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Tribological behavior of heat treated Al 7075 aluminium metal matrix composites

V C Uvaraja[a]*, N Natarajan[b], K Sivakumar[a], S Jegadheeshwaran[a] & S Sudhakar[c]

[a]Department of Mechanical Engineering, Bannari Amman Institute of Technology, Sathyamangalam 638 401, India
[b]Sri Ranganathar Institute of Engineering and Technology, Coimbatore 641 014, India
[c]Department of Engineering Design, BEML, Mysore 570 017, India

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Aluminium metal matrix composites (AMMCs) are developed owing to their excellent properties like light weight, high levels of strength, stiffness and wear resistance. In the present work, an attempt is made to study the effect of two hard phase reinforcement particulates namely, silicon carbide (varying weight percentage) and a constant weight percentage of boron carbide on tribological behavior of Al 7075 alloy matrix. The weight percentages of silicon carbide particulate considered here are 5%, 10%, and 15% whereas for boron carbide a constant 3% weight is used throughout the study. Aluminium alloy as base matrix is reinforced with a mixture of two types of particulates along with magnesium (Mg) 1% as binding element. The composite thus formed is termed as aluminium metal matrix composite. These composites are manufactured by the stir-cast liquid metallurgy method. The unreinforced aluminium alloy and composite specimens are carefully machined using lathe machine and prepared for heat treatment process by subjecting to solutionizing treatment at a temperature of 530°C for 1 h followed by quenching in water. Further the specimens are subjected to artificial aging for durations of 4, 6 and 8 h at a temperature of 175°C. The mechanical and tribological properties of composites and the unreinforced alloys before and after heat treatment are examined by Vickers hardness test machine and pin-on-disc test machine respectively. The wear rate and friction co-efficient are evaluated as a function of applied load, sliding velocity, sliding time, and weight fraction for the heat treated particles. The wear surface morphology and wear mechanism of the pins are investigated using scanning electron microscope (SEM) and are correlated with wear test results.

Keywords: Aluminium metal matrix composite, Heat treatment, Aging, Pin-on-disc, Wear, SEM

Composite materials are one of the most advanced and adaptable engineering materials which find applications in automobile, aerospace, medicine, infrastructure and defense. A composite material can provide superior and unique mechanical and physical properties as it combines the most desirable properties of its constituents while suppressing their least desirable properties. Today, the composite materials marketplace is widespread[1,2].

Metal matrix composites (MMCs) can be developed by many diverse techniques. Based on the type of reinforcement, size and morphology, the MMCs are fabricated by different methods such as stir casting, squeeze casting, spray deposition, liquid infiltration, powder metallurgy, etc.[3] In casting process, the reinforcing elements such as metal carbides, metal borides, metal nitrides and metal oxides are dispersed within molten alloy matrix under atmospheric pressure[4]. Recently, liquid processing method is developed to make MMCs with higher volume fraction of reinforcement under much lower pressure[5]. The modern research studies reported that the homogeneous mixing can be obtained by selecting appropriate processing parameters like stirring speed, time and temperature of the molten metal, preheating temperature of the mould and uniform feed rate of the particles[6].

The focus of the selection of suitable process engineering depends on the desired kind, quantity and distribution of the reinforcement components, the matrix alloy and its application[7]. Among the various aluminium alloys, 7075 and 6061 are quite popular choice as a matrix material to prepare metal matrix composites owing to its better formability characteristics and the option of modification of the strength of composites through heat treatment[8,9]. The addition of SiC particles into the aluminium matrix improves the wear resistance due to the heat treatment process[10,11]. In particulate reinforced AMMCs, reinforcement is added to the matrix of the bulk material to increase its stiffness and strength[12]. The

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*Corresponding author (E-mail: c_uva@rediffmail.com) addition of hard ceramic particles like SiC, Al_2O_3, B_4C etc, results in enhanced wear resistance and strength to weight ratio than the conventional alloys[13,14]. Achievement of these properties depends primarily on the selection of reinforcement, its method of production and chemical compatibility with the matrix[15]. Many of the researchers to concentrate both on experimental and analytical portions of AMMCs to gain a better understanding about the mechanical behavior of these materials and their excellent wear resistance[16]. Based on the above considerations, this study is aimed to investigate the effects of heat treatment on the wear behavior of aluminium composites containing silicon carbide and boron carbide particles.

Materials Selection

In the recent research, SiC and B_4C particulates reinforced Al 7075 alloy (Al-Zn-Mg) matrix composite is preferred, as it provides exceptional combination of strength to weight ratio and damage tolerance at elevated and cryogenic temperatures. The nominal chemical composition of Al 7075 alloy is given in Table 1. The density measurements are all set according to the ASTM standard C1270-88. The values of hardness and density for matrix materials are 160 VHN and 2.76 g/cm^3 respectively in tempered condition. The particulate morphology study reveals that the shapes of both reinforcements are angular-irregular which can be observed in SEM images as shown in Fig. 1. Hardness of the specimens is measured using Vickers hardness tester by applying a load of 10 kg and the average value of hardness from 10 different data of the experiments is considered.

Table 1—Composition of Al 7075 by weight percentage

Elements	Si	Fe	Cu	Mn	Ni	Zn	Ti	Mg	Cr	Al
% by weight	0.06	0.18	1.63	0.074	0.05	5.62	0.049	2.52	0.22	Balance

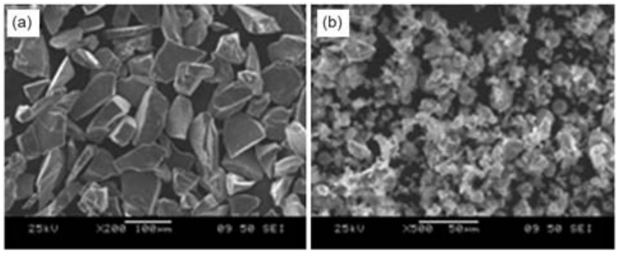

Fig. 1—SEM morphologies of (a) silicon carbide (SiC) and (b) boron carbide (B_4C)

Experimental Procedure

In manufacturing particulate reinforced MMCs, stir casting technique is one of the popular liquid metallurgy routes (LMR) and is known as a very promising route for manufacturing near net shape metal matrix composite components at a normal cost[17]. This is one of the vortex methods to create a good distribution of the reinforcement material in the matrix. In the present work, stir casting technique is used to fabricate about 1 kg of Al 7075 alloys with varying weight percentages of SiC (5%,10%, 15%) and a constant weight percentage of B_4C (3%) reinforcement. In order to achieve good binding between the matrix and particulates, one weight percent of magnesium alloy is added. The experimental set up is as shown in Fig. 2.

The stir casting furnace is mounted on the floor and the temperature of the furnace is precisely measured and controlled in order to achieve sound quality of composite. Two thermocouples and one PID controller are used for this purpose. As mild steel materials are having high temperature stability, they are selected as stirrer rod and impeller. The stirrer is connected to 1 HP DC Motor through flexible link and is used to stir the molten metal in semi solid state. The screw operator lift is used to bring the stirrer in contact with the composite material. The melt is maintained at a temperature between 750 and 800ºC for one hour. Vortex is created by using a mechanical stirrer. SiC of 5, 10 and 15 wt% with particulates size in range of 30-70 µm and a constant 3 wt% of B_4C

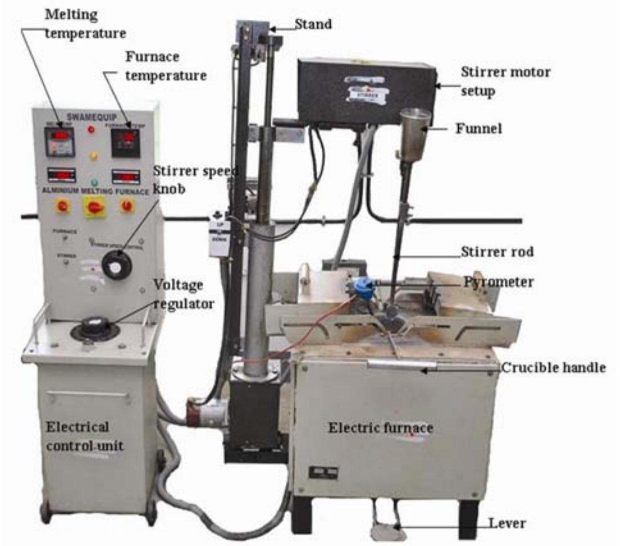

Fig. 2—The experimental set-up used in fabrication of AMMCs (Al 7075- SiC-B_4C)

with particulates size in the range of 5-20 µm are accurately weighed. Before adding the particulates into the matrix, it is preheated in the range of 400 to 550ºC and added into the melt with constant mechanical stirring for about 10 min at 500 to 650 rpm condition.

After complete addition of the particulates into the melted Al alloy, the composite alloy is tilted and poured into preheated (300ºC) permanent steel die and finally the die is allowed to cool in atmospheric air (room temperature). The composite gets solidified in a die in the form of a cylindrical bar of diameter 28 mm and length of 280 mm. The solidified composite test sample is removed from the die and machined for required dimensions. The test specimens are machined to obtain cylindrical pins having a diameter of 8, 10 and 12 mm and a height of 32 mm. The specimen faces are metallographically polished. The cast composites are machined and subjected to solutionizing at a temperature of 530°C for 1 h followed by quenching using water. The quenched samples are then subjected to artificial aging for different durations of 4, 6, 8 h at a temperature of 175ºC.

Metallographic examination

Microstructures of as-cast and heat treated aluminum composite samples are examined by metallographically as shown in Fig. 3 (a-d). The heat treated reinforced and unreinforced samples are polished prior to testing. The procedure involves grinding of composite aluminium surfaces manually by 240, 320, 400, 600 grit silicon carbide papers and then polishing them with 5, 1 and 0.5 m alumina using low speed polishing machine. This preparation technique created considerable surface relief between hard and soft aluminium matrix. The polished samples are cleaned ultrasonically with acetone and methanol solutions. The counter face materials are polished and cleaned ultrasonically with acetone and methanol solutions before each wear test. The steel slider is polished using the above described procedure and all the tests are conducted at room temperature. In order to have information about the weight percentage of SiC and B_4C reinforced aluminum 7075 alloy composites, image analyzer study is performed. The micrographs clearly indicate the evidence of minimal porosity in both the Al alloy and the composites. The obtained micrographs reveal an excellent bond between the matrix alloy and the reinforcement as shown in Fig. 3 (a-d).

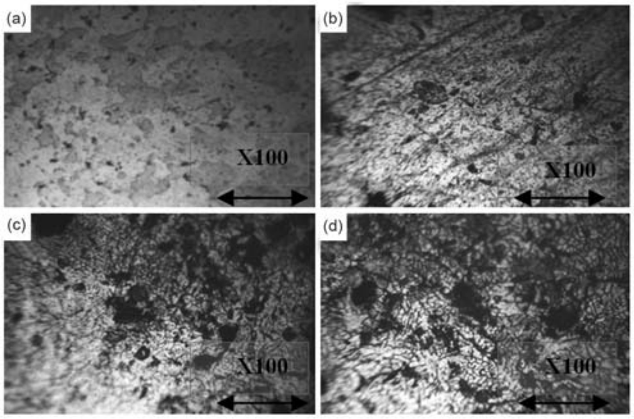

Fig. 3—Optical microscope images of the cast Al 7075 and Al 7075 composites

Density measurement

Density is the physical property that reflects the physical characteristics of the composites. In a composite, the proportion of the matrix and the reinforcement are expressed either as the volume fraction (*w*), which is relevant to fabrication, or the volume fraction (ϑ), which is commonly used in property calculations. By relative weight and volume fractions via density (ρ), the following expression is obtained and its general form is known as rule of mixture.

$$_c = \quad {}_m\vartheta_m + \quad {}_r\vartheta_r \qquad \dots (1)$$

where ρ_c, ρ_m and ρ_r are density of the composite, the matrix and the reinforcement respectively, and ϑ_m, ϑ_r are volume fraction of the matrix and the reinforcement respectively.

Experimentally, densities of a matrix alloy and its composite are determined by water displacement technique. A microbalance is used to weigh the samples up to the precision level of 0.001 g in water and in air for the purpose of the density measurement. An average of three observations is considered in this study[18,19]. The unreinforced and reinforced Al alloy density is calculated theoretically by rule of mixture concept. Both the theoretical and the experimental values are offered in Fig. 4. As seen from Fig. 4 discrepancy is there between the experimental and the used theoretical results. The heterogeneous dispersion of particles in the composites resulted in sample's variable density depending on locations. Nevertheless, the experimental and theoretical results agree with each other qualitatively.

From Fig. 4, it can be concluded that the experimental and the theoretical density are in line with each other and confirms the suitability of the liquid metallurgy technique for the successful composite preparation. It is observed that the density of the composite is higher magnitude than that of the base matrix, also the density of the composites increases with increase in filler content. The increase in density of composites can be attributed to higher density of the reinforcement particles.

Hardness result

The specimens are age hardened and the Vickers hardness values for different conditions are shown in Fig. 5. The solutionizing temperature and duration of 530°C and 1 h respectively is adopted and quenched in water media. At a temperature of 175°C with different duration of time the samples are heated and cooled naturally. Quenching and aging significantly alters the micro-hardness of both the Al 7075 matrix alloy and its composites. The results is obtaining maximum hardness is observed for both the Al 7075 alloy matrix and reinforced composites.

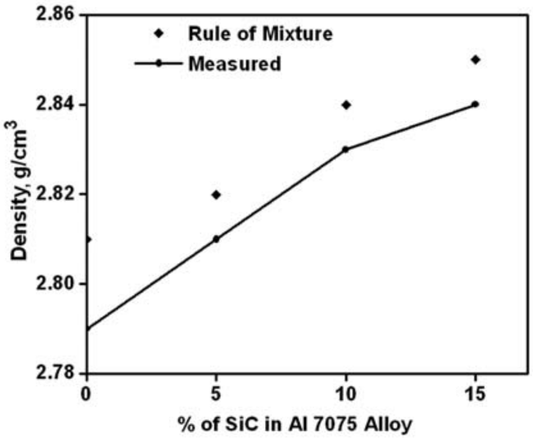

Fig. 4—Theoretical and experimental density of Al 7075 based AMMCs

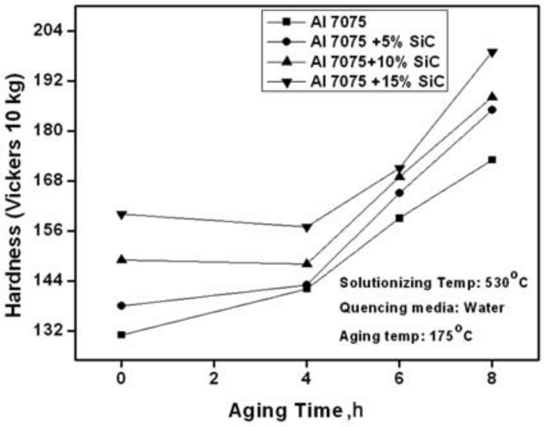

Fig. 5—Variation of hardness with increase in aging time under heat treated condition

Mechanism of wear test

Figure 6 shows the complete pin-on-disc wear test experimental setup. The slider disc is made up of 0.95 to 1.20% carbon (EN31) hardened steel disc with hardness of 62 HRC having a diameter of 165 mm. A track diameter of 100 mm is used in all the experiments. The initial surface finish (R_a) of the steel disc is 1 µm. The heat treated aluminium metal matrix composite (AMMC) samples are prepared as pins of dimensions 12 mm in diameter and 32 mm in height. It is important to ensure that the test sample's end surfaces are flat and are polished by using metallographic techniques prior to wear testing. Conventional aluminium alloy polishing techniques are used to make the contact surfaces of the monolithic composite aluminium specimen ready for wear test.

The procedure involves grinding of composite aluminium surface manually by using 240, 320, 400 and 600 grit silicon carbide papers followed by polishing with 5.0, 1.0 and 0.5 m alumina using low speed polishing machine. This preparation technique enabled in creating considerable surface relief between hard and soft aluminium matrix. The polished specimens are then cleaned ultrasonically with acetone and methanol solutions. Similarly, the counter face materials are also polished and cleaned ultrasonically with acetone and methanol solutions before each wear test. The steel slider is polished by the above described procedure and all the tests are conducted at room temperature.

Fig. 6—Pin-on-disc sliding wear testing machine with integrated system

The tests are carried out by applying normal loads such as 10, 20 and 40 N at a maximum sliding distance of 4241 m at different velocities such as 1.5, 3.0 and 4.5 m/s. The wear rates of test samples are measured in weight units by weighing the specimen before and after the test and are finally converted into volumetric wear loss. The wear losses of the specimens are measured using a high precision (accuracy 0.001 g) electronic balance. The differences in weight loss of the entire test treated samples are measured before and after the wear test under dry condition. Using this weight loss data, the composite's volume loss is calculated.

Results and Discussion

The wear and frictional force characteristics of the heat treated composites containing varying weight percentage of silicon carbide (5 %, 10 % and 15 %) and constant weight percentage of B_4C (3%) at different conditions are examined. The sliding wear behaviour of heat treated specimens is done using a pin-on-disc machine.

Effect of applied load on wear rate

Figure 7(a-c) shows graphs of wear curves for heat treated composite specimens and cast alloy under aging durations of 4, 6 and 8 h. Applied load is also been one of the major factors influencing the wear rate of the composites. It indicates the effect of applied load on wear rate of unreinforced Al 7075 alloys along with their corresponding AMMCs of different percentage reinforcements (5 to 15 wt% SiC and 3 wt% B_4C), when speed tested for 15 min. At constant speed, the wear rate of the composites and the matrix increases with increase in load. The wear rate of the composites is less than that of the matrix alloy at all loads. Similar trend is observed in the study of dry sliding wear behavior of Al5083/B_4C metal matrix composites (MMCs)[20]. The composites with hard particles thus exhibits better wear resistance than matrix alloys under heat treated condition, which may be due to the fact that the surface of the matrix materials tend to get delaminated in the absence of harder reinforcement, thus increasing the wear. Base metal showed higher wear, whereas metal matrix composites with 15 wt% SiC and 3 wt% boron carbide particle, aged for 8 h duration showed lower wear. The amount of wear decreased with increase in aging duration.

Effect of weight percentage of reinforcement particulate on wear rate

Figure 8(a-c) illustrates the variation in wear rates of both Al alloy and their heat treated AMMCs at different loads and sliding velocities as a function of percentage reinforcement. The comparative wear study of both Al 7075 alloy and composites are made

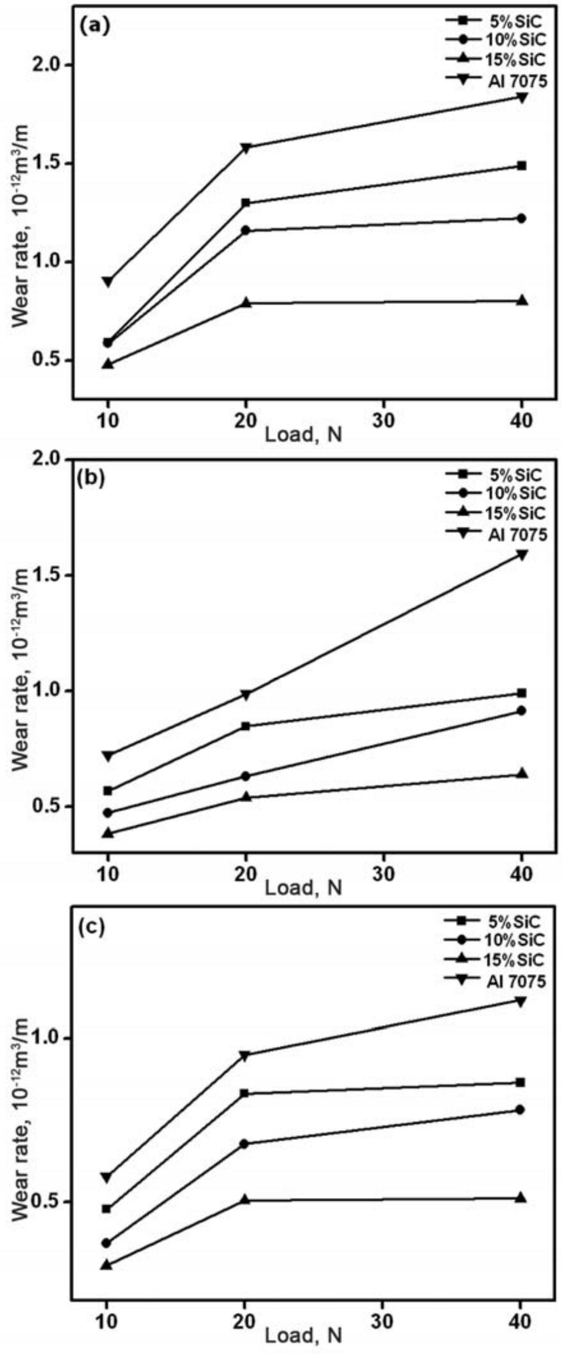

Fig. 7—Variation of wear rate with increasing load of Al 7075 and composites for an aging duration of (a) 4 h, (b) 6 h and (c) 8 h, at 40 N

and the individual effects of weight percentage of particulates on their wear rate are discussed.

In this work, wear rate is calculated after a sliding time period of 5, 10 and 15 min for all the samples at three different sliding velocities. As far as the results are concerned, the main observation being the decrease of wear rate with the increase in weight percentage of the particulate reinforcement, sliding time and sliding velocity. The reinforced AMMCs have shown lower wear rate as compared to unreinforced Al 7075 alloy. This can be attributed to the fact that an improved hardness of the composite, resulting from the incorporation of hard particles, which acts a harder phase into the matrix. Increase in hardness results in the improvement of wear and seizure resistance of the material. When the hard particles are strongly bonded with matrix, they protect the surface against severe destructive action by the counter face, because of the strong interface bond, which plays a critical role in transferring loads from the matrix to hard particles.

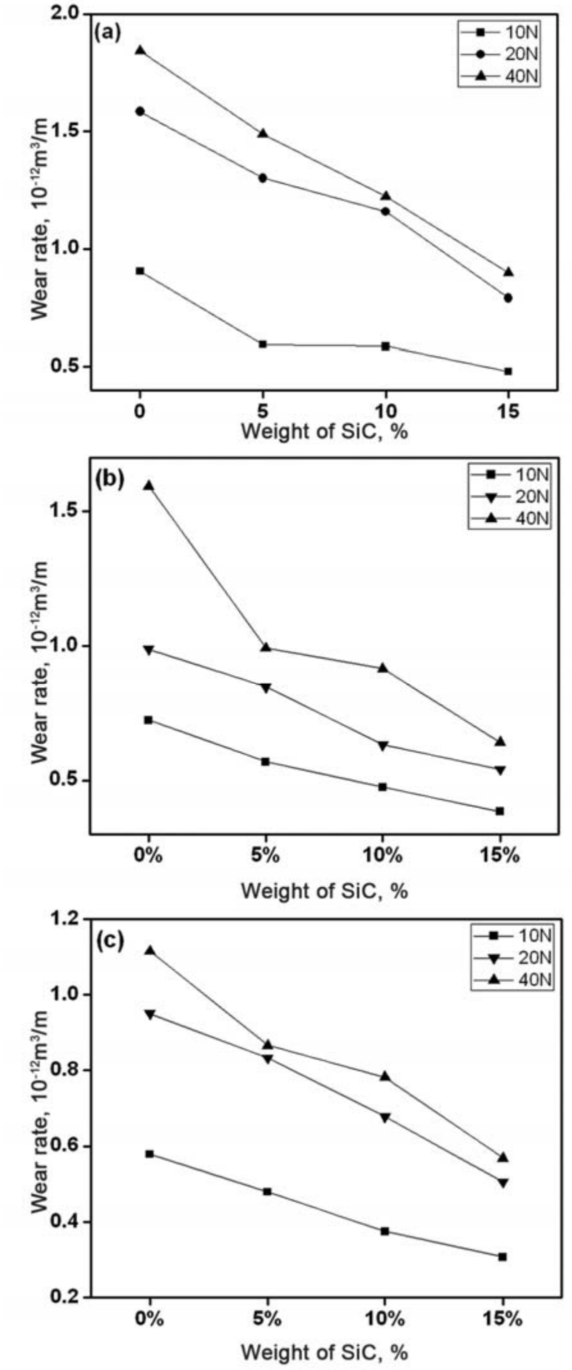

Fig. 8—Variation of wear rate with increasing percentage of reinforcements in Al 7075 composites for an aging duration of (a) 4 h, (b) 6 h and (c) 8 h, at 40 N

Effect of applied load and weight

Figure 9(a) gives the specific wear rate for Al 7075 AMMCs (otherwise known as Lancaster wear

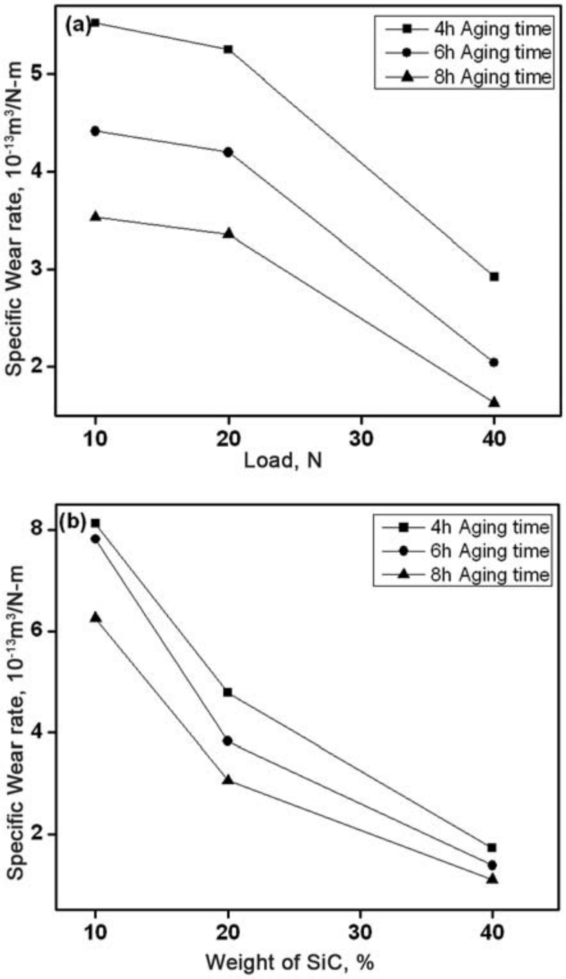

Fig. 9—Variation of specific wear rate with (a) applied load (b) percentage of reinforcement for Al 7075 AMMCs

co-efficient) as a function of load. The values are in the range of 1.146×10^{-13} to 0.695×10^{-13} m^3/N-m and 1.188×10^{-13} to 0.496×10^{-13} m^3/N-m. The specific wear rate decreased with load for all the materials, indicating improved wear resistance at the higher loads. From Fig. 9(b) it can be observed that 5 wt% SiC AMMCs is highest specific wear rate and 15 wt% SiC composite exhibited lowest specific wear rate, such that 15 wt% SiC corresponds to highest wear resistant material.

Effect of applied load on friction co-efficient

Figure 10(a-c) shows the variation of frictional force of cast alloy and heat treated aluminium composites for different aging duration. Normal load varied between 10 to 40 N for aging duration from 4 to 8 h. It indicates that the increase in friction co-efficient with increase in load is attributed for the maximum speeds at different weight fraction of the reinforcement. It is observed that, the value of friction co-efficient is low at initial loads for both the matrix alloy and its composites. However, the composite with 15 wt% of weight fraction possesses the lowest friction co-efficient at any particular load.

It is found that the average friction co-efficient are in the range of 0.35 and 0.33 for Al 7075 AMMCs. Thus, friction co-efficient increases with increase in applied load. It is concluded that the increase of load leads to a significant increase in the friction co-efficient as shown in Fig. 10(a-c). According to Bowden and Tabor[21] theory, effects of normal and tangential loads are considered separately. It is well thought-out that the normal load determines the real area of contact and to shear over this area, tangential force is needed. If the normal load is increased, then the real area of contact also increased along with tangential force, resulting in the increase of instantaneous value of friction co-efficient. From this test, it is confirmed that the friction co-efficient of the composite with 15 wt% SiC is low for all loads. On the other hand, considering the different load conditions, the wear rate is as intense as the friction co-efficient.

Effect of weight percentage of reinforcement particulate on friction co-efficient

Figure 11(a-c) specify the effect of reinforcement percentage on friction co-efficient. According to Rabinowicz[22], the friction force required to start sliding is usually greater than the force required to maintain sliding and hence, kinetic friction co-efficient generally is a positive slope at slow sliding velocity and a negative slope at high sliding velocity. Friction should have mainly occurred between the particles and the disc surface. The average friction co-efficient between disc and alloy is 0.38 and an average friction co-efficient between disc and composites is 0.32. Due to the formation of tribolayers, the friction co-efficient decreases as the weight fraction increases.

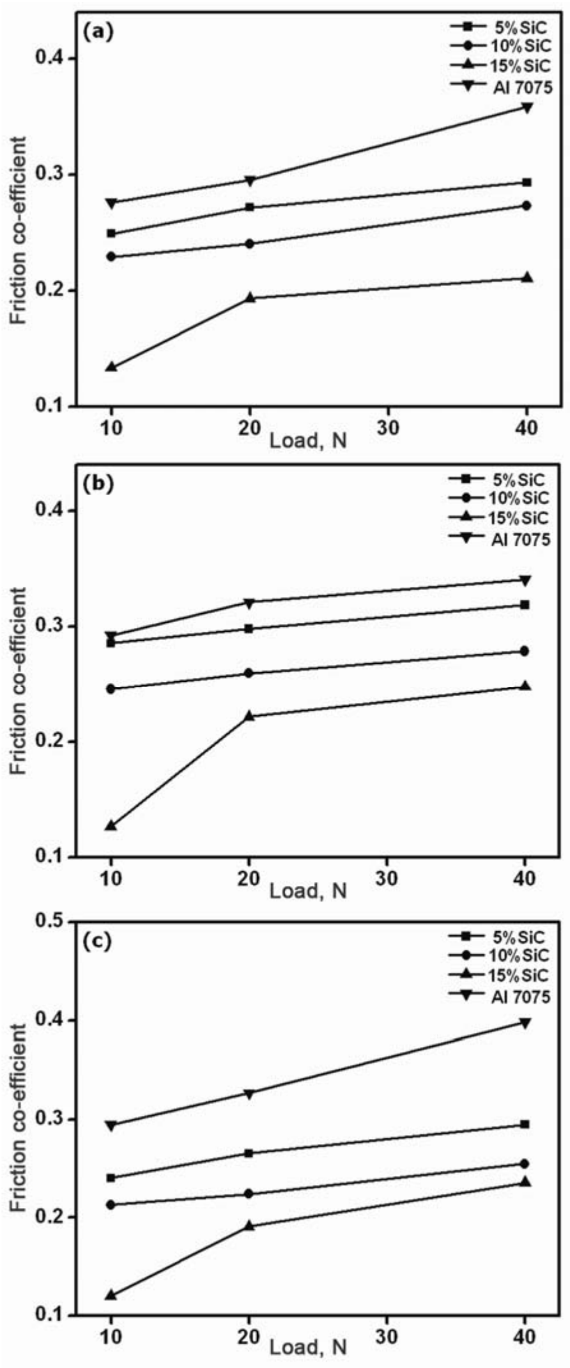

Fig. 10—Variation of frictional force with increasing load of Al7075 and composites with variation in ageing duration at 40 N

Analysis of tribological characteristics

The wear rates of aluminium based alloys and its composites are highly influenced by different wear mechanisms and are controlled by applied load, percentage of reinforcement, sliding velocity and sliding time. Based on the detailed interpretation carried out on the worn surfaces and wear debris, three stages are identified: first stage overcoming the roughness of the machine marks on the disc surface, second stage piling up of the tribo-layer and third stage dynamic competition between material transfer processes (transfer of material from pin onto disc and formation of wear debris and their subsequent removal).

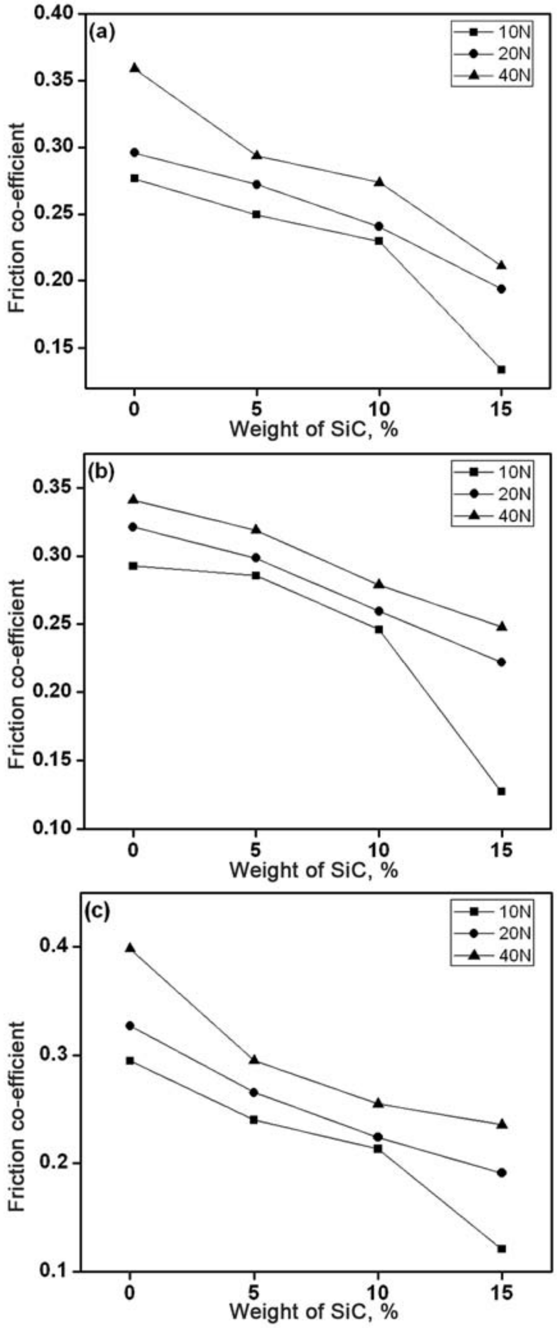

Fig. 11—Variation of frictional force with increasing percentage of reinforcement Al7075 and composites with variation in ageing duration at 40 N

All these stages are not clearly distinguishable from each other. It might be that either one of them is dominant at any given instant of time. At the beginning of the wear test, under actual load and speed conditions, contact area and nature of contact might change. Hence, every test is initiated with run-in-wear stage with low loads and speeds to compensate for these changes. But under new set of test conditions, there are some disturbances in the friction force curve. Occurrence of which can be attributed to the process of overcoming machining marks, which is marked by the rise in frictional force.

In the next stage, frictional force tends to decrease. This is believed to be due to gradual submerging of machining marks and/or wear debris in the pool of material transferred from the pin, i.e., formation of tribo-layer. Transfer of the pin material occurs because of the ploughing action of the hard asperities of the disc material against the relatively soft pin material.

Final stage of wear test is the dynamic competition between material transfer processes. The transfer of material from the pin onto disc causes submerging of machining marks/debris on the disc.

As the applied load increases, more material is to shear off from both pin and disc as shown in Fig. 7(a-c). Thus, tribo-layer thickness might have increased with increase of normal load and sliding distance, causing the wear rate of composites and matrix materials to increase.

The volumetric wear loss of matrix alloys and its composites with the increase in hard particles is revealed from Fig. 8(a-c). It is experimentally proved that the volumetric wear loss of the composites decrease with increased content of hard particles in the matrix alloys. However, for a given reinforcement content, the composites posses lower volumetric wear loss than the matrix alloy. It is also observed that the AMMCs possess lower wear rates than that of the base alloy with the increasing content of SiC. A reduction of 29.75%, 34.78% and 54.03% in wear rates is observed for composites containing 5 wt%, 10 wt% and 15 wt% SiC when compared with the matrix Al 7075 alloy, under the conditions of 40 N load, 4.5 m/s sliding velocity and 15 min of sliding time.

As the normal load increases, the real area of contact increased along with tangential force leading to the instantaneous increase in the value of friction co-efficient. From the analysis of graphs, it is concluded that the increase of load leads to a significant increase in the friction co-efficient. However, under identical test conditions, Al 7075/10%SiC/3%B_4C possessed better friction co-efficient.

The experimental results of friction co-efficient with normal loads are shown in Figs 9a and 9b for Al 7075 based heat treated AMMCs. It is observed that the friction co-efficient of matrix alloy and their composites decrease with increase in sliding distance.

It is observed that there is a significant decrease in the friction co-efficient of AMMCs with the increasing content of SiC. A reduction of 17.24%, 20.83% and 27.27% in the friction co-efficient is observed for composites containing 5 wt%, 10 wt% and 15 wt% SiC respectively, when compared with the matrix Al 7075 alloy. Similar trend is reported by many researchers and this can be mainly attributed to the excellent lubricating properties of SiC[23].

The wear resistance of the composites increases with increase in percentage of hard particles as depicted in Fig. 8(a-c). Whereas, the friction co-efficient of composites decreases with increase in the content of hard reinforcement particles as indicated in Fig. 11 (a-c) as reported similar trends in earlier study[24]. Composites aged at 8 h shows the lowest frictional co-efficient. This indicates that the wear of this composite is very low compared to composites aged at 4 and 6 h. The extent of fluctuation of frictional co-efficient is also very less. A similar behavior is reported in other studies[25-27] on the aluminium matrix composites. Figure 12 clearly explains the effect of weight percentage of the harder SiC reinforcement particulate on the percentage reduction of wear rate, under maximum load, maximum sliding velocity and maximum aging time conditions.

Scanning electron microscope examination

Microstructural studies are carried out using JEOL model scanning electron microscope (SEM). Micrographs are obtained under maximum applied load (40 N), maximum sliding velocity (4.5 m/s), maximum sliding time (15 min) and different percentage of reinforcement of heat treatment for unreinforced materials and composites. Micrographs of the wear surface of Al 7075 composite specimens after wear are shown in Fig. 13(a-d).

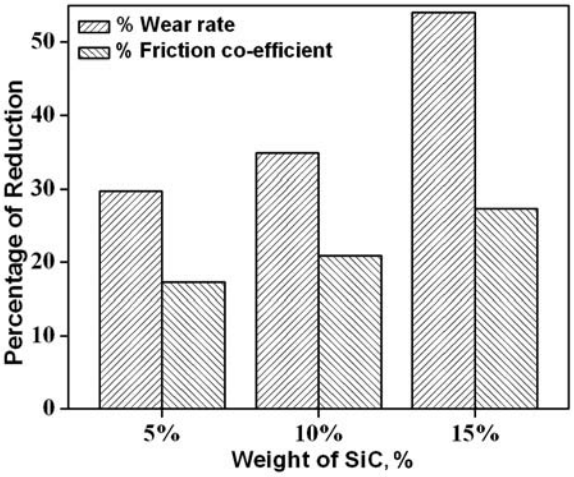

Fig. 12—Effect of weight percentage of SiC on the percentage reduction of wear rate

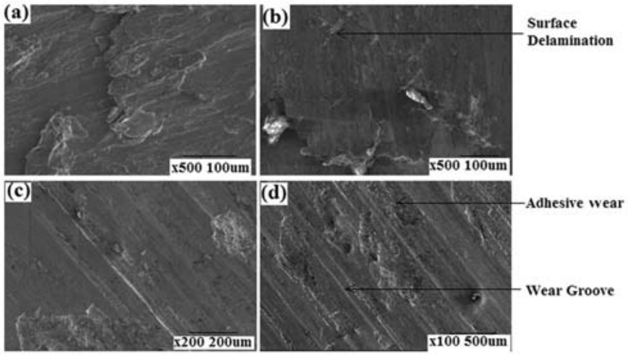

Fig. 13—SEM photographs of the wear surfaces of heat treated composites at 40 N

A non-uniform wear consisting of grooves, micro cutting and scratch marks, formed by the reinforcing materials are observed in composite specimens after wear. This indicates that the wear of the composite is due to the abrasion wear. Delamination is also observed on the wear surface of the composite which induces sub surface cracks that gradually grow and eventually shear to the surface forming long thin wear sheets. The morphological changes on the worn surface of the composite samples are studied under different parameters like applied load of 40 N, sliding velocity of 4.5 m/s, sliding time of 15 min, 15wt% of particulate reinforcement and 8 h of heat treatment.

Figure 13(a-d) shows the SEM worn surface micrographs of unreinforced and reinforced Al alloy samples. The pure A1 7075 have a smooth surface nature with more tribolayers formed. Hence, the wear rate is more in the unreinforced sample. The examination shows that the worn surface of the composite is generally much rougher than that of the unreinforced alloy.

The Al 7075 based AMMCs reinforced with 15%SiC/3%B_4C particulate show more cavities and large grooved regions on the worn surface after wear (L = 40 N, S = 4.5 m/s and t = 15 min) as shown in Fig. 13d . The other weight percentage of reinforcement particles interaction effects are marginal as shown in Fig. 13(b-c). Grooves are mainly formed by the reinforcing particles in the matrix. As the sliding velocity increases, the number of grooves also increases and the reinforcements are projecting out from the pin surface due to ploughing action between the counterface pin and the formation of wear debris also observed. The hard particles are found inside the cavities in which some particles are found broken, where as few other particles are pulled out from the surface. These indicates an abrasive wear mechanism which is essentially a result of hard particles and resist the delamination process, so that the wear resistance is more in the case of AMMCs.

Conclusions

From the investigations on heat treated Al 7075/SiC/B_4C AMMCs, the following conclusions are drawn:

(i) Liquid metallurgy technique could be successfully adopted in the preparation of Al 7075/SiC/B_4C composites, as the developed composite consists of the two particulate reinforcements along with a good binder.

(ii) Heat treatment is a significant effect on micro-hardness of Al 7075 matrix alloy and its composites. The treated composite with 15% SiC depicts high hardness value of 160 to 199VHN. Hence, harder SiC and B_4C particles contribute significantly to the improved wear resistance.

(iii) Aluminium composites exhibit better wear resistance compared to the unreinforced alloy. Moreover, increasing reinforcement content increases the wear resistance and reduces the friction co-efficient of the AMMCs at all the loads and sliding velocities studied.

(iv) Al 7075 based AMMCs exhibit a notable decrease in friction co-efficient and wear rates with increase in the content of particulate reinforcement. A maximum reduction of 27.27% and 54.03% in friction co-efficient and wear rates respectively for composites containing 15 wt% SiC when compared to the matrix alloy is observed.

(v) Increased aging duration reduces the wear of both unreinforced alloy and aluminium composites. 8 h aging shows higher wear resistance with the combination of high percentage of reinforcement.

(vi) The dominant wear mechanism for aging duration of 4 h is abrasion and delamination.

(v) Finally, under identical test condition the adhesive wear loss of composites decreases, with the increase in content of reinforcement in the matrix alloy. Heat treatment is an intense effect on adhesive wear behavior of matrix alloy and its composites.

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