International Journal of Pure and Applied Mathematics
Volume 120 No. 6 2018, 3787-3798
ISSN: 1314-3395 (on-line version)
url: http://www.acadpubl.eu/hub/
Special Issue

http://www.acadpubl.eu/hub/

EXPERIMENTATION ON COMPOSITE BRAKE PADS WITH ALUMINUM REINFORCEMENT OF SIC AND FLYASH

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July 3, 2018

Abstract

The present work aims to develop Aluminium metal matrix composites by incorporating of reinforcements such that combination of best properties could be achieved. The metal base was selected was Aluminium 6061 and it is reinforced with varying volume percentage of Silicon carbide &Fly ash. These AMC were developed by using crucible casting technique, in which predetermined reinforcement is added to the molten matrix is stirred well to obtain desired castings. The Rockwell hardness andImpact tests revealed that composite with Sic10% Flyash 5% shows highest hardness value of 72 HRB and 11 Joules which is better than base alloy aswellas tensile is more SiC 5% Flyash 5% shows highest Tensile strength value 144.34 N/mm2. Highly reinforced composites show higher hardness and Impact strength and Moderate tensile strengthvariations.

1 Introduction

Composite materials are important engineering materials due to theiroutstanding mechanical properties. Composites are materials in which the desirable properties of separate materials are combined by mechanically or metallurgically binding them together. Each of the components retains its structure and characteristic, but the composite generally possesses better properties. Composite Materials offer better properties than customary combinations for different applications as they have high solidness, quality and wear protection. The improvement of these materials began with the creation of consistent fiber-fortified composites. The high cost and trouble of preparing these composites confined their application and prompted the advancement of irregularly fortified composites (Oz emiret.al.1999).Aluminum (Al) is a silvery white and ductile member of the poor metal group of chemical elements. Al is an abundant, light and strong metal which has found many uses. Like all composites, aluminum-matrix composites are not a single material but a family of materials whose stiffness, strength, density, and thermal and electrical properties can be tailored. The matrix alloy, the reinforcement material, the volume and shape of the reinforcement, the location of the reinforcement, and the fabrication method can all be varied to achieve required properties. Regardless of the variations, however, Al composites offer excellent thermal conductivity, high shear strength, excellent abrasion resistance, high. The effect of weight percentage of the reinforced particles on mechanical behavior such as hardness and corrosion of the composites can be investigated. The requirement of composite material has gained popularity in these days due to their various properties like low density, good wear resistance, good tensile strength and good surface finish. Among different particulates utilized, SIC is one of the slightest costly and low thickness support accessible in immense amounts as strong waste result in ceramic plant . The Hardness quality will likewise be thought about. For the accomplishment of the over, a trial set up is prepared where all the vital data sources will be made. In this work a composite is developed by adding SIC & FLYASH in Aluminum metal by volume ratio with various percentage.. The composite has to be prepared by crucible casting technique and has to be analyzed various mechanical properties.

2 Literature review

M. Polajnara et al.[1] has studied Friction and wear execution of practically evaluated pliable iron for brake cushions has inspected because of its wear protection, practically reviewed pliable iron (FGDI). Rathod Abhik, et al.[2] has investigated about asessment of Properties for Al-SiC Reinforced Metal Matrix Composite for Brake Pads was explored, MMC has been utilized as a part of designing application in expansive path due to their mechanical and physical properties. A.A. Agbeleyea, et al.[3]studied about the Tribological Properties of Aluminum-Clay composites for brake plate rotor applications checked on in this paper, the mechanical and tribological practices of different pieces of aluminum 6063 amalgam earth (Al-mud) composites for brake cushion applications were considered. Yousef M. Abdel-Rahim, et al.[4] has investigated Generalized up braking qualities of erosion cushion engineered graphite composites had examined to talks about frictional sliding reaction and steadiness of graphite-based composite brake cushion material under scopes of weights (P), sliding speeds (V) and material properties .X.D.Nong, et al.[5]established a study on the Investigation in SiC3D/Al combination co-persistent composites ventilated brake plate, had looked into, A novel ventilated shaft brake circle arranged by SiC3D/Al amalgam co-consistent composites was displayed in this examination, which can adequately lessen the unspring weight of rapid trains. Jayashree P .K,et al.[6] has studied about the Eco-accommodating asbestos free brake-cushion Using banana peels had examined the utilization of asbestos fiber is being kept away from because of its cancer-causing nature that may cause wellbeing dangers. W.Krenkel, et al.[7] investigated C/C-SiC Composites for Advanced Friction Systems Ceramic Matrix Composites (CMC), in light of fortifications of carbon filaments and frameworks of silicon carbide, indicate better tribological properties in correlation than dark cast iron or carbon/carbon. Gurvishal Singh, et al.[8] ha studied on the Full-artistic slowing mechanisms for elite grinding applications had surveyed Ceramic framework composites (CMC) are promising materials for rubbing applications. Normally, C/SiC rotors are joined with natural cushions . Inside this work, two sorts of CMC brake cushions were examined, C/SiC and additionally C/SiC 11 Coke with vol.% coke as filler, went with the Low

Met reference cushions.Vishal Mahale,et al.[9] studied about theStainless Steel Swarfs for Replacement of copper in Non Asbestos Organic Pads Nowadays broad research is going ahead in the field of grinding materials (FMs) for advancement of eco-accommodating brake-materials by expelling copper as it is a demonstrated danger to the oceanic creatures.Vishal Mahale,et al.[10] has studied Experimental studies of friction-induced brake squeal: Influence of environmental sand particles within the interface brake disc-pads was investigated concerning, the disk brake squeal may be a terribly annoying sound that affects the client comfort.

3 EXPERIMENTAL SET UP

3.1 Pit Furnace

PIT furnace was utilized to heat the material to wanted temperatures by conduction, convection, or blackbody radiation from electrical protection warming components. A pit heater in chronicled utilization is a heater in which the subject material is secluded from the fuel and the majority of the results of burning including gases and flying fiery remains.

3.2 MIXING RATIO

In this project Aluminum and silicon carbide, Fly ash mixed below mentioned categories

Sample1: AL 90% SIC 5% FLY ASH5%
Sample2: AL 85% SIC10 % FLY ASH5%
Sample3: AL 80% SIC10 % FLY ASH10%

3.2.1 DESIGNING OF TESTING MATERIAL

Cylindrical Specimen:

size-2.5cm diameter &Length-30cm

Rectangular Specimen:

10x3.5x1.6 Cm

Volume-3.14/4*25^2*320*percentage of composite*density*percentage of excess of material

MODEL CALCULATION FOR RATIO:1

$$Cylindrical = \pi d^2 * L \tag{1}$$

=π/4*2.5^2*300—vol 147.16
Plate = L*B*H
=10*3.5*106=56
Al=589*2.7*0.95—-377g+30%
=113/500g—rod
Plate =56*2.7-151.2*0.3% extra 1431+45g-200g, 500+200=700g
Rod + plateRatio 1: 700g for 2nos

4 RESULTS :

ROCKWELL HARDNESS TEST

- Rockwell Hardness systems use a direct readout machine determining the hardness number based upon the depth of penetration of either a diamond point or a steel ball. Deep penetration indicated a material having a low Rockwell Hardness number.
- However, a low penetration indicates a material having a high Rockwell Hardness number. The Rockwell Hardness number is based upon the difference in the depth to which a penetrator is driven by a definite light or minor load and a definite heavy or Major load.
- The ball penetrators are chucks that are made to hold 1/16 or 1/8 diameter hardened steel balls. Also available are 1/4" and 1/2" ball penetrators for the testing of softer materials.
- There are two types of anvils that are used on the Rockwell hardness testers. The flat faceplate models are used for flat specimens. The V type anvils hold round specimens firmly.
- Test blocks or calibration blocks are flat steel or brass blocks, which have been tested and marked with the scale and Rockwell number. They should be used to check the accuracy and calibration of the tester frequently.

HARDNESS VALUE

Table. 1. Rock well hardness strength

S.No	Material	HRB
1	AL 90% SIC 5% FLY ASH5%	74
2	AL 85% SIC10 % FLY ASH5%	82
3	AL 80% SIC10 % FLY ASH10%	86

GRAPH FOR HARDNESS

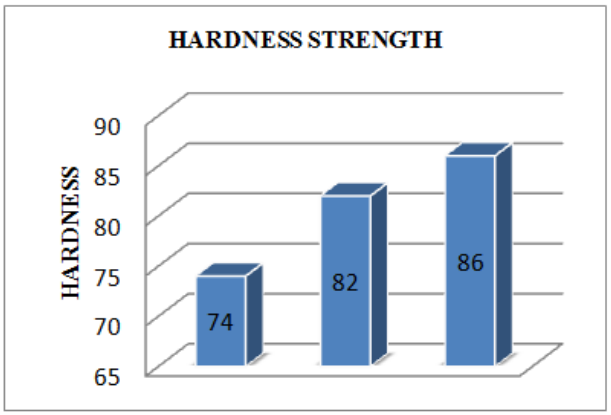

Figure.1. Hardness test

4.1 IMPACT TEST

Izod impact strength testing is an ASTM standard method of determining impact strength. A scored test is for the most part used to decide affect quality. Effect is a critical wonder in administering the life of a structure. On account of air ship, effect can happen by the fowl hitting the plane while it is cruising, amid take - off and arriving there is affect by the trash display on the runway. An arm held at a specific height (constant potential energy) is released. The arm hits the sample and breaks it. From the energy absorbed by the sample, its impact strength is determined.The North American

standard for Izod Impact testing is ASTM D256. The results are expressed in energy lost per unit of thickness (such as ft-lb/in or J/cm) at the notch. Alternatively, the results may be reported as energy lost per unit cross-sectional area at the notch (J/m or ft-lb/in). In Europe, ISO 180 methods are used and results are based only on the cross-sectional area at the notch (J/m).The dimensions of a standard specimen for ASTM D256 are 4 x 12.7 x 3.2 mm (2.5" x 0.5" x 1/8"). The most common specimen thickness is 3.2 mm (0.125"), but the width can vary between 3.0 and 12.7 mm (0.118" and 0.500").The Izod impact test differs from the Charpy impact test in that the sample is held in a cantilevered beam configuration as opposed to a three point bending configuration.

IMPACT VALUE

Table. 2. Impact Strength in joules

S.No	Composition	Impact Strength in Joules
1	AL 90% SIC 5% FLY ASH5%	8
2	AL 85% SIC10 % FLY ASH5%	9
3	AL 80% SIC10 % FLY ASH10%	13

GRAPH FOR IMPACT

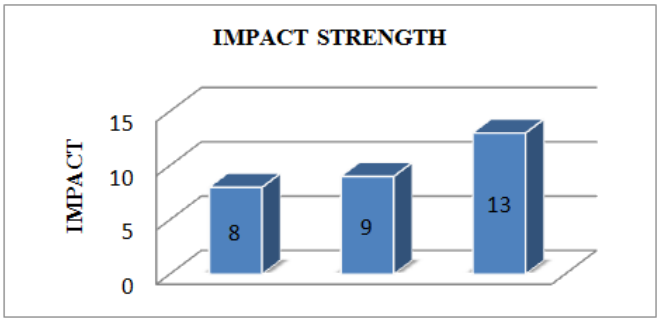

Figure.2. Impact strength

4.2 Tensile Test

Friction processed joints are evaluated for their mechanical characteristics through tensile testing. A tensile test helps determining

tensile properties such as tensile strength, yield strength, percentage of elongation, and percentage of reduction in area and modulus of elasticity. The welding parameters were arbitrarily picked inside the range accessible in the machine. The joints were made with irregular parameters and assess elasticity and consume off. At that point the joints were made and assess the mechanical and metallurgical qualities. The erosion welded examples were set up according to the ASTM principles. The test was done in an all inclusive testing machine (UTM) 40 tones FIE make.

Elongation

Twisting in continuum mechanics is the change of a body from a reference design to a present arrangement. A design is a set containing the places of all particles of the body. In spite of the regular meaning of misshaping, which suggests contortion or change fit as a fiddle, the continuum mechanics definition incorporates inflexible body movements where shape changes don't happen A distortion might be caused by outer burdens, body powers, (for example, gravity or electromagnetic powers), or temperature changes inside the body. Strain is a depiction of distortion as far as relative uprooting of particles in the body. Diverse equal decisions might be made for the statement of a strain field contingent upon whether it is characterized as for misshaping field comes about because of a pressure field actuated by connected powers or is because of changes in the temperature field inside the body. The connection amongst stresses and initiated strains is communicated by constitutive conditions, e.g., Hooke's law for linear elastic materials. Deformations which are recovered after the stress field has been removed are called elastic deformations. In this case, the continuum completely recovers its original configuration. On the other hand, irreversible deformations remain even after stresses have been removed. One type of irreversible deformation is plastic deformation, which occurs in material bodies after stresses have attained a certain threshold value known as the elastic limit or yield stress, and are the result of slip, or dislocation mechanisms at the atomic level. Another type of irreversible deformation is viscous deformation, which is the irreversible part of visco elastic deformation

Table.3. Elongation along with composition samples

Sample	Elongation
Composite 1	9.84mm
Composite 2	8.62mm
Composite 3	10.65mm

ELONGATION

Table 4: Elongation with dia load 16

Identi	Dia	CSA	YL	YS	TL	TS	IGL	FGL	%E	FD	%RA
	mm	mm2	kN	N/mm^2	kN	N/mm^2	mm	mm			
A1	16.2	207.2	19.5	94.29	24	115.8	100	109.8	9.84	14.3	22.9
A2	16	200.4	18.4	91.62	25	124.6	100	108.6	8.62	14.1	22.6
A3	16.1	202.4	19.4	95.95	24.2	119.5	100	110.7	10.7	14.4	19.7

GRAPH FOR TENSILE

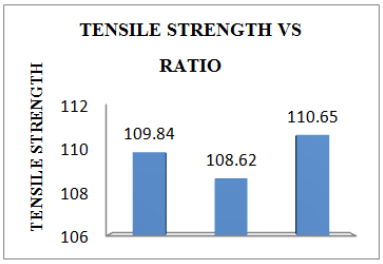

Fig.3Tensile Strength Vs ratio

MMC has been used in engineering application in broad way because of their mechanical and physical properties. They are broadly used in the field of automobile and aerospace because of their high strength to weight ratio, lighter weight, lower cost, and good behaviour. In present study the mechanical behaviour of aluminium metal matrix composite and SiC and flyash has been analyzed. Brake Pad is manufactured by route of casting which is widely preferred because of its low cost, high volume production, ease of operation, sustainability and attractive manufacturing process. Brake pads are developed with light alloy Aluminium 6061 reinforced with SiC& Flyash to augment the strength and wear resistance and explore the advantage of low density of the matrix.

Conclusion

These castings were studied for behavior and subjected to mechanical testing to study the effects of various reinforcements. The Rockwell hardness and impact tests revealed that composite with 10% Sic 10% Fly ash shows highest hardness value of 95 HRB and higher impact value 13J and Tensile strength also higher value obtained(110.65 n/mm^2) which is better than base alloy aswellas tensile is more 10% Sic 10% Fly ash shows highest Tensilestrength value 110.65N/mm^2.Highly reinforced composites show higher variations due to the agglomeration of particles.

References

[1] M. Polajnara, MhaseVijay, Manoj Satpute,Aluminium alloy Al-7075 reinforcement and Stir casting -a Review, IIJME, Nov 2015. Vol (4) 86-92

[2] Rathod Abhik, PiyushKumar Singh, Shubham Rai, Hiren Patel, Bharat Kumar, A Review on Effect of Reinforcement Particles on the Mechanical Properties of Aluminium Based Composites, IJIRSET, Sep 2015.Vol (10) 95-111

[3] A.A. Agbeleyea, J. U. Odo, I.D. Adiele, J.N. Ani, C.W. Onyia & B.A. Okorie , Effects of Silicon Carbide (SIC) Nano Particulates Addition on Mechanical Properties of Aa2618 Alloy, April 2015 Vol (3) 67-72.

[4] Abdel-Rahim, C M Sharanaprabhu, Shashidhar K Kudari, Study on the effects of SiC particles on tensile properties for Al/SiC composites, IJSTM, March 20158(1), 1-8.

[5] X.D.Nong., R. Praveen, S. Raghuraman, Silicon Carbide Reinforced Aluminium Metal Matrix Composites for Aerospace Applications:A 210.1: 76-82. A Literature Review, IJIRSET, November 2013.

[6] Jayashree P .K, Gowri Shankar M.C, Achutha Kinia, Sharma S. S and Raviraj Shettya, Review on Effect of Silicon Carbide (SiC) on Stir Cast Aluminium Metal Matrix Composites, IJCET, Aug 2013,455(5), 299-304.

[7] W.Krenkel, VijayKumar S. Jatti, Ravi Sekhar and T.P.Singh, Synthesis and Characterization of SiC Reinforced HE-30 Al Alloy Particulate MMCs, IJET, July 201320(7), 1411-1417.

[8] Gurvishal Singh, Harwinder Lal, Daljit Singh and Gurdeshbir Singh, An approach for improving wear rate of Aluminium based metal using red mud, sic and Al2O3 matrix composites, IJMERR, Jan 2013171(2), 2673-279.

[9] Vishal Mahale, Joseph Ajibade OMOTOYINBO, Davies Oladayo FOLORUNSO, High Temperature Mechanical Properties of Silicon Carbide Particulate Reinforced Cast Aluminium Alloy Composite, LEJPT, Jan 2011vol 10 No.5.

[10] S. Das, R. Behera, A. Datta, G. Majumdar, B. Oraon, G. Sutradhar, Experimental Investigation on the Effect of Reinforcement Particles on the Forgeability and the Mechanical Properties of Aluminium Metal Matrix Composites, Material Science and Applications, Nov 2010vol 8 No.6.