3.1.1 Grants received from Government and non-governmental agencies for research projects / endowments in the institution during the last five years

Academic Year	:	**2021-2022**
Name of the Project Application	:	Investigate the tribological behaviour of self-lubricating the magnesium matrix composite
Name of the Principal Investigator	:	**Dr. B.Radha Krishnan** Associate Professor, Department of Mechanical Engineering, Nadar Saraswathi College of Engineering and Technology, Vadapudupatti, Theni.
Name of the Funding Agency	:	**Tamil Nadu State Council for Science and Technology**
Amount Sanctioned	:	**Rs. 7500/-**
Duration of the project	:	Six Months

TAMILNADU STATE COUNCIL FOR SCIENCE AND TECHNOLOGY
DOTE Campus, Chennai-600025
STUDENT PROJECTS SCHEME 2021-2022

Investigate the tribological behaviour of self-lubricating the magnesium matrix composite

Students: [1]S.Sarankumar, [2]N.Dinesh Kumar, [3]M.Rishi, [4]K.Soundhar

[1,2,3,4] Final Year, Department of Mechanical Engineering, Nadar Saraswathi College of Engineering and Technology, Theni -625531

Guide: Dr.B.Radha Krishnan., M.E., Ph.D., MISTE.,

Assistant Professor, Department Mechanical Engineering,

Nadar Saraswathi College Engineering and Technology, Theni.

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1. Background and Significance:

In recent years, mechanical and automobile industries doing research for replacing lightweight materials instead of heavy-weight materials. But the challenge of replacement is the lightweight materials should have superior physical and mechanical properties. Most of the industries prefer the aluminium allot for its less weight and great strength.

Normally, Magnesium is a lightweight metal with low density (1.74 g/cm^3), which is lower than aluminium (2.7 g/cm^3), and steel (7.9 g/cm^3). Compared with Al, Steel, and Titanium, the Mg has good physical properties, which can minimize the recurrent costs.

Mostly, Magnesium and Mg alloys have been preferred for structural application, and here Mg should have greater strength and withstand the high temperature.

2. Research Gap:

The main problem of Magnesium and Mg alloy cannot be used in tribological machine components and load-bearing applications due to the average strength at room and elevated temperature, and poor frictional characteristics. So these problems show that the Mg-based parts are unsuitable for producing the bearing, gears, cylinders, and Piston.

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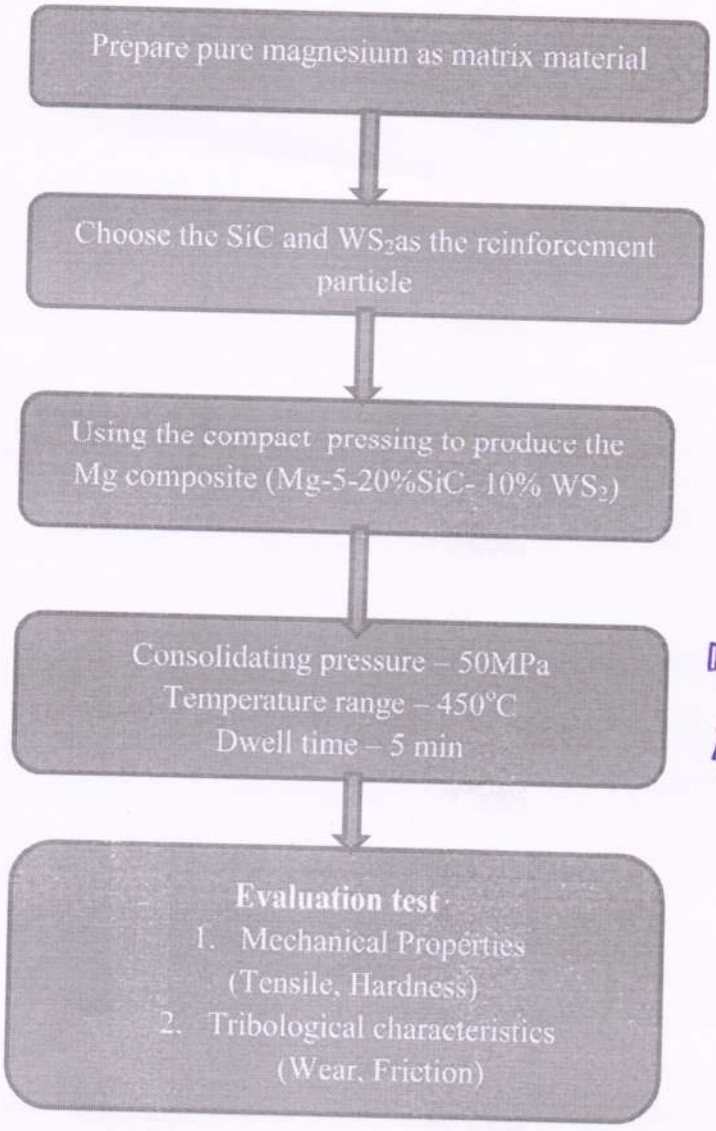
3. Solution:

The solution for the problem, as mentioned earlier, is to improve the tribological and mechanical properties. It can be possible by reinforcing hard particles like SiC, Al_2O_3, ZnO, CaB_6, TiB_2, and SiO_2. This project Reinforcement of SiC with Mg composite at the range of 5-20% for improving the ultimate tensile strength and elastic modulus at the temperature range of 150°C. For reducing the friction, we can add $MoS_2$and WS_2 particles. Here in this project, we preferred WS_2 reinforced with Mg composite for reducing friction.

4. Objective:

- To improve the mechanical properties of Mg composite such as Ultimate tensile strength, elastic modulus while adding SiC.
- To improve the self-lubrication characterization and reduce the friction, which adding the WS_2.

5. Methodology:



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1. Magnesium powder is the matrix material, and the particle size is 63μm to 250μm.
2. Reinforcement particles: SiC Particles -30Um for improving the mechanical strength Tungsten disulfide -2μm in the second reinforcement phase for reducing wear and friction.
3. Powder metrology process to produce the Mg-5-20%SiC- 10% WS_2, the composite size is 20mm diameter and 12mm long.

6. Work plan (Tentative):

S.No	Activity	Duration
1	Materials purchasing	2 Weeks
2	Composite preparation	1 Month
3	Mechanical properties testing	1 Month
4	Tribological testing	1 Month
5	Journal Publication	5 Months
6	Report preparation	2 Months
Total Duration		10 Months 2 Weeks

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TNSCST

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Member Secretary

Lr.No.TNSCST/SPS/2021-2022/

11.03.2022

NADAR SARASWATHI COLLEGE OF ENGINEERING AND TECHNOLOGY
12 MAR 2022
Dt:
3854

To
The Principal
Nadar Saraswathi College of Engineering and Technology
Vadapudupatti, Theni – 625 531

Sir/Madam,

Sub: TNSCST – Student Project Scheme (2021-2022) – approval intimation–grant release- reg.

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With respect to the above scheme, the list of projects approved by the State Council is enclosed along with terms and conditions. You are requested to adhere to terms and conditions such as submission of UC and seminar paper in time.

No	Guide Name and Institutional Address	Title of the Project	Students Name	Project Code	Amount
1	Dr.B.Radha Krishnan Assistant Professor, Dept. of Mechanical Engineering Nadar Saraswathi College of Engineering and Tech., Vadapudupatti, Theni-625531	Investigate the tribological behaviour of self-lubricating the magnesium matrix composite	S.Sarankumar N.Dinesh Kumar M.Rishi K.Soundhar	EME-0154	7500/-

Herewith enclosed the cheque for the approved grant and disburse the grant to the concerned students through the guides at the earliest.

Kindly send the utilisation certificate (format enclosed) and seminar paper (Ref.T&C-No.5&6) on completion of the project.

Thanking you,

Yours faithfully,

11.3.22
Member Secretary.

Encl: a) Terms & Conditions (T&C)
b) Format of Utilisation Certificate (UC)
c) Cheque for Rs.7,500/- No: 409336 dt:11.03.2022

Copy to: The individual guides

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INVESTIGATE THE TRIBOLOGICAL BEHAVIOUR OF SELF-LUBRICATING THE MAGNESIUM MATRIX COMPOSITE

S.Sarankumar, N.Dineshkumar, M.Rishi, K.Soundhar

Department of Mechanical Engineering, Nadar Saraswathi College of Engineering and Technology, Theni-625531

Abstract

To investigate the Tribological behavior of self-lubricating Magnesium metal matrix composite. Mg is used as matrix material and WC and SiC are preferred as reinforcement materials. The samples were prepared with powder metallurgy in following proportion 95% Mg - 3% SiC - 2% WC, 95%Mg- 2%SiC-3%WC, 94%Mg-3%SiC-3%WC. The results are obtained by SEM analysis, hardness test, wear test and tensile test. This composite metal is directly used in EDM machines as an EDM tool.

Introduction

In recent years, mechanical and automobile industries doing research on replacing lightweight materials instead with heavy-weight materials. But the challenge of replacement is that lightweight materials should have superior physical and mechanical properties. Most industries prefer the aluminium alloy for its less weight and great strength. Normally, Magnesium is a lightweight metal with low density (1.74 g/cm3), which is lower than aluminium (2.7 g/cm3), and steel (7.9 g/cm3). Compared with Al, Steel, and Titanium, the Mg has good physical properties, which can minimize the recurrent costs. Mostly, Magnesium and Mg alloys have been preferred for structural application, and here Mg should have greater strength and withstand the high temperature.

Research Gap

The main problem of Magnesium and Mg alloy cannot be used in Tribological machine components and load-bearing applications due to the average strength at room and elevated temperature, and poor frictional characteristics. So these problems show that the Mg-based parts are unsuitable for producing the bearing, gears, cylinders, and Piston.

Experimental Methodology

A) **Materials:** Magnesium is brittle and fractures. In this project, we used grey color powder. Silicon carbide is a low density and high strength material. It also has good high-temperature strength for reaction bonds. It has high hardness and wear resistance. Tungsten carbide has very high impact resistance and it has very high strength for material so hard and rigid. Compressive strength is higher than virtually all melted and cast or forged metals and alloys. Where the Mg is reinforced with WC and SiC in a certain percentage those are mentioned above.

B) **Methods:** Here all processes are done by Powder Metallurgy process. Powder metallurgy is the process of blending fine powdered materials, pressing them into a desired shape or form

(compacting), and then heating the compressed material in a controlled atmosphere to bond the material (sintering). The Ball milling process is used for the proper mixing of Mg+SiC+WC composites at the dwell time of 1hour, and then the Compaction process is done by a 5ton hydraulic hand press machine, and finally, the Sintering process is made through the furnace at 150°C for 3 Hours. Magnesium powder is the matrix material, and the particle size is 177μm. Reinforcement particles: SiC Particles - 30μm for improving the mechanical strength, WC Particles - 20μm in the second reinforcement phase for reducing wear and friction. The powder metrology process to produce the composite size is 12mm in diameter and 30mm in length.

Objectives

- To improve the mechanical properties of Mg alloy for High load application.
- To improve the self-lubrication characterization and reduce the friction, which adds the WC.

Result & Discussion

The solution to the problem, as mentioned earlier, is to improve the Tribological and mechanical properties. It can be possible by reinforcing hard particles like SiC, Al2O3, ZnO, CaB6, TiB2, and SiO2. This project Reinforcement of SiC with Mg composite at the range of 5-20% for improving the ultimate tensile strength and elastic modulus at the temperature range of 150°C. In this project, we preferred WC reinforced with Mg composite for reducing friction.

a) SEM Analysis: Microstructure analysis results show the material bonding and agglomeration. In this work less agglomeration formed due to the powder metallurgy process.

b) Wear Test: The wear rate was reduced while adding the SiC and WC. The carbide particles are used to improve the hardness value of Mg composite.

c) Hardness Test: The hardness value gradually improved while adding the carbide particles. The hardness value achieved 35HR for 94%Mg-3%SiC-3%WC.

Conclusion

The Magnesium composite was prepared with SiC and WC with various compositions. The following points are observed while investigating the Tribological properties,

1. The less agglomeration formed while adding the SiC and WC through powder metallurgy.
2. The wear rate is gradually reduced when increasing the Sic carbide.

Guide: **Dr B.Radha Krishnan**, Associate Professor, Department Mechanical Engineering, Nadar Saraswathi College of Engineering and Technology, Theni – 625531.

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STUDENT PROJECT SCHEME 2021-2022
UTILISATION CERTIFICATE

(TWO COPIES)

1. Name of the guide and address : Dr. B. Radha krishnan, Associate Professor, Mechanical Engineering, Nadar Saraswathi College of Engineering and Technology, Theni

2. Name of the student(s) : S. Sarankumar, N. Dineshkumar, M. Rishi, K. Soundhar

3. Title of the project : Investigate the tribological behaviour of self-Lubricating the Magnesium Matrix Composite

4. Project code : EME-0154

It is certified that a sum of Rs. 7500 (Rupees Seven thousand Five hundred) Sanctioned by the council for carrying out above mentioned student project has been utilized for the purpose for which it was sanctioned and sum of Rs. N.L remaining unutilized is refunded.

Signature of the guide

Signature of the HOD

09/06/22

Signature of the
REGISTRAR/PRINCIPAL/DEAN
With SEAL

Dr. C. MATHALAI SUNDARAM, M.E., M.B.A., Ph.D.,
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