



# STUDYING THE MECHANICAL PROPERTIES OF TIRE RUBBER BEFORE AND AFTER CONSUMPTION

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<p><b>Received:</b> 6<sup>th</sup> November 2023 <b>Accepted:</b> 3<sup>rd</sup> December 2023 <b>Published:</b> 4<sup>th</sup> January 2024</p>	<p>The purpose of this studying is to investigation of the mechanical characteristics of the rubber tires before and after consumption. A new and old car tires were used and three samples from each tire were used to prepare the samples [tensile strength, hardness, and wear]. When the sample is examined, it's found that the tire before use had a tensile value of 11.5 MPa and a hardness value of 56.5 and the tire after use had a tensile value of 4.5 MPa and a hardness value of 72.5, meaning that the tire after use has less hardness and tensile strength. This is due to the breakage of the chains in the rubber due to friction and heat between the ground and the rubber. The results of the wear test show that the weights losses of the tires before using after part "half" an hour on the wear device is 0.001g, and the weight losses of the tire after using after "half" an hour on the wear device is 0.0015g, therefore the weight loss of the sample are few since the rubbers are reinforced by many type of fibers.</p>

**Keywords:** Rubber; Tire; Tensile strength; hardness; Wear.

## 1. INTRODUCTION

Rubber, being an exceptional material, finds extensive utilisation in various engineering domains, including automotive, civil, and electrical applications [1], [2]. It is widely recognised that unfilled rubber has very low physical strength and is not practically useful. Fillers are additional substances incorporated into a rubber compound with the intention of either strengthening or reducing the cost of the compound. However, fillers can also be employed to alter the physical characteristics of both unvulcanized and vulcanised rubbers. Commonly used additives consist of carbon black, calcium silicate, calcium carbonate, and clay. Fillers can be categorised as either black or non-black (white) fillers. White fillers are less commonly utilised in the rubber business compared to black fillers. It is employed in the manufacturing of tires, hoses, and cables. White fillers are commonly employed in the footwear, general rubber goods, and automobile industries [3]. The rubber materials are extensively utilised in various applications nowadays because of their exceptional mechanical qualities. Rubber materials find significant utility in various applications such as seals, tires, gaskets, hoses, and vibration absorbers. The products in the automotive sector function in challenging environments. The user's latest requirements have focused on the ability of these materials to withstand high temperatures and keep their mechanical properties in such conditions [4], [5]. Tire wear and abrasion refer to the inevitable degradation of rubber material that occurs when tires come into contact with road surfaces. This degradation is primarily caused by the formation of fatigue cuts and the detachment of rubber debris [6]. In this study, the mechanical characteristics of local rubber tires will be investigated. The tensile strength, hardness, and wear rate would be characterized and compared for the new and used tires.

## 2. MATERIALS AND METHODS

### 2.1. Materials

Two tires of the same type were brought, one new and the other used for a year. Both tires were purchased from the local market, and on this basis, these two types were used for the purpose of conducting the necessary tests. After the tires were chosen, they were cut according to ASTM-D into different shapes to prepare the tensile, hardness, and wear samples.

### 2.2. Methods

The mechanical properties such as tensile strength, shore Hardness and wear rate were characterized. Tensile strength was measured using a universal testing machine. Hardness was measured using a shore A hardness devise. The wear rate was measured by measuring the volume of material removed over a certain time period. For all tests, three samples have been taken, and the average was taken.

### 3 RESULTS AND DISCUSSIONS

#### 3.1 Tensile Test results

Figure 1 shows the tensile strength of the new and used tires. It is found that the tensile strength reduced when we compare the two types of tiers. It is shown from the figure that the new tire has a tensile strength of 11.5 MPa and the used tire has a tensile strength of 4.5 MPa. It is found that there is a huge reduction in tensile strength when comparing the results of the new and the old tire. This reduction could be attributed to the effect of environmental factors such as heat and sun light, which cause breakup and bond scission in the backbone of rubber. These results are in good agreement with [7], [8], which state that during the use of rubber products, there will be a reduction in the mechanical properties due to the effect of the working environment on the rubber products, thus causing a change in the properties.

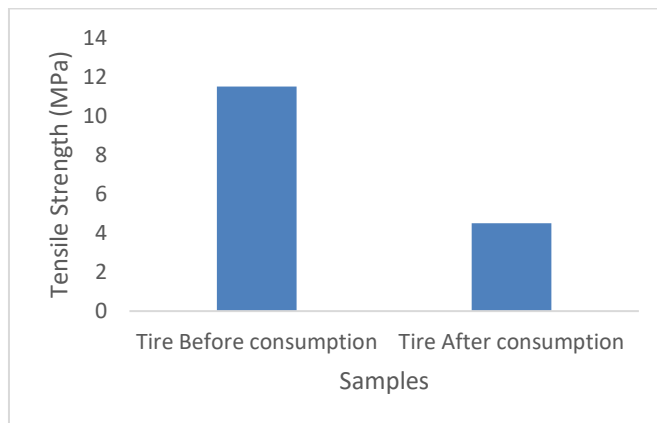


Figure1: The tensile strength for tire before and after consumption.

#### 3.2 Hardness Test results

Figure 2 shows the shore A hardness for new and used tire samples. It was found that the hardness increased when we compared the results of the two tires (new and used). From figure 2, it is shown that the new tire has a hardness of 56.5 shore A and the used tire has a hardness of 72.5 shore A. From these results, it can be seen that there is an increase in tire hardness after consumption, which can be attributed to chain scission and breakup caused by environmental factors, as in [9], [10]. In addition, according to other researchers, the noise of the new tire is much lower than the old one for the same reasons.

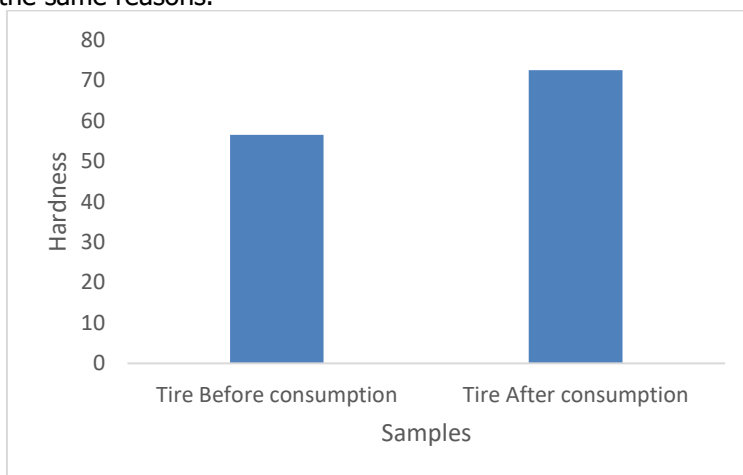


Figure 2: The Shore A hardness for tire before and after consumption.

#### 3.3 Wear Test results

Figure 3 shows the wear rate for the new and used tires. It was found that the used tire has a higher wear rate than the new tire. From Figure 3, it is found that the new tire has a wear rate of 0.001 and the used tire has a wear rate of 0.0015. These results could be attributed to the higher stiffness of the used tire and, thus, the higher hardness as indicated above. The environmental factors have a strong effect on the rubber properties. By the time the rubber products become hard and weak, they are easily losing their properties. These results are in agreement with [11]–

[13], who stated that the rubber parts have high wear rates when a long time passes and thus their properties are reduced.

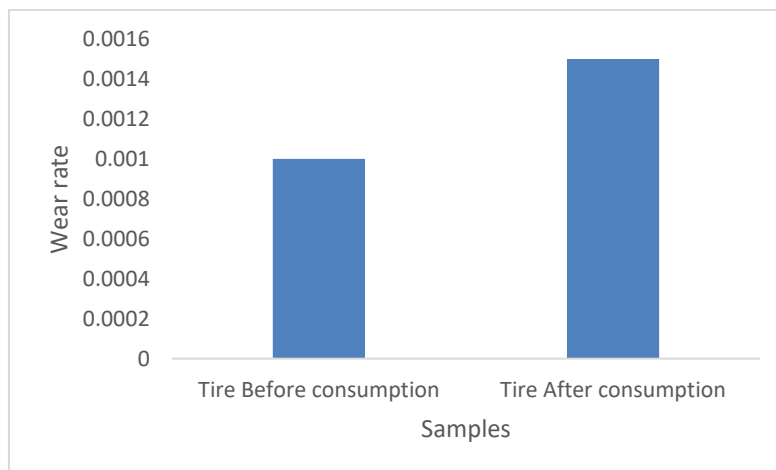


Figure 3: The wear rate for tire before and after consumption.

## CONCLUSION

From the above results, it can be concluded that the new tire has better mechanical properties than the used tire. It was found that the tensile strength was higher for the new tire and both the shores. The hardness and wear rate are lower, which is best to give better performance by the time these results are changed and thus cause a change in tire performance. So, from this study, we can determine the life of tires and thus determine the best time for each tire to change before it reaches its critical stage.

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