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Experimental Investigation of Al-Mg-SiC-Fly Ash Composites for Automotive Alloy Wheel Rims

Chintala Sai Virinchy[a,d], V. Jayakumar[b], Abdul Hafeez Asif[a] and R. Pugazhenthi[c]

[a]*Dept. of Mech. Engg., Saveetha School of Engg., Saveetha Institute of Medical and Tech. Sci., Chennai, India*
[b]*Dept. of Mech. Engg., Amrita School of Engg., Amrita Vishwa Vidyapeetham, Chennai, India*
[c]*Dept. of Mech. Engg., Vels Institute of Sci., Tech. & Advanced Studies, Chennai, India*
[d]*Corresponding Author, Email: virinchysai1310@gmail.com*

ABSTRACT:

The conservation of resources is the biggest concern for the past half century. The mankind is heading towards the betterment of living with a key intention to obtain pertaining results with less effort. One such field which has been an extensive outreach for research and innovation is the composite materials. This study focuses on design and development of a new composition of materials which has enhanced mechanical properties than the existing materials. This study is about combining four materials namely aluminium, magnesium, SiC and fly ash in various proportions and to test the obtained specimens. The test specimens are fabricated with aluminium as the metal matrix and other materials (Mg, SiC & fly ash) as reinforcements. Three different combinations are designed by keeping the fly ash, silicon carbide at constant percentage and varying the contents of aluminium and magnesium. The results of the tests are promising and the proposed composition can be a potential reliable replacement material for existing alloy wheels.

KEYWORDS:

Automotive; Alloy wheels; Novel composite material; Alloy wheel rim

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1. Introduction

The decrease of natural resources has been a major problem and to satisfy the requirements of increasing population most of the automotive makers and their sub-contractors are trying to decrease the burden of the members in recent years. During this approach low value, high strength to weight ratio materials are being explored and investigated. Replacing composite materials for standard metallic substances has major benefits owing to their better strength and specific stiffness. They have the foremost advantage of high strength to weight ratio, offer excellent fatigue strength, better torsional buckling and high specific strain energy storage capability and are resistant to corrosion. Magnesium AZ91E-2% Al_2O_3 for alloy wheels is investigated [1]. The experiment was carried out with the maximum load that can be applied on the rim. The result observed was that the titanium alloy had the best properties when compared to that of aluminium and magnesium [5]. Various types of tests and FEA techniques were employed for the analysis.

The deflection in alloy wheel Al2024-T351 was much less than A 356.2 alloy wheel [15]. The FEM is employed for validating thin composite beams. The main reason to model a thin composite beam is optimization of weight can be achieved through it [2]. High strength steel in a composite beam and its flexural behaviour is analysed. The nonlinear deformation behaviour reduces with the increase of steel grade [4]. The ULW carbon fibre or thermoplastic composite material using spread low technology [3]. Rotary fatigue test simulation was used to analyse the fatigue life of aluminium wheels and the weakness area can be protected [6]. Deflections were more in aluminium and more stress was induced compared to that of forged steel and latter was concluded as the best material for designing wheel rims [7]. A352.6-T6 Aluminium alloy's fatigue life is evaluated by the generation of S-N curve. The safety factors that are proposed as a result is useful as prediction for a reliable fatigue life, when the components are subjected to a radial fatigue load [8].

In a comparative study for two different materials such as carbon steel and Al alloy, the displacement in Al alloy wheel rim is more as compared with the steel at different loading conditions. They absorbed more loads which declared that aluminium alloys were more suitable [9]. For a 5 spoke wheel, aluminium is the best among magnesium alloy, steel alloy and aluminium alloy. The aluminium alloy offered better heat conduction and improvement of heat dissipation from the brakes. This can reduce the risk of brake failures [10-11]. $AlSi_7MgO_3$ aluminium alloy is used in a car wheel rim. The light weight Mg alloy is a good heat conductor and have an excellent aesthetic appearance [12]. The automotive wheel rims tend to ovalize at the point of contact when maximum displacement was applied at the bead seat [13]. The aluminium automotive manual [14] has a well