A SIGNIFICANT REASSESS ON PERFORMANCE AND MACHINING OF METAL MATRIX COMPOSITES

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Abstract: Aluminium metal matrix composites have attracted extensive attention in engineering applications due to their relatively low costs and excellent properties. Aluminium-based metal matrix composites have found applications in the manufacture of various automotive engine components. Various Reinforcement materials were added to fabricate the composites. Different fabrication techniques have evolved over the past 15 years for the fabrication of Metal matrix composites. In this paper, the fabrication of aluminum metal matrix composites with various reinforcements and the mechanical behavior are reviewed.

Keywords: Metal matrix composite, Reinforcements, Stir casting, Hardness, Machining.

INTRODUCTION

A metal matrix composite is composite material with at least two constituent parts, one being a metal necessarily, the other material may be a different metal or another material, such as a ceramic or organic compound. MMCs are made by dispersing a reinforcing material into a metal matrix. The reinforcement surface can be coated to prevent a chemical reaction with the matrix.The matrix is the monolithic material into which the reinforcement is embedded, and is completely continuous. This means that there is a path through the matrix to any point in the material, unlike two materials sandwiched together.The reinforcement material is embedded into a matrix. The reinforcement is used to change physical properties such as wear resistance, friction coefficient, or thermal conductivity . The reinforcement can be either continuous, or discontinuous. In recent years, metal matrix composites find their extensive engineering application due to their high strength-to-weight ratio, stiffness and resistance to corrosion and high temperature.

FABRICATION TECHNIQUES OF MMC AND THEIR MECHANICAL PROPERTIES:

Pradyumna Phutane et al.[1] fabricated HE -30 Al composite reinforced with SiC particulates.The average particle size of the reinforcing material was 25 μm. The SiC particle reinforcements were done at 3 and 5 weight percentages. Composites are fabricated by stir casting technique. HE- 30 Aluminium was melted in the furnace. The preheated reinforcements are added and Stirring was done for 10 minutes at an average stirring speed of 500 rpm. The melt was superheated above liquidus temperature and poured into preheated permanent metallic moulds. The specimens were machined to the required size to carry out tensile, hardness and microstructure tests.The optical micrographs of composites showed uniform distribution of silicon carbide particulates in the HE-30 aluminum metal matrix. It was revealed that the hardness of composite samples increased with increasing weight percentages of silicon carbide particles. Strength of prepared composites was higher in case of composites, while ductility of composites was lesser when compared to cast HE-30 aluminum alloy. The tensile strength shows an increasing trend with increasing weight percentage of silicon carbide.

Akhil. R et al,[2] fabricated aluminium ,silicon based alloy (LM6) composites with Lead oxide glass particles as reinforcement with percentage addition of 2.5%, 5%, 7.5%, and 10% . Stir casting process is employed in this process . Aluminum alloy was melted in a crucible by heating it in a furnace at 800°C for three to four hours. The lead oxide glass particles were heated at 800^{o}C to 700^{o}C for one to three hours to make their surfaces oxidized. The molten melt is poured in the cylindrical mould for the development of the required samples. Tensile test and hardness test were conducted on the formed metal matrix composite. Spectro analysis and micro analysis were also conducted on the MMC. In LM6 Metal Matrix Composite with PbO Glass Reinforcement addition of lead oxide glass increases the mechanical properties such as hardness and tensile strength of the of the aluminium metal matrix composite. Spectro analysis shows that increasing the amount of PbO reinforcement will increase the Si as well as Pb content in the metal matrix material.The micro structure study shows that the generation of Si dendrites in the Aluminium matrix and also shows the non-uniform dispersion of the PbO glass by the use of the sand cast technique.

Metin kok,[3] performed a study on the machinability of Al_2O_3 particle reinforced aluminium alloy composite. In this MMC 2024 Al alloy composites reinforced with 30 wt. %Al_2O_3 particles, having a composition by wt of 93% alumina, 1.8% TiO_2, and maximum 0.8% Fe_2O_3,1,1% CaO and 0.2% other magnetic materials. Composites were fabricated by the vortex method with subsequently applied pressure, using a 2 kW power resistance heated furnace under argon gas. Machining were carried out without coolant and at a constant depth of cut equal to 2 mm and feed rate of 0.1 mm rev^{-1} . The tool life of the TiN coated K10 tool was significantly longer than that of the HX tool. However, in the machining of the matrix alloy the tool life difference between cutting tools was larger than that in the machining of the composite. The tool life decreased with an increase in the cutting speed for both tools in all cutting conditions. The surface roughness of the workpiece was mostly affected by cutting speed. It was shown that cutting speed was the influential machining parameter on the tool wear. The tool wear increased considerably with increasing cutting speed.

Necat Altinkok et al.,[4] performed the study of tensile behavior and microstructure of Al_2O_3/SiCp reinforced aluminium based MMCs produced by the stir casting method. For this composites, hybrid ceramic powder mix was prepared by chemical route then inserted in A332 alloy in melt condition.. Al_2O_3/SiC powder mix was prepared and heated up in ceramic crucible in the furnace. This hybrid ceramic powder with different SiC particle size range was added into liquid matrix alloy and composites were fabricated. The effect of the reinforcing particle size on tensile strength, density and porosity properties of Al_2O_3/SiC particle reinforced MMCs were investigated. Tensile strength of Al_2O_3/SiC particle the composites were improved by the addition of the Al2O3/SiC particles. A description of phenomenon like particles cracking, interfacial failure associated to matrix reinforcement reaction layers, fracture behavior and ductile behavior of the matrix was analyzed by scanning electron microscopy (SEM).

Belete Sirahbizu Yigezu et al ,[5] studied Influence of Reinforcement Type on Microstructure, Hardness, and Tensile Properties of an Aluminum Alloy Metal Matrix Composite.This MMC is prepared by using Al-4% Cu-2.5% Mg foundry alloy was used as the matrix material and 400 mesh size (18 μm - 40 μm) 5 wt% SiC and Al2O3 particles were used as the reinforcement. The melting process was carried out in a muffle furnace with graphite crucible. Initially, Al-4% Cu-2.5% Mg foundry alloy was charged into the crucible and heated to about 700°C till the entire alloy was melted. The ceramic particles were preheated to 850°C for two hours before incorporation into the melt. The preheated SiC/Al_2O_3 particles were then added at a uniform rate. During the incorporation of reinforcement particles the melt was stirred with mechanical stirrer at the speed of 700 rpm. After the matrix alloy fully melted a small amount of degasser (C_2Cl_6) was added to mini-mize the presence of hydrogen gas in the melt. All the melting process was carried out under the cover of argon gas. Microstructural characteriza-tion was done using scanning electron microscope (SEM). For identifying the compositional elements and confirm-ing the formation of SiC/Al_2O_3 particles and the pres-ences of other intermetalic phase X-ray diffraction (XRD) and energy dispersive X-ray analysis (EDX) was carried out.mechanical property test were done by Vickers bulk hardness at load of 5 kg was carried out on the composite samples after polishing with a fine grained emery papers. The scanning electron microscopy (SEM) results showed that reasonably well dispersed of particles with small porosity at some locations. In addition, some deleterious reaction phases were observed at the interfaces of both test materials.The fracture surfaces study revealed that the Al-4% Cu-2.5% Mg/5% SiC composite showed a brittle fracture surface, whereas the Al-4% Cu-2.5% Mg/5% Al2O3 composite demonstrate the formation of some necking before tensile failure and which is an indicator of the presence of some ductility.

C.Neelima Devi et al,[6] studied Micro structural aspects of Aluminium Silicon Carbide Metal Matrix Composite. Aluminium (6061) and Silicon Carbide (grit size 60) are mixed by casting process in mass basis ratio of 100:5, 100:10, 100:15, and 100:20. The microstructures of aluminium silicon Carbide metal matrix composite of varying proportions are revealed that at lower stirring speed with lower stirring time, the particle clustering was more. Uniformity in stirring speed and stirring time resulted in better distribution of particles which results in high strength and low weight composition for aerospace and structural applications with cost effective casting process. From micro structural analysis, it was observed that Aluminium Silicon Carbide composite having cluster particles and some places are identified without SiC inclusions. This was due to varying the contact time between the SiC particles and molten aluminium during processing and high surface tension and poor wetting behavior between Aluminium and SiC particles. To overcome the surface tension problem and improve wetting properties, a mechanical force be applied uniformly during distribution of reinforcement in the metal matrix composites.In all microstructures consist of coarse grains of aluminium solid solution iron-rich (silicon carbide) inter metallic particles in the grain boundaries are observed and this can influence the fracture behavior.

S.Prabagaran et al[7] Analysed the Machinability of Aluminium Metal Matrix Composites Reinforced With B_4C And Graphite Particles Under Specified Machining Conditions. The composites namely AA6061-B4C and AA6061-B_4C-Gr are fabricated using Stir casting technique. The B_4C particle which is used to fabricate the composite is of 20 – 50 microns size and that of Graphite particles is 20 microns. Turning operations were conducted on composite specimen to measure the surface finish and to observe the swarf formation pattern. Incorporation of hard B_4C particles in AA6061-B_4C composite generates lower surface roughness values due to the burnishing effect produced by rubbing micro B_4C particles trapped between the flank face of the tool and work piece. Incorporation of soft graphite particles in AA6061-B_4C composite generates higher surface roughness values due to the severe disturbance in bonding between Graphite particles and aluminium matrix. Swarf formation in case of machining of AA6061 is almost continuous and having large radius and in case of machining of AA6061-B_4C-Gr composite is shorter of discontinuous nature with serrated edge that enables easy machining.

Manoj Singla et al,[8] performed the development of Aluminium Based Silicon Carbide Particulate Metal Matrix Composite. Oil fired tilting furnace has been used for preparing the MMC. Scraps of aluminium were preheated at 450˚C for 3 to 4 hours before melting and mixing the SiC particles were preheated at 110˚C for 1 to 3 hours to make their surfaces oxidized. Manual mixing was used because it was very difficult to mix using automatic device when the alloy was in a semi-solid state. After sufficient manual mixing was done, the composite slurry was reheated to a fully liquid state and then automatic mechanical mixing was carried out for about 10 minutes at a normal stirring rate of 600 rpm. Hardness test has been conducted on each specimen using a load of 250 N and a steel ball of diameter 5 mm as indenter. With increase in composition of SiC, an increase in hardness, impact strength and normalized displacement have been observed..

T.Rajmohan et al,[9] performed the Optimization of machining parameters for multi-performance characteristics in drilling hybrid metal matrix composites. Aluminium alloy Al 356 was used as a matrix material. The composites were fabricated with 5–15wt% of SiC particles in steps of 5wt% and a fixed quantity of 3wt% of mica. The aluminium alloy was first melted in an electric furnace. Mica and SiC, preheated to a temperature of about 620˚C, were added to the molten metal at 750˚C and stirred continuously. The stirring was done at 500 rpm for 5–7 min. Magnesium was added in small amounts during stirring to increase the wetting. The melt with reinforcement was poured into a permanent metallic mould. Drilling tests were conducted on a vertical CNC machining centre. The surface roughness of the work piece was measured. Grey relational analysis in the Taguchi method is used for the optimization of the multiple response problems.. The experimental results for optimal settings show that there was a considerable improvement in the performance characteristics of the machining process.

Ugur Soy et al[10] performed the Evaluation of the Taguchi method for wear behavior of Al/SiC/B4C composites. In this study the test specimen used is aluminum matrix composites with an A360 matrix reinforced with silicon carbide (SiC) and boron carbide (B_4C) ceramic particles. Pressure infiltration method was used to manufacture aluminum and its composites. SiC and B4C ceramic foams were produced after firing the dried coated polyester sponge. Then liquid aluminium alloy at 800˚C was infiltrated into the highly porous ceramic foam using pressure infiltration method to produce particle reinforced aluminum matrix composites.. Taguchi application Experiments were carried out to analyze the influence of testing parameters on specific wear rate of work pieces made of aluminum and its composites. Wear tests of the cylindrical pin specimens versus AISI316L stainless steel were carried out for dry sliding condition using a pin-on-disc arrangement. It is found that the parameter design of the Taguchi method provides a simple, systematic, and efficient methodology for the optimization of the wear test parameters. Taguchi's robust design method can be used to analyze the dry sliding wear problem of the aluminum matrix composites.

V.N.Gaitonde[11] studied Metal Matrix Composites Machining using Response Surface Methodology. Aluminum alloy A356 reinforced with 20% of SiC particulates was used as specimen. The chemical composition of the A356 aluminum matrix is aluminum with 7% Si and 0.4% Mg. The average dimension of the SiC particles is about 20 μm. PCD tools is used for machining the MMC. The specimen is used for determining the effects of process parameters on three machinability characteristics, namely, machining force (Fm), cutting power (P) and specific cutting force (Ks) during turning. The mathematical models determined by the multiple-regression analysis to predict machining force, cutting power and specific cutting force are developed. The mathematical models so developed are used to predict the machinability aspects by substituting the values of cutting speed and feed rate within the ranges selected. Analyze of the parameters involved experiments by FFD, RSM models and mathematical models. Based on the results the machining force and cutting power increase with feed rate, while the specific cutting force decreases for a given value of cutting speed. The machining force and cutting power are highly sensitive to variations in cutting speed at higher values of feed rate as compared to lower values. The specific cutting force is less sensitive to cutting speed variations for a given feed rate. A combination of higher feed rate with high cutting speed is advantageous for minimizing specific cutting force.

Keshavamurthy et al [12]. 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-si_3N_4 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.

S Dharmalingam et al,[13] performed Optimization of abrasive wear performance in aluminium hybrid metal matrix composites using Taguchi -grey relational analysis. This study is performed on Al–Si alloy (Al–Si10Mg) containing hard reinforcement as alumina (Al2O3) particles and soft reinforcement as molybdenum disulphide has been used. The alloy contains 10.65wt% Si, 0.14wt% Cu, 0.48wt% Mg, the rest being aluminium. Al–Si10Mg alloy was charged into an electrical resistance heated furnace The melting process was carried out under argon atmosphere in a graphite crucible and heated to 1073 K. Mixing of reinforcement was conducted with a graphite impeller by stir casting method with a separate graphite crucible. Pre-heated alumina particles were incorporated into the molten metal and stirring was continued for further 10 min. Al–Si10Mg MMCs reinforced with 10wt% alumina is produced. The same procedure was repeated for hybrid MMC with 2wt% and 4 wt% of molybdenum disulphide with 10wt% Al2O3 to the aluminium alloy. Hardness of the composite was measured using Vickers micro hardness tester. A pin-on-disc apparatus was used to study the abrasive wear behaviour. molybdenum disulphide percentage (0.5874%) exerts a significant influence on the abrasive wear of the aluminium hybrid composites.Wear rate decreased with increase in sliding speed and molybdenum disulphide content, but increased with load and abrasive size. Coefficient of friction increased with load but decreased with increase in sliding speed and molybdenum disulphide content. Hybrid aluminium composites with 10 wt% Al2O3 with 2wt% MoS2 hybrid MMCs gave the best wear performance for the optimized abrasive wear parameters obtained.

Rama rao et al[14] . 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.

V.C.Uvaraja et al,[15] did the comparision on Al6061 and Al7075 alloy with SiC and B_4C reinforcement hybrid metal matrix composites. Stir casting technique was used to fabricate 6061 Aluminum alloy and Al 7075 alloy with varying weight percentages of SiC (5, 10, and 15) and a constant weight percentage of B4C (3) reinforcements. The melt was maintained at a temperature between 750 to 800˚C for one hour. Weighed quantity of SiC (5,10 and 15wt.%) along with 3 weight percentage of B4C particulate, preheated at 600ºC were added to the melt with constant stirring for about 10min at 500 to 650rpm for all samples. Pin-on-Disc Wear Test, Microstructure studies sing SEM, Rockwell Hardness test were performed on the samples. Hardness of the composites found increased with increased filler content and the increases in hardness of Al6061-SiC-B4C & Al7075-SiC-B4C composites are found to be 75 to 88HRC and 80 to 94HRC respectively. From the study it is found that Al7075-SiC-B_4C exhibits superior mechanical and tribological properties.

Rohatgi et al[16]. 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.

Pragya Shandilya et al[17] studied Parametric optimization during wire electrical discharge machining using response surface methodology. This study is made to optimize the process parameters during machining of SiCp/6061 Al metal matrix composite (MMC) by wire electrical discharge machining (WEDM) using response surface methodology (RSM). Aluminum (6061) based MMC, made by stir casting technique having 10% SiC particles (by weight) were used as the specimen. servo voltage *(SV)*, pulse-on time *(TON)*, pulse-off time *(TOFF)* and wire feed rate *(WF)* were chosen as variables to study their effects on kerf as response parameter. The kerf was measured using the stereo microscope. and is expressed as sum of wire diameter and twice of wire-work piece gap. SEM analysis was used to determine the effect of input process parameters on the microstructure of the cut surface. SEM images of the cut surfaces have revealed that the fine surface finish was obtained when machining was done at a combination of lower levels of input process parameters. When machining was done at combination of higher levels of input process parameters, craters and black patches arise on the machined surface. AFM analysis of machined surfaces shows that there is considerable decrease in surface roughness with decrease in voltage ANOVA results show that voltage and wire feed rate are highly significant parameters and pulse-off time is less significant. Pulse-on time has insignificant effect on kerf. The results of the study based on WEDM of SiCp/6061 Al MMCs can be used for effective and economical machining of SiCp/6061 Al MMCs by WEDM.

V. C. Uvaraja et al, [18] studied Tribological Characterization of Stir-Cast Hybrid Composite Aluminium 6061 Reinforced with SiC and B4C Particulates. The specimen used is 6061 aluminium with SiC and B4C particulate reinforced composite. The particulate reinforced 6061 aluminium alloy with a constant weight percentage of B4C particulate and varying range of SiC particulate is produced by stir casting technique. The melt was maintained at a temperature between 750 to 800 oC for one hour.Vortex was created by using a mechanical stirrer. Weighed quantity of SiC (5,10 and 15wt.%) along with 3 weight percentage of B4C particulate, preheated at 600ºC were added to the melt with constant stirring for about 10min at 500 to 650rpm for all samples. 1% of magnesium alloy is added to increase binding . Dry sliding wear tests were carried out using pin -on- disc type wear tester. Rockwell hardness tester with at least six indentations of each sample is used to test the hardness of the specimen. The Optical Microscopy is used to see the misrostructure of the specimen. Hybrid composites showed high hardness as compared to unreinforced alloy due to hard phase silicon carbide and boron carbide particulates embedded uniformly in aluminum 6061 based matrix. Hybrid composite sample with 10wt. % SiC and 3wt% B4C composition have better tribological properties.

The reinforcement of Al 6061 alloy with SiC and B4C particulates up to a volume fraction of 5 to 15 wt. % has marked effect on wear rate. The wear rate and coefficient of friction decrease with increasing volume fraction of reinforcements.

Udhaya prakash et al[19]. 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

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.

A K Srivastava et al,[20] studied the microstructural features and mechanical properties of carbon nanotubes reinforced aluminium-based metal matrix composites. The carbon nanotubes have been produced by the catalytic chemical vapour decomposition (CVD) of the propylene. The carbon nanotubes have been produced by the catalytic chemical vapour decomposition of the propylene. The aluminum powder of purity higher than 99.5% with an average particle size of ~ 200 mesh (per square inch) has been mixed homogeneously with the different wt% (1, 2, 4 and 10) of carbon nanotubes by hand grinding for 30 min. The mixtures are hot- pressed at 793 K under a pressure of 25 MPa for 30 min. Transmission electron microscope (TEM) is used for microstructural characterization. A scanning transmission electron microscope with a field emission gun operated at 100 kV has also been used to study the distribution of nanotubes in the aluminum matrix. The Vickers indenter microhardness was measured with an ultramicro indentation system fitted with a diamond indenter with a right pyramid and square base. Microstructure-property correlation has been elucidated in view of the high mechanical strength and thermal stability of the nanotubes reinforced in a metallic matrix. Enormous increase microhardness on increasing the content of the tubes in aluminum matrix is found. The distribution of carbon nanotubes in aluminum matrix has been seen uniform with a higher concentration of the tubes at the grain boundaries.

Anilkumar et al [21]. 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.

S.Gopalakannan et al[22] performed the modelling and optimization of EDM process parameters on machining of Al 7075-B4C MMC using RSM. In this study MMC composed of Al 7075 as metallic base material which is reinforced with B_4C a hard cermic reinforcement . Al 7075 consists of Al,Zn,Mg and Cu reinforced 10 wt% of B4Cwith average particle size of 25 microns by stir casting method.the experiment were designed based on central composite design of response surface method. The predicted values match the experimental values well with R2 of MRR, EWR and SR. Pluse current, pulse on time affect the MRR and they have statistical significance on both EWR and SR the higher pulse off time offers lower the EWR value.

E. Kilickap et al, [23] studied tool wear and surface roughness in machining of homogenized SiCp reinforced aluminium metal matrix composite . They investigated machining parameters on tool wear & surface roughness for 5% SiC-p Al-MMC. They found that cutting speed is the most influential machining parameter on tool wear. Feed rate is the second influential machining parameter. Higher depth of cut, slightly increased tool wear.

Kemal Aldasa[24] performed Experimental and theoretical analysis of particle distribution in particulate metal matrix composites . Study shows that there is usually particle clustering or agglomeration occurs in PMMC. This clustering significantly decreases the local property of the PMMC. However, uniform distribution of particles in the final product is essential in the PMMCs to obtain desired mechanical and thermal properties.

A. Pramanik, L.C. Zhang and J.A. Arsecularatne[25] performed Prediction of cutting forces in machining of metal matrix composite Pramanik et al. developed a mechanics model to predict the forces for machining aluminum alloy based MMCs reinforced with ceramic particles. The resultant cutting force was considered to consist of components due to chip formation, ploughing and, particle fracture and displacement. They showed that force due to chip formation is much higher than those due to ploughing and particle fracture.

A. M. S. Hamouda et.al.[26] expressed the Processing and characterization of particulate reinforced aluminium silicon matrix composite and measured the value for the quartz particulate reinforced LM6 alloy composites and it has been found that it gradually increases with increased addition of the reinforcement phase. They also found that the tensile strength of the composites decreases with the increase in addition of quartz particulate. In addition, their research article is well featured by the particulate-matrix bonding and interface studies which have been conducted to understand the processed composite materials mechanical behavior and it was well supported by the fractographs taken using the scanning electron microscope (SEM).

Ramesh et al[27] analysed the Microstructure and Metallurgical Properties of Aluminium 7075 – T651 Alloy / B_4C 4 % Vol. Surface Composite by Friction Stir Processing and finds that the surface composite fabricated with the rotational speed of 500 rpm, traverse speed of 60 mm/min using three passes produced a good processed surface composite. In addition, for a given traverse speed, the grain size in the nugget zone is reduced with increasing the rotational speed. He also found that the average hardness of friction stir processed surface composite was 1.5 times higher than that of the base metal aluminum 7075 – T651.

K.L. Meena et al.[28] presented the paper on An Analysis of Mechanical Properties of the Developed Al/SiC-MMCs and finds that Optical micrographs shows reasonably uniform distribution of SiC particles. Tensile strength increases with the increase in reinforced particulate size and weight fraction of SiC particles. Also % Elongation and % Reduction in area decreases with the increase in reinforced particulate size and weight fraction of SiC particles. Hardness and Density increases with the increase in reinforced particulate size and weight fraction of SiC particles. Impact Strength decreases with the increase in reinforced particulate size and increases with the increase in weight fraction of SiC particles.

Weglewski et al [29]. 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.

M. Asif, K et al[30] performed the Development of Aluminium Based Hybrid Metal Matrix Composites for Heavy Duty Applications and investigates the dry sliding wear behavior of aluminium alloy based composites, reinforced with silicon carbide particles and graphite. The results reveal that wear rate of hybrid composite is lower than that of binary composite. The wear rate decreased with the increasing load and increasing speed. He also compares the results of the proposed composites with iron based metal matrix composites at corresponding values of test parameters. The comparative study reveals that the proposed composites have lower friction coefficient, less temperature rise and low noise level; however they have little higher wear rate.

M. L. Ted Guo[31] et al expressed the Tribological behavior of self-lubricating aluminium/SiC/graphite hybrid composites synthesized by the semi-solid powder-densification method and reveals that hardness decreases with the amount of the graphite addition fracture energy decreases monotonously as the amount of graphite addition increases. Friction co-eff. decreases as the % of graphite addition increases. Amount of graphite released on the wear surface increases as the % of graphite addition increases. Graphite released from the composites did bond on the wear surfaces on the counter parts however the amount bonded is small, and there is no significant difference in the amount bonded for different Graphite additions.

CONCLUSION

From literature review the result shows the mechanical properties of the composites can be increased considerably by increasing the weight percentage of reinforcements. Various steps involved in stir casting method has been discussed , and importance has been given to different key points, such as selection of weight of reinforcement, particulate size, preheating and melting temperature of Al matrix and stirring speed .Uniform distribution of reinforcements in the matrix is achieved by constant stirring.

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