"Characterization of Aluminum 7085/WC/Fly Ash Hybrid Composites for Vibration Applications"

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Abstract - *The present work on preparation of fly ash and tungsten carbide reinforced AA 7085composites by stir casting and characteristic evaluation of characteristics*

AA 7085/WC/Fly ash composites are fabricated with fairly uniform dispersions en-route the process of stir casting.

•The microstructure of the fabricated composites were analyzed using a typical SEM which revealed uniform dispersion of reinforced particulates with strong bonding between the aluminum 7085 and particulates.

•The tensile strength improved from 245.8426 MPa to 314.026 MPa, while the yield strength enhanced from 176.312 MPa to 234.02 MPa, percentage elongation reduced from 9.22 to 3.64, the improvement in tensile strength is due to the addition of tungsten carbide reinforcement particles which enhances the tensile characteristics. There is substantial increase in tensile strength of C7composites when compared with 'C1' Specimen. The ductility of the composite specimens reduces with the increase in strength and thus the C7 composites exhibit a reduced ductility as compared to C1 composite specimen. The percentage elongation of the MMC's decreased with increase in tungsten carbide and flyash content, which confirmed that tungsten carbide addition increased brittleness.

•The compressive strength increased from 1274.2 MPa to 1522.02 MPa, while % reduction dropped down from 6.56 to 2.34, this is majorly due to the bonding of reinforcements with the matrix phase that will ultimately enhance its ability to resist compression.

From current investigations and critical inferences of the given work, there is a vast scope for future researching the following areas.

- *Detailed wear characterization can be carried out.*
- *Corrosion studies can be carried out.*
- *Dynamic loading analysis can be done.*
- *Results can be correlated using analysis packages.*
- *Detailed characterization of the process methodologies can be carried out effectively.*

***Key Words*: Stir Casting Technique, Universal Testing Machine, Lathe Machine, Brinell Harness Testing Machine**

1. INTRODUCTION: Current Engineering applications require materials that are more grounded, lighter and progressively moderate. Real research for the progression of materials that have extraordinary solidarity to weight extent and are sensible for vehicle applications are picking up significance. In-advantage of execution demands for some propelled material systems, a wide scope of properties which are difficult to meet using solid materials is accomplished on the way composite materials. Metal framework composites are famed to promise such uniquely fitted a thing essential in a huge extent of structure uses. A part of things mixes incorporates large unequivocal quality, less warm coefficients, large wear opposition, extraordinary reducing limits, high express robustness and appealing components of disintegration check.

Generally, one section goes about as a grid in which the fortifying stage is strengthened. The framework part is as such, the heap bearing stage, while the support is the heap exchanging stage. Right when the system part is metal, we consider such a composite a metal network composite (MMC). The help can be particulates, short fibers or constant fiber. There are three components that choose the characteristics of a composite which are support, system, and interface. The activity of the system was seen as that of a medium or cover to hold the strong and firm fibers or various types of reinforcements. Consistently, regardless, we can understand that the execution of the composite material will be always affected by the mechanical structure and its characteristics. It is particularly legitimate for the MMC in light of the fact that the explicit showing of

solidifying a fortress can result in changes in the fine structure of the metallic cross-section and, hence in their structure fragile properties. The undertakings to make financially engaging composite portions have achieved a couple of innovative assembling methodologies right presently being used in the car and aviation spaces. It is plainly obvious, especially for composites, that the improvement in manufacture approach alone isn't adequate to crush the cost acceleration. It is essential that there be an organized upgrade in fabrication, attributes, tooling, quality confirmation, for composites

2. METHODOLOGY

2.1 Methodology Adopted

2.2 PROCESSING TECHNIQUE: Processing technique is important to synthesize fly ash and tungsten carbide reinforced composites, the main purpose of many research and experiments is to enhance circulation of reinforcements in composite materials & also improve the bonding between reinforcements and matrix phase. Also chemical reaction should be avoided during the process of fabrication of composites.

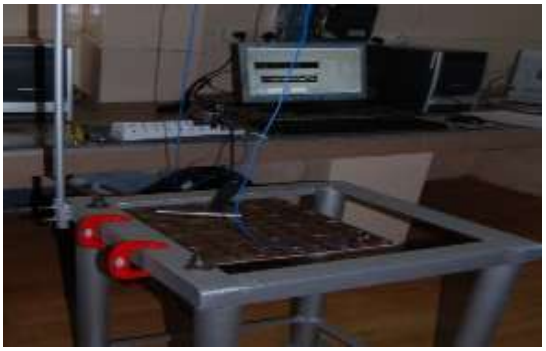
2.3Experimental setup for stir casting technique:

2.4 TESTS CONDUCTED: The various tests conducted to evaluate the characteristics of the composite materials are herewith presented below:

- Tensile Tests
- Compression Tests
- Hardness Tests

Vibration Characterization

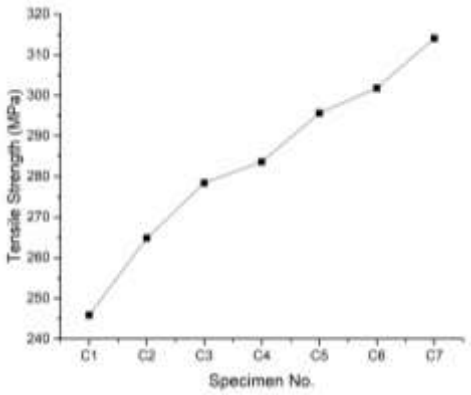
2.5 VIBRATION TESTS:

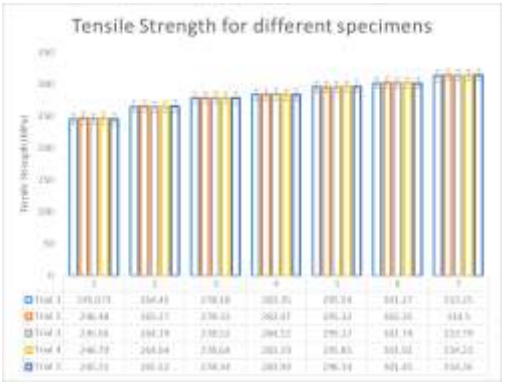


The vibration tests were accomplished in a vibration test setup fitted with a FFT analyzer, it comprises of a data logger connected to the system interface configured using a Lab VIEW software. The test setup comprises of a cantilever arrangement to which the composite plates are mounted and excited using excitation hammers connected to the accelerometers that takes note of the reading in the system, the arrangement of this setup is as shown in below figure.

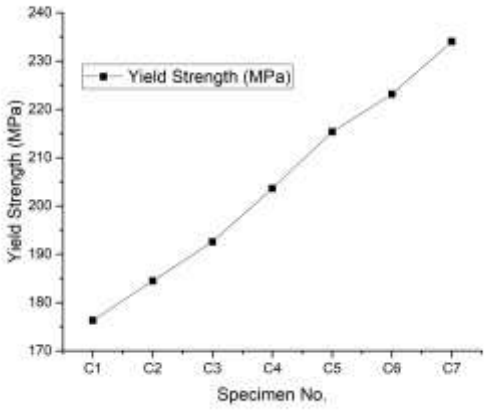
2.5 RESULTS AND DISCUSSION:

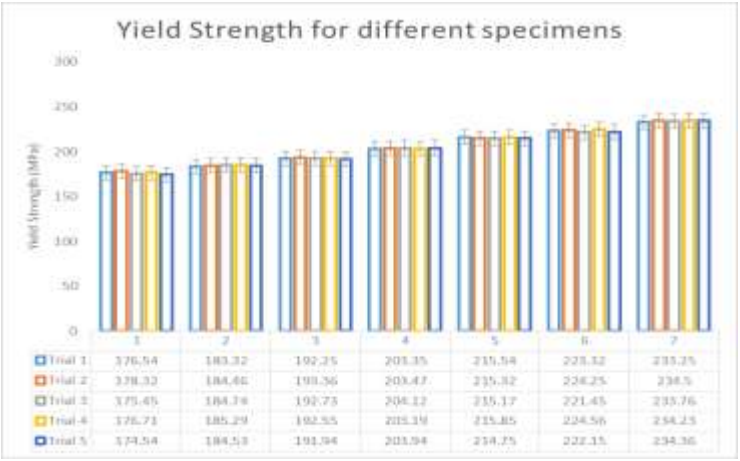
Results of Ultimate Tensile Strength



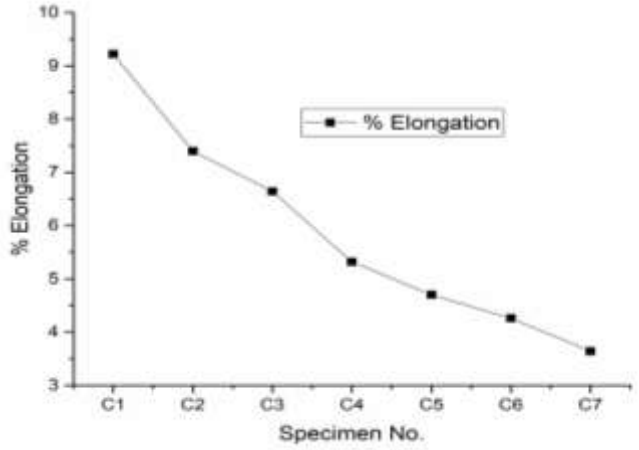


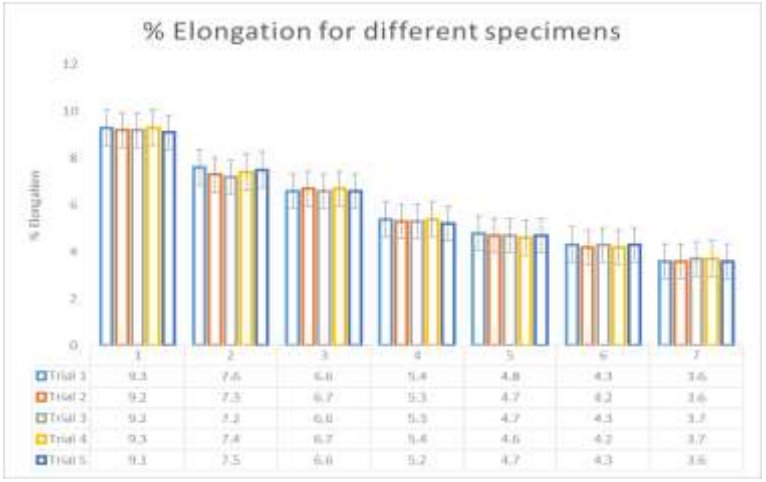
Results of Yield Strength



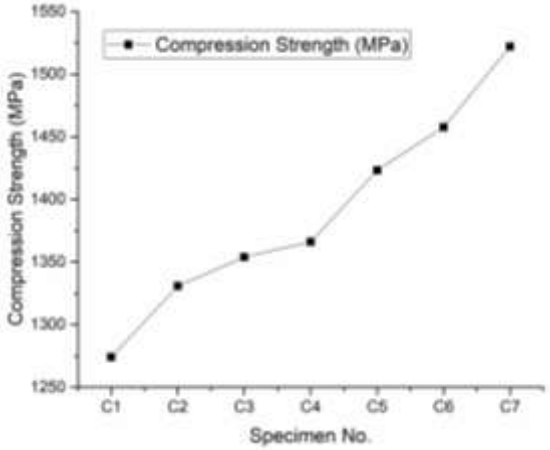


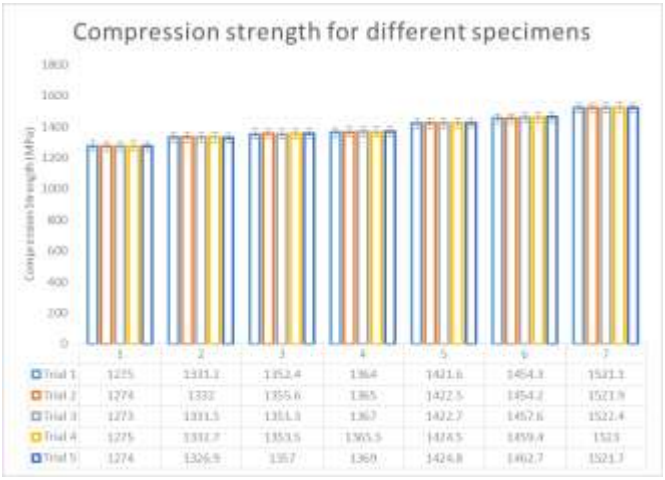
Results of % Elongation



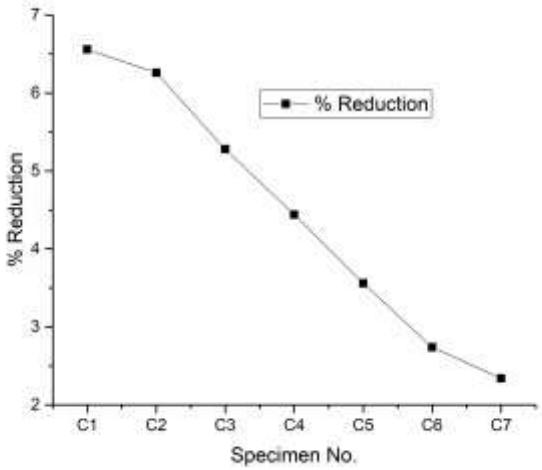


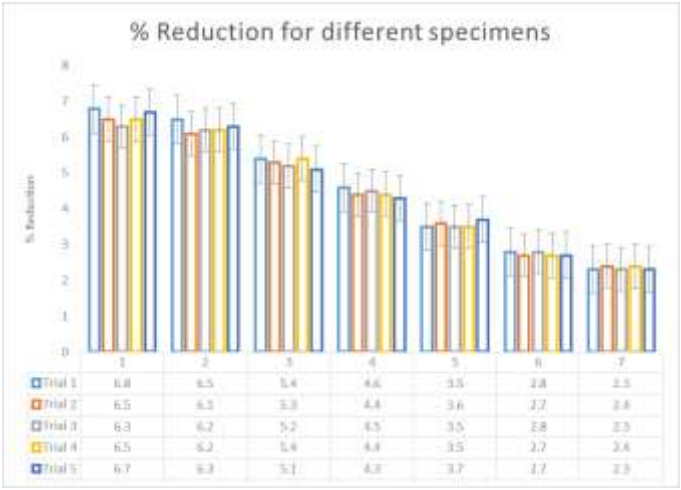
Results of Compression Strength (MPa)



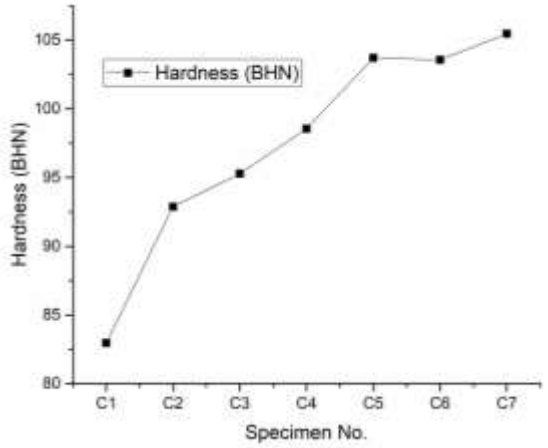


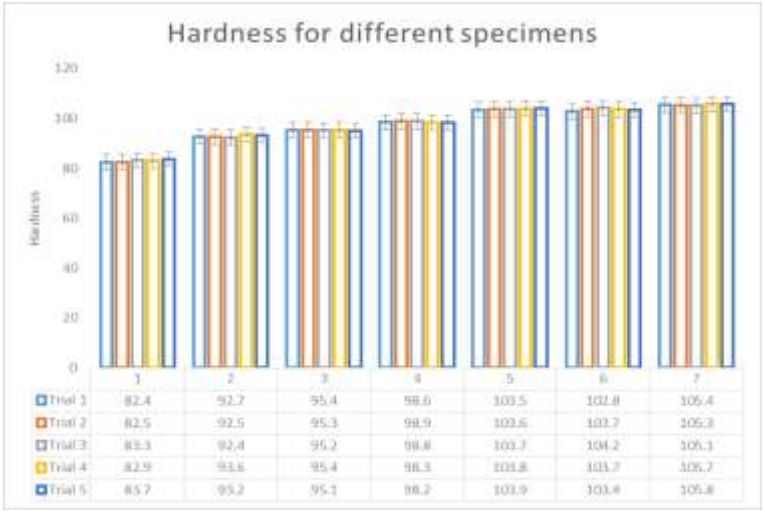
Results of % Reduction





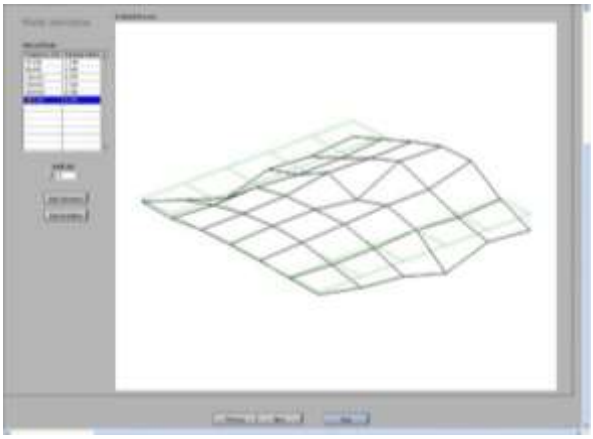
Results of Hardness Test

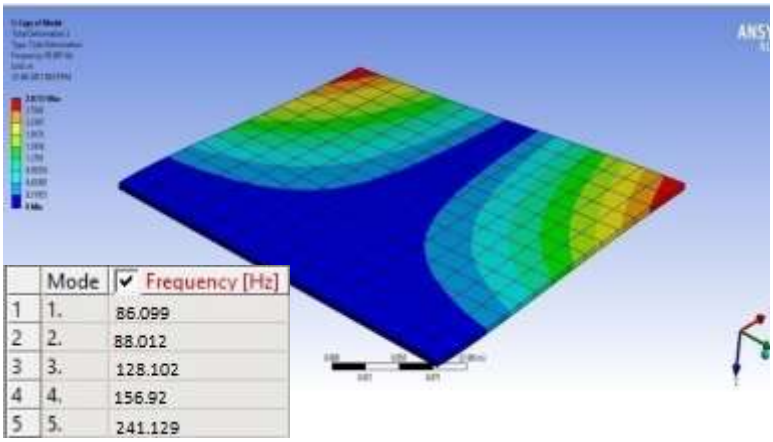




FRF Modal data of the composite specimens

Results of modal frequency analysis





2.6 CONCLUSIONS

The present work on preparation of fly ash and tungsten carbide reinforced AA 7085composites by stir casting and characteristic evaluation of characteristics has led to following conclusions.

- AA 7085/WC/Fly ash composites are fabricated with fairly uniform dispersions en-route the process of stir casting.
- The microstructure of the fabricated composites were analyzed using a typical SEM which revealed uniform dispersion of reinforced particulates with strong bonding between the aluminum 7085 and particulates.
- The tensile strength improved from 245.8426 MPa to 314.026 MPa, while the yield strength enhanced from 176.312 MPa to 234.02 MPa, percentage elongation reduced from 9.22 to 3.64, the improvement in tensile strength is due to the addition of tungsten carbide reinforcement particles which enhances the tensile characteristics. There is substantial increase in tensile strength of C7composites when compared with 'C1' Specimen. The ductility of the composite specimens reduces with the increase in strength and thus the C7 composites exhibit a reduced ductility as compared to C1 composite specimen. The percentage elongation of the MMC's decreased with increase in tungsten carbide and flyash content, which confirmed that tungsten carbide addition increased brittleness.

- The compressive strength increased from 1274.2 MPa to 1522.02 MPa, while % reduction dropped down from 6.56 to 2.34, this is majorly due to the bonding of reinforcements with the matrix phase that will ultimately enhance its ability to resist compression.

- The hardness enhanced from 82.96 to 105.46, this increase in characteristic property is due to the fact that the micro titanium reinforcements resist the movement of dislocations within the matrix. An improvement in hardness is observed for C7composites when compared with C1 Specimen.

- The vibration analysis carried out has herewith validated that the composite specimen fabricated has the capability to damp the vibrations and the results of analytical simulations carried out using ANSYS software has proved it. Further, the damping ratio varies for different modal shapes from 0.157 e-3 to 2.180 e – 3 for C7 composite specimen, this shows an incremental enhancement in the vibration characteristics as compared to the base Aluminum 7085 alloy, since the damping ratio for aluminum 7085 alloy validated from the ASTM data hand book predicts the values for damping ratio to vary from 0.4 (e-4) to 0.4 (e-3). Also the amplitude of vibration is reduced for varying frequency with the addition of reinforcements.

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