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Impact of sulfur compounds on motorbike wheel damper rubber manufacturing materials with 3 Phr, 4 Phr, and 6 Phr compositions

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Abstract: Rubber force is a simple but important thing for vehicles. This component is located in the rear wheel drum which is directly connected to the gear. Many factors influence the damage to this component. This research aims to determine how much influence stearic acid has on the hardness and tensile strength values of the lifting rubber compound. The materials used to make the compound are rubber smoked sheet (RSS) and synthetic rubber mixed with the chemicals stearic acid, black carbon white oil, ZnO, paraffin wax, MBTS, comaron resin and sulfur. These ingredients are mixed using two roll mixing until they combine and form a compound sheet. To determine the maturation time of rubber, a rheometer process is carried out. The next process is vulcanization of rubber using a mold that is pressed at a temperature of 1600C and a pressure of 150 psi. Tensile testing uses rubber testing equipment with SNI ISO 37: 2015 (IDT–2011) standards. Hardness testing uses a tool with a Shore A hardness tester scale with ISO 7619–1:2010 standards. Based on the results of the tests carried out, the addition of sulfur has a very significant effect on the hardness value and tensile strength value. For the hardness value of compound 3 with a sulfur composition of 6 phr, it has the highest hardness, namely 77 Shore A and the lowest value is composition 1 with a hardness value of 65.6 Shore A. The highest tensile strength value is 15,394 N/mm^2 in composition 1 and the lowest value is in composition 3 with a value of 11.44 N/mm^2

Keywords: Sulfur; compound; violence; tensile strength

1. INTRODUCTION

Vehicles have many components to operate, both main components and supporting components. Of the several components attached to the vehicle, one important component is rubber drum [1]. The position of the force rubber / drum rubber is integrated with the rear gear housing. Apart from being used to protect the rear gear housing from the drum, this rubber is also used as a shock absorber when the motorbike accelerates [2]. Try to always check regularly because if it is loose or there is a gap between the gear and drum. If ignored, it will reduce the life of the chain and gears because the rotation of the gears and chain does not match, resulting in more friction.

Testing is needed to determine the hardness and tensile strength of motorcycle drum rubber materials. Tests are also carried out so that we know the effect of compound rubber and the composition of the materials used to make rubber drums. This way we can make rubber drum components perfectly.

The objectives to be achieved from this research are: a) Comparing the results between artificial specimens with sulfur variations of 3Phr, 4Phr, 6Phr with goods on the market. b) Understand the effect of the sulfur mixture in rubber material specimens on hardness tests and tensile tests

2. LITERATURE REVIEW

In previous research on tensile testing, specimen 1 with the addition of black carbon 50 phr and sulfur 3 phr from the tire material composition had a value of 237.23 Kg/cm^2, specimen 2 with black carbon 55 phr and sulfur 3.5 phr test value The tensile strength is 232.35 Kg/cm^2, specimen 3 is 201.5 Kg/cm^2 with 60 phr black carbon and 4 phr sulfur, while the value for the market specimen is 194.77

Kg/cm^2. For hardness testing, specimen 1 has a value of 65.67 on the Shore A scale, specimen 2 has a hardness value of 70.33. In specimen 3 the value was 74.33 and in the market specimen it was 67.33 on the Shore A scale. From these data it can be seen that the greater the addition of black carbon and sulfur to the composition of the tire material, the higher the hardness value of the specimen but the lower the tensile strength value. Meanwhile, adding less black carbon and sulfur will result in lower hardness values and higher tensile stress values [3][4][5].

From the hardness test, it was found that increasing the amount of carbon black and sulfur would increase the hardness value of the compound, where in this study it was obtained 75 (compound 1), 75 (compound 2), 77 (compound 3). These results indicate that the hardness of the artificial compound is greater than the manufactured compound. For tensile testing, it was found that the greater the amount of carbon black and sulfur in the artificial compound, the tensile strength would increase, namely 13.46 N/mm^2 (compound 1), 15.32 N/mm^2 (compound 2), 16.69 N/mm^2 (compound 3), while in the wear test an inverse trend was obtained where the higher the carbon black and sulfur, the lower the average wear rate of the compound on both wet and dry tracks. This shows that the manufactured compound still has greater tensile strength than the artificial compound and the average wear rate is lower than the manufactured compound [6].

In research on the effect of tire compound composition on the grip coefficient on cement tracks. The compound composition consists of a mixture of raw rubber with chemicals that have not yet occurred vulcanization [7]. The rubber used is natural rubber RSS and synthetic rubber SBR, while the chemicals used are softeners, fillers, anti-oxidants, accelerators and other chemicals. From the results of this research, the grip coefficient value was 0.653 for dry track conditions and 0.576 for wet track conditions. This value is produced by the composition of compound 1 with variations of 30% black carbon and 2% sulfur from the total composition of the compound. In the shore A test, the largest result was 77 for composition 3 with a composition of 30% black carbon and 2.2% sulfur [6][8].

In the research "The effect of sulfur on the hardness of products (rubber bushings) with different amounts of sulfur of 8 grams, 10 grams and 12 grams" the rubber used to make the compound for making specimens is the RSS type with a composition of 200 grams which will be mixed with other addictive ingredients such as zinc oxide, accelerator, anti oxidant, stearic acid, each with a composition of 4 grams [9][10]. It was found that the hardness results varied between the three homemade rubber bushing specimens, which in this study were 38 (8 gram composition), 38.7 (10 gram composition), 39.1 (12 gram composition), with SNI 19-1144-standards. 1989 using a shore A durometer, this shows that the more sulfur the composition, the higher the hardness value [11] [12].

3. METHOD

This study seeks a theoretical basis and previous research results to support the research. Other sources are taken from books, journals and internet sites.

Preparation of tools and materials

Looking for RSS, Styrene Butadiene rubber (SBR), black carbon, white oil, ZNO, stearic acid, paraffin wax, MBTS, coumaron resin, sulfur and test equipment and preparing the tools needed during research [13].

Compound manufacturing

First, prepare materials such as natural rubber, synthetic rubber and other chemicals to be mixed using two roll mixing so that they are evenly mixed, after that you will get a very thin mixture called compound [14].

Compound Testing

Hardness testing was carried out using a Shore - A hardness tester which was carried out by testing the Shore A-70 hardness standard. The standard used is SNI 1903 2011.

In tensile testing, the compound is printed to the required length and width and then assembled into the chuck on both sides, top and bottom. The way to carry out this test is by applying a tensile force to the material and from the tests that have been carried out, it can be seen to what extent the material being tested can increase in length and reach the breaking point. The test standard used in this tensile test is SNI.ISO 37-2015, (IDT-2011) [15].

In hardness testing, the condition of the compound is still in sheet form, then after a rheometer process is carried out to find out how long it takes to cure the compound. after that it is vulcanized in sheet form and cut according to ISO 7619-1:2010 standards.

4. RESULTS AND DISCUSSION

Data on hardness testing results:

From the histogram results in Figure 1 it can be seen that the specimen with a 3 phr sulfur mixture (compound 1) has a hardness value of 65.6 shore A, the 4 phr sulfur mixture (compound 2) has a hardness value of 72.6 shore A, and the sulfur mixture 6 phr (compound 3) has a hardness value of 77 shore A. from the data above it can be concluded that the more sulfur composition is added, the higher the hardness value.

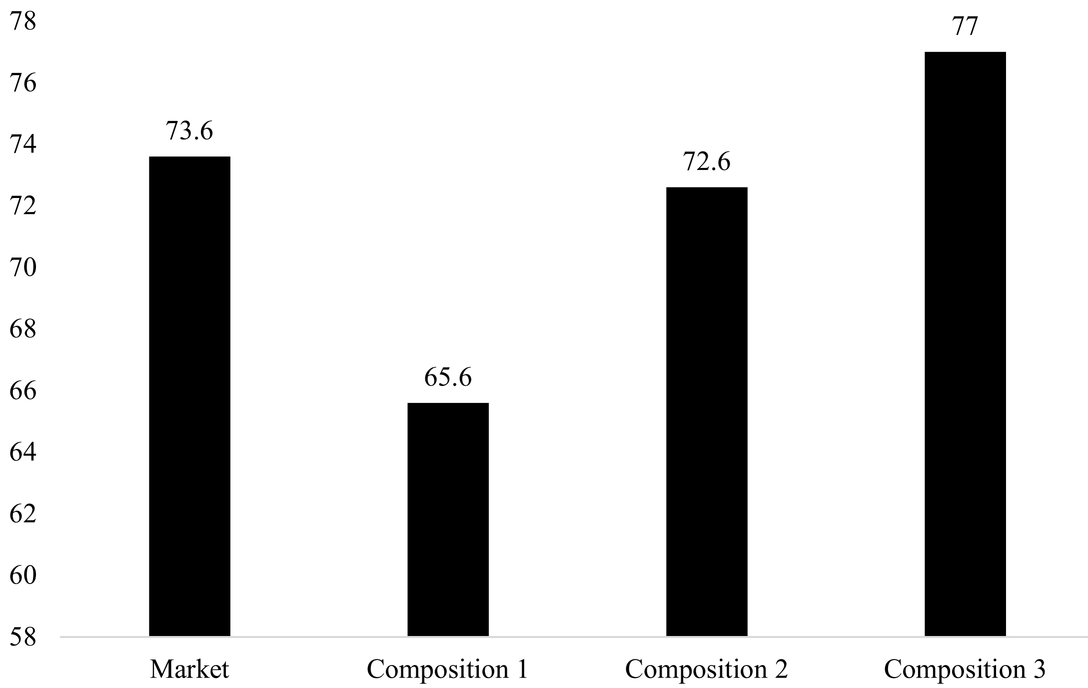

Figure 1. Comparison between specimen types and hardness test values.

Based on Figure 1, it can be concluded that, the effect of adding sulfur to grade rubber specimens on hardness testing, composition 3 with the addition of 6 phr sulfur has better hardness than market grade rubber, namely with an average hardness value of 73.6 shore A. In composition 2 with the addition of 4 phr sulfur has a lower hardness value compared to market grade rubber with a hardness value of 72.6 shore A. Composition 1 with the addition of 3 phr sulfur has the lowest hardness value compared to market grade rubber with a hardness value of 65.6 shore A. So it can be concluded that composition 3 is good for use in the production of grade rubber because it has a very small difference in hardness values compared to market grade rubber.

Tensile test results data

From Figure 2 it can be concluded that the tensile test results of artificial specimen 1 with a sulfur content of 3 phr have a stress value of 15.394 N/mm^2, artificial specimen 2 with a sulfur content of 4 phr has a stress value of 12.71 N/mm^2, artificial specimen 3 with a sulfur content of 6 phr has a stress value of 11.44 N/mm^2. Meanwhile for market specimens it has a tensile stress value of 13.312 N/mm^2.

From Figure 2, it can be concluded that the tensile test results from market and artificial specimens 1, 2, 3 have the highest average, namely artificial specimen 1 of 15.394 N/mm^2. The lowest average value was obtained from specimen 3, namely 11.44 N/mm^2. This research shows that the addition of sulfur can reduce the tensile properties of the results above the addition of 4 phr sulfur in specimen 2 with a value of 12.71 N/mm^2 which is closer to the market specimen.

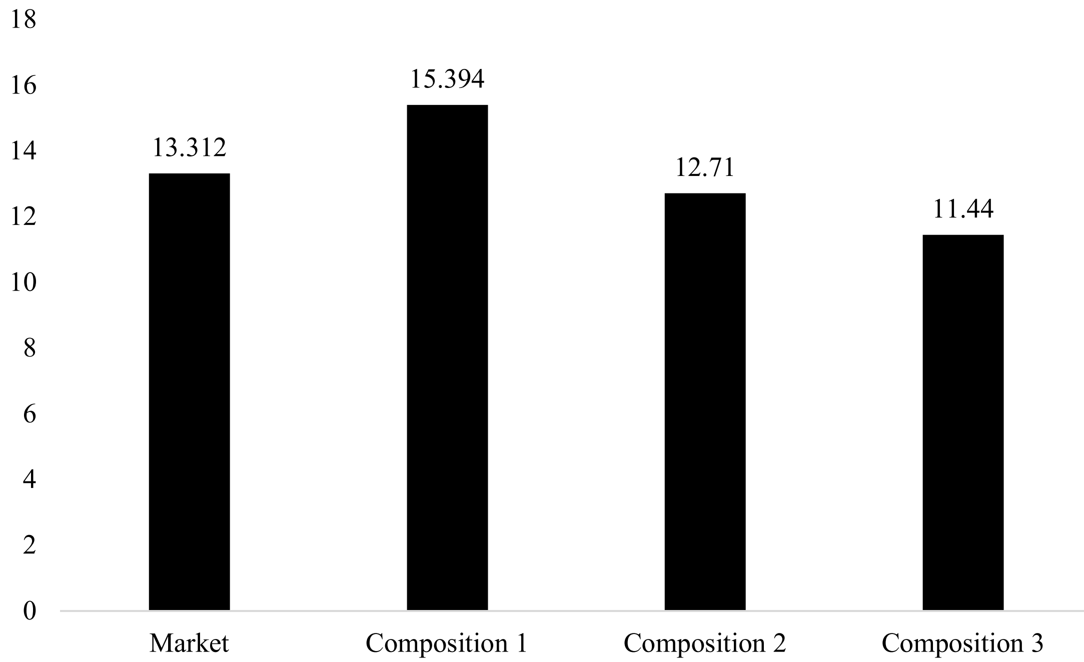

Figure 2. Comparison between specimen types and tensile test values.

3 CONCLUSION

After carrying out all the research and analysis, conclusions can be drawn, namely: a) In making rubber specimens, the level of sulfur composition has a very big influence on the amount of hardness. Specimen variation 1 with a sulfur composition of 3 phr gets a value of 65.6 on the Shore A scale, specimen 2 with a sulfur composition of 4 phr has a hardness value of 72.6 on the Shoree A scale, specimen 3 with a sulfur composition of 6 phr gets a hardness value of 77 on the Shore A scale, and in market specimens it is 73 on the Shore A scale. From these data it can be seen that the greater the addition of sulfur to the composition of the rubber, the greater the hardness value. b) For tensile testing, specimen 1 with the addition of 3 phr sulfur from the composition of the rubber material has a value of 15.394 N/mm^2, specimen 2 with 4 phr sulfur has a tensile test value of 12.71 N/m^2, specimen 3 is 11.44 N/mm^2 , while the market specimen value was 13,312 N/mm^2. From these data, it can be seen that the greater the addition of sulfur to the rubber composition, the lower the tensile strength value of the specimen, and the smaller the addition of sulfur composition, the higher the tensile stress value obtained.

REFERENCE

[1] N. Muhammad, "Analisis Sistem Rem Tromol Pada Trainer Sistem Rem Mobil Suzuki Futura Tahun 2003," *J. Mek.*, vol. 11, no. 09, pp. 2–6, 2013.

[2] Sugiharjo and Awang Surya, "Analisis Rem Forklift Model Fd30t-17 Terhadap Availability di Perusahaan Pengolah Limbah," *JTTM J. Terap. Tek. Mesin*, vol. 3, no. 1, pp. 27–40, 2022, doi: 10.37373/jttm.v3i1.126.

[3] Z. H. Mery Christina, Bahruddin, "PENGARUH KADAR ASAM STEARAT, MERCAPTODIBENZOTHIAZYLDISULFIDE (MBTS) DAN SULFUR TERHADAP SIFAT DAN MORFOLOGI THERMOSET RUBBER DENGAN FILLER CARBON BLACK-ABU TERBANG SAWIT," vol. 1, no. 2, pp. 1–11, 2014, [Online]. Available: https://jom.unri.ac.id/index.php/JOMFTEKNIK/article/view/4086

[4] A. Falaah, A. Cifriadi, and Mochamad Chalid, "Pengaruh jenis karet alam terhadap sifat fisika vulkanisat karet untuk produk bantalan jembatan," *J. Sains Mater. Indones.*, vol. 17, no. 602/AU3/P2MI-LIPI/03/2015, pp. 69–76, 2015.

[5] S. P. Ammineni, C. Nagaraju, and D. Lingaraju, "Thermal degradation of naturally aged NBR with time and temperature," *Mater. Res. Express*, vol. 9, no. 6, 2022, doi: 10.1088/2053-1591/ac7302.

[6] P. I. P. Muhammad Alfatih Hendrawan, "STUDI KARAKTERISTIK SIFAT MEKANIK KOMPON KARET DENGAN VARIASI KOMPOSISI SULFUR DAN CARBON BLACK SEBAGAI BAHAN DASAR BAN LUAR," *Simp. Nas. Teknol. Terap.*, vol. 3, 2015, [Online]. Available: https://publikasiilmiah.ums.ac.id/xmlui/bitstream/handle/11617/6215/5.SNTT_2015_submission_19.pdf?sequence=1

[7] A. Hasan, E. Dewi, I. Purnamasari, D. Irawan, and P. Y. A. S, "Sifat Fisik Vulkanisat Karet Dengan Bahan Pengisi Variasi Tanah Liat Di Berbagai Lapisan Area Tambang PT. Bukit Asam (Persero) TBK.," *J. Kinet.*, vol. 10, no. 01, pp. 31–37, 2019.

[8] M. Maciejewska and A. Sowi, "Vulcanization of Styrene-Butadiene Elastomer Filled with Carbon Black," 2021.

[9] A. R. I. Sugiyanto, "Pengaruh Sulfur Terhadap Kekerasan Produk (Rubber Bushing) Dengan Perbedaan Jumlah Sulfur 8Gram , 10Gram," 2013.

[10] Pramuko Ilmu Purboputro, "PENGARUH KOMPOSISI BELERANG TERHADAP KEKERASAN DAN KEAUSAN BAHAN KARET LUAR BAN PADA LINTASAN ASPAL," pp. 12–17, 2012.

[11] W. Riki Hendarto, Pramuko IP, "Koefisien Grip Dengan Lintasan Semen," 2014, [Online]. Available: https://eprints.ums.ac.id/30418/20/11.NASKAH_PUBLIKASI.pdf

[12] M. A. H. Ihwan Basirun N.S, Pramuko. I P, "PENGARUH BLACK CARBON DAN SULFUR TERHADAP KOEFISIEN GRIP BAHAN BAN LUAR DENGAN BATIKAN BULAT DI LINTASAN BETON PADA KONDISI KERING DAN BASAH," 2016, [Online]. Available: https://eprints.ums.ac.id/43407/3/Halaman Depan.pdf

[13] M. Maciejewska, A. Sowinska, and J. Kucharsk, "Organic zinc salts as pro-ecological activators for sulfur vulcanization of styrene-butadiene rubber," *Polymers (Basel).*, vol. 11, no. 10, 2019, doi: 10.3390/polym11101723.

[14] F. Delvitasari and M. Maryanti, "Pengaruh Suhu dan Waktu Vulkanisasi Terhadap Sifat Kekerasan dan Visual Produk Footstep Sepeda Motor," *J. Teknol. Agro-Industri*, vol. 7, no. 2, pp. 81–90, 2020, doi: 10.34128/jtai.v7i2.123.

[15] SNI ISO 37:2015, "SNI ISO 14044-2017.pdf."