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PREPARATION AND EVALUATION OF MECHANICAL PROPERTIES OF A356/SiCp/Grp HYBRID COMPOSITES

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ABSTRACT

Aluminium matrix composite with multiple reinforcement are finding increased applications because of its light weight and improved mechanical properties. Aluminium alloy composites containing two reinforcements such as SiC and Graphite particles in wt% were prepared by squeeze casting method. The primary reinforcement Gr Particle was varied as 1,3 and 5 Wt%. The molten mixture was poured into a die when the stirring is complted and metal matrix composites were produced by applying the pressure. Optical microscopic examination, microhardness, density and porosity measurements were carried out. The results showed that hardness values were increased by increasing weight percentage of graphite reinforcements during squeeze casting . Porosity and other casting defevcts such as shrinkage cavities were minimized due to pressure applied during solidification. Increase in weight percentage of graphite composites caused to increase porosity even in squeeze casting but lesser than gravity cast matrix allo. Microstructure shows the absence of micro porosity , and grain reinforcement interfacial bond between matrix and reinforcement.

I INTRODUCTION

1.1 ALLOY

An alloy is a material composed of two or more metals or a metal and a nonmetal. An alloy may be a solid solution of the elements (a single phase), a mixture of metallic phases (two or more solutions) or an intermetallic compound with no distinct boundary between the phases. Solid solution alloys give a single solid phase microstructure, while partial solutions exhibit two or more phases that may or may not be homogeneous in distribution, depending on the thermal (heat treatment) history of the material. An inter-metallic compound has one other alloy or pure metal embedded within another pure metal.

Alloys are used in some applications, where their properties are superior to those of the pure component elements for a given application. Examples of alloys are steel, solder, brass, pewter, Duralumin, phosphor bronze and amalgams.

1.2 COMPOSITES

Composite materials (also called composition materials or shortened to composites) are materials made from two or more constituent materials with significantly different physical or chemical properties, that when

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combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure. The new material may be preferred for many reasons: common examples include materials which are stronger, lighter or less expensive when compared to traditional materials.

Most composites are made of just two materials. One is the matrix or binder. It surrounds and binds together Fibbers or fragments of the other material, which is called the reinforcement.

1.2.1 Why we use composites?

The biggest advantage of modern composite materials is that they are light as well as strong. By choosing an appropriate combination of matrix and reinforcement material, a new material can be made that exactly meets the requirements of a particular application. Composites also provide design flexibility because many of them can be moulded into complex shapes. The downside is often the cost. Although the resulting product is more efficient, the raw materials are often expensive.

1.3.1 POLYMER MATRIX COMPOSITES

Polymers (also known as plastics or resins) are far more popular than other two matrix materials, namely, metals and ceramics. Almost all reinforcements, inorganic and organic, can be used with polymers to produce a wide range of reinforced plastics or polymer composites.

The densities of polymers are usually very low. Polymers are easily processable. The processing and curing temperature are normally in the lower range, and in some cases, the ambient temperature will suffice. This brings down the manufacturing cost substantially due to a low energy input. Further, polymers constitute a wide class of organic materials, each having a distinct characteristic feature. This makes them all the more attractive from the point of view of developing composites having different properties.

1.3.2 METAL MATRIX COMPOSITES

Metal matrix composites, at present though generating a wide interest in research fraternity, are not as widely in use as their plastic counterparts. High strength, fracture toughness and stiffness are offered by metal matrices than those offered by their polymer counterparts. They can withstand elevated temperature in corrosive environment than polymer composites. Most metals and alloys could be used as matrices and they require reinforcement materials which need to be stable over a range of temperature and non-reactive too. However the guiding aspect for the choice depends essentially on the matrix material. Light metals form the matrix for temperature application and the reinforcements in addition to the aforementioned reasons are characterized by high moduli.

Titanium, Aluminium and magnesium are the popular matrix metals currently in vogue, which are particularly useful for aircraft applications. If metallic matrix materials have to offer high strength, they require high modulus reinforcements. The strength-to-weight ratios of resulting composites can be higher than most alloys.

The melting point, physical and mechanical properties of the composite at various temperatures determine the service temperature of composites. Most metals, ceramics and compounds can be used with matrices of low melting point alloys.

Table No.1.1: Metal matrices and reinforcements

Matrix	Reinforcements
Aluminium and alloys	C, Be, SiO_2, B, SiC, Al_2O_3, Steel, B_4C, Al_3Ni, Mo, W, Z_rO_2
Titanium and alloys	B, SiC, Mo, $SiO_{2,}$ B_e,ZrO_2
Nickel and alloys	C, B_e, $Al_2O_{3,}$SiC, Si_3N_4, steel, W, Mo, B
Magnesium alloys	C, B, glass, Al_2O_3
Molybdenum and alloys	B, ZrO_2

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Iron and Steel	Fe, Steel, B, Al_2O_3, W, SiO_2,ZrO_2
Copper and alloys	C,B, Al_2O_3, E-glass

METAL - MATRIX COMPOSITES (MMC)

Advanced composites based on metallic matrices have a somewhat recent history, yet the opportunities look very promising. The first MMCs were developed in the 1970s for high-performance applications using continuous fibers and whiskers for reinforcement.

MMCs combine both metallic properties (ductility and toughness) with ceramic properties (high strength and modulus) possess greater strength in shear and compression and high service temperature capabilities. The frontier zone between the matrix and reinforcement phase (interface or interphase) is an essential part of MMC. Bonding between the two phases develops from interfacial frictional stress, physical and chemical interaction and thermal stresses due to mismatch in the coefficients of thermal expansion of the matrix and reinforcement. During the design of a MMC the underlying interfacial phenomenon which governs the transmission of thermal, electrical and mechanical properties is of utmost importance.

The recent recognition that addition of ceramic reinforcements enables manipulation of physical as well as mechanical properties of MMCs has led to increasingly wide spread use of these materials in electronic packaging and thermal management applications.

Research and development on MMCs have increased considerably in the last 10 years due to their improved modulus, strength, wear resistance, thermal resistance and fatigue resistance and improved consistency in properties and performance in general compared to the un-reinforced matrix alloys. The reinforcements are added extrinsically or formed internally by chemical reaction. The properties of MMCs depend on the properties of matrix material, reinforcements, and the matrix-reinforcement interface.

PROPERTIES OF METAL MATRIX COMPOSITES

Reinforcements and composites are typically made by proprietary processes, and, as a consequence, the properties of materials having the same nominal composition can be radically different. The issue is further clouded by the fact that many reinforcements and MMCs are still in the developmental stage, and are continually being refined. Numerous test methods are used throughout the industry, and it is widely recognized that this is a major source of differences in reported properties.

Some MMC properties cannot be measured as they would be for monolithic metals. For instance, toughness is an important but hard to define material property. Standard fracture mechanics tests and analytical methods for metals are based on the assumption of self-similar crack extension; i.e., a crack will simply lengthen without changing shape. Composites, however, are non homogeneous materials with complex internal damage patterns.

1.6 CASTING

Casting is a manufacturing process by which a liquid material is usually poured into a mold, which contains a hollow cavity of the desired shape, and then allowed to solidify. The solidified part is also known as a casting, which is ejected or broken out of the mold to complete the process. Casting materials are usually metals or various cold setting materials that cure after mixing two or more components together; examples are epoxy, concrete, plaster and clay. Casting is most often used for making complex shapes that would be otherwise difficult or uneconomical to make by other methods.

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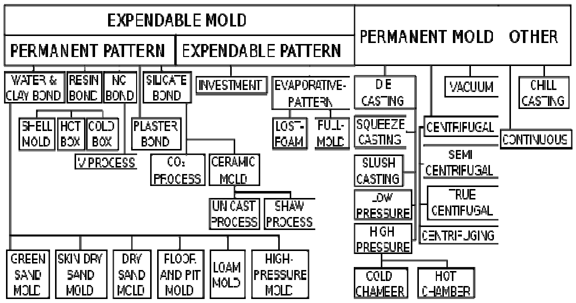

1.6.1 SQUEEZE CASTING

The squeeze casting process uses an accurately measured or metered quantity of molten metal which is poured into a heated mould via a launder. The mould is closed to produce an internal cavity in the shape of the required component.

The molten metal is forced/ displaced into the available space of the die cavity. As with most casting processes, using a permanent pattern, the mould is coated with a suitable release agent and for squeeze casting it is usually in the form of a graphite coating.

Pressure continues to be applied to the molten metal until it has solidified and forms the required component. The press is then withdrawn and the component is ejected. Squeeze casting is most suited to the production of light alloy components in large production quantities. Retractable and disposable cores can be used to create complex internal features.

Pros

1. Offers a broader range of shapes and components than other manufacturing methods.
2. Little or no machining required post casting process.
3. Low levels of porosity.
4. Good surface texture.
5. Fine micro-structures with higher strength components.

Fig No. 1.7: Components of Machine

1.7.1 DENSITY

6. No waste material, 100% utilization.

Cons

1. Costs are very high due to complex tooling.
2. No flexibility as tooling is dedicated to specific components.
3. Process needs to be accurately controlled which slows the cycle time down and increases process costs.
4. High costs mean high production volumes are necessary to justify equipment investment.

Fig No. 1.8: Archimedes' Principle

The density, or more precisely, the volumetric mass density, of a substance is its mass per unit volume.

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Mathematically, density is defined as mass divided by volume

$$\rho=\frac{m}{v}$$

where ρ is the density, m is the mass, and V is the volume.

Different materials usually have different densities, and density may be relevant to buoyancy, purity and packaging. If the relative density is less than one means that the substance floats in water.

The density of a material varies with temperature and pressure. This variation is typically small for solids and liquids but much greater for gases. Increasing the pressure on an object decreases the volume of the object and thus increases its density. Density is an intensive property in that increasing the amount of a substance does not increase its density; rather it increases its mass.

ARCHIMEDES PRINCIPLE

Archimedes' principle indicates that the upward buoyant force that is exerted on a body immersed in a fluid, whether fully or partially submerged, is equal to the weight of the fluid that the body displaces. Archimedes' principle is a law of physics fundamental to fluid mechanics.

Practically, the Archimedes principle allows the buoyancy of an object partially or wholly immersed in a liquid to be calculated. The downward force on the object is simply its weight. Thus the net upward force on the object is the difference between the buoyant force and its weight. If this net force is positive, the object rises; if negative, the object sinks; and if zero, the object is neutrally buoyant - that is, it remains in place without either rising or sinking.

In simple words Archimedes principle states that when a body is partially or completely immersed in a fluid, it experiences an apparent loss in weight which is equal to the weight of the fluid displaced by the immersed part of the body.

1.8 MICROSTRUCTURE

Microstructure is defined as the structure of a prepared surface or thin foil of material as revealed by a microscope above 25× magnification. The microstructure of a material (which can be broadly classified into metallic, polymeric, ceramic and composite) can strongly influence physical properties such as strength, toughness, ductility, hardness, corrosion resistance, high/low temperature behavior, wear resistance, and so on, which in turn govern the application of these materials in industrial practice. Microstructure at scales smaller than can be viewed with optical microscopes is often called ultra structure or nanostructure.

When a polished flat sample reveals traces of its microstructure, it is normal to capture the image using macro photography. More sophisticated microstructure examination involves higher powered instruments: optical microscopy, electron microscopy, X-ray diffraction and so on, some involving preparation of the material sample (cutting, microtome, polishing, etching, vapor-deposition etc.). The methods are known collectively as metallographic as applied to metals and alloys, and can be used in modified form for any other material, such as ceramics, glasses, composites, and polymers.

Two kinds of optical microscope are generally used to examine flat, polished and etched specimens: a reflection microscope and an inverted microscope. Recording the image is achieved using a digital camera working through the eyepiece.

Fig No. 1.9: Optical Microscopy

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1.9 AIMS AND OBJECTIVES OF THE PRESENT STUDY

- To reduce presence of cavities like pores and voids.
- To obtain maximum mechanical properties at a pressure of 100MPa.
- To improve hardness of the composites.
- To minimize the density and porosity.

CHAPTER 2
LITERATURE REVIEW

Composite materials are gaining wide spread acceptance, due to their characteristic behavior and high strength-to-weight ratio. Of these aluminium metal matrix composites are finding increased applications, because of their improved mechanical and tribological properties.As suggested by Himanshu Kala, et al, aluminium alloys are more and more used due to good corrosion resistance, high damping capacity, low density and good electrical and thermal conductivities. AMC's have been tested and proved useful in different engineering sectors including functional and structural applications because of variation in mechanical properties depending upon the proportion of reinforcement and chemical composition of Al matrix

As discussed by S. Suresha, et al, [9] the addition of SiC particulates increases both mechanical strength and wear resistance of Al alloy. But the consequent increase in hardness makes the machining difficult. AMCs reinforced with SiC particulates are known for higher modulus, strength and wear resistance compared to conventional alloys.

According to A. Baradeswaran, et al, [1] generally lubricant is externally added to reduce the wear. This poses the problem when the materials need the periodic applications of lubricant particularly to wear parts which are difficult to access. For such applications self-lubricating materials are preferred because the solid lubricant contained in them can be automatically released during the wear process to reduce the wear. Graphite is one of the most widely used solid lubricant materials.

K. Sukumaran , et al, suggested that,[7]In the case of composite, the squeeze casting is found to be very effective not only in minimizing the defect level thereby increasing the mechanical properties. But in improving the overall distribution of the second phase particles, the squeeze cast 2124-10SiCp composite shows improved wear resistance and lower coefficient of friction compared to that of 2124 alloy.

Harun Mindivan, et al,[3] suggested that Magnesium should be added to these alloys at a fraction of 1 wt.% before casting to improve the wettability between the melt and the SiC particles.

Maleki A, et al,[5] said that, applied pressure decreases the grain size and SDAS of primary phase. SDAS was dropped from about 47 µm for atmospheric pressure to about 34 µm for an external pressure of about 100MPa. Applied pressure modifies and reduces the average aspect ratio of the eutectic silicon particles. The average aspect ratio of the eutectic silicon particles was dropped from 5 for atmospheric pressure to about 1.5 for an external pressure of about 100MPa. It has also made the morphology of the eutectic silicon particles more uniform.

V C Uvaraj, et al, [10] suggested that conventional aluminum alloy polishing techniques should be used to get ready the contact surfaces of the monolithic composite aluminum specimen. The procedure involves grinding of composite aluminum surfaces manually by 240, 320, 400 and 600 grit silicon carbide

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papers and then polishing them with 5, 1 & 0.5 µm alumina using low speed polishing machine. The polished surfaces were cleaned ultrasonically with acetone and methanol solutions.

Y Sahin [6] concluded that, the density increased with increasing the volume fraction of particulates. The increase in density indicates that particle breakage may not have any significant influence on the composites. It is believed to achieve an improvement of the bonding between the particle and matrix.

CHAPTER 4

EXPERIMENTAL DETAILS

4.1 CASTING PROCESS

The bottom pouring type casting furnaces are used in order to reduce manual work as the melt is directly poured into the mould/die. The necessity to lift the melt and pour into the mould is reduced and a single person can perform various casting methods using this machine.The required quantity of A356 alloy was melted in a graphite crucible at 750˚C in an electric resistance furnace. The melt was stirred at a speed 630 rpm using a graphite impeller to create vortex inside the melt. Silicon carbide and graphite particles of fine size (20 µm) were selected for present work. The reinforcements added to the metal matrix where at definite proportions.

The stirrer blade, pathway tube and die were coated with high temperature paste "Wolfrakote TOP". The molten metal in the furnace was added with kavaral to remove impurities from the metal. The impurities remain in the upper surface of the metal, which was removed using a scoop.

Fig No. 4.1: Coating of die using Wolfrakote TOP

Fig No. 4.2: Kavaral

The ceramic particles for reinforcement were taken in definite proportion of wt% to the matrix element and mixed properly before charging. Particles prior to mixing were preheated at 450 ˚C to drive off the moisture. The pathway tube and die are also preheated before pouring the molten metal into the die. They are heated to avoid solidification during pouring.

During mechanical stirring 1 Wt% magnesium was also added to increase the wettability of reinforcing particles. The presence of magnesium in aluminum matrix composite not only has the beneficial effects of alloying but also reduces the surface tension and better wetting dispersion respectively. Magnesium reacts with the oxygen present in the surface of the dispersed, thinning the gas layer, and thus improving wetting and reducing the agglomeration. [9]

The preheated reinforcement mixture was added to furnace after the formation of vortex in the melt. The particles were charged near vortex with the help of funnel kept on top of vortex into the melt. The reinforcement was added completely and mixed well with the help of mechanical stirrer. The molten metal is then allowed to pass through the bottom opening of the furnace to the die. The bottom pouring was operated by the remote switch. The molten slurry is then poured into the preheated die of 50mm diameter and 300mm length.

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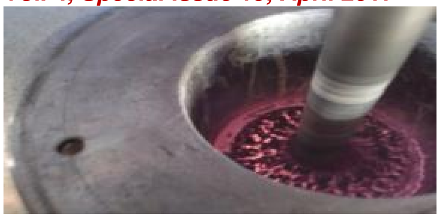


Fig No. 4.3: While Adding Reinforcement

Fig No. 4.4: Vortex Formed During Stirring

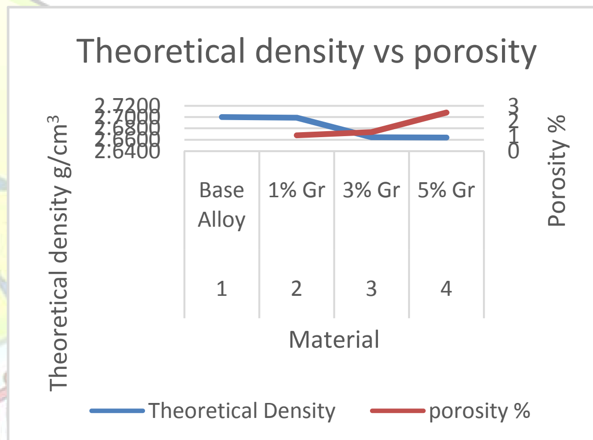
The hydraulic power pack powered by an electrical motor capable of attaining 100 tons pressure. This power pack is coupled with a piston which is fixed on the heavy structured frame. This frame also houses the split die which is made of mild steel and capable of withstanding pressure upto 50 tons. The pressure applied can be directly controlled by digital indicator cum controller which is fitted on the control panel.

Once the molten metal is poured into the die, the piston was pressed down at a pressure of 100 MPa for a few minutes in order to squeeze the melt. Then the melt was allowed to solidify and the billet was removed from the mould and machined for required dimensions.

4.2 SAMPLE PREPARATION

The squeezed billet was cut into small pieces of required dimensions. Care should be taken to note that the test sample's end surfaces were flat and polished metallographically prior to testing. Conventional aluminium alloy polishing techniques were used to get ready the contact surfaces of the aluminium composite specimen for testing.

The procedure involves grinding of composite surfaces using grinding wheel of grit AA60 and then manually by 220 and 400 grit silicon carbide papers and then lapping them with valve lapping paste. This preparation technique created considerable surface relief between hard and soft aluminium matrix. The polished surfaces were cleaned with acetone solution. Christo Ananth et al.[4] discussed about E-plane and H-plane patterns which forms the basis of Microwave Engineering principles.



4.3 DENSITY AND HARDNESS

The density of the specimen was calculated based on Archimedes' principle. The weight of the disc in air was calculated using digital balance. The weight in water was calculated by immersing the disc fully in the water. According to Archimedes' principle, the change in volume of liquid is equal to the weight of disc in water. The ratio of mass in air to water provides the density of the specimen.

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Fig No. 4.5: Before immersing specimen

Fig No. 4.6: After immersing specimen

Microhardness was measured by Vickers hardness testing machine at different phases. Microhardness measurement was done on each set of sample by taking minimum of three indentations per sample at 200 gf load for 5s.

CHAPTER 5

RESULT AND DISCUSSION

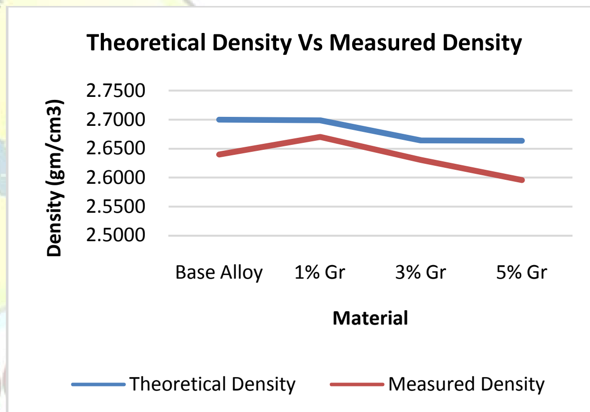
5.1 DENSITY AND POROSITY

The density was measured from Archimedes principle. The theoretical density and porosity was also calculated.

Table No. 5.1: Density and Porosity of different compositions

S.No	Material	Theoretical Density (gm/cm^3)	Measured Density (gm/cm^3)	Porosity %
1	Base Alloy	2.7000	2.6400	
2	1% Gr	2.6987	2.6703	1.05
3	3% Gr	2.6642	2.6304	1.27
4	5% Gr	2.6636	2.5958	2.55

The theoretical density is high when compared to measured density in all three compositions of graphite.



The density decreases as the percentage of reinforcement of graphite increases. The porosity value increases as the graphite percentage increased.

5.2 MICROHARDNESS

The microhardness measurement at different phases of composite has been carried out to know the effect of reinforced particulates on the alloy matrix. It is observed that the hardness of aluminum composites increases with increase in Gr particle content as given in Table 5.1

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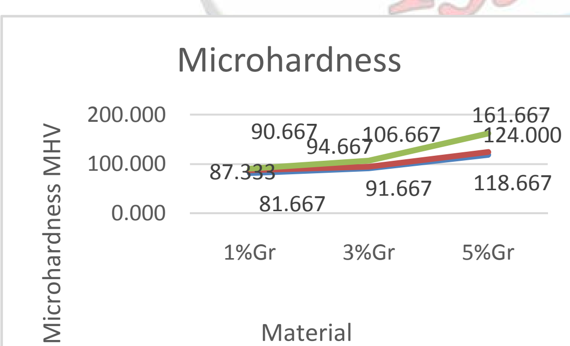
Table No. 5.2: Micro Hardness at Base, Inter Phase &Phase

S.No	Load (gms)	MHV 0.2				
		Al	1% Gr	3% Gr	5% Gr	
1	200	78	85	109	120	Aluminium
2		76	91	105	124	
3		70	86	106	112	
4		83	94	94	121	Inter phase
5		80	93	93	122	
6		78	85	88	129	
7		74	82	95	139	Phase
8		75	83	90	169	
9		71	80	99	177	

Microhardness measurements have been carried out on the embedded reinforced particles as well as in the vicinity of particles and matrix. Reinforced particles show high hardness, which decreases as we move away from particle to matrix. The high hardness at particle/matrix interface indicates good interfacial bonding between particle and alloy matrix

Table No. 5.3: Average Micro Hardness at Base, Inter Phase & Phase

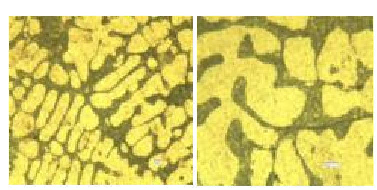


S.no	Material	MicroHardness		
1	1% Gr	81.667	87.333	90.667
2	3% Gr	91.667	94.667	106.667
3	5% Gr	118.667	124.000	161.667

The composite with 5% Gr shows high micro hardness value at particle, interface and matrix in comparison to other composites, which is achieved by good interfacial bonding and refinement of microstructure.

5.3 MICROSTRUCTURE

The properties of the MMCs depend not only on the matrix, particle, and the volume fraction, but also on distribution of reinforcing particles and interface bonding between the particle and matrix. In practical way, to achieve a homogenous distribution is difficult. But the distribution of SiC_p in these composites is uniform. For the microstructure of these composite specimens, no pores existed in these specimens due to the improvement of wettability when the A356 alloy was used. The microstructure images of different combinations using optical microscopy are given below.



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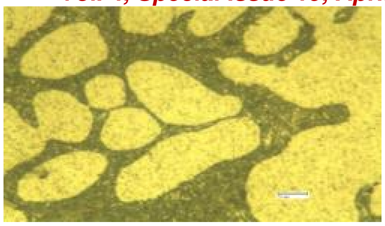

Fig No. 5.1: Microstructure of 1% Gr (a) 200X (b) 500X(c) 500X

Dendritic structure got modified during casting, which is influenced by many factors such as dendritic fragmentation, restriction of dendritic growth by the particles. Ceramic particles also act as a barrier for the dendritic growth and this phenomenon is more pronounced. However, the particles are observed to form network structure at certain places. Moreover, eutectic silicon network is fine and the dimension of inter-dendritic region is comparably less than that of the particle diameter

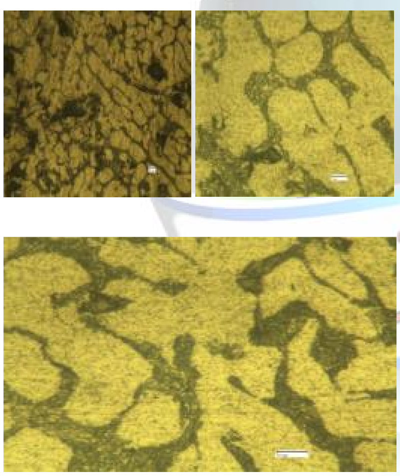

Fig No. 5.2: Microstructure of 3% Gr (a) 200X (b) 500X (c) 500X

It indicates that no evidence of the presence of cavities neither at interfaces nor in the matrix was found with optical microscopy, which indicates that a good bonding between the matrix and ceramic particulate was obtained. Absence of voids at interface indicates the good bonding between the matrix and the reinforced particles, which helps in better load transfer from the matrix to reinforcement materials.

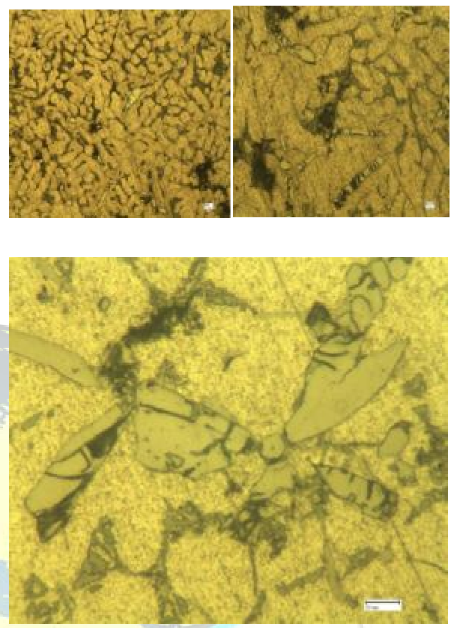

Fig No. 5.3: Microstructure of 5% Gr (a) 100X (b) 200X (c) 500X

Overall analysis of structure indicates that microstructure is refined whereas eutectic silicon are having blunted and globular morphological features. This refinement may lead to better tribological and mechanical properties of the composite. The colonization of eutectic silicon in the vicinity of the particles enhances wear resistance of material.

Microstructure analysis shows that addition of SiC has a pronounced effect on the microstructure refinement, particularly eutectic silicon. The degree of microstructure and eutectic silicon refinement increases in accordance with the increase of SiC reinforced particle percentage.

CONCLUSION

1. In the case of composite, the squeeze casting is found to be very effective not only in minimizing the defect level thereby increasing the mechanical properties but in improving the overall distribution of the second phase particles.

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2. Dual reinforcement particles have different functions in the composite. Silicon carbide refines the eutectic silicon whereas graphite provides good interfacial bonding and acts as a solid lubricant.
3. The combination of silicon carbide and graphite particle in equal proportions of reinforcement in the composite exhibits better hardness at three phases as compared to other combinations at a load of 200g.
4. The density value decreases when reinforcement particulate increases.
5. The microstructural analysis shows the homogeneous nature of hybrid metal matrix composite. The homogeneity of the composites results in uniform distribution of reinforcement particles.

REFERENCES

[1] Baradeswaran. A , A. Elaya Perumal (2014) ‘Study on mechanical and wear properties of Al 7075/Al2O3/graphite hybrid composites’ - Composites: Part B 56 (2014) 464–471

[2] Hamid Abdulhaqq A, Ghosh PK, Jain SC, Ray Subrata. The influence of porosity and particle content on dry sliding wear of cast in situ Al(Ti)-Al2O3(TiO2) composite. Wear 2008;265(1-2):14–26

[3]Harun Mindivan, E. Sabri Kayali, H¨useyin Cimenoglu, (2008) ‘Tribological behavior of squeeze cast aluminum matrix composites’ - Wear 265 (2008) 645–654

[4] Christo Ananth, S.Esakki Rajavel, S.Allwin Devaraj, M.Suresh Chinnathampy. "RF and Microwave Engineering (Microwave Engineering).", ACES Publishers, Tirunelveli, India, ISBN: 978-81-910-747-5-8, Volume 1,June 2014, pp:1-300.

[5] Maleki. A, A. Shafyei, B. Niroumand (2009) ‘Effects of squeeze casting parameters on the microstructure of LM13 alloy’ - journal of materials processing technology 209 (2009) 3790–3797

[6] Sahin. Y, (2003) “Preparation and some properties of SiC particle reinforced aluminium alloy composites” – Journals of Materials and Design, 2003

[7] Sukumaran. K , K.K. Ravikumar, S.G.K. Pillai, T.P.D. Rajan, M. Ravi, R.M. Pillai, B.C. Pai (2008) ‘Studies on squeeze casting of Al 2124 alloy and 2124-10% SiCp metal matrix composite’ - Materials Science and Engineering A 490 (2008) 235–241

[8] Suresh Kumar, RanvirSinghPanwar, O.P.Pandey (2013) ‘Effect of dual reinforced ceramic particles on high temperature tribological properties of aluminum composites’ - Ceramics International

[9] Suresha. S , B.K. Sridhara (2010) ‘Wear characteristics of hybrid aluminium matrix composites reinforced with graphite and silicon carbide particulates’ - Composites Science and Technology 70 (2010) 1652–1659

[10] Uvaraja1. V. C, N. Natarajan (2012) ‘Optimization of Friction and Wear Behaviour in Hybrid Metal Matrix Composites Using Taguchi Technique’ - Journal of Minerals and Materials Characterization and Engineering, 2012, 11