

A COMPARATIVE STUDY OF STRENGTH AND HARDNESS OF TWO MOTORCYCLE SPOKE WHEELS

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ABSTRACT

The wheels are a vital component for safety in driving as well as supporting the vertical load of the vehicle when the vehicle is rotating or at rest and serves as a continuation of the rotary motion of the engine to move from one place to another. These wheels are used in a motorcycle made from iron and aluminum alloys material. We perform the tensile and hardness test to obtain their strength and hardness value. We found from our measurement that the maximum tensile stress for the aluminium and iron velg are 155.08 MPa and 277.62 MPa, respectively. The values are directly proportional with the hardness of those material, in which the hardness of iron velg is much higher than that one of aluminium velg by 521.8 VHN.

Keyword: *wheel; tensile test; hardness test; strength.*

1. INTRODUCTION

Wheels are an important spare part for a vehicle, because they make the shape of the tires perfectly round which allows the vehicle to travel from one place to another. The wheels are also an accident-prone point because these parts receive loads of weight and impact when facing uneven road textures [1].

The condition of the wheels that are not round automatically affects driving comfort. The more severe the wheel shape changes, the more difficult the vehicle is to control. The risk of damage to the wheels causes the demand for wheels to increase [2]. The demand for alloy wheels in Indonesia continues to increase, both from the modification of wheels and the need for standard spare parts for certain brands of

vehicles. One of the problems that arise is that it occurs with a wide variety of aftermarket wheels, for example if aftermarket wheels do not match the weight of the vehicle there is a risk of dents or breaks. For that, of course it must be standardized for the safety and comfort of the rider.

On motorbikes, there are several types of wheels that are widely applied to various types of motorbikes [3]. The advantages of spoke wheel wheels can better reduce collisions, especially on trail motorbikes that often pass on bumpy roads. In the second type of wheels, Cast Wheel (Racing Wheel) which is specifically used for racing wheels, the main advantage is in the handling. Therefore, the automotive world, especially motorcycles in Indonesia, use Spoke Wheel and Cast Wheel

(Racing Wheel). Generally, users in Indonesia are more interested in Spoke Wheel wheels because they display a variety of different colors and consumers can also choose wheels with factory standard quality using the main material of iron, or after market products using the main material, namely aluminum [4-6].

One of the weaknesses of the spoke wheel, where when walking on an uneven road construction the impact that occurs on this wheel results in dents, broken. But the maintenance of Spoke Wheel wheels is very simple, so it can maintain the durability of the wheels so that they can last a long time, the method is quite easy, just cleaning with clean water when exposed to rain water, if not cleaned, the surface layer of the wheels will gradually reveal rust spots so that it can reduce its durability [7,8]. To maintain the condition of the Spoke Wheel, it is necessary to adjust it at least once a month and the driver must also avoid potholes in order to maintain wheel durability.

The quality of the wheels can be measured by the tensile strength and compression of the alloy wheels. To evaluate the quality of the wheels that are widely used, we conducted a comparative study of the tensile strength and hardness of two types of spoke wheel motorcycles.

2. METHODS

The specimens are obtained from the D.I.D and Vrossi wheels which are made of aluminum and iron alloys, respectively. The wheels were cut using a grinder into 12 parts with a length of each specimen of 8 cm, then the surface was smoothed using sandpaper.

Three specimens for each aluminum and iron material were tested for tensile and hardness by using the Hydraulic Universal Testing Machine Model WEW – 300D and the Digital Micro Vickers Hardness Tester of the Beijing Time High Technology Ltd. Brand. Series: HVS – 1000Z, respectively.

3. RESULTS AND DISCUSSION

3.1 Tensile Test

Table 1 shows the specimens of aluminum alloy wheels and iron alloy wheels before and after the tensile test. W_i , W_f , T_i , T_f , G_i , and G_f indicate initial width, final width, initial thickness, final thickness, initial gauge length and final gauge length, respectively.

Table 1. Test data for specimens of aluminum and iron alloy wheels.

Specimen	W_i	W_f	T_i	T_f	G_i	G_f
Aluminium	8.7	8.7	5.1	5.1	25.0	33.2
Iron	8.1	8.1	3.2	6.27	25.0	29.9

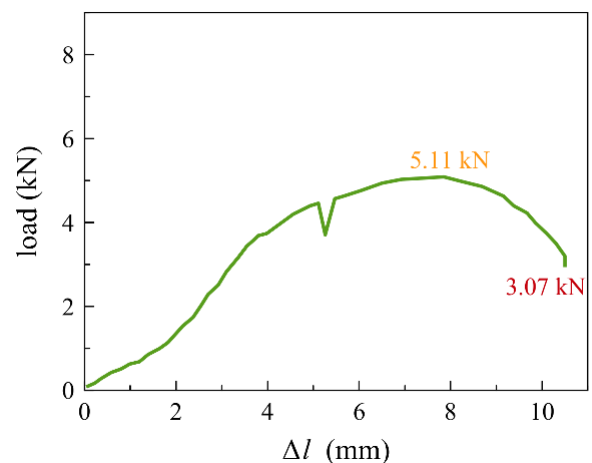


Figure 1. Graph of tensile test results for aluminium alloy wheel specimens

Figure 1 shows that the maximum tensile load is 5.11 kN and the breaking load is 3.0 kN. If the sectional area of the plane in the test area is obtained when the maximum load is $44.37 \times 10^{-6} \text{ m}^2$, then the value of the maximum tensile stress is 115.08 MPa. The change in the maximum length of the specimen before breaking is 10.5 mm. Thus, if the initial length of the test area is 25.0 mm, the maximum strain of the object before breaking is 0.33.

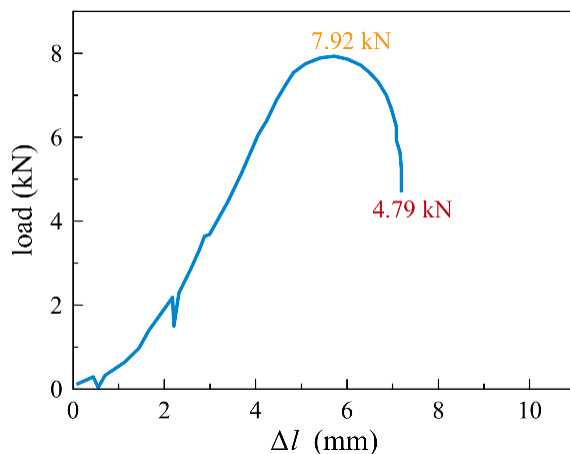


Figure 2. Graph of tensile test results for iron alloy wheel specimens

From Figure 2, we can see that the maximum tensile load is 7.92 kN and the breaking load is 4.79 kN. If the cross-sectional area of the plane in the test area is obtained when the maximum load is $25.92 \times 10^{-6} \text{ m}^2$, then the value of the maximum tensile stress is 277.62 MPa. The change in the maximum length of the specimen before breaking is 4.9 mm. Thus, if the initial length of the test area is 25.0 mm, the maximum strain of the object before breaking is 0.20.

From the results of the tensile test, we can find out the comparison of the strength and ductility of aluminum alloy wheels and iron alloys. Iron alloy wheels can withstand a greater maximum load than aluminum alloy wheels. On the other hand, aluminum wheels are more ductile than iron wheels.

3.2 Vickers Hardness Test

The results of the hardness test on the specimens of aluminum and iron alloy wheels showed an average result of 62.9 VHN and 584.7 VHN, respectively.

These results indicate that the hardness level of aluminum alloy wheels is much lower than iron alloy wheels. These results are consistent with the results of the tensile test, where the maximum stress on the aluminum alloy wheels is smaller than that one on the iron alloy wheels. So that in this case we can say that the hardness of a material is directly proportional to its tensile strength.

4. CONCLUSION

From our results, we can conclude that iron alloy wheels have a maximum tensile stress greater than that of aluminum alloy wheels. On the other hand, aluminum wheels are more ductile than iron wheels. Since the hardness level of aluminum alloy wheels is much lower than iron alloy wheels, we can also say that the hardness of a material is directly proportional to its tensile strength.

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