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Composite Materials of Al-7075,TiB2, TiC Tensile strength and Rockwell Hardness Test

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ABSTRACT
Composite material is a combination of two or more materials having compositional variations and depicting properties distinctively different from those of the individual materials of the composite. A composite mixture having more than one fiber is known as hybrid composite During the past decade, considerable research effort has been directed towards the development of in situ Metal Matrices hybrid Composites (MMCs), Using this approach, MMCs with a wide range of matrix materials (including Aluminium 7075 grade, Titanium carbide, Titanium boride), and second-phase particles (including borides, carbides, nitrides, oxides and their mixtures have been produced In the present work, the elemental TiC, TIB2 powders are mixed with Aluminium molten metal to produce the AL-7075, TiC, TIB2 MMC. The proposed investigation is to deal with development of Aluminium based composite through casting route. Synthesis, characterization of Tensile Test and Rockwell Hardness Test.

Keywords: *Aluminium 7075, TiC (Titanium Carbide) and TiB2 (Titanium diboride), MMCs (Metal Matrix Composites*

INTRODUCTION

I.METAL PROCESSING PARAMETER

For manufacturing of composite material by stir casting knowledge of its operating parameter are very essential. As there is various process parameters if they properly controlled can lead to the improved characteristic in composite material.

A. Stirring speed:-

Stirring speed is the important process parameter as stirring is necessary to help in promoting wetability i.e. bonding between matrix & reinforcement. Stirring speed will directly control the flow pattern of the molten metal. Parallel flow will not promote good reinforcement mixing with the matrix. Hence flow pattern should be controlled turbulence flow. Pattern of flow from inward to outward direction is best. In our project we kept speed from 250-650 rpm. As solidifying rate is faster it will increase the percentage of wetability.

B. Stirring temperature:-

It is an important process parameter. It is related to the melting temperature of matrix i.e. Aluminium. Aluminium generally melts at 660◦C. The processing temperature is mainly influence the viscosity of Al matrix. The change of viscosity influences the particle distribution in the matrix. The viscosity of liquid decreased when increasing processing temperature with increasing holding time stirring time. It also accelerates the chemical reaction b/w matrix and reinforcement. In our project in order to promote good wetability we had kept operating temperature at 620°C which keeps Al (7075) in semisolid state.

C. Reinforcement preheat temperature:-

Reinforcement was preheated at a specified 500◦C temperature 30 min in order to remove moisture or any other gases present within reinforcement. The preheating of also promotes the wetability of reinforcement with matrix.

D. Addition of TiC and TiB2:- Addition of Magnesium enhances the wetability. However increase the content above 1wt. % increases viscosity of slurry and hence uniform particle distribution will be difficult

E. Stirring time:-

Stirring promotes uniform distribution of the particles in the liquid and to create perfect interface bond b/w reinforcement and matrix. The stirring time b/w matrix and reinforcement is considered as important factor in the processing of composite. For uniform distribution of reinforcement in matrix in metal flow pattern should from outward to inward.

Stir Casting:-

In a stir casting process, the reinforcing phases are distributed into molten matrix by mechanical stirring. Stir casting of metal matrix composites was initiated in 1968, when S. Ray introduced alumina particles into an Aluminium melt by stirring molten Aluminium alloys containing the ceramic powders. Mechanical stirring in the furnace is a key element of this process.

The resultant molten alloy, with ceramic particles, can then be used for die casting, permanent mould casting, or sand casting. Stir casting is suitable for manufacturing composites with up to 30% volume fractions of reinforcement.

The cast composites are sometimes further extruded to reduce porosity, refine the microstructure, and homogenize the distribution of the reinforcement. A major concern associated with the stir casting process is the segregation of reinforcing particles which is caused by the surfacing or settling of the reinforcement particles during the melting and casting processes. The final distribution of the particles in the solid depends on material properties and process parameters such as the wetting condition of the particles with the melt, strength of mixing, relative density, and rate of solidification. The distribution of the particles in the molten matrix depends on the geometry of the mechanical stirrer, stirring parameters, placement of the mechanical stirrer in the melt, melting temperature, and the characteristics of the particles added.

An interesting recent development in stir casting is a two-step mixing process. In this process, the matrix material is heated to above its liquids temperature so that the metal is totally melted. The melt is then cooled down to a temperature between the liquids and solidus points and kept in a semi-solid state. At this stage, the preheated particles are added and mixed. The slurry is again heated to a fully liquid state and mixed thoroughly. This two-step mixing process has been used in the fabrication of aluminum.

Among all the well-established metal matrix composite fabrication methods, stir casting is the most economical. For that

reason, stir casting is currently the most popular commercial method of producing Aluminium based composites.

II. Tensile Test in Universal Testing Machine

The diameter of the hybrid composite Al-7075,TiC,TiB2 is 30mm. applied load = 100kgf =980.6N. At different areas in hybrid composite Al-7075,TiC,TiB2 we applied an load for 15 seconds by using load lever. The readings are noted down at three different areas.

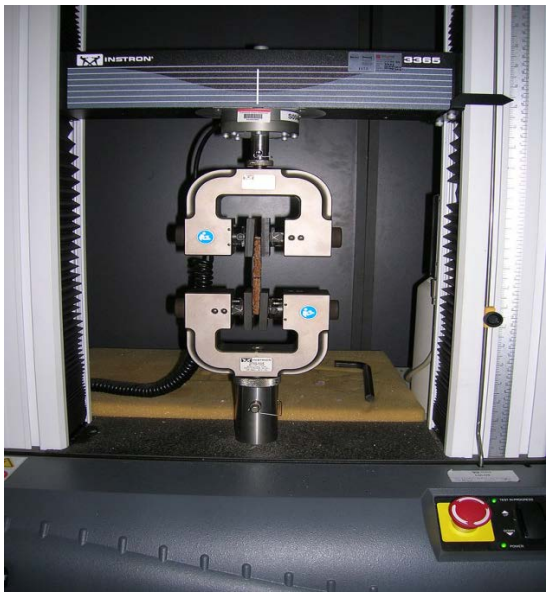

Fig. 1 Universal Testing Machine

Table.1Universal Testing Machine Results

Sl.No	Composites	Ultimate tensile strength (Mpa)	Percentage of elongation(%)
1	Al 7075	112	15
2	Al 7075 (2.5% TiC & TiB2)	115	13
3	Al 7075 (5% TiC & TiB2)	120	11
4	Al 7075 (7.5% TiC & TiB2)	128	9

Table.2 Hardness Test Results

Sl.No	Composites	Load (Kgf)	Load (N)	Hardness (HRB)
1	Al 7075	100	980.6	74
2	Al 7075 (2.5% TiC & TiB2)	100	980.6	76
3	Al 7075 (5% TiC & TiB2)	100	980.6	83
4	Al 7075 (7.5% TiC & TiB2)	100	980.6	87

III. Rockwell Hardness Test

The Rockwell test

The Rockwell test consists of measuring the additional depth to which a carbide ball or Brale diamond penetrator is forced by a heavy (major) load beyond the depth of a previously applied light (minor) load (SET point)

Fig. 2 Rockwell Test

The minor load is applied first and a SET position is established on the dial gauge or displacement sensor of the Rockwell tester. Then the major load is applied. Without moving the piece being tested, the major load is removed and with the minor load still applied, the Rockwell hardness number is automatically indicated on the dial gauge or digital display. The Brale diamond penetrator is used for testing materials such as hardened steels and cemented carbides. The carbide ball penetrators, available with 1/16 inch, 1/8 inch, 1/4 inch and 1/2 inch diameter, are used when testing materials such as steel-copper alloys, Aluminium and plastics to namea few. Rockwell testing falls into two categories: regular Rockwell testing (e.g., C and B scales) and Rockwell superficial testing (e.g., 30N and 30T scales). High Rockwell hardness numbers represent hard material snd low numbers soft materials.

The diameter of the hybrid composite Al-7075,TiC,TiB2 is 30mm. applied load = 100kgf =980.6N. At different areas in hybrid composite Al-7075,TiC,TiB2 we applied an load for 15 seconds by using load lever. The readings are noted down at three different areas.

CONCLUSIONS

The Mechanical properties of Al 7075,TiC,TiB2 hybrid composite such as Tensile strength and Hardness were investigated. It is shown that 7.5% of TiC (Titanium Carbide) and TiB2 (Titanium diboride) in Al 7075 is having maximum Tensile strength of 128Mpa and also Maximum Hardness 87HRB

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