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Study of Mechanical properties of AA7075 with nano silicon carbide

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Abstract - *Metal Matrix Composites are advanced engineering materials reinforced with two or more different materials that combine and improve mechanical properties. Adding nano silicon carbide (SiC) to the aluminium alloy 7075 improves mechanical properties. Aluminum Metal Matrix Composite (AMMC) is a composite that uses aluminum as a matrix. the various reinforcements used in our research are embedded in the matrix. Uses silicon carbide (SiC) nanoparticles. Aluminium Metal Matrix Composites (AMMC) today have automotive, aerospace, agricultural machinery, defense and marineproperties due to Essential properties such as high strength, low density and excellent wear resistance compared to other non-metals. Mining and many others industrial applications. Aluminium alloy has excellent thermal conductivity and light weight. The purpose of this study is to determine the mechanical properties of the aluminium alloy (AAl7075) when fortified with silicon carbide nanoparticles.*

***Key Words*: AMMC, Mechanical Properties, nano SiC, AA7075**

1. INTRODUCTION

Traditional treatment methods are severely restricted due to particle growth to maintain the nanostructures of the final product. Therefore, it takes an hour to develop consolidation and consolidation technologies suitable for nano and hybrid composites. Ultrafine particles have a large surface area and high surface activity, which makes them susceptible to contamination, which reduces Physical, chemical and mechanical properties of AMC, creation of nano-reinforcing materials a difficult task to handle. Careful handling of nano enhancement is required to take full advantage of the nano size effect [1].

The addition of nanoparticles significantly improves Composite material hardness, yield strength, tear strength. It contributes to the strength improvement that various strengthening mechanisms such as Reinforcement, miniaturization of particles, CTE mismatch correction adjustment between matrix and particles, load acceptance effect, etc. are achieved. Scattered pits of different sizes were observed on the fracture surface of the tensile test piece, confirming the high ductility of the nanocomposite. [2]. The introduction of compounds such as graphite and mica results in some improvements in the properties of the base metal, resulting in MMCs with improved Mechanical properties such as increased tensile strength, increased hardness, increased heat deflection temperature and reduced warpage. [3].

Adding hybrid reinforcements instead of single reinforcements further improves the hardness, toughness, strength, corrosion resistance, and wear resistance of composites [4]. Ductility is one such property that tends to decrease with the addition of reinforcements. It decreases steadily due to the fortification of silicon carbide, but in fly ash it decreases with the addition of up to 10%, and then gradually decreases [5]. Machining analysis showed that the TiB2 fortification rate was the most important factor of surface roughness with a contribution of 38.86%. Adding TiB2 reinforcement will increase the surface roughness value [6].

Due to the improved ultrastructure of, the proper the combination of strength and ductility (380 MPa at UTS, 16.4% elongation at break) was achieved with the Ni rich sample compared to previous reports. [7]. Al2O3 (2% constant), SiC (3%, 6%, 9%) and heat treatment temperatures (140° C, 160° C, and 180° C) proved to be important for experimental design. Selected [8].

Hardness of alloy A7075 increases from 102HV to 120HV by adding 1% by weight. 1.5wt% C particles in Micro Sic and A7075 matrices. The increase in hardness is 15.24% greater than that of the base alloy [9]. Metallurgical tests were performed on different zones of the material, and metallurgical analyzes were performed on sampleswith better tensile strength and hardness properties [10].

2. EXPERIMENTAL METHOD

2.1 CASTING PROCEDURE

First of all, cut in the small pieces of purchased AA 7075 to its long billet by using of power hacksaw machine. The cleaned one-piece billet (metal ingots) of 2kg weight put it in crucible which is kept in the electric arc furnace thereafter switch on from main board for continuously power supply to furnace. The melting temperature of AA 7075 is about 680 ° C, but the metal ingot is overheated to 1295 ° C by placing it in the furnace. During the melting time of AA 7075, a slag remover in the form of hexachlorobenzene is added.

At this time added reinforcement of nanoparticles powder of silicon carbide [SiC] by weight of 05gm (or 0.25% of weight) and it's repeated to further similar casting with 10gm (or 0.5% of weight) and 15gm (0.75% of weight) respectively. Add this reinforcement to the molten metal Al7075 at a stirring speed of 500 rpm for 6 minutes. Then prepare the cleaned mold by screwing in each part tightly so that there is no leakage of AA 7075. The agitated molten metal is poured into a cleanly heated mold. The injection temperature of the agitated molten metal is maintained at 950 degrees Celsius. After pouring the stirred molten metal into a cooling mold to solidify it. Therefore, after solidification, prepare a sample for testing.

Fig. no.- i. Melting of al in-furnace

Fig no.- ii. After adding reinforcement stirring of liquid aluminium.

Fig no.- iii. Casting in permanent mould

Fig. no.- iv. Final casting sample

2.2 HARDNESS TESTING

The hardness test for the cast material of AA 7075 alloy were perform to know the effect of nano silicon carbide particles in the matrix materials. For microhardness testing first the composite material is prepared for the Brinell hardness testing specimen, material has to be flat surface for Brinell hardness testing and surface has been polished by using different grade size emery polishing paper. The polished composite specimen was tested for their hardness using a Brinell hardness testing machine having 3000kgf load, and the steel ball indenter used with diameter of 10mm.

Fig no.- v. Brinell hardness testing machine

For the calculating of Brinell hardness number

Equation $BHN = 2P / [\pi D \{D\sqrt{(D2-d2)}\}]$

Where:
P = load in N units
D = ball indenter diameter (mm)

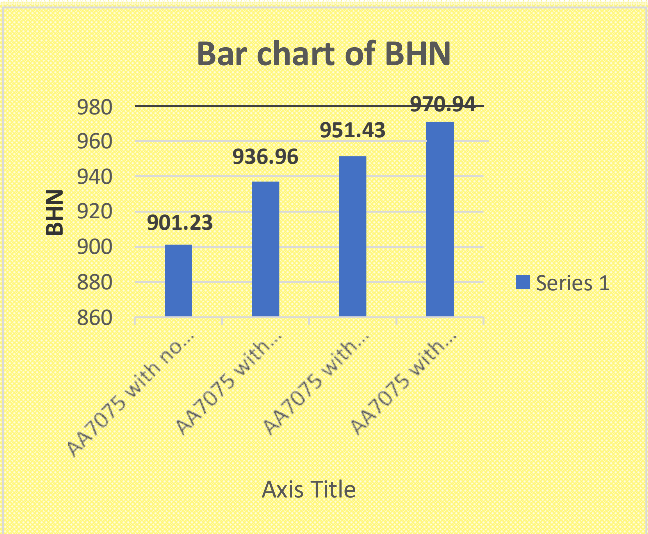
d = indentation diameter (mm)

The result of the hardness test of the composite material of AA7075 with reinforced nanoparticles of silicon carbide through the Brinell hardness testing machine are given here. There is different composition of nanoparticles of the silicon carbide are mixed in the AA 7075. First of all, tested only AA 7075 without mixing of reinforcement (nanoparticles) of the silicon carbide and its final calculated result is 901.23 BHN, when tested sample with reinforcement of silicon carbide of 0.25% of its weight then the result obtained 936.96 BHN, after that when tested sample with reinforcement of silicon carbide of 0.50% of its weight then the result obtained 951.34BHN, and finally tested sample with reinforcement of silicon carbide of 0.75% of its weight then the result obtained 970.94 BHN.

Table- i. Data used for detailed calculation of hardness

Sl. No.	Ball indenter diameter (D) mm	Indentation diameter (d) mm	BHN
AA 7075	10	6.10	901.23
AA 7075 with reinforcement of 0.25% nano silicon carbide	10	6.00	936.96
AA 7075 with reinforcement of 0.50% nano silicon carbide	10	5.95	951.34
AA 7075 with reinforcement of 0.75% nano silicon carbide	10	5.90	970.94

Fig. no.- vi. Result as in bar chart of Brinell hardness testing



2.3 MICROSTRUCTURE

The microstructure analysis of AA 7075 with nanoparticles of silicon carbide has been taken by metallurgical microscope. Surface prepared by polishing from different types of emery paper with different grit size. Then microstructure captured for flat surface with 500 pixels. The microstructure had obtained as given below in the figure:

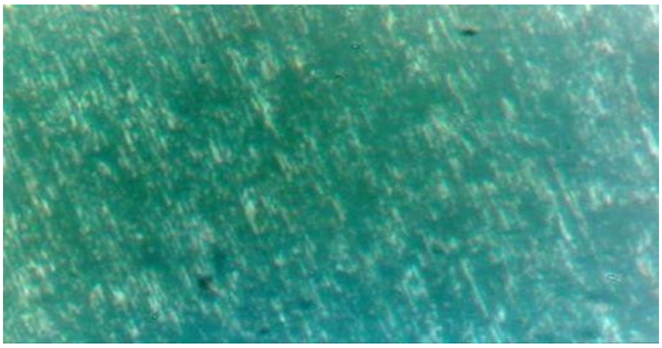


Fig. no. – vii. Microstructure of AA 7075 with no reinforcement

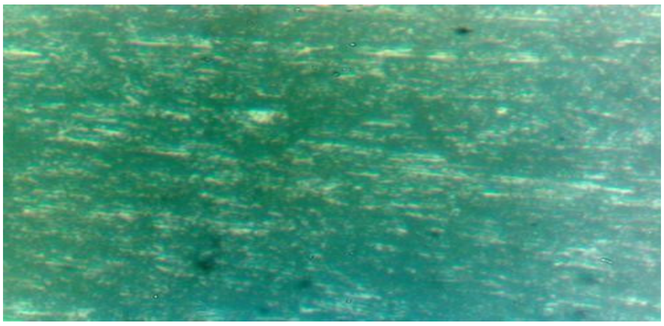


Fig. no – viii. Microstructure of AA 7075 with reinforcement of 0.25% nano SiC

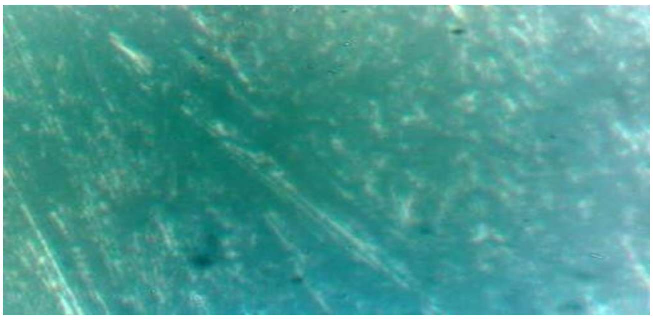


Fig. no – xi. Microstructure of AA 7075 with reinforcement of 0.50% nano SiC

Fig. no. – x. Microstructure of AA 7075 with reinforcement of 0.75% nano SiC

3. CONCLUSIONS

On the basis of hardness analysis can conclude this research work found that the parent or original AA 7075 obtained 901.23 BHN and with reinforcement material of 0.25%, 0.50%, and 0.75% obtained hardness are 936.96 BHN, 951.34 BHN and 970.94 BHN respectively.

Hence in view of the above results can also conclude that hardness as well as mechanical properties of the AA 7075 with nano silicon carbide reinforcement had enhanced rather than parent AA 7075.

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