

COMPARATIVE STUDY OF WHEEL RIM MATERIALS

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ABSTRACT

Rim is a central part of wheel over which a rubber tyre is mounted. In wheel assembly tyre mounted on the rim in between the left and right board flanges over the bead seat area. Wheel convert axle torque into the rotational motion that rotating tyre comes in contact with road surface and rotational motion gets converted into the linear motion of a vehicle, that means wheel assembly is very important part of any automobile without it vehicle cannot displace from one position to another. Well build road surfaces are not available everywhere in the world. On road there are so many up and downs as well as pot holes which are responsible for impact load on the wheel and rim directly. Wheel is subjected to the loads of passenger, goods in addition with self weight of vehicle itself, such load act as an alternating load and responsible for induction of alternating stresses into the rim and resulted fatigue failure of rim. Apart from above load wheel rim come in contact with environmental conditions which adversely affects on the rim. This paper presents comparative study of various types of wheel rim materials in comparison with wide varieties of aspects.

Keyword: - Mechanical properties, Chemical properties, Cost, Heat dissipation, Cost, Ground contact, deformation, appearance, weight.

1. EVOLUTION OF WHEEL RIM

First vehicle was designed and manufactured by Mercedes and Benz Company at the end of eighteenth century. At that time they used a steel wired spoke wheel rim in his cars. From 1890 to 1960 steel wire wheels are used mostly in the cars, such wired spoke wheel become obsolete in the market after 2010. Still such wheels are rarely seen in the two wheelers. In the decade of 2000-2010 wired rims of bikes are replaced by casted wheel rims due its stylish appearance. Casted rims are easy to clean, light in weight, excellent corrosion resistance, durable, excellent heat dissipation from its body to the surrounding. In US researchers are studying on the carbon fiber material, which is very light. Prototype developed by researches currently used in SUV vehicle rims. For heavy duty vehicles single piece forged wheel rims are used.

1.1 Basic Requirement of Wheel Rims

Depending upon the application where wheel rims are used its design requirement also changes. Design of agricultural vehicles Wheel rims far differ from the passenger vehicles. But basic design requirements are similar. Basic requirements of any vehicle wheel rim includes following mechanical characteristics.

- i) Structural Stiffness
- ii) Static Strength (Deformation under all types of loads).
- iii) Fatigue strength.
- iv) Impact Strength.

1.2 Other Design Consideration

Apart from mechanical properties there are some important factors must be considered while selecting a material for wheel rim. Other design consideration includes Heat Dissipation, style and weight, dimensional tolerances and corrosion resistance. Rim material should be as light as possible so that unsprung weight gets directly reduced.

2. COMPARISON

Following table depicts comparative study of various factors considered while designing wheel rim for materials such as aluminium alloys, Magnesium Alloys, Steel C1008, Carbon Fiber and Forged Steel.

Table-1: Comparison of Various Materials for different aspects

Material Factor Considered	Aluminium	Magnesium Alloys	Steel C1008 (Sheet metal wheel)	Carbon Fiber	Forged steel
Weight	Light	Medium	Heavier than Mg & Al	Light	Heavier than Mg & Al
Appearance	Pleasant	Pleasant	Bright	Somewhat dull	-----
Cost of Rim	Costlier	Costlier	Cheap	Costlier	Expensive
Material Cost	Costlier	Costlier	Cheap	Costlier	Cheap
Deformation under load	Too much deformation	Less as compared to Al	Less as compared to Al & Mg	-----	Less deformation than other materials.
Corrosion Resistance	Excellent	Excellent	Poor but improved by adding alloys.	Excellent	-----
Cast ability	Casted easily	Casted easily	Difficult to cast	-----	-----
Maintenance/Repair of rim	Easy to repair	Can't repaired	-----	-----	-----
Effect on Unsprung Weight	Reduce	Reduce	More than the Al & Mg	-----	More than Al, Mg & Steel C1008
Heat Dissipation	Better	Best	Good	-----	Good
Durability	As equal to forged rim	Durable	-----	-----	Durable
Mechanical properties	Poor than Steel	Poor than Steel	As good as forged steel.	-----	Better than forged wheels
Number of Piece in a Rim	If casted single piece & Sheet metal multi piece	Generally casted hence single piece	Generally two piece.	-----	Single piece
Flammability	Not Flammable	Flammable	Not Flammable	Flammable	Not Flammable
Driving comfort	-----	-----	-----	-----	-----
Road Handling	-----	-----	-----	-----	-----
Ground contact	Regain Easily	Regain Easily	Good ground contact for light weight rims.	Better ground contact.	Poor Ground contact.

In above comparison two factors not explained yet they are mentioned in the table so that designer can consider and study over that parameters while designing a wheel rim.

4. CONCLUSIONS

Right material for right design plays an important role in the life of any mechanical components. Comparative study will help any designer while selecting materials for wheel rims of any type of ground vehicles. Deformation of light weight alloy wheel is more than the steel and forged steel, which means forged steel, can be used for light as well heavy duty vehicles such as trucks, tractors, trolley, scooter, bikes etc.

Heat dissipation and corrosion resistance of Mg and Al alloy is better as compared to Steel C1008 and forged steel.

Al materials presented in table-1 are durable yet durability is also dependent on the manufacturing method employed for rim, dimensional design of rim.

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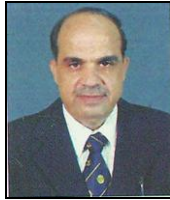
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