

[Read publisher preview](#)[Download citation](#)[Copy link](#)[Home](#) > [Composites](#) > [Materials](#) > [Physics](#) > [Materials Science](#) > [Metal Matrix Composites](#)[Article](#)[Publisher preview available](#)

Wear Optimization of Aluminium and Hybrid Reinforcement Metal Matrix Composites Using Response Surface Methodology



Materials Science Forum

October 2022 · 1073(6):37-48

DOI:10.4028/p-8x10qb

Authors:



S. Muzeer

Sivaganesan Selvaraju  
Vels University

To read the full-text of this research, you can request a copy directly from the authors.

[References \(15\)](#)

## Abstract

Aluminum 6061 alloy-based alloys were used to make various motor vehicle parts such as connecting wire, O-ring, circular blocks, disc brakes and aircraft primary components, but the use of alloys was restricted in some of their applications due to their low strength, poor stiffness and high friction wear resistance. Hybrid Aluminium Metal Matrix Composites are achieved the potential mechanical properties compared to single reinforced composite materials. Tribological behaviour of hybrid composites were optimized by Response Surface Methodology (RSM) using Design of experiment statistical analysis. The contribution of various parameters rotational speed, sliding distance and axial load on hybrid composite materials were evaluated by Analyses of Variance (ANOVA). For each output response, a multilayer linear equation was used to examine the relationship between the parameters. According to the results, hybrid compounds provide greater adaptability and reliability in the development of a component of the product depending on the reinforcement composition and structure.

## Discover the world's research

- 25+ million members
  - 160+ million publication pages
  - 2.3+ billion citations
- [Join for free](#)

[Publisher Preview](#) <sup>①</sup>

A preview of this full-text is provided by Trans Tech Publications Ltd.

Content available from **Materials Science Forum**   
This content is subject to copyright. [Terms and conditions](#) apply.

Materials Science Forum  
ISSN: 1662-9752, Vol. 1073, pp 37-48  
doi:10.4028/p-8x10qb  
© 2022 Trans Tech Publications Ltd, Switzerland

Submitted: 2022-04-08  
Revised: 2022-04-30  
Accepted: 2022-05-04  
Online: 2022-10-31

## Wear Optimization of Aluminium and Hybrid Reinforcement Metal Matrix Composites Using Response Surface Methodology

MUZEER.S<sup>1,a\*</sup>, SIVAGANESAN.S<sup>2,b</sup><sup>1</sup>Vels University, Pallavaram, Chennai, INDIA<sup>2</sup>Vels University, Pallavaram, Chennai, INDIA<sup>a</sup>saiyed.muzeer.30@gmail.com, <sup>b</sup>sivaganesanme@gmail.com

**Keywords:** Analyses of Variance, Optimisation, Hybrid composites, Response surface methodology, wear, reinforcement.

**Abstract.** Aluminum 6061 alloy-based alloys were used to make various motor vehicle parts such as connecting wire, O-ring, circular blocks, disc brakes and aircraft primary components, but the

[Read publisher preview](#)[Download citation](#)[Copy link](#)

potential mechanical properties compared to single reinforced composite materials. Tribological behaviour of hybrid composites were optimized by Response Surface Methodology (RSM) using Design of experiment statistical analysis. The contribution of various parameters rotational speed, sliding distance and axial load on hybrid composite materials were evaluated by Analyses of Variance (ANOVA). For each output response, a multilayer linear equation was used to examine the relationship between the parameters. According to the results, hybrid compounds provide greater adaptability and reliability in the development of a component of the product depending on the reinforcement composition and structure.

## Introduction

Aluminum AA6061 hybrid reinforcement composites are plays important role in various industrial applications such as automobile (engine components), safety, construction and aircraft structures due to the development in properties. The aluminium alloy properties are reduction in weight, high corrosion resistance, enhanced thermal properties and high wear resistance [1,2]. The lifespan of the materials is affected by a wide range of factors, and the composition used has a significant impact on the quality of life. The choice of material for the appropriate application will vary based on the price of the material, the estimated density, strength, modulus and functional parameters.

Reinforcement metal oxides silica, B<sub>4</sub>C, SiC, BN and TiN are used to form alloy matrix alloys [3,4]. Aluminium metal matrix composites of tribological characteristics such as wear and friction contribute a significant role while the manufacturing process as reported by the previous researches [5,6]. The moving and rotary parts that are designed to operate in greasing circumstances might ultimately have to operate in semi-lubricated or dry wet conditions. As a result, wear increases due to high operating temperature fluctuations, leading to replacement of mechanical components during operation. As a result, it is one of the main problems to be considered in trying to extend the life of a broken material. Hybrid composite materials are selected as alternatives to compounds in the dry lubricate conditions.

Uvaraja et al 2012 examined the varying wear parameters such as sliding speed, applied load, sliding distance and different volume fractions on AA6061 aluminium reinforced with B<sub>4</sub>C and SiC composites [7]. The results show that 10 wt% SiC and 3% B<sub>4</sub>C have better wear resistance. Also, the measured hardness values are higher than those of pure aluminum alloys. The addition of 5% SiC and 15% B<sub>4</sub>C to AA6061 alloys had significant effects on the interface. Radhika et al 2011 improved the wear parameter such as load, sliding distance and sliding speed used by ANOVA using the Response Surface System (RSM) respectively for the coefficient of friction and the rate of wear. The prediction 'smaller the better' have used to analyse the wear performance of aluminium-based metal matrix composites [8,9].

All rights reserved. No part of contents of this paper may be reproduced or transmitted in any form or by any means without the written permission of Trans Tech Publications Ltd, www.scientific.net. (Research Gate for subscription journals-07/02/24,12:24:47)

Citations (0)

References (15)

### Effect of SiC Reinforced Particle Parameters in the Development of Aluminium Based Metal Matrix Composite

[Article](#) [Full-text available](#)

Sep 2019

[Manish Maurya](#) · [Nagendra Kumar Maurya](#) · [Vivek Bajpai](#)
[View](#) [Show abstract](#)

### An Investigation on Mechanical and Wear Characteristics of Al 6063/TiC Metal Matrix Composites Using RSM




[Article](#) [Full-text available](#)

Sep 2019

[P Venkateshwar Reddy](#) · [P. Rajendra Prasad](#) · [D.Mohan Krishnudu](#) · [E. Venugopal Goud](#)
[View](#) [Show abstract](#)

### Investigation on mechanical properties and dry sliding wear characterization of stir cast LM13 aluminium alloy-ZrB<sub>2</sub>-TiC particulate hybrid composites

[Read publisher preview](#)[Download citation](#)[Copy link](#)

 Arun Bharathi ·  Ashoka Perumal ·  Samson Jerold Samuel C




[View](#) [Show abstract](#)

---

**Investigation on mechanical properties and dry sliding wear characterization of stir cast LM13 aluminium alloy-ZrB<sub>2</sub>-TiC particulate hybrid composites**

[Article](#) [Full-text available](#)

Mar 2019

 Arun Bharathi ·  Ashoka Perumal ·  Samson Jerold Samuel C

[View](#) [Show abstract](#)

---

**Wear and Corrosion Behavior of Al-Si Matrix Composite Reinforced with Alumina**

[Article](#) [Full-text available](#)

Mar 2015

Khalid Abd El-Aziz ·  Dalia Saber ·  Hossam E. M. Sallam


[View](#) [Show abstract](#)

---

**Tribological Behaviour of Aluminium/Alumina/Graphite Hybrid Metal Matrix Composite Using Taguchi's Techniques**

[Article](#) [Full-text available](#)

Apr 2013 · IND LUBR TRIBOL

 N. Radhika · R. Subramaniam

[View](#) [Show abstract](#)

---

**Wear behavior of Al 7075/Al<sub>2</sub>O<sub>3</sub>/SiC Hybrid NMMC's by Stir Casting Method**

[Article](#)

Jan 2020

S. Suresh ·  Harinath Gowd ·  Devakumar M.L.s.




[View](#) [Show abstract](#)

---

**Analysis of EN24 steel in turning process with copper nanofluids under minimum quantity lubrication**

[Article](#)

Feb 2019 · J BRAZ SOC MECH SCI

 M Naresh Babu Babu ·  Anandan v. ·  Nambi Muthu krishnan


[View](#) [Show abstract](#)

---

**Tribological characterization of stir-cast hybrid composite aluminium 6061 reinforced with SiC and B<sub>4</sub>C particulates**

[Article](#)

May 2012

 Uvaraja V C ·  Natarajan Nanjappan

[View](#) [Show abstract](#)

---

**Investigations on dry sliding wear behavior of in situ casted AA7075-TiC metal matrix composites by using Taguchi technique**

[Article](#)

Aug 2014 · MATER DESIGN

 Bas Sel ·  Anandakrishnan Veeramani ·  Muthukannan Duraiselvam

[View](#) [Show abstract](#)

---

[Show more](#)

[Read publisher preview](#)[Download citation](#)[Copy link](#)Recommended publications Discover more about: [Metal Matrix Composites](#)Article [Full-text available](#)

Experimental investigation on tribological performance and development of wear prediction equation o...

May 2022 · International Journal on Interactive Design and Manufacturing (IJIDeM)

● Khoman kumar dewangan · ● Balaji Dabade · Lalit N. Wankhade · [...] · ● Ganesh Ramchandra Chavhan

Aluminum matrix composites are used in high-temperature applications such pistons, cylinder heads, and blocks for automobile engines. As a result, it's important to evaluate the performance of an aluminium metal matrix composite at high temperatures.in this study, we tried to find out the tribological behaviour of composite Al–SiC at elevated temperatures. The current study examines the wear ... [\[Show full abstract\]](#)

[View full-text](#)

Article

Dry sliding wear behavior of heat treated hybrid metal matrix composite using Taguchi techniques

November 2014 · Materials &amp; Design (1980-2015)

● Dr T S Kiran · ● M. Prasanna Kumar · ● Satyappa Basavarajappa · ● B.M. Viswanatha

Dry sliding wear behavior of zinc based alloy and composite reinforced with SiCp (9 wt%) and Gr (3 wt%) fabricated by stir casting method was investigated. Heat treatment (HT) and aging of the specimen were carried out, followed by water quenching. Wear behavior was evaluated using pin on disc apparatus. Taguchi technique was used to estimate the parameters affecting the wear significantly. The ... [\[Show full abstract\]](#)

[Read more](#)

Article

Influence of bioceramic reinforcement on tribological behaviour of aluminium alloy metal matrix comp...

September 2021 · Journal of Materials Research and Technology

● Bhuvaneswari v. · ● Rajesh Kumar L · K Nimel Sworna Ross

Composite materials have become inevitable in many current day engineering applications. Aluminium alloy based composites were used in numerous fields of engineering and technology owing to their enormous advantages including low processing cost and broader scope of application. Developing a sustainable bio composite has become the order of the day to mitigate associated environmental issues. In ... [\[Show full abstract\]](#)

[Read more](#)

Article

A study of sliding wear behaviors of Al-7075 alloy and Al-7075 hybrid composite by response surface...

September 2013 · Materials &amp; Design (1980-2015)

● Ravinder Kumar · Suresh Dhiman

In this paper, an attempt has been made to investigate the specific wear rate of the unreinforced Al 7075 and hybrid aluminum metal matrix composite reinforced with the hard ceramic (7 wt.% of SiC) and soft solid lubricant (3 wt.% of graphite) fabricated by using stir casting method. The unlubricated pin-on-disc wear tests were conducted to examine the wear behavior of the aluminum alloy and its ... [\[Show full abstract\]](#)

[Read more](#)

Article

Tribological behaviour of aluminium based hybrid metal matrix composites (Al6061/B4C/ZrO2/SiC)

February 2022 · Materials Today Proceedings

S. Muzeer · ● Sivaganesan Selvaraju

This research is aimed into the use of stir casting technique to make a variety of reinforced aluminium and non-reinforced hybrid composite materials. Aluminium Metal Matrix reinforced with different volume proportions of ZrO2 (2%, 4% and 6%) and SiC (4%, 8%, 12%) particulate by stir casting techniques. Al6061 and B4C are selected as a base material and ZrO2 and SiC utilized as a reinforced

Read publisher preview

Download citation

 Copy link



Last Updated: 09 Dec 2024



- Company

[About us](#)

[News](#)

[Careers](#)
- Support

[Help Center](#)
- Business solutions

[Advertising](#)

[Recruiting](#)