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Dynamic Properties of Rubber Blends (NR/BR.cis) Under the Effect of Different Blending Ratio and Carbon Black Type

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Abstract

Due to the wide use of rubber components in different engineering applications such as vibration isolators, engine mounts, car tires, and bridge bearing pads, etc. This rubber component mostly subjected to high levels of vibration and noise which are among the most reasons that lead to the failure of the structures. In the present paper has been performed experimentally to investigate the influences: different content ratios of natural rubber (NR) and polybutadiene (BR.cis) rubber blends [1: (50/50) %, 2: (60/40) %, 3: (70/30) %, 4: (80/20) %, 5: (90/10) %, 6: (100/0) % pphr], and two carbon blacks types (N375, and N220) on the dynamic properties (Rebound Resilience, Damping Time, and Decay Rate). The experimental results showed that the rubber compound that has the blending ratio [1: (50/50) %] has high resilience (low damping), high damping time and high displacement for two carbon black types used in this work. While these properties were improved whenever the rubber blend close to the percentage [5: (90/10) %]. The damping time, amplitude, and resilience of a rubber compound with a blending (90/10) % and carbon black (N220) are decreased by (24.53 %, 36.854 %, and 36.852 %), respectively, compared with a rubber blend that has the blending ratio of (50/50) %.

Keywords: Rubber blend, Dynamic properties, Rebound resilience, Damping time, and Decay rate.

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1. Introduction

The study of dynamic properties of composites materials under different conditions has been gained extensive attentions by many researches [1 - 5]. Resilience is one of the important dynamic properties of a rubber vulcanized, and in designing parts for shock or energy absorption, data in the resilience of the material are essential, for such applications a material with low resilience is required. Resilience is one of the important dynamic tests in which the test piece is exposed to one impact force a lone. This property is representing one of the outstanding features of rubber and it is a very important characteristic to predict the damping of vibration in specific applications. Rebound resilience shows the ability of rubber vulcanized to absorb and return the impact energy which depends on rubber type, vulcanization conditions, and curing ingredients, temperature, and fillers amounts [6, 7]. In other materials, such as steel, the impact strength is defined as the impact energy required to create a crack in the cross-sectional area, while in the case of rubber impact, it is different, strain or stress is very rapidly applied on the rubber materials as impact force. This energy does not produce a crack in rubber specimen, but some of this energy is resumed as a mechanical energy and the residual energy is dissipated as a heat in the rubber [8, 9]. Al-Maamori and Alnesrawy [10], investigated the influence of the added mixture of carbon black and reclaimed tire grains in different fractions to the various content ratios of (Natural / Styrene-butadiene / Polybutadiene) rubber blends on the rebound and damping time. They used sixteen compounds contained four content ratios of (NR/SBR/BR) rubber blends and four fractions of (carbon black (N375)/reclaim). They investigated for all blends ratio the damping time and rebound resilience percentage decreased while the hardness increased with increasing (carbon black/reclaim) content ratio. Ismail et al. [11], studied the effect of content ratios of blends (natural rubber (NR)/recycled acrylonitrile-butadiene rubber (NBR)) on the behaviors (hardness, swelling, resilience, and fatigue). Five recipes of rubber mixtures were used with concentrations as follows (95:5), (90:10), (85:15), (75:25) and (65:35). They concluded that the increasing content ratio of (NR/NBR) mixture gave good resistance to swelling little increased in hardness. Ghafil [12] studied the dynamic response of a small generator resting on rubber mounts. Firstly, he calculated the static stiffness (Ks) by compression test and damping coefficient (C) by vibration test. Secondly, he showed the stresses and strains generating in this generator resting on rubber mounts numerically by finite element method utilizing by ANSYS software version 15.0. Abd-Ali et al. [13] investigated the influence of shape factors of rubber components on the efficiency of the vibration structure resting on the rubber mounts. Executed a simulation for these rubber mounts using ANSYS software version 11. The results of the mechanical part application test showed that the working life of the hexagonal shape was longer than the other two models, but the obtained results produced by ANSYS showed a decrease in stress intensity for the hexagonal model. Al-Nesrawy et al. [14], studied the effects of particle size of carbon black on the mechanical characteristics such as specific gravity and hardness and dynamic properties like damping time and resilience of polybutadiene rubber (BR) composites. They concluded that the dynamic properties (resilience percentages and damping time) decreased with increasing carbon black content ratios, on the reverse behavior of mechanical properties. Ismail et al. [15] investigated the influence of carbon black loading levels (20, 30, 40, 50, and 60 pphr) on mechanical characteristics of (NR-SMRL)/Nitrile rubber (NBR) blends for percentage (50:50). The obtained result indicated to increase in both (tensile strength and hardness) with increasing the carbon black loading levels. On the contrary, resilience decreases, which that the relationship between resilience and carbon black loading levels is inverse. Pöschl et al. [16] investigated the influence adding of different kinds of carbon black at the same loading of level for all these kinds of carbon black on the mechanical characteristics as well as the capacity to dampen mechanical vibrations for the styrene-butadiene rubber. They found that the (SBR) mixture has good stiffness at adding (N110 and N330). On the contrary, the carbon black (N990) has lower reinforcement effects and good damping characteristics, especially at higher frequencies due to the loss of part of the mechanical energy, which dissipated to the environment as heat when the mechanical rubber parts are under dynamic loading. Chollakup et al. [17], investigated the influence of particle diameter and carbon black concentration on the properties of rubber compounds. Used two types of carbon black (N220) and (N330) with particle diameters ranging from (20 to 25 nm) and (26 to 30 nm) respectively as a reinforcing factor of natural rubber. They concluded that the dynamic and static properties of rubber compounds filled with carbon black (N330) lower than that of (N220) and vice versa. Furthermore, from the comparison of the rubber compounds at the same concentration filled with carbon black (N220 and N330), they showed that the value of (tan δ) and heat build-up of the rubber compound filled with (N330) higher than those of (N220).

Generally, most of the researchers reviewed above studied the effects of type of rubber materials and their mixing ratios and the type of carbon, but they differ from the rubber materials and their mixing percentages and type of carbon used in the current work. Thus, in this article, studied the dynamic properties of rubber materials under the effects different content ratios (NR/BR) of rubber blends and two types of carbon blacks (N220 and N375).

2. Experimental work

2.1. Materials

Natural rubber (NR), polybutadiene rubber (BR), and carbon black (N220 and N375) were supplied by an al-Najaf Tire Factory, and the properties of these materials are listed in Table 1 and 2, respectively.

Table 1. Properties of natural and polybutadiene rubbers [18].

Properties	**(NR) Value**	**(BR.cis) Value**
Color	red	white
Specific gravity	0.934	0.915
Tg (°C)	- 72	- 56
Tensile strength at break (MPa)	17.23 - 25	23 - 27
Hardness (Shore A)	20 - 100	20 - 40
Resilience	Excellent	Excellent

Table 2. Properties of carbon blacks N220 and N375 [18].

Property	**(N220) Value**	**(N375) Value**
Particle size (nm)	23	35
Specific gravity	1.8	1.8
Surface area (m^2/g)	110 ± 6	98 ± 5
Ash content (%)	0.75 Max.	0.75 Max.
Pour density (g/l)	350 ± 30	345 ± 30
Iodine adsorption (mg/g)	121 ± 6	92 ± 5

2.2. Preparations

The rubber compounds used in this article were prepared from natural rubber (SMR-20), polybutadiene (BR.cis), and two types of carbon black (N220 and N375) filled the mixtures with the other ingredients, such as vulcanizing agent (Sulfur), accelerator (CBC), activator (Steric Acid and Zinc Oxide), retarder (CTP.100), Antioxidant (TMQ), paraffin wax, and process oil. A twelve recipes of rubber compounds were prepared and examined in the state company for rubber industries/al-najaf branch. The recipes formulation are listed in Table 3.

Table 3. Ingredients of recipes were used in this work.

Item	**Material**	**Loading Level (PPhr)**					
1	NR	50	60	70	80	90	100
2	BR.cis	50	40	30	20	10	0
3	Zinc oxide	5.5					
4	Steric acid	1					
5	TMQ	1.5					
6	Paraffin wax	0.5					
7	Process oil	5					
8	Carbon black (N220, N375)	48					
9	CBS	1.5					
10	Sulfur	2.3					
11	CTP.100	0.15					
Total Ingredients		165.45					

*PPhr : Part Per Hundred.

2.3. Mastication and mixing process

Mastication and mixing process of rubber compounding in this article are conveniently done by using two roll mill machines as shown in Fig. 1. The two-roll mill consists of two opposing rotating rolls that are put close together with their roll axes parallel and horizontal, allowing for a tiny gap between them to place the rubber pieces between them. The front and back rolls usually have different speeds; the front roll has a slower speed.

Fig. 1 Laboratory two roll mill machine.

The mixing process was done in two stages. The first stage is known as the master-batch. It includes the mixing of rubbers, activators, paraffin wax, antioxidant, reinforcement agents (carbon black), and process oil with each other. The process oil and carbon black are blended at the end of this stage to provide proper dispersion and good coupling with rubber. The second stage is known as the final-batch. It includes the mixing of sulfur, accelerators, and retarder with master-batch that obtained from first stage at the end of this stage to prevent the pre-vulcanization as a result of temperature raised. The mixing process was done in the following steps:

2.3.1. Master batch

1. The block rubber is inserted in above of the roll nip at the beginning and set the gap between the two rolls into 0.5 cm. After then the rubber is passed through the gap for many times until the rubber wraps and adhere to the front roll.
2. Passed the rubber horizontally and vertically alternately into a nip many times to achieve homogeneity after the rubber has been cut diagonally and rolled it.
3. Additives such as stearic acid and zinc oxide are then added one after the other to ensure proper mixing of the substances with the rubber and repeat step 2.
4. The wax and (TMQ) are added and repeat step 2.
5. The carbon black and process oil are added and then repeat step 2 and ensure that the carbon black is suitably dispersed and distribution in the rubber.

2.3.2. Final batch

1. Addition of accelerators (CBS), retarder (CTP.100) and sulfur respectively to the master batch in the ends of the process to avoid the pre-vulcanization which may take place when the temperature rises.
2. Decrease the rolls mill opening into 0.3 cm and repeat step 2.
3. Sheeting the batch to a thickness of 0.6 cm.
4. Cooling the batch at room temperature.

2.4. Rebound resilience mould.

For the prepared specimens for the resilience test, the mold in the laboratories of Al-Najaf Tire Factory was utilized, which is composed of three parts, called the middle, upper, and bottom. The middle part has dimensions of (200 × 180 × 6.5 mm^3) with nine cavities. Each cavity has the dimensions of (diameter = 40 mm, and thickness = 4 mm). The other two parts are used as the upper part is a cover, and the last one is a bottom base to adjust the rubber specimen thickness, as shown in Fig. 2.

Fig. 2 The mold for resilience test specimen.

2.5. Vulcanization procedures

1. The mould is put in the closed press, as shown in Fig. 3, to a curing temperature within (± 1 °C) and stays at that temperature for at least twenty minutes before inserting the un-vulcanized rubber parts. To check the temperature of the mould using a thermocouple or other appropriate instrument for measuring temperatures, such as an infrared thermometer.
2. When removing the mould from the press machine to add the rubber pieces, the necessary precautions must be taken into account to avoid the excessive cooling of the mould due to contact with cold metal surfaces or exposure to the air tunnel.
3. Placing nine grams of the rubber compound in each cavity of a resilience test mould and then inserting the mould in a press machine under effects of pressure of 24 MPa and temperature of 165 °C to complete the vulcanization process, then left the specimen from the mould and cooled for some time to be ready for the test.
4. Before preparing and testing vulcanized rubber compounds the temperature must be (23 ± 2 °C) for a minimum of sixteen-hour and a maximum of ninety-six hours.

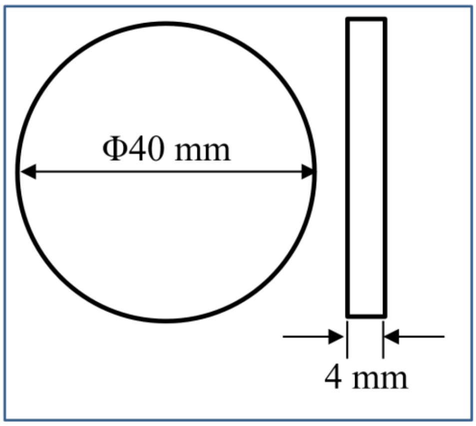
2.6. Rebound resilience testing

This test was carried out according to D2632 by the Dunlop Tripsometer device depicted in Fig. 4, which consists of a pendulum in the form of a steel disc mounted on a frictionless bearing with a pointed ball of a diameter of 4 mm fixed to the circumference of the disc at a distance of 250 mm from the centered fixed by a bracket. The weight of the ball with the bracket is 60 g and it is considered an unbalanced mass in relation to the steel disc, the disc moves due to the unbalanced mass.

Fig. 3 Hydraulic press machine.

Fig. 4 Tripsometer device.

Fig. 5 shows the specimen test: (a) schematic specimen and (b) Specimen.



(a) Schematic rubber specimen.

(b) Rubber specimens.

Fig. 5 Resilience test specimen.

To execute this test must be followed the following steps:

1. The test pieces were placed in oven for 2 hours at 50 °C, as shown in Fig. 6.
2. Turn on the Tripsometer device and ensured the pressure and temperature reach to a specified value.
3. The specimen is placed in device after remove the test pieces from oven.
4. Left the steel disc to the falling angle (45°).
5. Release the steel disc to strike the specimen.
6. Recorded the resilience in percentage from the connected computer or recorded the rebound angle and then calculated the resilience from the following equation [19]:

$$R(\%) = \frac{1 - \cos\theta_1}{1 - \cos\theta_2} \times 100\ \% \qquad (1)$$

Where:
R : Resilience (%).
θ_1: Rebound angle (Degree).
θ_2: Falling angle (Degree).

(a) Oven without cover. **(b)** Oven with cover.

Fig. 6 Specimens in oven without cover.

As well as for the above steps it is recorded a small video by a camera for each specimen from the beginning of the test to the end, and then this video was treated by a slow-motion program to enable recorded the angle against damping time or vertical amplitude versus damping time.

3. Results and discussion

In this section, the obtained results are discussed extensively. The results are carried out by an experimental work to obtain the appropriate dynamic properties of rubber compounds with different blend ratios of natural and polybutadiene rubber, and types of carbon black.

Figures 7, and 8 show the variation of angle vs. time with a different content ratio of rubber blend for two types of carbon black (N375, and N220), respectively. Also, the damping time for the various content ratios of the rubber blend for each carbon black, as depicted in the Table 4. From these figures and this table, the maximum values of decay rate occur at the blending ratio [1: (50/50) %] of rubber blend for the carbon black type (N375, and N220), while the maximum damping time occurs at the blending ratios [2: (60/40) %], and [1: (50/50) %] for carbon black types (N220) and (N373), respectively. The interpretation of this refers to high resilience (low damping). Besides, the minimum decay rate and damping time occur at the blending ratio [5: (90/10) %] of rubber blend for two types of carbon black used in this work. The interpretation of this refers to low resilience (high damping). In other words, at the blending ratio [1:(50/50) %], a large part of the energy is absorbed, a small part of this energy dissipates as heat, and the other quantity is returned energy. In contrast, at the blending ratio [1: (50/50) %] of rubber blend, a small part of the energy is absorbed, a small value of this energy dissipates as heat, and the other quantity (high value) is returned energy.

Figures 9, and 10 display a sketch of resilience against the content ratio of rubber blend for two carbon black kinds (N375, and N220), respectively. Also, it observed from these figures that the highest value of resilience occurs at the ratio [1: (50/50) %] of the rubber blend, while the lowest value of resilience occurs at the ratio [5: (90/10) %] of the rubber blend for two kinds of carbon black used in this work. Figs. 9, and 10 give evidence for the points made in Figs. 7, and 8, respectively.

Table 4. Damping time for different content ratio of rubber blend and two carbon black types (N375, and N220).

Content ratio of (NR/BR) %	Carbon Black (N375)	Carbon Black (N220)
(50/50)	21.66	16.39
(60/40)	21.05	16.76
(70/30)	14.875	14.49
(80/20)	14.75	13.57
(90/10)	12.833	12.37
(100/0)	12.913	12.85

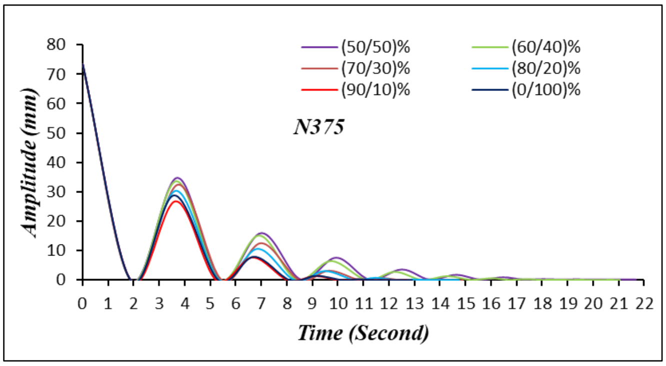


Fig. 7 Graph between amplitude vs. time with different content ratio of rubber blend for carbon black N375.

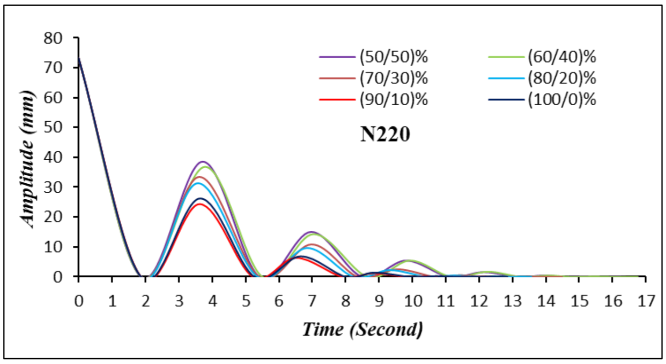


Fig. 8 Graph between amplitude vs. time with different content ratio of rubber blend for carbon black N220.

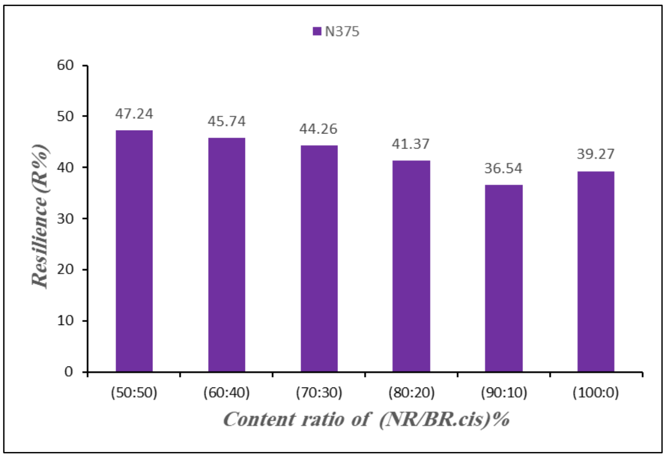


Fig. 9 Resilience vs. content ratio of (NR/BR.cis) with carbon black N375.

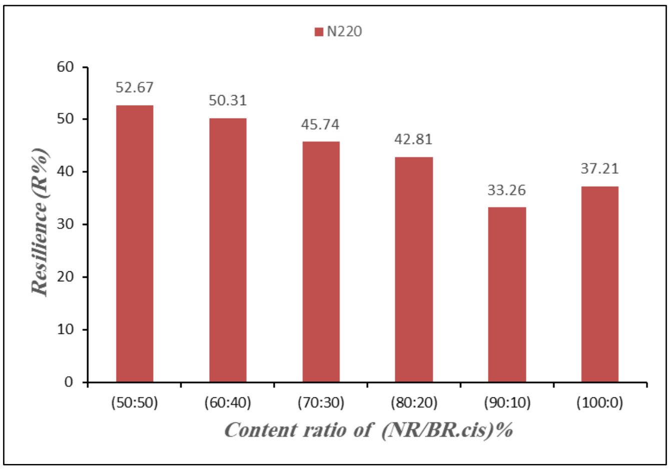


Fig. 10 Resilience vs. content ratio of (NR/BR.cis) with carbon black N220.

Finally, Figures 11 and 12 illustrate the comparison between the curves obtained from the sketching of resilience vs. the rubber blending ratio as well as amplitude against time for different two carbon black types (N375, and N220), respectively. From these two figures, it can be seen that the low resilience (high damping), low amplitude (high decay rate), and minimum damping time are (33.26 %), (24.37 mm), and (12.37 S). All the above properties are observed at the percentage [5: (90/10)] with carbon black (N220). The reason for this is that the particle size of the carbon black (N220) is smaller than the particle size of carbon black (N375), which makes the carbon black (N220) have a high surface area and good dispersion that increases the interaction between, atoms of the rubber blend. This interaction increases the cross-linking of the rubber compound.

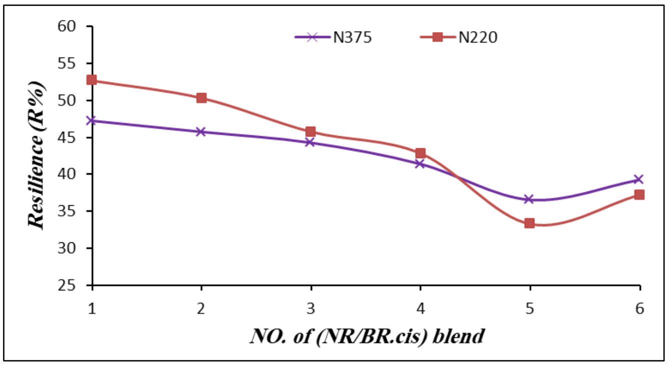


Fig. 11 Relationship between resilience vs. No. of rubber blend ratio for different two carbon black kinds.

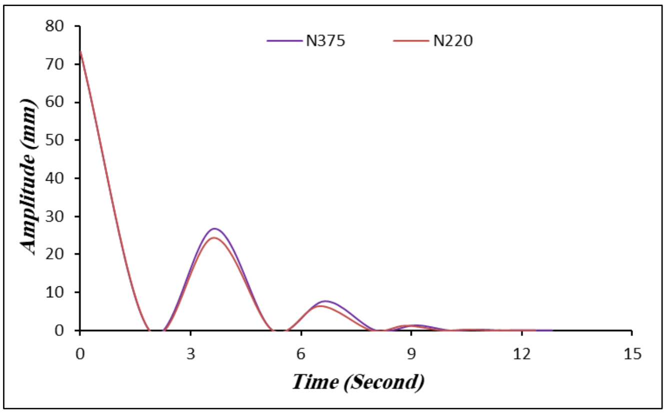


Fig. 12 Relationship between amplitude vs. time for different two carbon black kinds.

4. Conclusions

The current research studies an experimental dynamic properties of rubber blend (NR/BR.cis) with different blending ratios [1: (50/50) %, 2: (60/40) %, 3: (70/30) %, 4: (80/20) %, 5: (90/10) %, 6: (100/0) % pphr] and different two types of carbon black (N375, and N220). From the present study the following can be concluded:

1. Dynamic properties of the blends (NR/BR.cis) with a blending ratio (50/50) % are improved when the percentage of polybutadiene (BR.cis) decreases and the percentage of natural rubber increases and especially at the blending ratio (90/10) % for all carbon black used in this work.
2. The rubber compound with a blending ratio (90/10) % with carbon black (N220) has maximum dynamic properties as compared with other carbon black types used in this work.
3. The damping time, amplitude, and resilience of a rubber compound with a blending (90/10) % and carbon black (N220) are decreased by (24.53 %, 36.854 %, and 36.852 %), respectively, compared with a rubber blend that has the blending ratio of (50/50) %.

References

[1] H. A. Talla, J. K. Oleiwi, and A. K. F. Hassan, “Performance of Athletic Prosthetic Feet Made of Various Composite Materials with PMMA Matrix: Numerical and Theoretical Study”, Journal of Composite and Advanced Materials, Vol. 31, No. 4, pp. 257-264, 2021. https://doi.org/10.18280/rcma.310410

[2] O. A. Abdullah, and A. K. F. Hassan, “Effect of prestress level on the strength of CFRP composite laminate”, Journal of Mechanical Science and Technology, Vol. 30, pp. 5115-5123, 2016. https://doi.org/10.1007/s12206-016-1029-1

[3] W. Farouq, H. Khazal, and A. K. F. Hassan, “Crack analysis of functionally graded materials under thermal loading using extended element free Galerkin method”, Materials Today: Proceedings, 2021. https://doi.org/10.1016/j.matpr.2021.02.768

[4] A. M. Abood, H. Khazal, A. K. F. Hassan, “On the determination of first-mode stress intensity factors and T-stress in a continuous functionally graded beam using digital image correlation method”, AIMS Materials Science, Vol. 9, No. 1, pp. 56-70, 2021. https://doi.org/10.3934/matersci.2022004

[5] A. M. Abood, H. Khazal, and A. K. F. Hassan, “Evaluation of mixed-mode stress intensity factor and T-stress in continuous epoxy glass functionally graded beam using digital image correlation”, Materials Today: Proceedings, 2021. https://doi.org/10.1016/j.matpr.2021.03.233

[6] M. Chanda and S. K Roy, “Plastic Technology Handbook”, 4th Edition, Taylor and Francis Group, LLC, 2006.

[7] C. M. Blow, “Rubber Technology and Manufacturing”, Published by Institute of the Rubber Industry IRI, 1981.

[8] W. D. Callister, “Materials science and engineering: an introduction”, John Wiley & Sons, 2007.

[9] R. P. Brown, “Physical testing of rubber”, Chapman and Hall, 2006.

[10] M. H. Almaamori, S. H. Alnesrawy, A. Hasaani, and H. Jaafar, “Reclaimed Tire and Carbon Black Mixture Effect on Mechanical Properties of Rubber Blends SBR / NR / BR cis Uses as Damping Materials”, Australian Journal of Basic and Applied Sciences, Vol. 8, No. 17, pp. 585-590, 2014.

[11] H. Ismail, H. S. Ahmad, and A. A. Rashid, “Fatigue, resilience, hardness, and swelling behaviour of natural rubber/recycled acrylonitrile-butadiene rubber (NR/NBRr) blends”, Polymers and Polymer Composites, Vol. 23, No. 8, pp. 583-588, 2015. https://doi.org/10.1177/096739111502300808

[12] H. N. Ghafil, “Vibration Analysis of a Generator Anti-Vibration Rubber Mounts”, Journal of Computer Science & Computational Mathematics, Vol. 6, Issue 4, pp. 105-111, 2016. https://doi.org/10.20967/jcscm.2016.04.004

[13] N. K. Abd Ali, M. M. Farhan, and A. S. Moosa, “The Effect of Shape Factor on the Operation Periods of Anti-Vibration Rubber”, Industrial Engineering Letters, Vol. 17, No. 1, pp. 31-38, 2017.

[14] S. H. Al-nesrawy, F. F. Mahmood, N. M. Hadi, and F. K. Abdmoeen, “Effect of Carbon Black Particle Size on the Damping Properties of Butadiene Composites”, Journal of Chemical and Pharmaceutical Sciences, Vol. 10, No. 2, pp. 983-988, 2017.

[15] R. Ismail, Z. A. Mahadi, and I. S. Ishak, “The effect of carbon black filler to the mechanical properties of natural rubber as base isolation system”, IOP Conference Series: Earth and Environmental Science, Vol. 140, No. 1, 2018. https://doi.org/10.1088/1755-1315/140/1/012133

[16] M. Pöschl, M. Vašina, P. Zádrapa, D. Měřínská, and M. Žaludek, “Study of carbon black types in SBR rubber: Mechanical and vibration damping properties”, Materials, Vol. 13, No. 10, 2020. https://doi.org/10.3390/ma13102394

[17] R. Chollakup, S. Suethao, P. Suwanruji, J. Boonyarit, and W. Smitthipong, “Mechanical properties and dissipation energy of carbon black/rubber composites”, Composites and Advanced Materials, Vol. 30, 2021. https://doi.org/10.1177/26349833211005476

[18] Dunlop Co., “Raw Materials Specification”, Dunlop Manual, Vol. 1, No.1, Section 1-1, 1988.

[19] R. P. Brown, “Physical testing of rubber”, Chapman and Hall, 2006.

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