Tribological Studies of Aluminum Hybrid Metal Matrix Composite by Using Stir Casting Method: Survey Paper

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Abstract- *Combination of more then two reinforcement materials. The combined effect of reinforcements on Al Metal Matrix composites with individual and multiple particulate reinforcements like Hybrid Metal matrix composites are finding increased applications in automobile, space, aerospace, underwater, and transportation applications.*

Keywords- Al 7075, Stirs casting, Aluminum Oxide (Al_2O_3), fly ash, silicon carbide (SiC).

I. INTRODUCTION

The following table is considered weight percentage and properties of Al 6061 and Al 7075

Table1. Chemical composition of Al6051 and Al7075 by weight percentage

Chemical composition	Si	Fe	Cu	Ma	Mg	Cr	Zn	Ti	Al
Al6061	0.62	0.23	0.22	0.03	0.84	0.22	0.10	0.1	Bal
Al7075	0.4	0.5	1.6	0.3	2.5	0.15	5.5	0.2	Bal

In [10], Karthigeyan et.al. Al7075 alloy composites containing different volume fraction of short basalt fiber are developed using the stir casting process. The experimental strength values of the composites are compared with the theoretical values in this paper. The results suggested that the experimental values best suited the theoretical values owing to the random distribution of basalt fibers in the Al7075 matrix.

Parameters	Al 6061	Al 7075	SiC	Al2O3
Elastic Modulus	70 – 80	70 – 80	410	300
Density	2.7	2.81	3.1	3.69
Poisson's Ratio	0.33	0.33	0.14	0.21
Hardness (HB – 500) 30 60 28 W 1175	30	60	28W	1175
Tensile Strength(MPA)	115	220	3900	2100

Particle reinforced composites have a better plastic forming capability. And thus they have emerged as most sought after material with cost advantage and they are also known for excellent heat and wear resistance applications. In this paper it is aimed to present the experimental results of the studies conducted regarding hardness, tensile strength and wear resistance properties of Al6061-SiC and Al7075-Al2O3 composites.

II. LITERATURE SURVEY

In [1], Rajendra .S .K et.al. have investigated Aluminium alloy 7075 is an aluminium alloy, with zinc as the primary alloying element. It is strong, with a strength comparable to many steels, and has good fatigue strength and average machinability, but has less resistance to corrosion than many other Al alloys. Its relatively high cost limits its use to applications where cheaper alloys are not suitable. 7075 aluminium alloy's composition roughly includes 5.6–6.1% zinc, 2.1–2.5% magnesium, 1.2–1.6% copper, and less than half a percent of silicon, iron, manganese, titanium, chromium, and other metals. It is produced in many tempers, some of which are 7075-0, 7075-T6, 7075-T651.

Aluminium Alloy 7075 offers the highest strength of the common screw machine alloys. The superior stress corrosion resistance of the T173 and T7351 tempers makes alloy 7075 a logical replacement for 2024, 2014 and 2017 in many of the most critical applications. The T6 and T651 tempers have fair machinability. Alloy 7075 is heavily utilized by the aircraft and ordnance industries because of its superior strength.

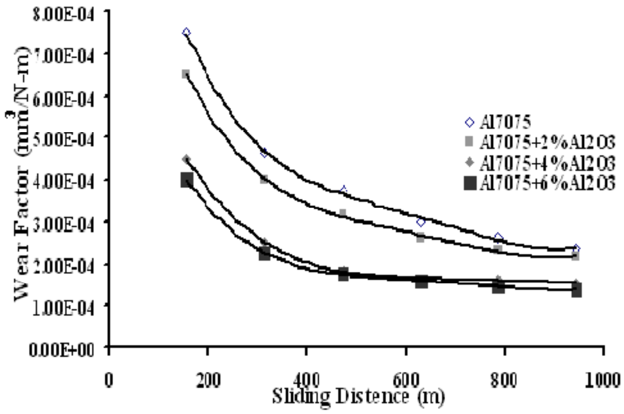
In [2], **Indumati B Deshmanya** et.al. have investigatedThe average micro-hardness of stir-cast and forged composites is almost double that of the aluminium matrix. It is observed from Eqn. (1) that individually all the process parameters have positive sign and hence contribute significantly, in improving the hardness. The effect of reinforcement size is more pronounced up to 60μm and after that it has a tendency to reduce the hardness. Maximum hardness is obtained at 50μm. Similarly, at 15% weight proportion, maximum hardness is obtained (140VHN). At 425°C and corresponding to 15% reduction in area due to forging, the micro-hardness is around 135-140VHN. The effects of 2-factor interactions are not uniform and there exists a point of inflexion. The improvement in hardness of forged composites may be attributed, primarily to the addition of harder Al2O3 as well as the ability of the forging process toclose the voids and other discontinuities present in the as-cast composites. This is in line with similar observations made by Ceschini et al [19]. Further, the application of a secondary process like forging will bring about significant grain refinement of as-cast composites. The F-ratio for the model is more than the tabulated one indicating that the model is adequate. The R-squared and adjusted R-squared values show that the process parameters are quite influential in deciding their effectiveness on hardness at 95% confidence level.

In [3], **G. B. Veeresh Kumar1**et.al.have investigatedThe wear factor, defined as the ratio of wear volume (in mm3) to the product of applied load (inN) and sliding distance (in meter), is an important parameter, which quantifies the wearresistance (wear factor). Thus the wear factors of the material studied are presented. Figure 6a-cand figure 7a-c shows the wear factor for Al6061 and its composites containing SiC under anapplied load of 10N and various sliding speeds and under the sliding speed of 100rpm andvarious applied loads respectively. Similarly figures 8a-c and 9a-c show the wear factor forAl7075 and its composites containing Al_2O_3.

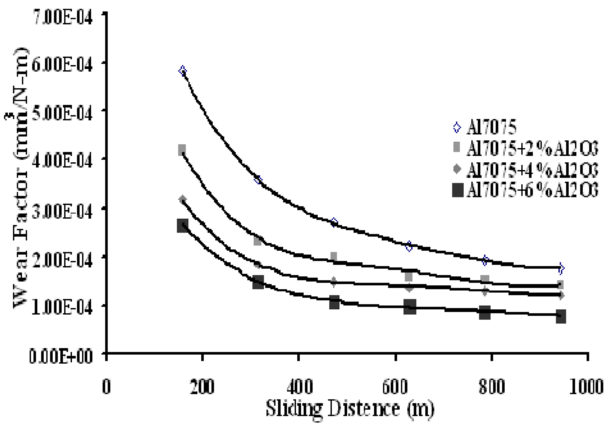
Liquid metallurgy techniques were successfully adopted in the preparation of Al6061-SiCand Al7075-Al_2o_3composites containing the filler contents upto 6 wt %'age.

The wear resistance of the composites are higher, further the SiC contributed significantly in improving the wear resistance of Al6061-SiC composites.

The tensile strength properties of the composites are found higher than that of base matrix and Al6061-SiC composites superior tensile strength properties then that of Al7075-Al_2O_3 composites.



(a)



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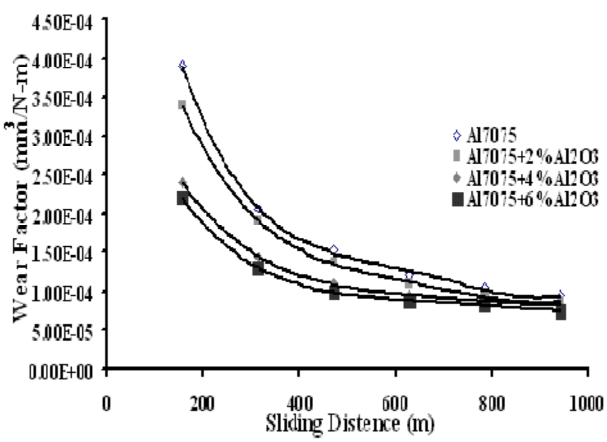

(c)

Figure 1. Variation of Wear Factor at different Loads for Al7075-Al_2o_3composites sliding at aspeed of 100rpm under applied load of (a) 20N, (b) 30N & (c) 50N.

In [4], **Prof.S.RNimbalkar**et.al. have investigated This review presents the views, different experimental technics, results obtained and conclusions made over the years by numerous investigators in the field of particle reinforced Al-7075MMCs. A considerable amount of interest in Al-7075MMCs evinced by researchers from academics and industries has helped in conduction of various studies and has enriched our knowledge about the physical properties, mechanical properties and tribological characteristics. Several techniques are followed by researchers for the processing of particulate reinforced MMCs. It has been studied and concluded that the density of the composites increases with thein corporation of the hard ceramic reinforcement into the matrix material. In view of the above conclusions on density, experiments were conducted on the Al7075 to determine the density by weight to volume ratio and by rule of mixture. The experimental and theoretical densities of the composites were found to be in line with each other. There is an increase in the density of the composites compared to the base matrix. It can be concluded that the ceramic reinforced Al-7075 MMCs will have better wear resistance than the unreinforced alloys. Further, the techniques used by the researchers to predict the wear coefficient were also discussed. Finally there is an immense potential, scope and opportunities for the researchers, in the field of prediction of mechanical and tribological properties of Aluminium 7075 matrix composites by using soft computing techniques, aluminium casting methods and process parameters, reinforcing various hard ceramic particulates.

In[5]**V. Hariharan** have investigated Researchers have been studies related to the tribological behaviours of aluminium metal matrix composites. Baradeswaran and Elaya Perumal [1] have investigated the 7075 aluminium alloy-graphite composites for its tribological behavior under dry sliding conditions. The wear rate of Al 7075 decreases with increasing graphite content and it was minimum about 5 wt. % of graphite which possesses the superior wear properties than that of other compositions 10, 15 and 20 wt. % of graphite. Baradeswaran and ElayaPerumal [2] have investigated the effects of graphite and Al2O3 content in the Al 7075. The Al 7075/Al2O3/graphite hybrid composite was prepared with 5 wt. % graphite particles addition and 2, 4, 6 and 8 wt. % of Al2O3 the wear rate decreases with the addition of Al2O3 and reaches a minimum at 2 wt. % Al2O3 and 5 wt. % of graphite and the wear rate is about 36% less than that of the matrix material Al 7075, whereas Fig. 1 and 2 shows the wear rate of the hybrid composites retains up to certain sliding speed and load. The effect of graphite addition on friction coefficient is shown in Fig.3. The presence of graphite in the hybrid composite decreases the coefficient of friction. Moreover the hybrid composites exhibited lower coefficient of expansion and wear rate.

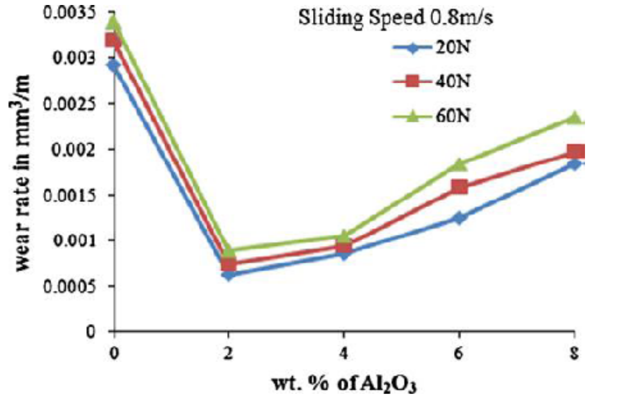

Fig.1 Wear rate of hybrid composites (Baradeswaran et al. [1])

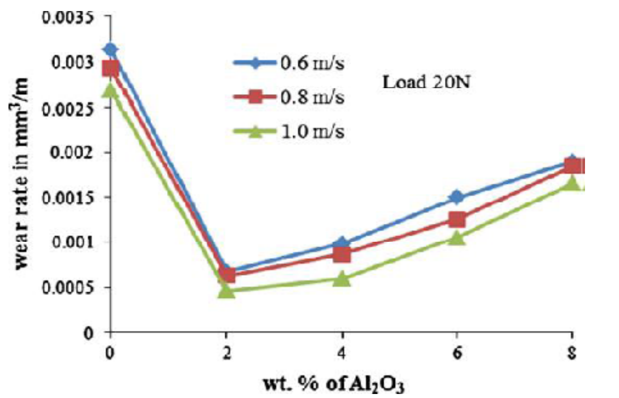

Fig.2 Wear rate of hybrid composites (Baradeswaran et al. [1])

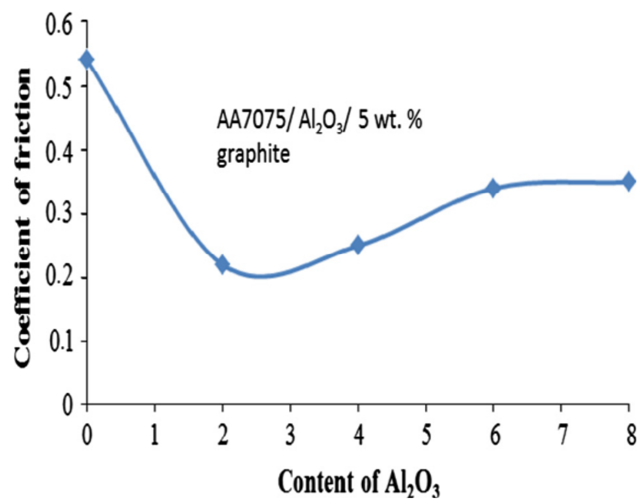

Fig.3 Coefficient of friction of hybrid composites (Baradeswaran et al. [1])

Al 7075 hybrid metal matrix reinforced with ceramic and graphite particles. The addition of graphite content to aluminium alloy increase the wear resistance up to certain wt. % of graphite particles and decrease the hardness of composites. Also the machinability is increased with addition of graphite particles. The effect of adding ceramic particles such as SiC, $Al_2O_3$and B4C in AA 7075 to increase the mechanical properties such as tensile strength, compressive strength and flexural strength.

VI. CONCLUSION

In this final conclusion of Al 7075 hybrid metal matrix composite is mixing with $Al_2O_3$is improved better mechanical and tribological properties to this above survey. Also the machinability is increased with addition of graphite particles. The effect of adding ceramic particles such as SiC, flyash andAl_2o_3in Al 7075 to increase the mechanical properties such as tensile strength, compressive strength and flexural strength. The addition of Al_2o_3 in base material Al7075 tribological properties increases.

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