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EVALUATION OF MECHANICAL PROPERTIES OF ALUMINUM METAL MATRIX COMPOSITES (AL+SIC+MG+ FLYASH)

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ABSTRACT

Technology is advancing, demand of the hour is increasing and to face that engineers are also ready. Maintaining the economic production with optimal use of resources is of prime concern for the engineers. Aluminum alloy materials or simply composites are combinations of materials. They are made up of combining two or more materials in such a way that the resulting materials have certain design properties on improved properties. The Aluminum alloy composite materials consist of high specific strength, high specific stiffness, more thermal stability, more corrosion and wear resistance, high fatigue life Conventional materials like Steel, Brass, Aluminium etc will fail without any indication. Cracks initiation, propagation will takes place within a short span. Now a day to overcome this problem, conventional materials are replaced by Aluminium alloy materials. Aluminium alloy materials found to the best alternative with its unique capacity of designing the materials to give required properties. In this experimental work Various mechanical properties test have been conducted by varying mass fraction of SiC and fly ash Magnisium with Aluminum to attain maximum tensile strength.
Key words: Al+SiC, Samples, Stir casting, Tensile strength.

1. INTRODUCTION

Composite materials are important engineering materials due to their outstanding mechanical properties. Composites are materials in which the desirable properties of separate materials are combined by mechanically or metallurgical binding them together. Each of the components retains its structure and characteristic, but the composite generally possesses better properties. Composite materials offer superior properties to conventional alloys for various applications as they have high stiffness, strength and wear resistance. The development of these materials started with the production of continuous-fiber-reinforced composites. The high cost and difficulty of processing these composites restricted their application and led to the development of discontinuously reinforced composites. 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 temperature operation, nonflammability, minimal attack by fuels and solvents, and the ability to be formed and treated on conventional equipment. Silicon carbide (SiC) is composed of tetrahedral of carbon and silicon atoms with strong bonds in the crystal lattice. This produces a very hard and strong material. SiC is not attacked by any acids or alkalis or molten salts up to 800oC. In air, SiC forms a protective silicon oxide coating at 1200oC and is able to be used upto 1600oC. The high thermal conductivity coupled with low thermal expansion and high strength gives this material exceptional thermal shock resistant qualities. SiC ceramics with little or no grain boundary impurities maintain their strength to very high temperatures, approaching 1600oC with no strength loss. Chemical purity, resistance to chemical attack at temperatures, and strength retention at high temperatures has made this material very popular as wafer tray supports and paddles in semiconductor furnaces. Properties of silicon carbide are low density, high strength, low thermal expansion, high hardness, and high elastic modulus. Particle reinforced composites have relatively isotropic properties compared to short fiber or whisker reinforced composites. The properties of the composites can be tailored by manipulating parameters such as reinforcement particle distribution, size, volume fraction, orientation, and matrix microstructure. Metal matrix composites (MMCs), such as SiC particle reinforced Al, are one of the widely known composites because of their superior properties such as high strength, hardness, stiffness, wear and corrosion resistance. SiC particle reinforced Al based MMCs are among the most common MMC and available ones due to their economical production. They can be widely used in the aerospace, automobiles industry such as electronic heat sinks, automotive drive shafts, or explosion engine components. The physical and chemical compatibility between SiC particles and Al matrix is the main concern in the preparation of SiC/Al composites. Therefore, the particle reinforced metal matrix composites can be synthesized by such methods as powder metallurgy (PM), standard ingot metallurgy (IM), disintegrated melt deposition (DMD) technique, spray atomization, and position approach. Different method results in different properties. In this study the casting method carried out to prepare SiC particle reinforced AlMMC.The effect of weight percentage of the reinforced particles on mechanical behavior such as hardness and corrosion of the composites can be investigated Aluminium silicon composite. MMCs are resistant to fire, can operate in wider range of temperatures, do not absorb moisture, have better electrical and thermal conductivity, are resistant to radiation, and do not display out gassing. On the other hand, MMCs tend to be more expensive, the fiber-reinforced materials may be difficult to fabricate, and the available experience in use is limited.

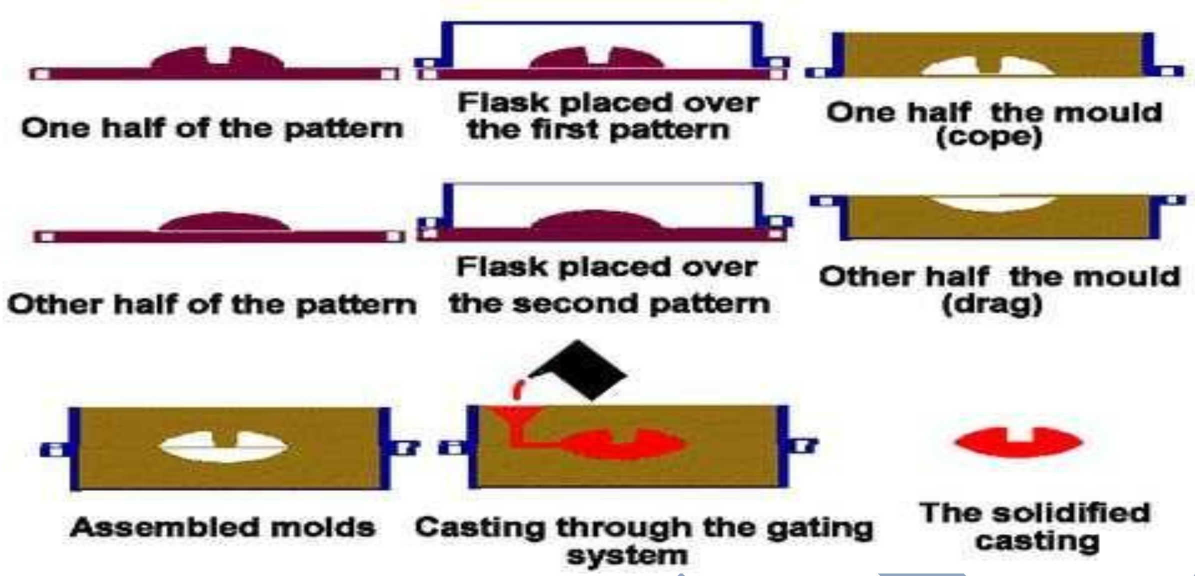

Fig 1 Casting procedure for composites.

2. EXPERIMENTAL DETAILS

Fig 2 Stir casting furnace

2.1 Aluminum and silicon carbide mixed below mentioned categories:

Sample1: 90%AL_20_3,2.5%Flyash,2.5%Megnisium, 5%Sic

Sample2: 84%AL_20_3,10%Flyash,3%Megnisium,3 %Sic

Sample3: 75%AL_20_3,10%Flyash,5%Megnisium, 10%Sic

Sample4: 90%AL_20_3,10%Sic

Fig 3 Casting of Al+SiC+Mg+Fly ash model

3.RESULT AND DISCUSSION

3.1 MIXING RATIO :

MATERIAL	Al (%)	SiC (%)	Mg (%)	FLYASH(%)
Sample 1	90	5	2.5	2.5
Sample 2	84	3	3	10
Sample 3	75	10	5	10
Sample 4	90	10		

TABLE 1

3.2 TABLE FOR HARDNESS

S.No	Material	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Mean Dia	Avg BHN
1	90%$AL_20_{3,}$2.5% Flyash,2.5% Mg,5%Sic	4.2	4.36	4.02	4.0	4.25	4.17	28.42
2	84%$AL_20_{3,}$10% Flyash,3% Mg,3%Sic	4.1	4.19	4.18	4.16	4.11	4.15	28.80
3	75%$AL_20_{3,}$10% Flyash,5% Mg,10%Sic	3.6	3.7	3.5	3.7	3.8	3.67	39.70
4	90%$AL_20_{3,}$10% Sic	4.0	4.1	4.16	4.28	4.28	4.2	27.84

Table 2 Hardness values for Al+SiC +Mg+Flyash composites

3.3 TENSILE STRENGTH (Dia of the Rod-16MM)-BREAK ING LOAD

S.No	Material	Tensile Load	Elongation(mm)
1	90%AL_2 $0_{3,}$2.5%Flyash,2.5% Magnesium, 5%Sic	7.2	10
2	84%AL_2 $0_{3,}$10%Flyash,3% magnesium, 3%Sic	8	8
3	75%AL_2 $0_{3,}$10%Flyash,5% magnesium, 10%Sic	10.7	5
4	90%AL_2 $0_{3,}$10%Sic	5.5	3

Table 3 Tensile strength of Al+SiC +Mg+Flyash composites.

3.4 DOUBLE SHEAR T EST (Dia of the Rod-12MM)

S.No	Material	Tensile Load KN
1	90%$AL_20_{3,}$2.5%Flyash,2.5%	13.70
	Magnesium, 5%Sic	
2	84%$AL_20_{3,}$10%Flyash,3%	15.25
	magnesium, 3%Sic	
3	75%$AL_20_{3,}$10%Flyash,5%	15.60
	Magnesium, 10%Sic	
4	90%$AL_20_{3,}$10%Sic	17.30

Table 4 Double shear test.

3.5 IMPACT TEST – IZOD

S.No	MATERIAL	IMPACT STRENGTH (JOULE S)
1	90%AL $_{2}0_{3,}$2.5%Flyash,2.5% Magnesium, 5%Sic	11
2	84%AL $_{2}0_{3,}$10%Flyash,3% Magne sium, 3%Sic	8
3	75%AL $_{2}0_{3,}$10%Flyash,5% Magne sium, 10%Sic	3
4	90%AL $_{2}0_{3,}$10%Sic	6

Table 5 Impact Test of Al+Sic+Mg+Flyash composites

CONCLUSION

Composite materials especially aluminum and silicon, fly ash Magnesium composites having good mechanical properties compared with the conventional materials. It is used in various industrial application these materials having light weight along with high hardness .It with stand high load compare with the existing materials are most applicable in the engineering products instead of existing materials. Finally It was concluded that the percentage of silicon increases automatically the hardness, double shear strength and increases at the same time the tensile value.

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