High Temp. Mater. Proc. 2019; [38:927–939](#_bookmark27) 

## Research Article

Fakhir Aziz Rasul Rozhbiany\* and Shawnim Rashied Jalal

The Effectiveness of Reinforcement and Processing on Mechanical Properties, Wear Behavior and Damping Response of Aluminum Matrix Composites

<https://doi.org/10.1515/htmp-2019-0039> Received Apr 06, 2019; accepted Jul 30, 2019

**Abstract:** Metal matrix composites are an essential prod- uct used in engineering materials. This product has wide applications in automotive, aerospace, and other uses because of their lower density, good specific strength, best machinability, and better mechanical properties com- pared to Al 6063 alloy. In this paper, four different rein- forced such as (MA), (MCA), (NFC) and (SA) with a constant rate of 5 wt.% for each reinforced element used and mixed with Al 6063 alloy as a metal matrix composite by us- ing modified two-step mechanical stirrer and having three blades at each step. Coated carbide tool insert was carrying out the turning process. Surface roughness measured af- ter turning of every change in cutting speed. Average chip length and its shape style formation performed within cut- ting speeds of 10 and 90 m/min, which appears in differ- ent length and shapes. Mechanical properties, damping characteristics, and wear loss improved dramatically by adding all reinforced composites to the base Al 6063 al- loys. As the results of experiments, the surface roughness decreased by adding all four types of reinforcements. The mechanical properties, wear loss and damping character- istics improved by the constituents of all kinds of reinforce- ments and also by mixing of all types of constituents to- gether. The effects of MA and NFC are more compared to MCA and SA for improving all conditions of experimen- tal results. Microstructure observation produces compact grain boundaries with strong grains of metal matrix com- posites compared to Al 6063 alloys.

**Keywords:** Surface roughness, Chip formation style, Me- chanical properties, Metal matrix composites (MMCs)

# Nomenclature

Alaluminum Laaverage chip length MAmortar ash MCAmet coke ash

MMCsmetal matrix composites NFCnano fibrillated composite Raaverage surface roughness SAstraw ash

SEMscanning electron microscope SNsample number

UTSultimate tensile strength Vccutting speed

YTSyield tensile strength

# 1 Introduction

Stir casting is mostly used to produce the MMCs called as materials system which has two or more micro/macro with different composition. Some properties of MMCs have better performance, high accuracy with a higher rate of production. An application of MMCs includes automotive area involves industrial applications because they have best properties. Aluminum and its alloys are chosen as the excellent stiffness, good mechanical properties, and best corrosion resistance with lightweight. The homogeneous distributions of reinforcements in the matrix of processing MMCs are significant challenges of production, and it has a strong impact on the quality of properties and material [[1–](#_bookmark28) [8].](#_bookmark29)

**\*Corresponding Author: Fakhir Aziz Rasul Rozhbiany:** Depart-

ment of Mechanical & Mechatronics Engineering, College of En- gineering, Salahaddin University-Erbil, Erbil, Kurdistan Regional Government (KRG), Iraq; Email: fakhir.rozhbiany@gmail.com

**Shawnim Rashied Jalal:** Department of Mechanical & Mechatron- ics Engineering, College of Engineering, Salahaddin University- Erbil, Erbil, Kurdistan Regional Government (KRG), Iraq

 Open Access. © 2019 F. Aziz Rasul Rozhbiany and S. Rashied Jalal, published by De Gruyter. Creative Commons Attribution 4.0 License

This work is licensed under the