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Tensile Property and Hardness of Al-7075 Matrix Reinforced with Silicon Carbide Particles

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Abstract - *Aluminium 7075 alloy as a matrix material and the silicon carbide as a reinforcement material have been used because it has potential applications in aerospace and aircraft industries because of its low weight to high strength ratio. It also used because it has high wear resistance and creep resistance property. The investigation about the tensile property and hardness of Al 7075 and silicon carbide is needed so that metal matrix composite fabricated for the aerospace and aircraft industries should be defect free. In this work Al 7075 is reinforced with 0, 5, 10, 15, 20 wt % of silicon carbide by stir casting method. The resulted casted specimens are tested to know the tensile property and hardness of the composite.*

Key words: Al 7075, Stir casting, Tensile Strength, Hardness.

1. INTRODUCTION

The use of metal matrix composite as structural engineering material has more attention in current years. Because of their more strength to low weight ratio, and toughness at high temperature which makes them suitable for various applications. Whereas engineering materials like steel are used as MMC because of its superior stiffness and high mechanical strength compare to matrix alloys, but the major disadvantage is its poorer ductility and lesser fracture toughness. MMC have high tensile and compressive stresses by transfer and distributing the applied load from ductile matrix to the reinforcement material. The transfer of load takes place from matrix to reinforcement if it has interfacial bonds. Therefore appropriate selection of matrix material and reinforcement material with their properties and the method of fabrication selected which effect this bond will significantly influence the resulting MMC.

2. METHODOLOGY

The current research is carrying out on Aluminium 7075 alloy which is reinforced with silicon carbide particles. For Al 7075 metal various weight percentage of silicon carbide is added by stir casting technique. Five samples each prepared for tensile test and Hardness test. Samples are prepared by varying the silicon carbide weight percentage as 0%, 5%, 10%, 15% and 20%. In this process initially silicon carbide powder is preheated at a temperature of 400^0c for an hour in the muffle furnace. After this preheated silicon carbide powder is poured in to the molten aluminium at a temperature of 750^0c.Degasifier and cover flux is added. Hexachloroethane (c_2cl_6) is used as a degasifier to remove the entrapped air and cover flux (45 % Nacl, 45% Kcl, and 10% NaF) is added to prevent oxidation losses of aluminium during melting this improves the yield of molten metal from the charge. The silicon carbide powder is mixed in the molten aluminium with the help of stirrer so that uniform supply of silicon carbide particles in molten aluminium can be achieved. Following stirring hold molten metal for 5minutes and then it is poured in to the suitable moulds. The moulds in which the molten metal is poured should be preheated in order to keep away from thermoelectric voltage arise due to huge differences in temperature, and not to decrease the repair life of the moulds or scratch the coating applied. After pouring allow the molten metal to solidify and then take out from the mould.

Fig: 1: Muffle furnace

Fig: 2: Pouring of Molten metal

Fig: 3: Casted Specimens

Fig: 4: Machined Specimens

3. EXPERIMENTATION

Material Selection:

Matrix Material:

Al7075 is chosen as matrix material due to wide applications in many engineering sectors. Aluminium 7075 is an aluminium alloy with zinc as main alloying element. The Composition of Al7075 is shown in the Table.

Table: 1: Composition of Al-7075

Material	Zinc	Mg	Copper	Titanium
Wt %	5.6-6.1	2.1-2.5	1.2-1.6	<0.5

Reinforcement Materials

Silicon carbide used as reinforcement material. The properties of silicon carbide are shown in the table below

Table 2: Properties of Sic

Mechanical Properties	**Values**
Melting Point ^{0}C	1400
Flexural Strength Mpa	550
Hardness	2800
Density g/cm^3	3.1
Fracture Toughness Mpa/m^2	4.6
Poisson's Ratio	0.14

Composition used for Metal Matrix Composite:-

Table 3: Composition

Sample	**Wt. of Al-7075**	**Wt. of Sic**
Al-7075 with 0% Sic	240 g	0 g
Al-7075 with 5% Sic	261 g	13.05 g
Al-7075 with 10% Sic	234 g	23.4 g
Al-7075 with 15% Sic	225 g	33.75 g
Al-7075 with 20% Sic	235 g	47 g

4. Results and Discussions

4.1 Tensile Test:

The tensile test specimen is ready with size according to ASTM standard E8. The specimen for tensile test is shown in figure 5. The tensile test is carry out in computerized tensometer.

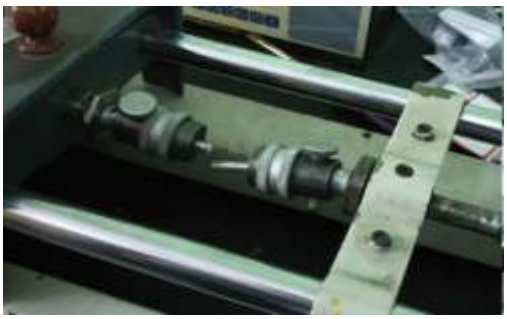

Fig: 5: Specimen on Tensometer

Fig: 6: Tested Specimens

Table: 4: Ultimate Tensile Strength (Mpa)

Materials	**Ultimate Tensile Strength (Mpa)**
Al-7075 with 0% Sic	153.95
Al-7075 with 5% Sic	162.09
Al-7075 with 10% Sic	170.38
Al-7075 with 15% Sic	207.29
Al-7075 with 20% Sic	190.7

Variation in Tensile Strength:

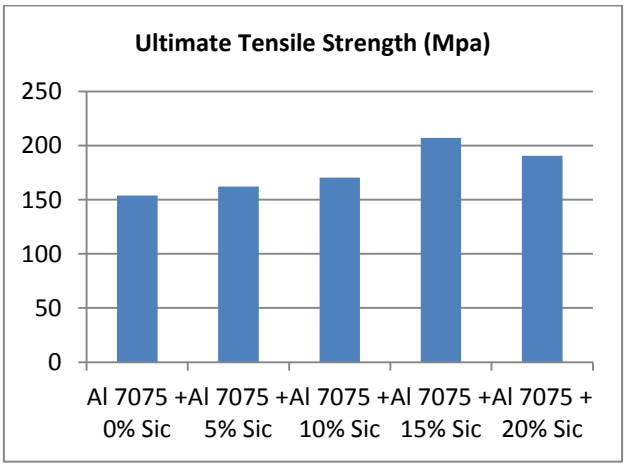

Fig: 7: Comparison of Ultimate Tensile strength

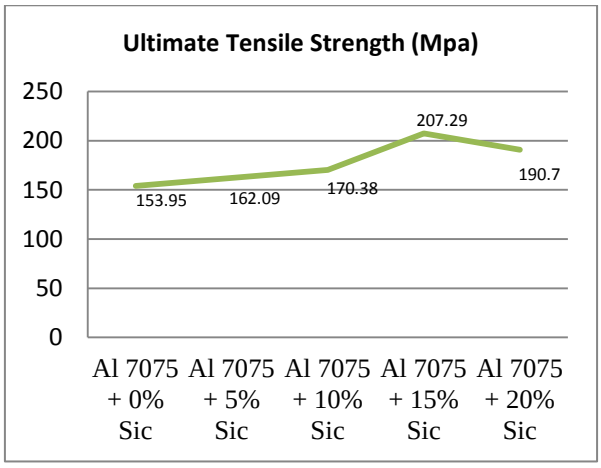

Fig: 8: Variation of Ultimate Tensile Strength

Tensile test are perform on a Tensometer for 0, 5, 10, 15 and 20 wt% of SiC composite and the reading are tabulate. It was practical that tensile strength increase with the increases in wt% of SiC until 15 wt% after that it gradually decreases as shown in the above graph. From the above graphs it clears that for 15 wt% of SiC in Al-7075 has maximum ultimate tensile strength.

Table: 5: % of Reduction in Area

Materials	Reduction Area %
Al-7075 with 0% Sic	0.052
Al-7075 with 5% Sic	0.054
Al-7075 with 10% Sic	0.056
Al-7075 with 15% Sic	0.069
Al-7075 with 20% Sic	0.067

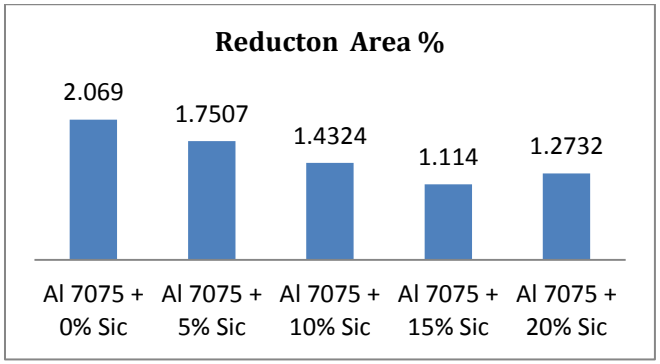

Fig: 9: % of Reduction in Area

From the above table it's clear that as the percentage of reinforcement i.e. Silicon Carbide, increase the reduction area percentage also increase until 15 wt% of Silicon Carbide then after this the percentage of reduction area decreases.

4.1 Hardness Test:

The conflict of materials against surface indentation is termed as hardness. The micro hardness of composites evaluates the border bond strength among reinforcing particles and matrix.

Experiment has been conduct by changeable weight fraction of SiC (0%, 5%, 10%, 15%, and 20%). Hardness is record and tabulate. Hardness test have been conduct on each sample by means of a load of 30 kgf and Pyramidal Diamond indenter whose faces are set at a 136 degree angle from one another. Dimension of impression prepared by indenter have been predict by microscope. The equivalent value of hardness (HV) was calculated from standard formula.

Table: 6: Vickers Hardness Number (VHN)

Materials	Vickers Hardness
Al-7075 with 0% Sic	274
Al-7075 with 5% Sic	347.62
Al-7075 with 10% Sic	365.68
Al-7075 with 15% Sic	385.18
Al-7075 with 20% Sic	375.24

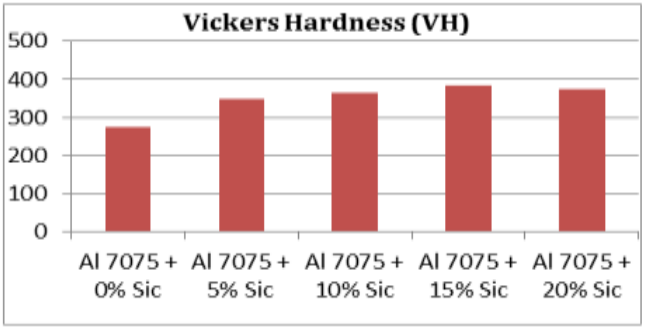

Fig: 10: Comparison of VHN

Above table show the Vickers hardness numbers of composite contain varying wt. % of SiC reinforcements. The chart shows that adding of SiC particles in Al7075 matrix composites enhance the hardness composite, when compare with unreinforced Al7075. When unreinforced Al7075 have Vickers hardness number (274), hardness rate increase with increase in SiC content and utmost hardness value obtained is (385.18) for 15 wt. % SiC reinforced Al7075 matrix. The existences of harder and well bonded SiC particles in Al7075 matrix that obstruct the movement of dislocation increase the hardness of composite.

5. CONCLUSIONS:

In this experimental study, Aluminium 7075 is reinforced with varying silicon carbide content (0, 5, 10, 15, 20 wt %) be prepared by using stir casting manufacture method. Tensile strength and hardness of the ready samples is calculated.

Base on the investigational results the following conclusion is made:-

The adding of silicon carbide in the Aluminium 7075 matrix increases the tensile strength and Vickers hardness when compared with unreinforced Aluminium 7075.

15 wt % of silicon carbide content in Aluminium 7075 matrix composite the maximum tensile strength and hardness.

From the outcome above, silicon carbide reinforced Aluminium 7075 matrix composite showed better tensile strength and hardness than the unreinforced Aluminium 7075.

References:

1. Md. Habibur Rahman, H. M. Mamun Al Rashed. "Characterization of Silicon Carbide Reinforced Aluminum Matrix Composites", Procedia Engineering, 2014
2. V Mahesh Kumar, C V Venkatesh. "A comprehensive review on material selection, processing, characterization and applications of aluminium metal matrix composites", Materials Research Express, 2019
3. C. Kannan, R. Ramanujam. "Comparative study on the mechanical and microstructural characterisation of AA 7075 nano and hybrid nanocomposites produced by stir and squeeze casting", Journal of Advanced Research, 2017
4. G. Ranjith Kumar, G. Rajyalakshmi, Vijaya Kumar Manupati. "Surface Micro Patterning of Aluminium Reinforced Composite through Laser Peening", International Journal of Manufacturing, Materials, and Mechanical Engineering, 2017
5. Atrian, A., G. H. Majzoobi, M. H. Enayati, and H. Bakhtiari. "Mechanical and microstructural characterization of Al7075/SiC