iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** III **Month of publication:** March 2023

DOI: https://doi.org/10.22214/ijraset.2023.49551

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue III Mar 2023- Available at www.ijraset.com

Evaluation of Mechanical Properties of Aluminium and Silicone Carbide with Red Mud

M. Gowtham[1], R. Mani[2], N. Parthiban[3], V. Karthikeyan[4], S. Hariharan[5], P. Srinivasan[6], J. Edison Thangaraj[7], P. Manikandan[8]

[1]*Assistant Professor, Department of Mechanical Engineering, SNS College of Technology, Coimbatore*
[2]*Professor, Department of Mechanical Engineering, Muthayammal Polytechnic institution, Coimbator*
[3, 4, 5, 6, 7, 8]*Assistant Professor, Department of Mechanical Engineering, VSB College of Engineering Technical Campus, Coimbatore*

Abstract: ***Aluminium metal matrix composites (AMCs)refer the class of light weight and it have been utilized in high-tech structural and functional applications including aerospace, defence, auto move, and thermal management area, as well as in sports and recreation on, Aluminium based metal matrix composites (MMCs) with add ion of SIC and Red Mud reinforcement was fabricated by using casting. Red mud emerges as the major waste material during production of alumina from bauxite by the Bayer's process. So composites using Red mud can be used to reduce the cost of the metal matrix and environmental related issues. The samples were produced by using the aluminium, silicon carbide and red mud. Two types of die 20mm used for compaction to obtain the specimen. The diameter of 20mm rod is used for the tensile, hardness and wear test. This present study evaluates the mechanical proper es of the composite and results were obtained.***

Keywords: Aluminium, Metal matrix composites, red mud, Silicone carbide, Bauxite.

I. INTRODUCTION

Metal matrix composite (MMC) is engineered combination of the metal Matrix) and hard particle/ ceramic (Reinforcement) to get tailored properties. MMC's are either in use or prototyping for the space shuttle, commercial airliners. electronic substrates, bicycles, automobiles, golf clubs, and a variety of other applications. Like all composites, aluminium-matrix composites are not a single material but a family of materials whose stiffness. strength, density, thermal and electrical properties can be tailored. The matrix alloy, reinforcement material volume and shape of the reinforcement, location of the reinforcement and fabrication method can all be varied to achieve required properties.

The aim involved in designing metal matrix composite materials is to combine the desirable attributes of metals and ceramics. The addition of high strength, high modulus refractory particles to a ductile metal matrix produce a material whose mechanical properties are intermediate between the matrix alloy and the ceramic reinforcement. Metals have a useful combination of properties such as high strength, ductility and high temperature resistance, but sometimes have low stiffness, whereas ceramics are stiff and strong, though brittle.

Aluminium and silicon carbide, for example, have very different mechanical properties: Young's moduli of 70 and 400 Gpa, coefficients of thermal expansion of 24 x 10-6 and 4 10-6/°C, and yield strengths of 35 and 600 MPa, respectively. By combining these materials, e.g. A6061/Sic/17p (T6 condition), an MMC with a Young's modulus of 96.6 Gpa and a yield strength of 510 MPa can be produced.

By carefully controlling the relative amount and distribution of the ingredients of a composite as well as the processing conditions, these properties can be further improved. The correlation between tensile strength and indentation behaviour in particle reinforced MMCs manufactured by powder metallurgy technique. The microstructure of Sic reinforced aluminium alloys produced by Molten metal method. It was shown that stability of Sic in the variety of n1anufacturing processes available for melt was found to be dependent on the matrix alloy involved.

Among discontinuous metal matrix composites, stir casting is generally accepted as a particularly promising route, currently practiced commercially. lts advantages lie in its simplicity, flexibility and applicability to large quantity production. It is also attractive because, in principle, it allows a conventional metal processing route to be used, and hence minimizes the final cost of the product. This liquid metallurgy technique is the most economical of all the available routes for metal matrix composite production, and allows very large sized components to be fabricated. The cost of preparing composites material using a casting method is about one-third to half that of competitive methods. and for high volume production, it is projected that the cost will fall to one tenth.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue III Mar 2023- Available at www.ijraset.com

II. MATERIALS AND METHODOLOGY

Aluminium is a chemical element in the boron group With symbol Al and atomic number 13. It is a silvery-white, soft, nonmagnetic, ductile metal. Aluminium is the third most abundant element in the Earth's crust and its most abundant metal. Aluminium makes up about 8% of the crust by mass, though it is less common in the mantle below. Aluminium metal is so chemically reactive that native specimens are rare and limited to extreme reducing environments. Instead, it is found combined in over 270 different minerals. The chief ore of aluminium is bauxite.

Silicon carbide (SiC), also known as carborundum is a compound of silicon and carbon with chemical formula SiC RES It occurs in nature as the extremely rare mineral moissanite. Synthetic silicon carbide powder has been mass-produced since 1893 for use as an abrasive. Grains of silicon carbide can be bonded together by sintering to form very hard ceramics that are widely used in applications requiring high endurance, such as car brakes, Car Cutches and ceramic plates in bulletproof vests. Electronic applications or silicone carbide such as light-emitting diodes (LEDs) and detectors in early radius OS were first demonstrated around 1907. SIC is used in semiconductor. Electronics devices that operate at high temperature high voltages, or both. Large Single crystals of silicon carbide can be grown by the Lely method; they can be cut into gems known as synthetic moissanite. Silicon carbide with high surface area can be produced from Sic contained in plant material.

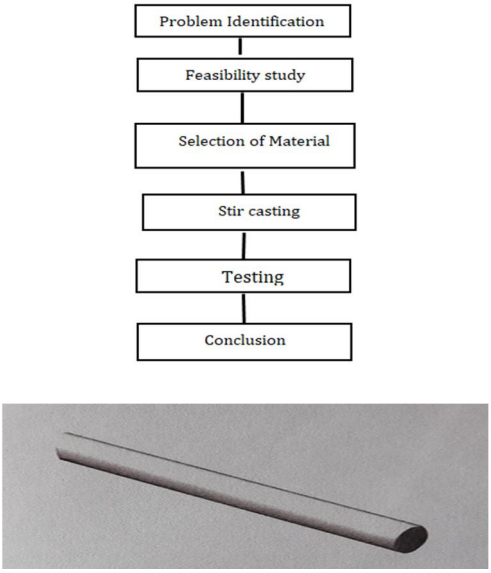


Figure 1: Material and Methodology

Red mud is one of the major waste material during production of alumina from bauxite by the Bayer's process. It is an insoluble product generated after bauxite digestion with sodium hydroxide at elevated temperature and pressure is known as red mud or ,,bauxite residue". It comprises of oxides of iron, titanium, aluminium and silica along with some other minor constituents. Based on economics as well as environmental related issues, enormous efforts have been directed worldwide towards red mud management issues i.e. of utilization, storage and disposal. Different avenues of red mud utilization are more or less known but none of them have SO tar proved tO be economically viable or commercially feasible. The red mud is classified as dangerous, according to NBR 10004/2004, and world while generation reached over 117 million tons/year. In present work experiments have been conducted under laboratory condition to assess the mechanical properties of the aluminium, red mud and Silicon carbide composite. This has been possible by fabricating the samples through stir casting technique. To enhance the mechanical properties, the Samples were also subjected to heat treatment.

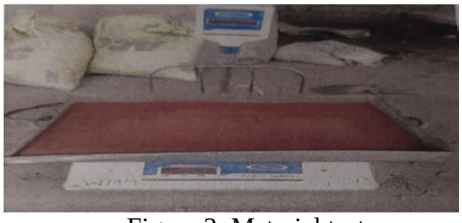


Figure 2: Material test

III. RESULT AND DISCUSSION

A. Tensile test
B. Hardness
C. Wear test

Hardness is the property of a material that enables it to resist plastic deformation, usually by penetration. However, the term hardness may also refer to resistance to bending, scratching, abrasion or cutting.

TEST PARAMETERS	OBSERVED VALUES
Ultimate tensile strength(N/mm^2)	120
%Elongation	2.1

Table 1: Tensile test observed value

Observed value in HBW (10mm ball/500 kg Load) = 62.13

RPM	LOAD (N)	TIME (sec)	SLIDING VELOCITY (m/s)	WEAR (micro)	COF	FRICTIONAL FORCE (N)
500	40	600	2.617	82.97	0.2878	11.51

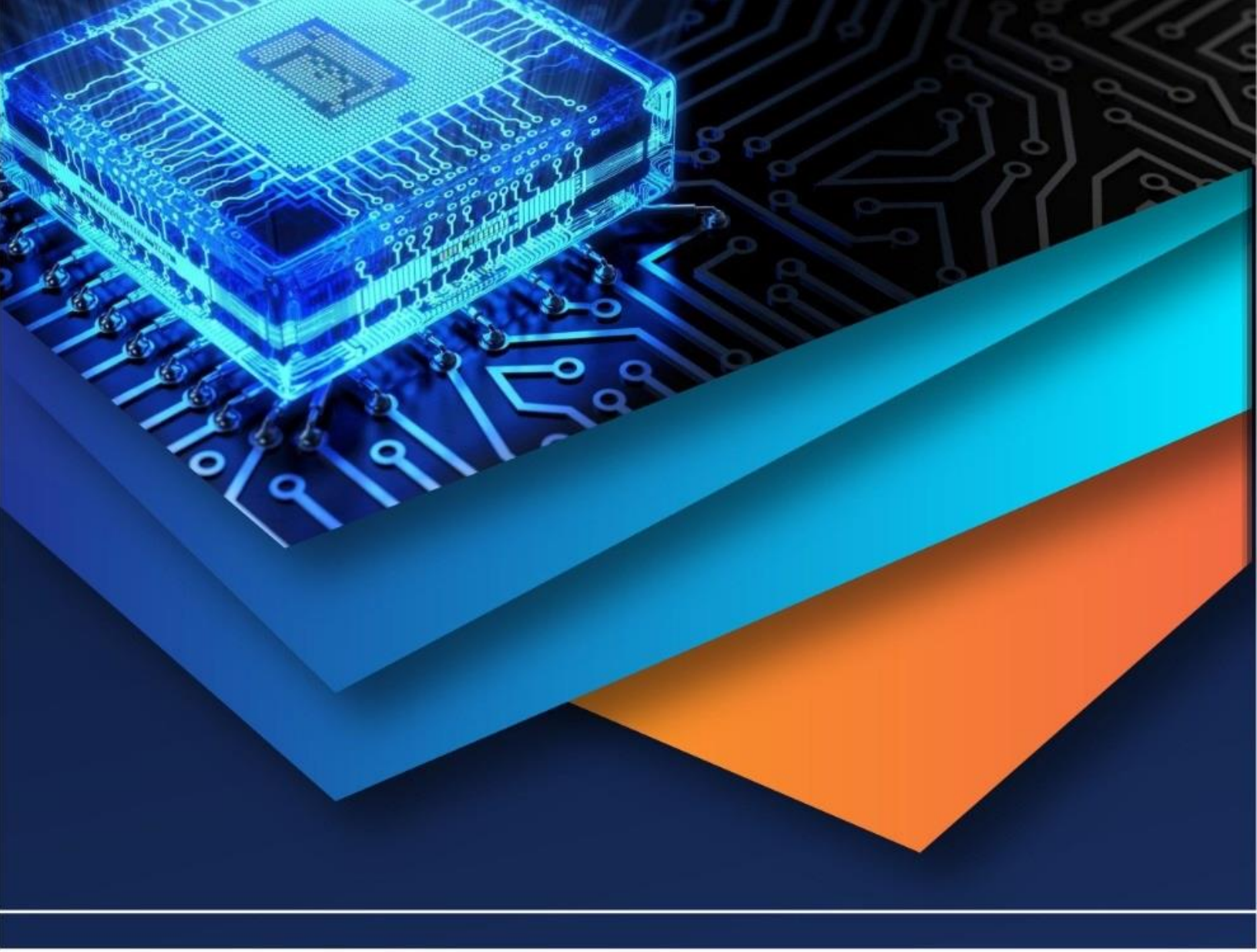
Table 2: Wear test observed value

IV. CONCLUSION

During the study it was concluded using red mud particles in the mental Composites can turn the industrial wastages, and also solve t the related issue and also obtained the proper die design for compacting work powder mixtures. The general conclusion that is revealed from the present w IS that by the combination of a matrix material with reinforcement such as Si and Red mud particles, it improves mechanical properties like tensile strength and hardness.

REFERENCES

[1] KS, L., Ummaji, B., Gururaj, P., Rayappa, K. and Yashavantha, J., 2018. Effect of red mud particles on scratch resistance of aluminum based metal matrix composites. American Journal of Aerospace Engineering, 5(1), pp.24-29.
[2] Panwar, N. and Chauhan, A., 2014. Development of aluminum composites using Red mud as reinforcement-A review. 2014 Recent Advances in Engineering and Computational Sciences (RAECS), pp.1-
[3] Chakrapani, P. and Suryakumari, T.S.A., 2021. Mechanical properties of aluminium metal matrix composites-A review. Materials Today: Proceedings, 45, pp.5960-5964.
[4] Challan, M., Jeet, S., Bagal, D.K., Mishra, L., Pattanaik, A.K. and Barua, A., 2022. Fabrication and mechanical characterization of red mud based Al2025-T6 MMC using Lichtenberg optimization algorithm and Whale optimization algorithm. Materials Today: Proceedings, 50, pp.1346-1353.
[5] Kumar, V.M. and Venkatesh, C.V., 2019. A comprehensive review on material selection, processing, characterization and applications of aluminium metal matrix composites. Materials Research Express, 6(7), p.072001.
[6] Singh, J. and Chauhan, A., 2017. Influence of reinforcement parameters and ageing time on mechanical behavior of novel Al2024/SiC/red mud composites using response surface methodology. JOM, 69, pp.2471-2479.
[7] Gireesh, C.H., Prasad, K.D., Ramji, K. and Vinay, P.V., 2018. Mechanical characterization of aluminium metal matrix composite reinforced with aloe vera powder. Materials Today: Proceedings, 5(2), pp.3289-3297.
[8] Dhanesh, S., Kumar, K.S., Fayiz, N.M., Yohannan, L. and Sujith, R., 2021. Recent developments in hybrid aluminium metal matrix composites: A review. Materials Today: Proceedings, 45, pp.1376-1381.
[9] Zhang, Y., Liu, X., Xu, Y., Tang, B., Wang, Y. and Mukiza, E., 2019. Synergic effects of electrolytic manganese residue-red mud-carbide slag on the road base strength and durability properties. Construction and Building Materials, 220, pp.364-374.
[10] Karthikeyan, R., Kumar, R.A., Manikandan, P. and Senthilnathan, A.K., 2021. Investigation of solar air heater with phase change materials using packed bed absorber plate. Materials Today: Proceedings, 45, pp.1360-1365. https://doi.org/10.1016/j.matpr.2020.06.236
[11] Karthik, R., Mani, R. and Manikandan, P., 2021. Tribological studies of Ni-SiC and Ni-Al2O3 composite coatings by Pulsed Electrodeposition. Materials Today: Proceedings, 37, pp.701-706. https://doi.org/10.1016/j.matpr.2020.05.717
[12] Srinivasan, P., Hariharan, S., Manikandan, P., NaveenKumar, S., Harish, N. and Balasubramanian, G., 2022. Tribological Studies of Shrinkage Defect and Effective Yield Upgrade of Grey Cast-Iron Castings. https://doi.org/10.22214/ijraset.2022.47196
[13] Mani, R., Manikandan, P., Harish, N. and Subramanian, G.B., Tribological Studies of Pin Fin type Forced Convection Solar Air Dryer with Help of PCM as a Thermal Storage Medium. Volume, 10, pp.500-504. https://doi.org/10.22214/ijraset.2023.48640
[14] Hariharan, S., Manikandan, P., Srinivasan, P. and Kannarasu, V., 2022. Design and Implement a Semi-Automatic Clutch System for Automobiles Using DCV and the Link Mechanism to Reduce Human Effort While Increasing Process Reliability and Accuracy. https://doi.org/10.22214/ijraset.2022.47526



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY