# Investigation of Mechanical Properties of Aluminium Alloy 7075 Reinforced with Tungsten Carbide and Fly-Ash Hybrid Metal Matrix Composites

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*Abstract*— The advancement of Hybrid Metal Matrix Composites has been an essential region of research enthusiasm for Material Science, since critical change of properties, for example, high particular quality, damping proportion, particular modulus and wear protection as accomplished, contrasted with unreinforced amalgams. The need of Metal network composites has ideally expanded in the field of aviation, car and electronic ventures. Be that as it may, because of their high cost, tests are typically done to diminish the cost of composites and economical materials are used for metal framework composites. Fly Ash being distinguished as a standout amongst the most economical and low thickness intermittent dispersoids is utilized as fortifications. It is subsequently expected that the fuse of Fly Ash particles in Aluminum amalgam will advance yet another utilization of this ease squander by item and in the meantime has the potential for monitoring vitality escalated Aluminum. In perspective of this, the present Investigation concentrates on the advancement of Al-WC-Fly-fiery remains Hybrid Metal Matrix Composite by blend throwing strategy. The mechanical properties of Al 7075, for example, Tensile quality, stretching, hardness, within the sight of Tungsten Carbide and Fly-cinder are assessed in precisely outlined research center that duplicate as almost as conceivable to benefit conditions. The microstructure of Al-Metal Matrix Composites is examined under SEM Test.

***Key words:*** Include Metal Matrix Composites, Al7075 combinations, Tungsten Carbide, Fly-fiery debris, Stir Casting

## I. INTRODUCTION

Aluminum and its combinations are utilized as a part of extensive variety of modern applications, for example, Aerospace, car ventures and Military. The working states of the metal contrast in different viewpoints like load conditions, temperature factors and different parameters. As all these required properties can't be met in a solitary metal, it has prompt the improvement of MMCs. MMCs have picked up significance as they display upgraded mechanical properties than unadulterated metal, for example, more noteworthy quality, enhanced solidness, decreased thickness, enhanced temperature properties, wear protection.

Particularly aluminum MMCs are quick developing as designing materials and rivaling the normal metals and amalgams. The size, shape and volume division of the support, Matrix material and response at the interface influences the Mechanical properties of composites.

In view of the writing review it is clear that however the application scope for AMC's is extending, the significant obstruction is the generation of these AMC's on a modern scale. It can either be a strong state handling or fluid state preparing. The straightforwardness and adaptability engaged with a Stir throwing strategy has made it a prime course for combination of AMCs among fluid state preparing. There have been accounted for intrinsic issues in mix giving such a role as absence of wetability between the particulate fortification and the fluid aluminum amalgam metal.

## II. LITERATURE REVIEW

PrabhakarKammer [1] manufactured Metal framework composite of Al 7075, fortified with fly fiery remains and e-glass fiber. It was discovered that elasticity and pressure quality enhanced when contrasted with al 7075 compound alone. Additionally an expansion in the Ultimate Tensile quality was apparent. HariPrasadaRao [2] led the Microstructure Exploration of the Aluminum - Tungsten Carbide Composite with various Manufacturing conditions and uncovered energizing outcomes, for example, great interfacial bond amongst grid and tungsten carbide particles; Improved Grain Structure contrasted with Pure Aluminum and expanded the effect protection.

P.K.Rohatgi [3] reports that with the expansion in volume rates of fly cinder, hardness esteem increments in Al-fly fiery remains composites. He additionally reports that the tractable flexible modulus of the fiery debris combination increments with increment in volume percent of fly slag. J. BabuRoa [4] ponders that metal framework composites (MMCs) have essentially enhanced properties contrasted with unreinforced combinations.

P.Vivekanandan [5] contemplated the properties of Aluminum – silicon carbide composite and uncovered that the hardness of Al-fly cinder composites has expanded with increment what's more of fly powder and the wear rates have diminished essentially with the fuse of fly fiery debris in Al dissolve. MahendraBoopathi [6] assessed the mechanical properties of aluminum-silicon carbide-fly fiery debris half breed composite and reasoned that the expansion of fortification the rate of stretching of the Hybrid MMCs diminished essentially.

P.Shanmughasundaram [7] contemplated that the advancement of lightweight materials has furnished the car business with a various conceivable outcomes for vehicle weight decrease. Hashim [8] has recognized four specialized challenges in mix throwing to be specific, trouble of accomplishing a uniform dispersion of the support material; Chemical responses between the fortification material and the network compound; wettability between the two fundamental substances; porosity in the MMC. These challenges should be overcome all together accomplish a MMC with an enhanced scope of mechanical properties. Certain other critical process factors that influence the mechanical properties of MMC have likewise been distinguished. The holding temperature, blending speed, impeller size and position in the liquefy are

to be considered in the generation of cast metal network composites.

In the present work, fly-fiery debris comprising of unmanageable oxides like alumina, press oxides and silica is utilized as fortifying stage alongside tungsten carbide which has noteworthy hardness properties. Composites were delivered with fly-fiery remains going from 5gm to 25gm and tungsten carbide with 2.5gm to 7.5gm. The physical and mechanical properties of the composites were assessed and contrasted and the monetarily accessible aluminum.

## III. TRIAL PROCEDURES

In the investigation, mix throwing technique was utilized for the union of metal lattice composite. A mix throwing setup comprises of a protection Muffle Furnace and a stainless Steel stirrer get together. The stirrer get together was associated with a variable speed vertical boring machine with scope of 50 to 1000 rpm by methods for a steel shaft. Earth graphite pot of 1.5 Kg limit was set inside the heater. The graphical portrayal of mix throwing was appeared in Figure 1.

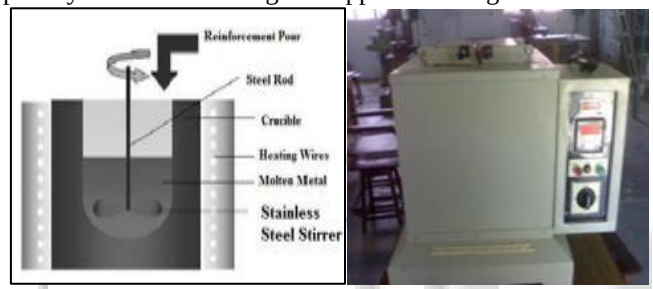



Fig. 1: Blend Casting Setup

Around 500gm of composite in strong shape (plate) was dissolved at 800°C in the protection heater. Preheating of fortification (Fly Ash at 550°C, tungsten carbide at 880°C) was improved the situation one hour to expel dampness and gases from the surface of the particulates. The stirrer was then brought vertically up down to a few centimeters from the base of the cauldron. The speed of the stirrer was bit by bit raised to 700rpm and the preheated fortified particles were included with a spoon at a steady rate into the soften. The speed controller kept up a consistent speed of the stirrer, as the stirrer speed got diminished because of the expansion in thickness of the soften when particulates were included into the dissolve.

After the expansion of support, mixing was proceeded for 2 minutes for appropriate blending of arranged particles in the network. The liquefy was kept in the cauldron for estimated half moment in static condition and afterward it was poured in the form. The creations of the examples are given in Table 1. The manufactured examples are appeared in the figure 2.

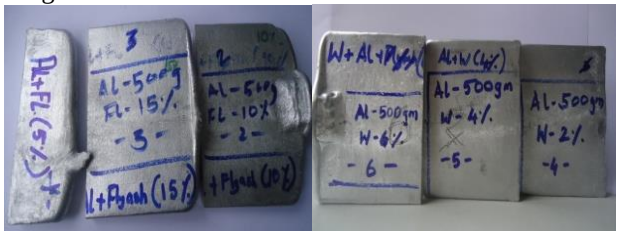


Fig. 2: Fabricated Samples

### A. Mechanical Properties Observation

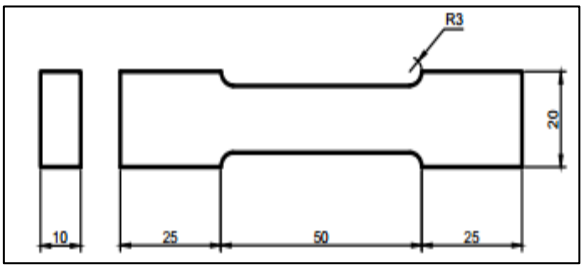



Fig. 3. Tensile Testing Sample Dimension

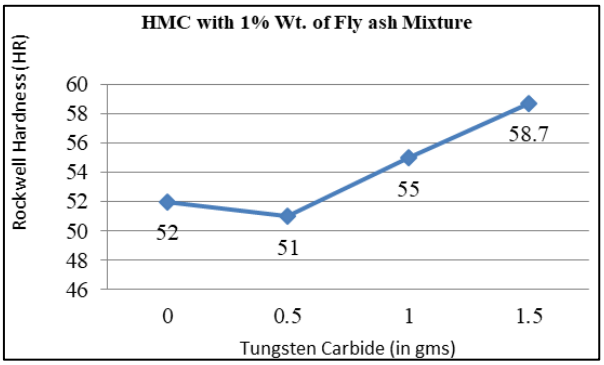
## IV. RESULTS & DISCUSSION

| Composition | | | | Results | | |
|---|---|---|---|---|---|---|
| Sample No. | Al (%) grams | Wt % | | Tensile Strength N/mm | Elon-gation % | Hardness (HR 30T) |
| | | Fly ash | WC | | | |
| 1 | 500 | 1 | 0.0 | 186.2 | 4.3 | 60.1 |
| 2 | 500 | 1 | 0.5 | 200.0 | 5.0 | 51.0 |
| 3 | 500 | 1 | 1.0 | 192.5 | 3.5 | 55.0 |
| 4 | 500 | 1 | 1.5 | 185.2 | 1.8 | 58.7 |
| 5 | 500 | 3 | 0.0 | 178.2 | 0.7 | 41.5 |
| 6 | 500 | 3 | 0.5 | 155.4 | 2.0 | 47.7 |
| 7 | 500 | 3 | 1.0 | 158.8 | 0.3 | 48.5 |
| 8 | 500 | 3 | 1.5 | 162.9 | 0.5 | 53.2 |
| 9 | 500 | 5 | 0.0 | 134.7 | 4.0 | 54.0 |
| 10 | 500 | 5 | 0.5 | 151.5 | 0.5 | 54.0 |
| 11 | 500 | 5 | 1.0 | 156.6 | 0.7 | 52.5 |
| 12 | 500 | 5 | 1.5 | 126.4 | 1.0 | 54.6 |

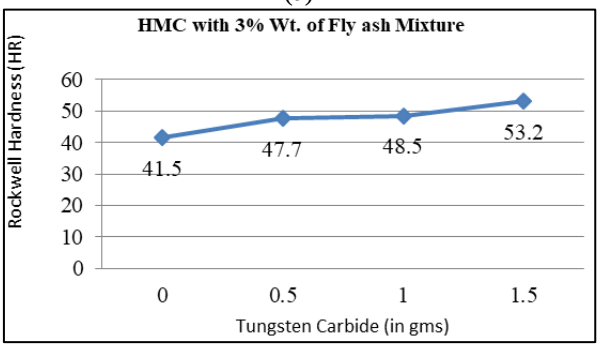
Table 1: Experimental Data for Al 7075 - Fly ash – WC Hybrid Composite

### A. Mechanical Properties of Al 7075 – Fly ash- Tungsten Carbide Hybrid Composite

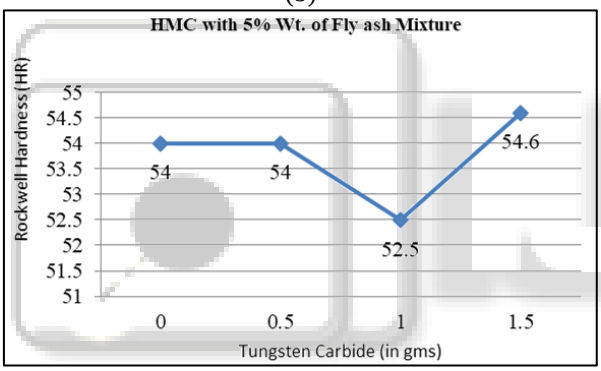
The figure 4.shows the impact of fly fiery debris and tungsten carbide fortification, on the hardness of Al7075. From the diagram it is clear that there is an ostensible increment in the hardness of the composite metal contrasted with the unadulterated aluminum, for a percent weight blend of 5% of fly fiery remains alongside .5%, 1%, and 1.5% of tungsten carbide individually. (The hardness of unadulterated Al7075 being 50.4HR) Contrarily for percent weight blend of 1% of fly fiery debris there is a noticeable drop in the hardness as 0.5% of tungsten carbide is included and as the substance of tungsten carbide is expanded the hardness slowly increments. However, for a percent weight blend of 3% of fly fiery debris there is a drop in the hardness of the composite material at first and demonstrates an unfaltering change as the percent weight of tungsten carbide is expanded.




(a)



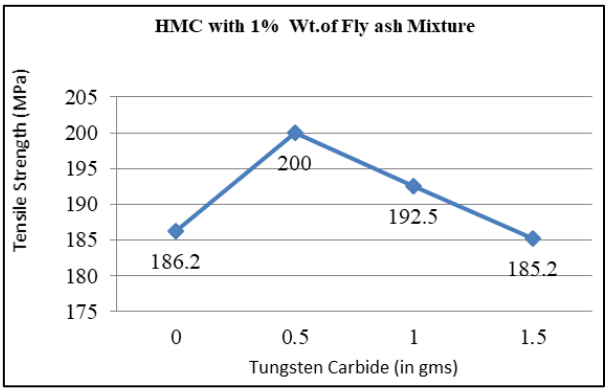

(b)



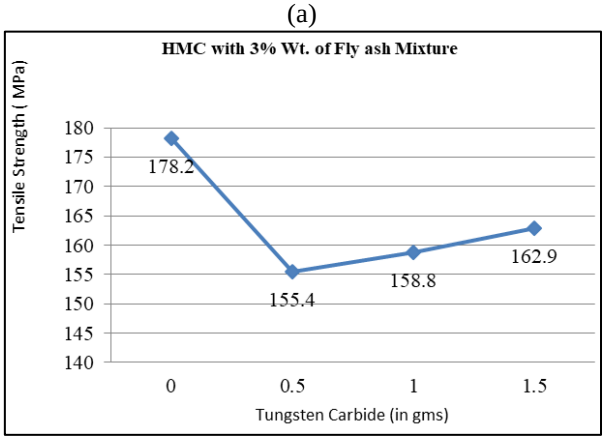

(c)

Fig. 4: (a), (b), (c). Effect of Fly ash and Tungsten Carbide on the Hardness of Al7075.

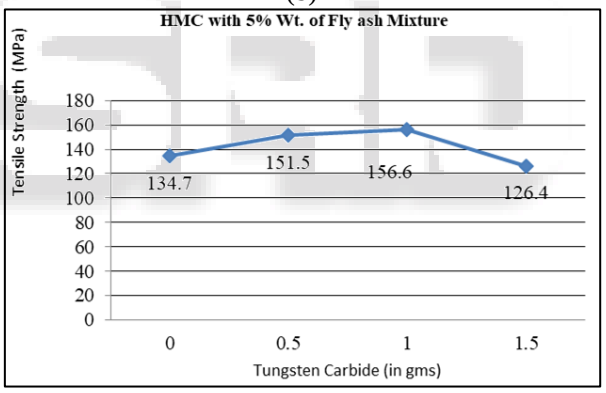
The figure 5 demonstrates the impact of fly fiery debris and tungsten carbide fortification on the Tensile Strength of Al7075. From the chart we infer that generally speaking there is a drop in the elasticity of the composite metal contrasted with the unadulterated aluminum. For a percent weight blend of 1% fly fiery debris alongside .5%, 1%, 1.5% of tungsten carbide separately, the rigidity expanded at first and wound up with a slight drop. Be that as it may, for a percent weight blend of 3% and 5% of fly cinder there is an extraordinary drop in the elasticity of the composite material contrasted with the unadulterated aluminum.




(a)




(b)




(c)

Figure 5 (a), (b), (c). Effect of Fly ash and Tungsten Carbide on the Tensile Strength of Al7075.

## V. CONCLUSION

Al-Fly fiery remains WC (Varied structures) composites were effectively created by blend throwing process. Generally speaking there was a best variety in the mechanical properties of the composite contrasted and the unadulterated metal.The accompanying conclusions have been drawn in view of the trial perceptions:-

1) Improved hardness of the composite metal is accomplished with increment in the weight percent of tungsten carbide for all variations of fly fiery remains blend.
2) Subsequently, with the expansion in the expansion of fly fiery debris alongside tungsten carbide, there is a drop in the elasticity of the composite material yet the prolongation property has demonstrated an ostensible increment.

3) The thickness of the composite diminished with the expansion in the substance of the support, also demonstrating better execution. This has ended up being a weight lessening factor.

## REFERENCES

[1] Prabhakarkammer, experimental studies on mechanical properties of e-glass short fibres& fly ash reinforced al 7075 hybrid metal matrix composites, international journal of applied research in mechanical engineering (ijarme) issn: 2231 –5950, vol-2, iss-2, 2012.
[2] Hariprasadaraopydi, microstructure exploration of the aluminum-tungsten carbide composite with different manufacturing circumstances, international journal of soft computing and engineering (ijsce) issn: 2231-2307, volume-2, issue-6, january 2013.
[3] Rohatgi. P.k (2006) , " application of fly ash in synthesizing low cost metla matrix composites for automotive and other engineering applications". Jom, vol.58, issue no.11, pp.71-76,2006.
[4] Rao.j.babu (2010), "development of light weight alfa composites", international journal of engineering, acience and technology. Vol2,issue no. 11,pp.50-59,2010.
[5] P vivekanandan (2013), "the experimental analysis of stir casting method on aluminium-fly ash composites", international journal of current engineering and technology, vol.3, no.1 (march 2013).
[6] Mahendraboopathi. M, evaluation of mechanical properties of aluminium alloy 2024 reinforced with silicon carbide and fly ash hybrid metal matrix composites, american journal of applied sciences, 10(3): 219-229, 2013, issn: 1546-9239.
[7] Shanmughasundaram, p, "some studies on aluminium-fly ash composites fabricated by two step stir casting method" european journal of scientific research, vol. 63, issue no.2, pp. 204-218, 2011.
[8] Hashim J, L.Looney& M..S.J.Hashmi, Metal matrix composites: Production by the stir casting method, Journal of Materials Processing Technology, 92, 1999, 1-7.
[9] Karthi.R.R [1], Dhanabalan.S[2] Comparitive Analysis of Plain and Herringbone Grooved Journal Bearing Under The Hydrodynamic Lubrication Conditions In Pak. J. Biotechnol. Vol. 14 Special Issue I (International Conference on Futuristic Innovations in Mechanical Engineering and Manufacturing Management) Pp. 25-31 (2017)
[10] Dhanabalan.S[1], Karthi.R.R[2], Sivakumar K[3], and Sathiya Narayanan C[4] Optimization of rotary EDM Process Parameters for Inconel 718 Using Artificial Neural Network in Pak. J. Biotechnol. Vol. 14 special issue I (International Conference on Futuristic Innovations in Mechanical Engineering and Manufacturing Management) Pp. 58- 60 (2017)
[11] Dhanabalan.S[1], Karthi.R.R[2] Multi-Objective Optimization of EDM Parameters for Ti alloy in Pak. J. Biotechnol. Vol. 14 special issue I (International Conference on Futuristic Innovations in Mechanical Engineering and Manufacturing Management) Pp. 54-57 (2017)
[12] Boopathi [1],Kapil Kumar[2], Karthi [5] Comparative Analysis of Drag Force in various Car Bodies using CFD - A Review in IJIRST || National Conference on Recent Advancements in Mechanical Engineering (RAME'17) || March 2017
[13] Karthi, R.R., Dhanabalan.S, An Investigation on Micro Robot for Medical Applications in Pak. J. Biotechnol. Vol. 14 special issue I (International Conference on Futuristic Innovations in Mechanical Engineering and Manufacturing Management) Pp. 32- 36 (2017)
[14] Karthi.R. R, Tamilarasu.B, Navaneethan.S Stewart-Gough Platform Manipulator with Six Degrees of Freedom Mechanism WWJMRD 2017; 3(8): 101-107 www.wwjmrd.com International Journal e-ISSN: 2454-6615 2017
[15] Karthi.R.R, Tamilarasu.B, Nagaraj.R, Boobal.A Knee Design for a Bipedal Walking Robot Based On Passive Dynamic Walking IJIR 2017**;** 3(11): 202-208 www.onlinejournal.in ISSN: 2454-1362
[16] Karthi R.R, Tamilarasu.B, Harshankumar.M, Sounder Rajesh.P Design And Synthesis Of Six Legged Walking Robot Using Single Degrees Of Freedom Linkage IJRDT 2017; 8(4): 176-189 www.ijrdt.org in ISSN (O) :- 2349-3585
[17] Karthi R.R , Tamilarasu.B , Gokul.P, Ragu.P Design and Analysis of Mechanical Behavior of Al-Si in Railway Vehicle Brake Slack Adjuster IJSRST 2017; 3(7):739-743 www.ijsrst.com in Print ISSN: 2395-6011
[18] R.R. Karthi, B. Tamilarasu, S. Gokul raja, M. Gowtham, P.Gokul Comparison of Mechanical Properties of Carbon Glass & Palm Banana Fibres Reinforced Hybrid Composite Bar IJSRD 2017;5(9); 782-786 www.ijsrd.com in ISSN (online): 2321-0613
[19] Tamilarasu. B, Sudhakaran. N, Yuvaraj. S, Vijay. P Design and Fabrication of Rescue Motor Vehicle WWJMRD 2017; 3(12): 475-480 www.wwjmrd.com International Journal e-ISSN: 2454-6615 2017