301
3	10 15 20	10 10 11	0.3 0.4 0.4	2000	480	1.324	0.987	0.337

Table 1. Following table provides test results of rubber specimen

Graphene added in gms	specimen	Time in min	Wear Rate in microns	Friction in N	Weight Added in gm (self+ 1500)	Speed in RPM	Initial Weight in gms	Final Weight in gms	Difference (Ini-fin) in gms
0.5	1	10 15 20	11 10 12	0.8 0.7 0.5	2000	480	0.958	0.861	0.097
1.5	2	10 15 20	9 7 6	0.9 0.8 0.8	2000	480	0.956	0.066	0.066

Table 2. Following table provides test results of graphene specimen

Time in min	Wear rate (microns)
5	-
10	12
15	12
20	13

Table 4. For specimen 2

Figure 12. Specimen2 without addition of graphene.

The above figure 12 plainly demonstrates that the wear rate is expanding for elastic example, where it was indicating wear rate of 12 microns at 10 minutes and when it came to 15 min it has demonstrated the consistent wear and wear rate got slowly expanded to 13 microns in 20 minutes.

Time in min	Wear rate (microns)
5	-
10	12
15	12
20	13

Table 5. For specimen 3

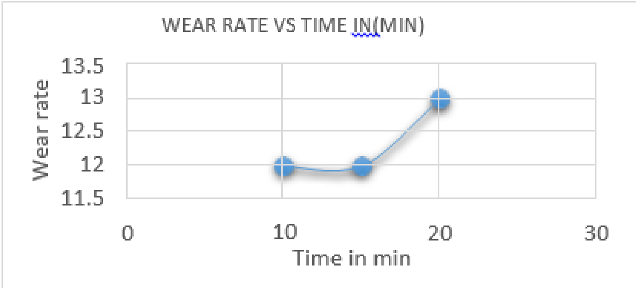

Figure 12. Specimen 3 without addition of graphene.

Here the above diagram demonstrates that the wear rate is diminishing for elastic example from 10 microns to 9 microns, when the time scopes to 15 and 20 minutes the chart is demonstrating the steady wear rate for elastic example, since it is an elastic example, the wear rate may increments or it might demonstrate the consistent wear rate in the following 20 minutes of trail on keeping the load consistent.

Charts and table shows results for graphene example:

Table 6. For specimen 1

included, here the graphene expansion has not demonstrated the huge outcome, since it is demonstrating the comparative properties of the elastic example where wear rate got expanded to 12 microns at 20 minutes of time term when at first it was observed to be 11 microns.

Table 7. For specimen 2 1.5gm of graphene added

Figure 14. Specimen with 1.5 gm addition of graphene.

The outline exhibits that the wear rate is growing as the time proceeds when 0.5gm of graphene is

0.5gm of graphene added

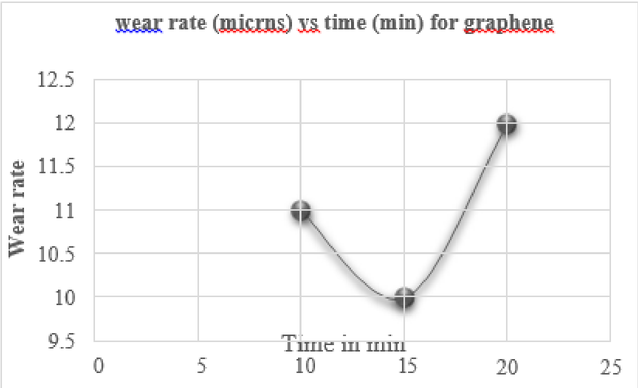

Figure 13. Specimen with 0.5 gm addition of graphene.

The chart demonstrates that the wear rate is expanding as the time continues when 0.5gm of graphene is incorporated, here the graphene extension has not shown the tremendous result, since it is exhibiting the similar properties of the versatile case where wear rate got extended to 12 microns at 20 minutes of time term when at first it was seen to be 11 microns.

Table 8. For specimen 3 2 gm of graphene added

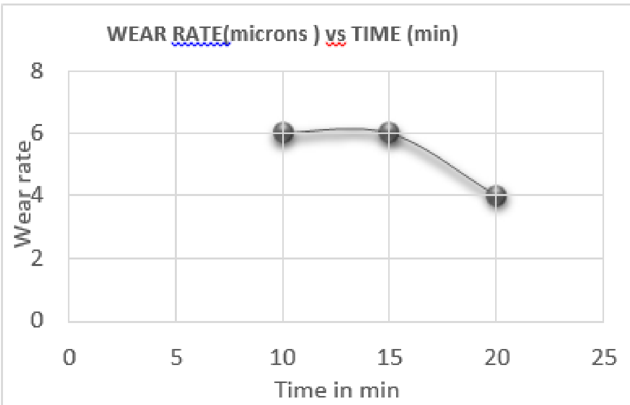

Figure 15. Specimen with 2 gm addition of graphene.

The above chart demonstrates that wear rate is diminishing as the time builds the option of 2gm of graphene has given the better outcomes when it is contrasted and the over two diagrams of fig 13 and 14 where we have included 0.5 gm and 1.5 gm of graphene. We can likewise saw from this chart at first there was a 6 microns of wear rate at 10 minutes of time and it was diminished to 4 microns at 20 minutes, the test unmistakably finishes up when there is an expansion in the graphene organization with elastic latex better outcomes can be acquired.

Percentage of weight reduction calculation.

Percentage of weight reduction = (initial-final) weight
/initial weight.

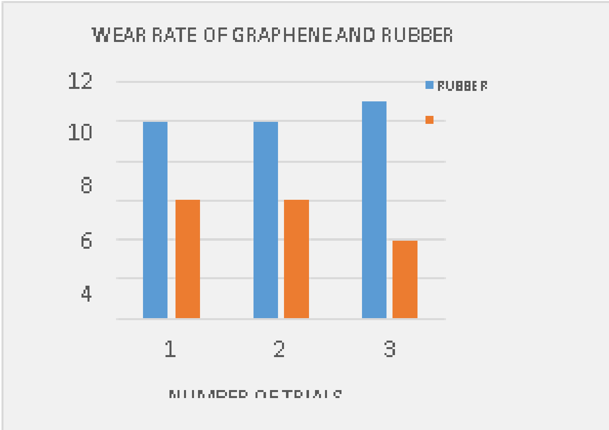

Figure 16. Compression of results

IV. FUTURE WORKS

The normal elastic (rubber) which we have utilized can be supplanted by the SBR latex that is styerene butadiene elastic latex so as to enhance the further mechanical properties for instance to enhance the quality, since SBR has gotten from the oil based commodity.

The vinyl pyridine elastic can be used for enhancing the coupling properties at whatever point SBR latex is utilized as a part of an extensive amount.

Numerous quickening agents, for example, 4010NA and additionally activators can be used in a particular sum contingent on the general arrangement of the normal elastic latex and graphene considered.

REFERENCES

[1] LinZhangaHongqiangLiab etl "Functionalized graphene as an effective antioxidant in natural

rubber " Manufacturing Volume, April 2018, Pages 47-54.

[2] NehaAgrawalA.S. PariharJ.P.SinghT.H. GoswamiD.N. Tripathi "Efficient Nano composite formation of Acyrlo Nitrile Rubber by incorporation of Graphite and Graphene layers: Reduction in Friction and Wear Rate" Procedia Materials Science Volume 10, 2015, Pages 139-148.

[3] Jin GwanSeo Chung KyeongLee Dongju Lee Sung HoSonga. "High-performance tires based on graphene coated with Zn-free coupling agents." Journal of Industrial and Engineering Chemistry Available online 17 April 2018.

[4] XiaodongXue QingYin HongbingJia XumingZhang YanweiWen QingminJi ZhaodongXu. "Enhancing mechanical and thermal properties of styrene-butadiene rubber/carboxylated acrylonitrile butadiene rubber blend by the usage of graphene oxide with diverse oxidation degrees" Applied Surface Science Volume 423, 30 November 2017, Pages 584- 591.

[5] HailanKang YinyinTang LeiYao FengYang QinghongFang DavidHui "Fabrication of graphene/natural rubber nanocomposites with high dynamic properties through convenient mechanical mixing" Composites Part B: Engineering, Volume 112, 1 March 2017, Pages 1-7.

[6] Yan, L. et al. Chemistry and physics of a single atomic layer: strategies and challenges for functionalization of graphene and graphene-based materials. Chem. Soc. Rev. 41, 97–114 (2012).