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# Aluminium Alloy Metal Matrix Composite: Survey Paper

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**ABSTRACT-**For the last few years there has been a rapid increase in the utilisation of aluminium alloys, particularly in the automobile industries, due to low weight, density, coefficient of thermal expansion, and high strength, wear resistance. Among the materials of tribological importance, Aluminium metal matrix composites have received extensive attention for practical as well as fundamental reasons. Aluminium alloys and aluminium-based metal matrix composites have found applications in the manufacture of various automotive engine components. Compound work pieces are developed to combine favourable properties of different materials. Many composite materials are used in home and industrial production. Weight reducing in rapid moving parts of automobile engines such as Crankshaft, connect rod. to a reduction of the weight and wear reduction purpose. For this review paper discussed with recent composite technology and performance behaviour and also we discussed MMC. the material mixed with non metal and analyzed in this mechanical properties and fabrication technique

**keyword**; aluminium alloys, fabrication technique, MMC

## 1. INTRODUCTION

From the last few years in much industrial application the important parameter in material selection is specific strength, weight and cost. Here we discussed the review paper relevant to this. Before going the review section we must know the difference between the composite and MMC. The composite defined as the made of several part or element but only combined different material not a non-metal whereas the non-metal is mixed with material this called MMC. Clearly we had seen the review paper. the main mixed material most probably like aluminium alloy and then it group, silicon carbide fly ash, graphite, boron carbide, RHA, fly ash cenospehere, silicon nitride, silicon carbide, etc..., in this material we fabricated by using different method with respected to the grain size the generally we go for the stir and GPIT technique were check the material distribution by using SEM analyzed with FEA model. Finally they going to tested the mechanical properties like tensile strength, ductility compressive strength. Hardness elongation etc..,

## 2. LITERATURE REVIEW

Rama rao et al[1] . examined that aluminium alloy-boron carbide composites were fabricated by liquid metallurgy techniques with different particulate weight fraction (2.5, 5 and 7.5%). Phase identification was carried out on boron carbide by x-ray diffraction studies microstructure analysis was done with SEM a composites were characterized by hardness and compression tests. The results shows increase the amount of the boron carbide. The density of the composites decreased where as the hardness is increased. Whereas The compressive strength of the composites was increased with increase in the weight percentage of the boron carbide in the composites.

Balasivanandha prabu et al [2]. Investigated that better stir process and stir time. The high silicon content aluminium alloy –silicon carbide MMC material, with 10% SiC by using a variance stirring speeds and stirring times. The microstructure of the produced composite was examined by optical microscope and scanning electron microscope. The results with respected to that stirring speed and stirring time influenced the microstructure and the hardness of composite.

also they investigate that at lower stirring speed with lower stirring time, the particle group was more. Increase in stirring time and speed resulted in better distribution of particles. The mechanical test results also revealed that stirring speed and stirring time have their effect on the hardness of the composite. The uniform hardness valued was achieved at 600 rpm with 10min stirring. but above this stir speed the properties degraded again. This study to establish the trend between processing parameters such as stirring speed and stirring time with microstructure and hardness of composite.

Karunamoorthy et al [3]. Analysed that A 2D microstructure-based FEA models were developed to study the mechanical behaviour of MMC. The model has taken into account the randomness and clustering effects. The particle clustering effects on stress-strain response and the failure behaviour were studied from the model. The optimization of properties was carried out from analysis of microstructure of MMC since the properties depend on particles arrangement in microstructure. In order to model the microstructure for finite element analysis (FEA), the micro-structures image converted into vector form from the raster than it conversion push to IGES step and mesh in FEA model in ANSYS 7. The failure such as particle interface decohesion and fracture the predicted for particle clustered and non-clustered micro structures. they analyzed that failure mechanisms and effects of particles arrangement.

Sozhamanna et al [4]. Analysed that the methodology of microstructure based elastic-plastic finite element analysis of PRMMC. This model is used to predict the failure of two dimensional microstructure models under tensile loading conditions. Hence analyses were carried out on the microstructure of random and clustered particles to determine its effect on strength and failure mechanisms. The FEA models were generated in ANSYS using SEM images. The percentage of major failures and stress-strain responses were predicted numerically for each microstructure. Here the mixture material Al alloy, SiC

Rohatgi et al[5]. Analysed that A356-fly ash cenosphere composites can be synthesized using gas pressure infiltration technique over a wide range of reinforcement volume fraction from 20 to 65%. The densities of Al356-fly ash cenosphere composites, made under various experimental conditions, are in the range of 1250-2180 kg/m3 corresponding to the volume fraction of cenosphere in the range 20-65%. The density of composites increased for the same cenosphere volume fraction with increasing size of particles, applied pressure and melt temperature. This appears to be related to a decrease in voids present near particles by and enhancement of the melt flow in a bed of cenosphere. The compressive strength Plateau stress and modulus of the composites increased with the composite density.

Venkat prasat et al [6]. Investigated that tribological behaviour of aluminium alloy reinforced with alumina and graphite this are fabricated by stir casting process. The wear and frictional properties of the hybrid metal matrix composites was studied by performing dry sliding wear test using a pin – on- test wear test. Experiments were conducted based on the plan of experiments generated through taguchi's technique. AL27 orthogonal array was selected for analysis of the data. Investigation to find the influence of wear rate sliding speed applied load sliding distance, as well as the coefficient of friction. The results show that sliding distance has the highest influence followed by load and sliding speed. Finally confirmation test were carried out to verify the experimental results and scanning electrons microscopic studies were done on the wear surfaces. The incorporation of graphite as primary reinforcement increases the wear resistance of composites by forming a protective layer between pin counter face and the inclusion of alumina as a secondary reinforcement also has a significant effect on the wear behaviour. The regression equation generated for the present model was used to predict the wear rate and coefficient of friction of HMMC for intermediate conditions with reasonable accuracy.

Keshavamurthy et al [7]. Experimented that Al6061 matrix composite reinforced with nickel coated silicon nitride particles were fabricated by liquid metallurgy. Microstructure and tribological properties of both matrix alloy and developed composites have been evaluated. wear tests and dry sliding friction were carried out using pin on disk type machine over a load range of 20-100N and sliding velocities is 0.31-1.57m/s. Results revealed that, coated of nickel in silicon nitride partical are uniformly distributed throughout the matrix alloy. Al6061-Ni-p-si3N4 composite exhibited lower wear rate and coefficient of friction compared to matrix alloy. the coefficient of friction decreased with increased in load up to 80N. Further increase in the load, also increasing coefficient of friction and sliding velocity.

Mahendra boopathi.M et al[8]. Experimented to Development of hybrid metal matrix composites has become an important area of research interest in materials science. In view of this, the present study was aimed at evaluating the physical properties of aluminium 2024 in the presence of fly ash, silicon carbide and its combinations. Consequently aluminium MMC combination the strength of the reinforcement with the toughness of the matrix to achieve a combination of desirable properties not available in any single conventional material. stir casting method was used for the fabrication of aluminium MMC. Structural characterization was carried out on MMC by x-ray diffraction studies and optical microscopy was used for the micro structural studies. The mechanical be haviours of MMC like density, elongation, hardness, yield strength and tensile test were ascertained by performing carefully designed laboratory experiments that replicate as nearly as possible the service conditions. In the presence of fly ash and silicon carbide [sic (5%) + fly ash (10%) and fly ash (10%) +sic (10%)] with aluminium, the result show that the decreasing the density with increasing harness and tensile strength was also observed but elongation of the hybrid MMC in comparison with unreinforced aluminium was decreased. The hybrid metal matrix composites significantly differed in all of the properties measured. Aluminium in the presence of sic (10%)-fly ash (10%) was the hardest instead of aluminium –sic and aluminium-fly ash composites.

Bienias et al [9]. Experimented that microstructure characteristics of aluminium matrix Ak12 composites containing of fly ash particles, obtained by gravity and squeeze costing techniques, pitting corrosion behaviour and corrosion kinetics are presented and discussed. It was found that one in the comparison with squeeze casting, gravity casting technology is advantageous for obtaining higher structural homogeneity with minimum possible porosity levels, good interfacial bonding and quite a uniform distribution of reinforcement, second one the fly ash particles lead to an enhanced potting corrosion of the Ak12/9%flyash (75-100 μm fraction) composite in comparison with unreinforced matrix (Ak12 alloy), and third one the presence of nobler second phase of fly ash particles, cast defects like pores, and higher silicon content formed as a result of reaction between aluminium and silica in Ak12 alloy and aluminium fly ash composite determine the pitting corrosion behaviour and the properties of oxide film forming on the corroding surface.

Anilkumar et al [10]. Investigation that mechanical properties of fly ash reinforced aluminium alloy (Al 6061) composites fabricated by stir casting. They are three sets of composites with fly ash particle sizes of 75-100, 45-50 and 4-25 μm were used. Each set had three types of composite samples with the reinforcement weight fractions of 10 15 and 20%. The mechanical properties studied were the compressive strength, tensile strength, ductility and hardness. Unreinforced Al6061 samples also tested the mechanical properties. It was found that the compressive strength, tensile strength and hardness of the aluminium alloy composites decreased with the increase in particle size of reinforced fly ash. Increase in the weight fractions of the fly ash particles the ultimate tensile strength, compressive strength, hardness and decreases the ductility of the composite. The SEM of the samples indicated uniform distribution of the fly ash particles in the matrix without any voids.

Dora siva Prasad et al [11]. Investigated that Hybrid metal matrix composites with up to 8% rice husk ash and sic particles could be easily fabricated using double stir casting process. The uniform distribution of rice husk ash and sic was observed in the matrix. The porosity and hardness increases with the increase in percentage of the reinforcement whereas the density of hybrid composites decreases, The yield strength and ultimate tensile strength increase with the increase in RHA and sic content. It was found that in comparison to that of base aluminium alloy, the precipitation kinetic was accelerated by adding the reinforcement. This effect obtaining the maximum hardness by the aging heat treatment where also reduced time.

Udhaya prakash et al[12]. Experimentally investigated on machinability of aluminium alloy (A413)/flyash/B4C hybrid composites using wire EDM. The objective of this work is to investigate the effect of parameters like pulse off time, wire feed pulsed on time, gap voltage, and percentage reinforcement on the responses material removal rate as well as surface roughness while machining aluminium alloy(A413)/flyash/B4C hybrid composites using wire EDM. Experimentation has been done on taguchi's L27 orthogonal array under different combinations of parameters. Analysis of variance has been used to determine the design parameters significantly influencing the response. the responses has been evaluated using signal to noise ration analysis. The experimental result proposed optimal combination of parameters which give the maximum material removal rate and minimum surface roughness.

Smith et al [13]. Investigated that Measurements and predictions of residual stresses were made on four thick-section steel components, created by electron beam (EB) welding. All components were measured in the welded state, with one ferritic steel component then subjected to PWHT. In two ferritic components, the peak residual stresses, for the as-welded state, were found to about equal to the yield strength of the parent material. At the entrance and exit positions of the ferritic steel EB welds compressive residual stresses were found. This was in contrast to the stainless steel EB welds, during the welded state the tensile strength is measured. After PWHT of a ferritic EBW component the measured peak stresses reduced from about 600 MPa to 90 MPa. Numerical simulations of the EBW process predicted overall profiles of the residual stresses that matched the measurements, but FE analyses always predicted peak values. It was found that the measured distribution of residual stresses across the ferritic steel components was very similar irrespective of component thickness, and confined to distances of about 40% of the product thickness. In contrast in a stainless steel component the stresses are much more broadly distributed about the weld centreline.

Weglewski et al [14]. Analysed that Effect of grain size on thermal residual stresses and damage in sintered chromium–alumina composites. the results of experimental measurements and numerical modelling of the effect of particle size on the residual thermal stresses arising in sintered metal–matrix composites after cooling down from the fabrication temperature. On example of novel Cr(Re)/Al2O3 composites processed by (i) spark plasma sintering and (ii) hot pressing the residual thermal stresses are measured by neutron diffraction technique and determined by a FEM model based on micro-CT scans of the material microstructure. Then numerical model of micro cracking induced by residual stresses is applied to predict the effective Young modulus of the damaged composite. Comparison of the numerical results with the measured data of the residual stresses and Young's modulus is presented and fairly good agreement is noted.

## 3. CONCLUSION

From literature review related to the Aluminium alloy metal matrix Composite material we have concluded that, the pure aluminium mixed with sum other material through the process like stir, GPIT, and followed by different fabrication procedure. That the result show that increasing better mechanical properties than reducing the weight and cost.

## REFERENCES:-

[1] S.Rama rao. G. Padmanabhan, Fabrication and mechanical properties of aluminium-boron carbide composites, international journal of materials and biomaterials applications 2(2012) 15-18

[2] S.balasivanandhaprabu,l. Karunamoorthy, s. Kathiresan, b. Mohan, Influence of stirring speed and stirring time on distribution of particles in cast metal matrix composite. Journal of materials processing technology 171(2006) 268-273

[3] S. Balasivanandha prabu, l. Karunamoorthy Microstructure- based finite element analysis of failure prediction in particle-reinforced metal-matrix composite, journal of materials processing technology 207(2008)53-62

[4] G.g. sozhamannan. S. Balasivanandha prabu, r. Paskaramoorthy. Failures analysis of particle reinforced metal matrix composites by microstructure based models, materials and design, 31(2010) 3785-3790

[5] P.k. rohatgi , j.k. kim, N.gupta, simonalaraj, A.Daoud Compressive characteristics of A356/fly ash cenospehere composites synthesized by pressure infiltration technique, science direct 37(2006) 430-437

[6] N.Radhia, r. Subramanian, sivenkat prasat, Tribological behaviour of aluminium/alumina/graphite hybrid metal matrix composite using taguchi's techniques, journal of minerals and materials characterization and engineering 10(2011) 427-443

[7] C.s.ramesh, r. Keshavamurthy, b.h. channabasappa, s. Pramod, Friction and wear behaviour of Ni-P coated $Si_3N_4$ reinforced Al6061composites, tribology international 43(2010)623-634

[8] Mahendra boopathi, k.p. arulshri N. Iyandurai, Evaluation of mechanical properties of aluminium alloy 2024 reinforced with silicon carbide and fly ash metal matrix composites, American journal of applied sciences, 10(2013),219-229

[9] J. Bienias, m. Walczak, b. Surowska,j.Sobczak,Microstructure and corrosion behaviour of aluminium fly ash composites, journal of optoelectronics and advanced materials, 5(2003), 493-502

[10] H.c. anilkumar, h.s. hebbar and k.s. ravishankar, Mechanical properties of fly ash reinforced aluminium alloy (Al6061) composites, international journal of mechanical and materials engineering 6(2011) 41-45

[11] Dora siva Prasad, chintada shoba, nallu ramanainah, Investigations on mechanical properties of aluminium hybrid composite, mater res technol. 3(2014) 79-85

[12] J. Udaya prakash, t.v. moorthy, j. Milton peter, Experimental investigation on machinability of aluminium alloy(A413)/flyash/B4C hybrid composites using wire EDM, procedia engineering 64(2013) 1344-1353

[13] D.J. Smith , G. Zheng, P.R. Hurrell , C.M. Gill, B.M.E. Pellereau , K. Ayres D. Goudar c, E. Kingston, Measured and predicted residual stresses in thick section electron beam welded steels, International Journal of Pressure Vessels and Piping 120-121 (2014) 66-79

[14] W. Weglewski , M. Basista , A. Manescu , M. Chmielewski , K. Pietrzak Th. Schubert , Effect of grain size on thermal residual stresses and damage in sintered chromium–alumina composites, Composites: Part B 67 (2014) 119–12