Experimental Analysis of Metal Composites

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Abstract--- *Herein, in this process there was an attempt to prepare aluminum alloy metal matrix composite to examine its machinability, mechanical properties & physical properties. Discovery tells that, alloy of aluminum material is the best alternative for designing the material to give the essential characteristics. Alloy of aluminum metal matrix composite is getting vital recognition for using in vehicle and airplane, because of its low density, higher strength, high degree of stiffness & more resistance towards rusting. The AA7075 aluminum alloy is prepared by reinforcing the TiB2 (titanium borate), this composite is developed by applying TiB2 in the alloy of aluminum AA7075 according to mass ratio 5%, 10%, 15% respectively. The composite is formed with stir casting techniques. Furthermore, there are a wide variability of mechanical & physical tests are done such as hardness test, tensile test and microstructure testing. A hardness testing is conducting by using the Rockwell hardness test instrument. This test shows that addition to the reinforcement of TiB2 is increases its value of hardness, however an intensification in reinforcement nearly to 15%. The proliferation in reinforcement will decrease the hardness value.*

Index Terms--- metal matrix, mechanical properties, aluminum alloy, TiB_2, hardness test, tensile test.

I. INTRODUCTION

Introduction of composite/compound material

Composite/compound materials are mixed with two (2) or additional materials (e.g. reinforcing fiber, filler, and binder) that are different in macro scale information or shape. Metal matrix material is such a composition with at least two basic parts, one of metal, may be different metal or other material, such as clay or organic tile [1] [2]. The different types of the composites are:

- Metal Matrix Compounds (MMCs) consisting of metallic metallurgy (aluminum, magnesium, iron, cobalt, copper) and ceramic level (oxides, carbides) or loose metallic (lead, tungsten, molybdenum).
- Ceramic Metal Composite (CMC) made of pottery ceramic matrix and embedded fibers.
- Polymer matrix Composites made of matrix from thermoses (Unfinished Polyester (UP), Epoxy (EP)) or thermoplastic (Polycarbonate (PC), Polyvinylchloride, Nylon, Polystyrene) and stained glass, carbon steel thread or Kevlar fibers (spread level) [3] [4].

Typical comparative composite materials include: Mortars, concrete reinforced fiber, such as a reinforced polymer

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with the roots of metal Composites and the ceramic composite (composite ceramic and metal matrix).

Composite materials will be more comparable in terms of stiffness and hardness with conventional metals and found more structural design/planning application [5] [6]. Machining technique of composite materials needs an improved understanding of cutting processes in terms of accuracy and effectiveness. Poor machinability, particularly in a metal matrix compound (MMCs) display poor performance, lead to more rapidly wear of tool, and the process will become uneconomical [7] [8]. So model design (i.e. establishing the affiliation/connection b/w parameters of process & anticipated response) & optimization of the procedure (i.e. to obtain the best cutting parameters intended for an economy of the engineering process) essential for any performance of the manufacturing processes [9] [10].

Composite Material: AA7075

7075 aluminum alloy is an aluminum (Al) alloy, with zinc (Zn) as an underlying alloying element. It is resilient, and has comparative strength to numerous steels, & has high average fatigue strength & average machinability. It has lesser resistance to the corrosion than various other aluminum alloys, however has considerably better corrosion/rust resistance than the two thousand alloys. Its relatively high cost prohibits its presence, used in circumstances where cheaper alloy are not suitable [11]–[20]. 7075 Aluminum (Al) alloy is an aluminum (Al) alloy, with a Zinc as its main alloying includes Zinc 6%, Magnesium 2.3%, and Copper 1.4%. a company of Japan, Sumitomo Metal, first secretly developed the 7075 in 1943. 7075 was eventually used for aircraft in Imperial Japanese Fleet.

Density = 2.810 g/cm3

Tensile strength = 280 MPa

Melting points = 477-6350 C

Elongation = 9-10 %

Aluminium alloy is shown in Figure 1 [21] [22] [23].

I.

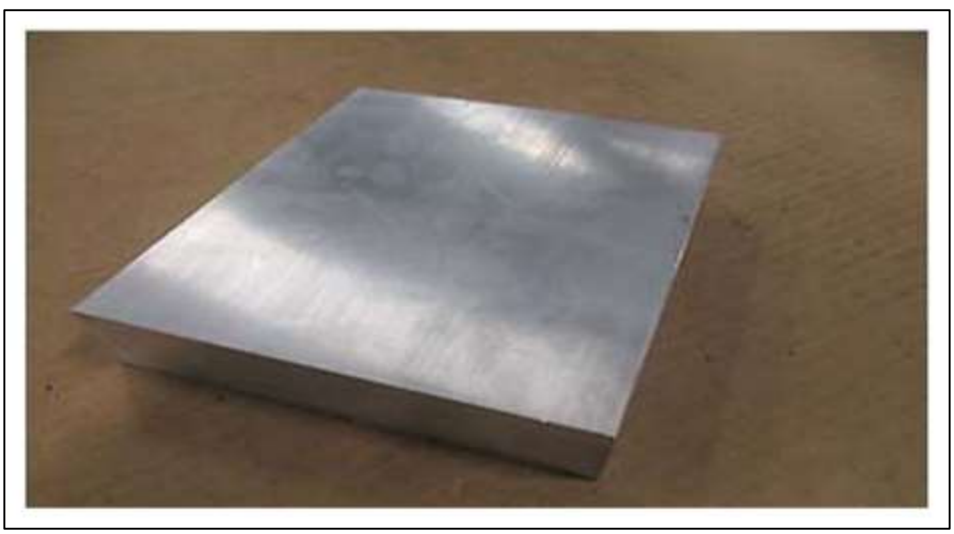

Figure 1. Aluminium alloy

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Composite Material: TiB_2

Titanium di boride (TiB2) is an exceptionally hard ceramics, with excellent heat conductivity, oxygenation and resistance to mechanical erosion of milling tools. TiB2 is also a rational electrical director/conductor, so that it may be employing as a cathode (-ve) material/elements in aluminum (Al) smelting & may be shaped by an electrical window. TiB2 is the strongest & most stable of many titanium-boron machining. The material/elements doesn't happen in nature/earth but possibly will be spun with carbo-thermal reduction in TiO2 & B2O3. TiB2 is similar to carbide titanium, the important substance for cermet's, & several of its properties/characteristics (e.g. hardness, thermal behavior, electric conductivity & oxidation resistance) are superior to those of TiC. TiB2 isn't naturally occurring in the ground. A diboride titanium powder can be produced by a different of high-temperature procedures, like direct titanium reactions or reaction of oxides of titanium/ hydrides, with a basic boron over 1000 ° C, a carbo-thermal reduction with a thermite response of titanium oxide and boron oxide, or hydrogen reduces in boron halides in the presence of the metal or its halides [24] [25] [26]. An example/simplification of a solid-state reaction is boro-thermic the reduction, which is illustrated in the Figure 2.

$$2\,TiO_2 + B_4C + 3C \rightarrow 2\,TiB_2 + 4\,CO$$

- Density ($g.cm^{-3}$) - 4.52
- Melting Point (°C) - 2970
- Hardness (Knoop) - 1800
- Elastic modulus (GPa) - 510 -575

Figure 2. Reaction equation of titanium (Ti) oxide & the boron halides

II. METHODOLOGY

In a methodology the job starts by melting the metal matrix in a graphite crucible. In this method reinforcing of reinforcement (TiB2) with metal aluminum (AA7075) using motion projection method (stir casting method) and select micro-quantities of metal to reinforce metal. First, melting of metal is performed in a graphite crucible with the assistance of the furnace. The metal juice AA7075 is melted in a crucible so that it is converted to molten level. Other than that pour TiB2 of 5% 10% 15% to weight ratio of the metal matrix. Now stir casting is carried out by rotating the HSS rod with the motor help with a gradual change/alternation in the speed after which it will solidifies in a crucible with smooth cooling. When it get solidifies in the crucible by spontaneous cooling, some pieces/part of metal are

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obtained. In addition to these basic pieces, make different types of specimens. These different categories of tests were tested using a tensile test, a microstructure test.

III. RESULT AND ANALYSIS

Micro structure test

Grain size of metal matrix composites are increased and the brittleness of the composite material are also increased with respect to the basic/elementary alloy. The microscopic images of specimen shows the grain structure clearly by magnify the object up to 100 times as represented in Figure 5 and Figure 6.

Figure 3. Specimen 1(TiB2 5%, AA7075 95%)

Figure 4. Fig.3-specimen 2(TiB2 10%, AA7075 90%)

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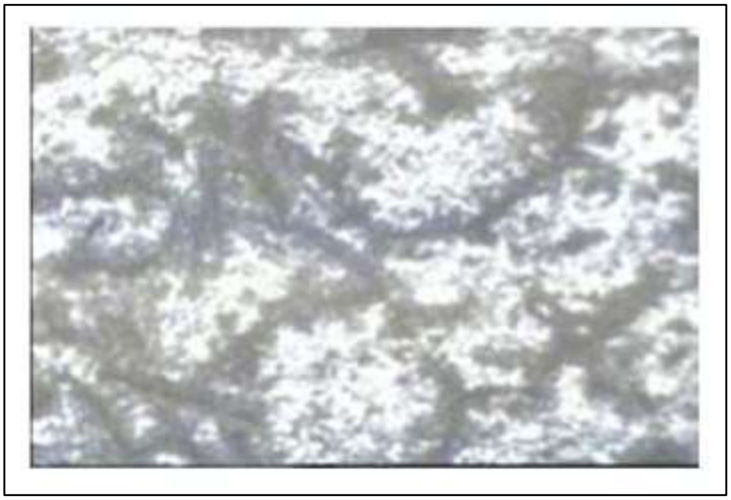

Figure 5. Microscopic images of specimen1

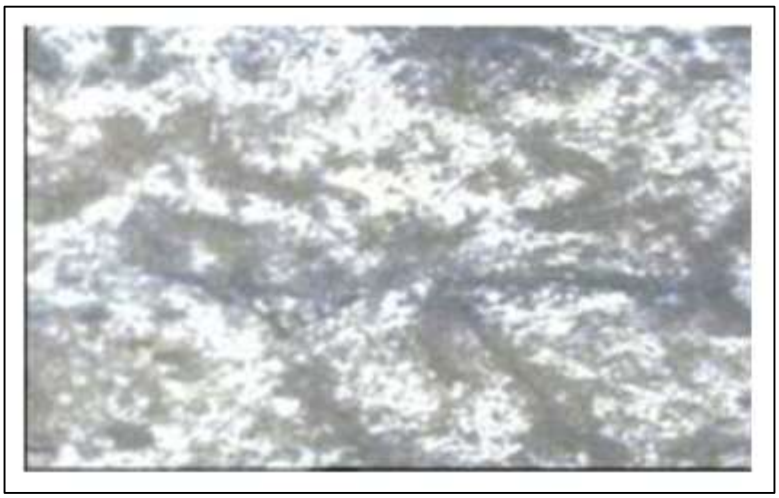

Figure 6. Microscopic images of specimen 2

Tensile test result:

In the tensile test, work is goes through different tensile forces to find the brake point and the pick point of the specimen of the different composition. For the specimen first it is about 3579.610 N and for the second about 9636.410 N. The specimen after the tensile test are shown in Figure 7 and Figure 8.

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Figure 7. Specimen 1st

Figure 8. Specimen 2nd

Displacement of the specimen/sample with respect to load is represented in form of graph in Figure 9 and Figure 10.

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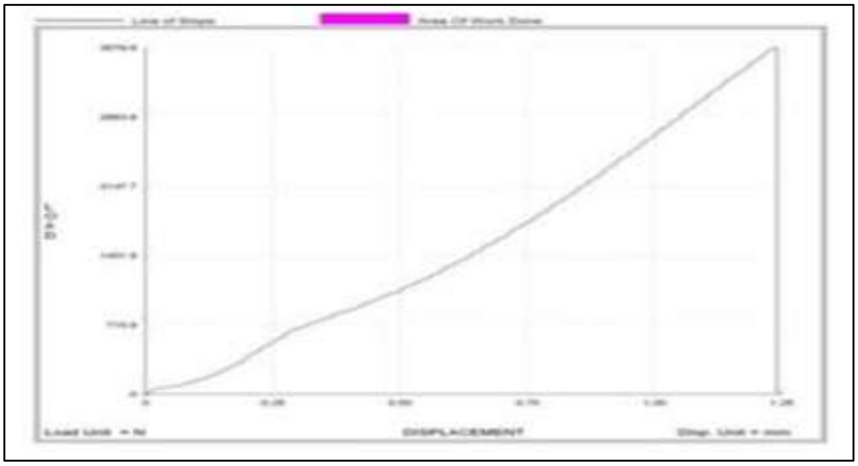

Figure 9. Graph b/w displacement & load of S1

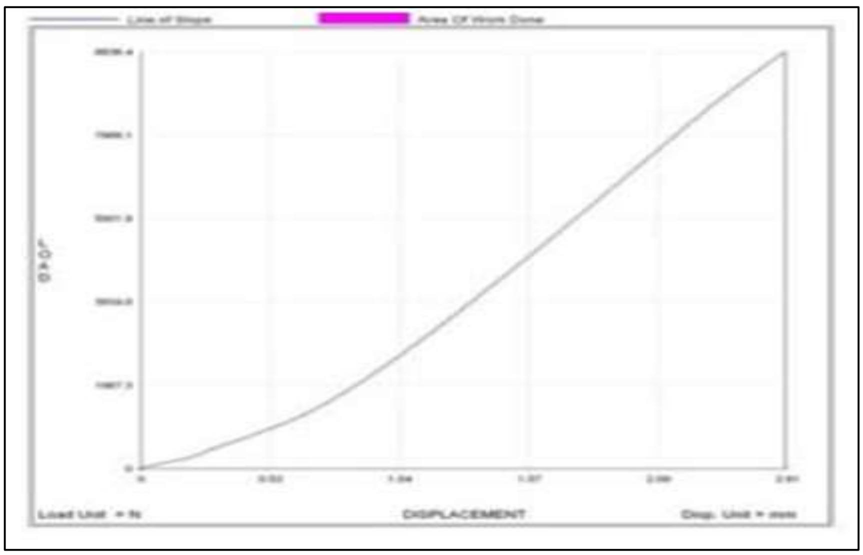

Figure 10. Graph b/w displacement & load of S2

Hardness test:

The hardness of the material are increases with rise in the composition of the TiB2. For of all the specimen is bout 75.34 and for the second it is about it is about 66.234. The number I a Rockwell hardness number. The sample after hardness test are given in Figure 11 and Figure 12.

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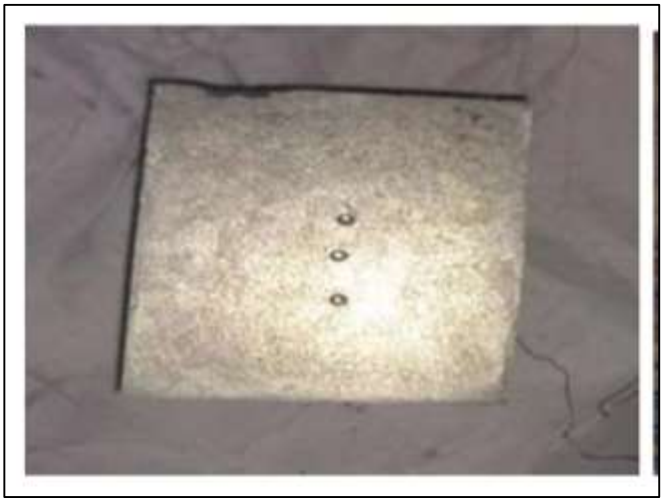

Figure 11. Specimen 1st

Figure 12. Specimen 2nd

IV. CONCLUSION

After conducting the experiment some outcomes that are observed are as follows:

- Brittleness of the composite metal increases as the % of the TiB_2 increase.
- The melting point of composite metal is higher than base metal.
- Hardness of composite metal increases.
- The tensile properties/characteristics of the composite metal are decrease.
- Elongation of the composite metal decreases.

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