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Development and Characterization of C355.0 Alloy Composite for Automotive Applications - A Review

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Abstract

Aluminum-based hybrid metal matrix composite plays an important role in the development of the industrial and automobile sectors. Because of satisfying the demands of advanced applications, such as lightweight and strength, easy to cast and less expensive compared to conventional materials. These required properties are primarily being obtained by selecting proper matrix reinforcement phase and manufacturing methods and the properties can be further increased by using suitable heat treatment methods recommended for the specific matrix phases. This paper reviews the effect of the different casting methods and heat treatment conditions on the mechanical and tribological properties of the C355.0 alloy. out of available casting techniques, the stir casting method was identified as the best method to cast C355.0 alloy to increase the mechanical properties and microstructure further, a heat treatment process was also discussed, which govern the dispersion of reinforcements over the matrix, and affects the mechanical, tribological properties of the composite. This work may guide researchers to select appropriate casting methods for manufacturing matrix and heat treatment methods to enhance the mechanical and tribological property in order full fill the requirements in the different areas of composite developments.

Keywords: *Aluminum Matrices Composite, C355.0, Chill Casting, Hardness, High Temperature, Hybrid Composite Reinforcement, Tensile Properties.*

1.0 Introduction

The Main requirement in the automobile and aerospace industries is that materials having high strength with low weight to be used for the development of modern materials called composites. Aluminium metal matrix composites are most commonly used in areas where weight is constrained because they are light in weight and have a high strength-to-weight ratio. Cast aluminium alloy with ceramic reinforcement particles leads to the modern generation of engineering materials with enhances mechanical properties to weight ratio[1].

Usually, 100% pure aluminum in does not use industries[2], because they are not meet the standards. Therefore, it is alloyed with silicon, copper, magnesium, and many other materials to increase the mechanical strength and other properties[3].

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The C355.0 is one of the alloys which consist of Al-Si-Cu-Mg alloy. The system in this C355.0 alloy mainly consists of silicon and copper where the silicon present in the C355.0 alloy increases the hardness of the alloy and copper will increase tribological and other properties also[2-5].

The property of the Aluminium Metal Matrix Composites (AMMCs) mostly depends upon the casting techniques and heat treatment also. So the selection of proper casting techniques[6-8] and heat treatment plays a major role in the soundness of casted composites. The most common method of manufacturing C355.0 alloys castings is mainly classified into two types one is solid-state methods like powder metallurgy and the other one is liquid state process like sand casting, die casting and centrifugal casting techniques.

This Report Works on the Best Casting Methods for C355.0 alloy and Heat Treatment processes

This section discusses the work on the best casting methods of aluminium C355.0 alloys.

2.0 Best Casting Methods of Aluminium C355.0 Alloys

2.1 Influence of Casting Techniques on Mechanical and Tribological Characteristics of C355.0 Alloy

Manufacturing of the C355.0 alloys was carried out in three different casting techniques (a) gravity die casting (b) sand casting[9] (c) centrifugal casting. The alloy is heated in a graphite crucible about 750^0- 800^0C and prepared to cast of 12mm dia. And height of 25mm by gravity die casting, 12mm diameter and15mm height by sand casting, 60mm diameter, and 120mm height by centrifugal casting method and surface preparation was done by etching all the surface using 220,400,600 and1000 grade papers and polished by Keller's solution machined as per American Society for Testing and Materials (ASTM) E-8 standards (Diameter 6.25mm and gauge length of 25mm, over the length of 50mm) for tensile test, American Society for Testing and Materials (ASTM) G99 standards (Diameter 10mm and length 30mm) for dry sliding wear test at room temperature hardness was tested using Brinell hardness test with a load of 250Kg-f with 10 mm ball indenter. From the investigation, it is reported that silicon particles are uniformly distributed in die casting among the primary phase and alpha-Al matrix is found with the help of microstructure it found that the un-etched surface of the as-cast obtained, the size of dendrite and the inter-dendrite arm spacing is small because of uniform cooling and faster rate by whereas in sand casting and centrifugal casting, it observed that porosity and impurities present during casting and variation of Cu and Si was identified the best hardness of 74HB was identified in die-casting and 53HB in sand casting and 69HB in the centrifugal cast and ultimate tensile strength of 212MPa was found in die casting and good tribological properties was found and the author concluded that best casting method used to cast C355 Aluminum with the optimum level of the mechanical and tribological property is die-casting[5].

A C355.0 with 5% SiC Metal Matrix Composites (MMCs) manufactured through die-casting technique with a stirrer was synthesized using different stirring speeds, temperature, and time, 17 tensile specimens were manufactured by varying the speed of stirring from 140 to 240 rpm and stirring time of 200 to 600 seconds, results indicate that by increasing the temperature, tensile strength decreased because when the stirring is done at high- temperature solidification time will be increased meantime the SiC particles go down to the bottom of the crucible and after solidification uniformity distribution not produced in the casting and tensile strength of the C355+5% casting increase with increasing stirring speed and time of stirring author predicated value for tensile strength was identified 323.3 MPa at the 95% PI less value was identified 298.354 MPa while at 95% PI high value was observed 348.046 MPa[10].

The main task of this experiment was to examine the mechanical properties of as-cast and T6 condition specimen because of the influence of controlled Colling rate of 5K/min during the solidification process of C355.0 alloy by using Differential Scanning Calorimetry (DSC) and evaluate the morphology and microstructure of intermetallic phases by optical Light Microscopy (LM), X-Ray Diffraction (XRD), Scanning Electron Microscope (SEM), TEM. The research was done on C355.0 casting metal matrix aluminium alloy, Differential Scanning Calorimetry (DSC) evaluation was done using SETARAM Setsys Evolution 1200 with 80-90 mg of casting aluminium. Measuring of temperature starts from 25^0C to 800^0C with constant increment heating rate of 500C in a dynamic argon atmosphere. The change

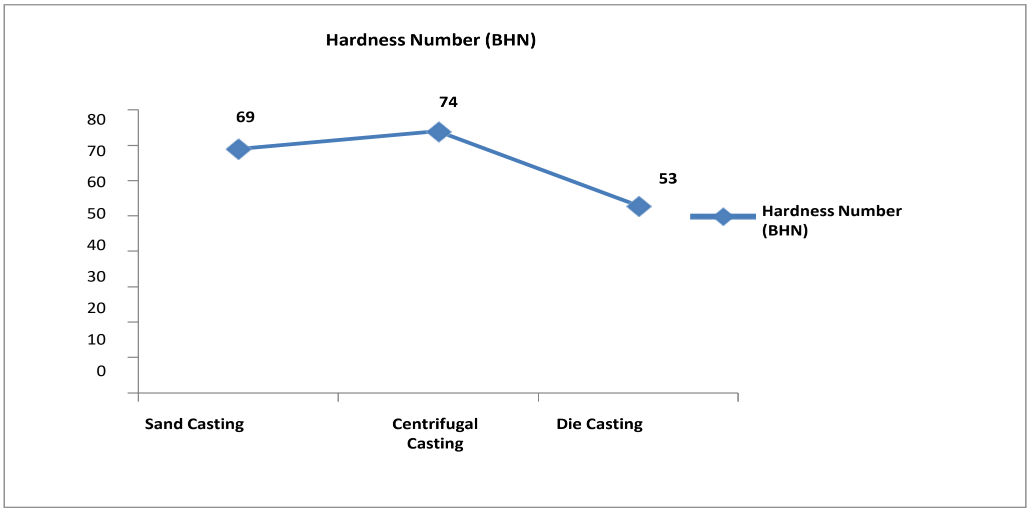

Figure 1. Influence of casting techniques on hardness of *C355.0* alloy[5].

in chemical transformation of C355.0 was recorded as follows L-(Al) Dendrite network, L- (Al)+Si+Al5FeSi, L(Al)+Si+AlMnFesi, L(Al)+Al2Cu+Al5FeSi, L(Al)+ Al2Cu+Si+Al5Cu2Mg8Si6, followed by temperature 610^{0}C, 564^{0}C, 532^{0}C, 510^{0}C, 499^{0}C, Inter metallic structure of Casted C355.0[11,12] alloy as-cast and tempered at T6 Conduction were observed by Scanning Electron Microscope (SEM) Micrographs and it is found that in as-cast condition Cu-containing inter metallic nucleating as dark grey rod, primary eutectic Si Particles with "Chinese script" and in T-6 conditioned casting revealed that eutectic silicon in a spherical shape and "Chinese script" was noted. The X-Ray Diffraction (XRD) technique was made to verify phase classification based on metallographic studies and specimens were prepared according to American Society for Testing and Materials (ASTM) standards and test the mechanical properties of as-casted and heat-treated casting material at T-6 condition it is observed that the highest Mechanical Properties along with good plastic properties obtained during aging at 150^{0}C. The M maximum hardness value of 116 HB was achieved after aging at 150^{0}C for 48 h and a hardness value of 102HB was obtained at 220^{0}C for the aging of 6h. And tensile properties of alloys aged at high-temperature 220^{0}C and 150^{0}C were almost similar (max R0.2-211.9 MPa, Rm-295MPa) and (max R0.2- 205MPa, Rm -307 MPa). Tensile strength of C355.0 increased continuously up to 10 hours -220^{0}C and 15 hours -150^{0}C of aging after which there is no increase in mechanical properties. and aging at 220^{0}C for 20 hours decreases the tensile strength[4].

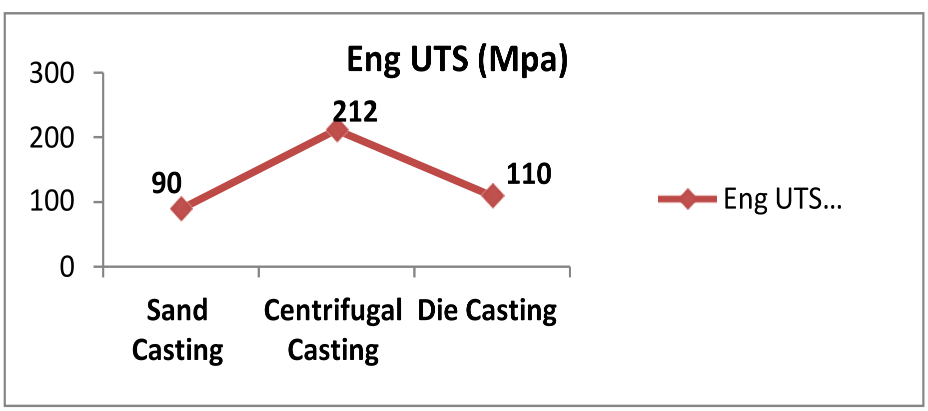

Figure 2. Influence of casting techniques on tensile strength of *C355.0* alloy[5].

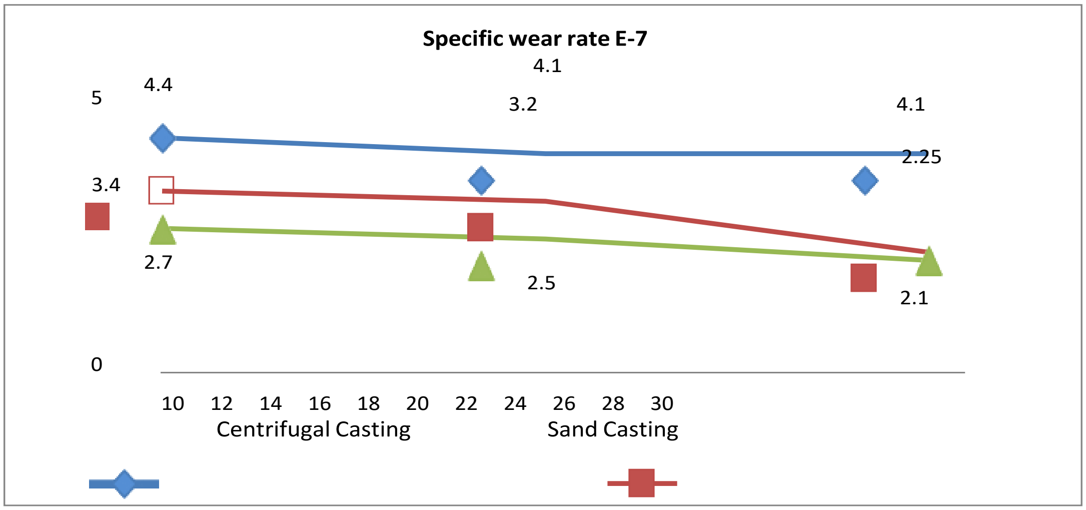

Figure 3. Influence of casting technique on wear rate of *C355.0* alloy[5,10].

2.2 Influence of Heat Treatment and Aging on Mechanical Characteristics of C355.0 Alloy

The mechanical properties and detailed microstructure of C355.0 alloy were tested at T-6 heat treated and over ageing high temperature exposure and compared with A356[13-15] and A357 alloy under the same condition (Figure 2) testing samples of size 5mm diameter and 1.5 mm thickness are tested in the temperature range from 20⁰-70⁰C, at 100C/min heating rate and subjected to solution heat treatment at exceptional temperature and water quenched at normal room temperature and aging were carried out in air furnace temperature ranges from 160⁰ to 210⁰ C for a maximum time of 12 h and specimens 20 in a set were prepared by American Society for Testing and Materials (ASTM) E-10-08 subjected to hardness test by Brinell Hardness tester having 25 mm diameter sphere indenter and 62.5 kg load and over ageing tests on T6 conditions were carried out at temperature ranges from 170⁰C -305⁰C, up to 168 h, the stretching test is also carried out in accordance to ISO 6892- 1:2009 on cylindrical samples obtained by casting and subjected to HIP and heat treat both in T-6 Heat treated[16] (ageing 210⁰C +_20 C for 41h) and over aging conditions. It is observed that complete solubilization will be obtained by soaking

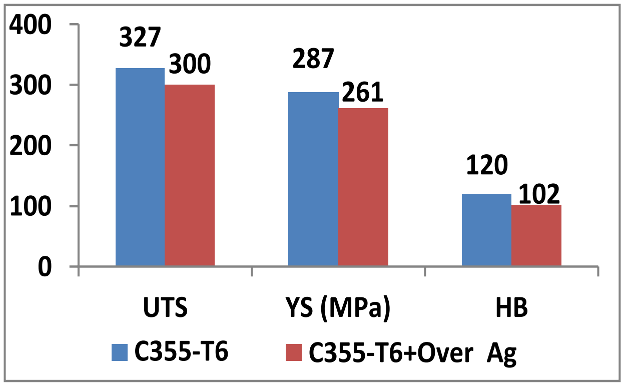

Figure 4. Influence of T6 and over ageing on Mechanical Property of *C355* alloy[2].

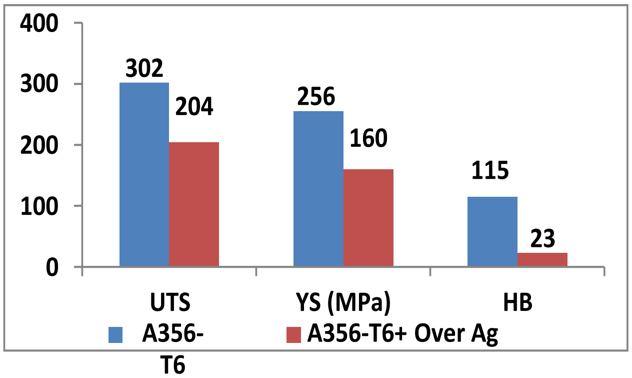

Figure 5. Influence of T6 and over ageing on Mechanical Property of *A356* alloy[2].

the solution with heat treatment for 490^{0}C for 2.5h, the subsequent increase in temperature to 520^{0}C and holding for 13h and water quenching at room temperature to get supersaturated solid solution and hardness of 121 HB reached at 1800C for 10h. Hardness was tabulated on the C355 T-6 sample after over-aging (170^{0}C -305^{0}C for soaking time up to 168h). Hardness remains unaffected by over aging to 185^{0}C and a slight decrease can be observed when over-aging time is more than 130 h and hardness reached up to 60HB at 305^{0}C for ageing time 1400min compression curve between A356-T6 and C355-T6 alloy at two different temperature (1750C and 205^{0}C) are tabulated and it is showing that C355 alloy at T6 condition keep the hardness unchanged at 175^{0}C, whereas A356 T6 subjected to reduction in hardness about 34% (up to 78 HB) and compared to over-aging 113HB after 7600 min at 205^{0}C the hardness is continuously reduced with increase in soaking time and C355 T-6 alloy produces hardness value of 80HB after 9900min, and noticed that A356-T6 alloy produce 45HB at same over-aging time, where are in tensile test at 210^{0}C for 41h C355-T6 alloy identified decrease in Ultimate Tensile Strength (UTS) and Yield strength (YS) of 8% and 9% and A356-T6 alloy shows decrease in 32% Ultimate Tensile Strength (UTS) and 40% in Yield strength (YS)[17] by this test it shown that A356-T6 alloys are more sensitive for over-aging compare to C355-T6 alloys because of Cu-based strengthening phases[2]. Fabrication of composites using triple particle silicon carbide and graphite as a reinforcement for A357 matrix and was found out that wear rate influencing factor was the sliding distance for all the hybrid composites[18].

2.3 Influence of Stir Casting Parameters and Reinforcement Grain Size on the Overall Performance of Composite

The effect of the influence of reinforcement combination in matrix, way of processing and processing parameters over mechanical properties of single reinforced and multi -reinforced materials is observed by casting various grades of aluminum like AA1100, AA295.5, AA359.0, AA2090, AA8090, AA7075 and it has been noted 7075 aluminum alloy under T-6 heat treatment condition executed highest Ultimate Tensile Strength (UTS) and Yield Strength (YS) as 570 MPa and 505MPa even at high temperature and reinforcement material link TiC, Al4c3SiC, Al_2O_3, B4CC, TiB_2 ZrBB are individual, it is noted that B4C executed density 2.52x103kg m^{-3}, high tensile strength 2759 MPa at 240C, Al_2O_3 exabuted density and tensile strength of 3.98x103 kg/m^3, 221MPa at 1090^{0}C and secondary reinforcement like Industrial wastes (Fly Ash) also tested with individual primary reinforcement and it is noted that boron carbide (B4C) and Fly ash used as primary and secondary reinforcement[19] along with AA7075 will give the high mechanical property for HAMCs and the above HAMCs(AA7075-B4C-FlyAsh) were manufactured with various manufacturing techniques like Stir casting, power Metallurgy and squeeze casting were followed and observed that the stir casting with impeller blade angle 300, stirring speed 550rpm 50% blade diameter of the crucible diameter, time 10minutes, federate 0.8 to 1.5 g/sec, melting and pouring temperature of 850^{0}C will give highest mechanical property and preheating of reinforcement FlyAsh-300^{0}C and B4C 400^{0}C will give optimum level of mechanical property[20].

A356-Al_2O_3 metal matrix composite was prepared with two castings of different reinforcement particle sizes of 20μm-micro and 50nm-nano using stir casting, % of reinforcement various from 1, 3, 5 and 10 Vol. for micro and 1, 2 and 3 Vol. % for Nano size particle reinforcement with a stirring speed of 200, 300 and 450 rpm and stirring was done 10 min before and after adding reinforcement to the metal matrix and it is noted that hardness and porosity increased with reduction in wettability and the compressive strength also increased with increase in Al_2O_3 and compressive strength of the Nano-Composite was

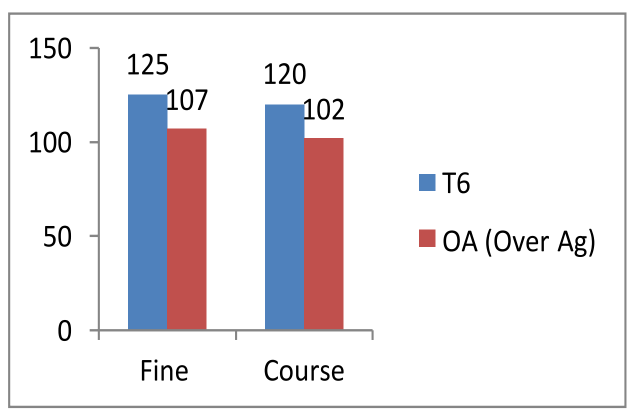

Figure 6. Influence of fine and coarse grains of *C355* alloy under *T6* and over aging condition on Hardness[3].

noted higher than the Micro-composites. The mechanical properties of A356-Al_2O_3 micro (20μm) and Nano (50nm) composites manufactured by a stir casting technique and testing with wt.% 1,3,5 and 7.5 of micro and 1, 2, 3 and 4 wt.% of Nano-sized particles were added to [21-23] A356 alloy with a stirring speed of 300rpm observed that porosity increased with the increase in reinforcement and remains same in 1% for both the castings and yield, the ultimate tensile strength of micro composite found to increase up to 5wt.% and strength increased up to 2wt.% for Nano-composite and it is reduced after increasing in percentage. Al-2wt.%Cu matrix reinforced with 1, 2, and 4 wt.% B4C - 100nm were manufactured through stir casting were evaluated. stirring was done 3min and 13min before and after adding reinforcement with a speed of 420rpm and tested that shows increasing reinforcement will increase the porosity, ultimate tensile strength and yield strength with a decrease in density at 2wt.% and 4 wt% all the three mechanical properties were decreased[1].

Fine grains (F) and coarse grains (C) microstructure specimens (Sand and Die Castings, respectively) were created using a gradient freezing device and subjected to standard room and high temperature stretching tests, both in the T6 case and after elevated temperature exposure. The thorough microstructure and fractographic evaluations were then used to establish a link between microstructure features and the alloy's tensile behavior. Mercantile-available C355.0 alloy was melted at 710^{0}C in an electric furnace to provide specimens for mechanical and microstructure evaluation. The alloy was refined by adding Ti and Br, and Strontium was added in the form of Al-Sr10 master alloy (200ppm), with the goal of inducing eutectic Si spherodization. The melted chocolate was put into a preheated fore. Long-lasting copper dies at temperature 200^{0}C to obtain round bars, the chemical structure of the cast C355.0 alloy was then identified through a mass spectrometer.

The die-cast circular bars were then once again melted in gradient freezing equipment, to develop specimens with mechanical properties with various Secondary Dendrite Arm Spacing (SDAS) values and hold the specimen in a elevated environment until they are fully melted. Shielded from corrosion by an Ar gas shield. The temperature was maintained at 710^{0}C and the samples were set to be retained at that calefaction for 30 minutes. The furnace can be reared at a predefined speed while the metal samples remain in a stationary position by varying the speed of the heating component and the cooling environment Air, water for course and Fine Secondary Dendrite Arm Spacing (SDAS) respectively, different microstructures can be obtained.

Two distinct melting furnace rpms were used (0.3mm/s for fine grain microstructure and 0.03mm/s for coarse grain microstructure), which corresponded to estimated mean Secondary Dendrite Arm Spacing (SDAS) ranges of 20- 25m (die casting) and 50-70m (sand casting), respectively. After that, the specimens were subjected to hot crustal pressing to remove internal porosity, followed by heat treatment to the T6 state, which included solution treatment at 530^{0}C for 24 hours, quenching in water at 60^{0}C, and finally testing. Round tensile specimens (Lo=25mm and gauge=1), artificial ageing of 25 minutes, and ageing at 18^{00}C for 6 hours, Some of the treated bars were exposed to age (Soaking at 210^{0}C for 41H) after fabrication (diameter do=5mm) By etching E3-01[24-27], Pro-Plus software was used to analyse pictures of bright metallographic testing components with 0.5 percent HF solution to determine Sr Modifying effect and estimate the existing average Secondary Dendrite Arm Spacing (SDAS) optical micrographs at 25X and 50X magnifications. Secondary Dendrite Arm Spacing (SDAS) of coarse and fine specimens is measured. Brinell hardness measurements (HB10)[28,29] were carried out according to the manufacturer's instructions. Tensile tests were carried out on a servo-hydraulic system according to American Society for Testing and Materials (ASTM)

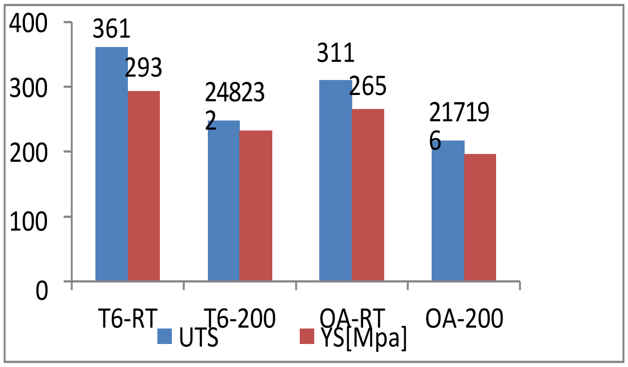

Figure 7. Influence of fine grains of *C355* alloy under *T6* and Over AGING condition on Ultimate Tensile Strength (UTS), YS (MPa)[3].

E10-08 standards, utilising a 62.5kg load and a 2.5mm diameter steel ball.

At elevated temperatures, a testing machine with a furnace and an extensometer for high-temperature tensile tests was used. Tensile specimens were held in the furnace for 20 minutes at a temperature (200^0C) according to ISO norms at a stress rate of 5MPa. Before running the test at the testing temperature[3]. Following T6 heat treatment, metallographic readiness was determined in accordance with American Society for Testing and Materials (ASTM) standards. American Society for Testing and Materials (ASTM) E3-01[24-27] was used to measure Secondary Dendrite Arm Spacing (SDAS) of coarse and fine specimens by etching shiny metallography testing components with 0.5 percent HF solution and analysing photos with Pro-Plus software to identify Sr- modifying effect and estimate the existing average Secondary Dendrite Arm Spacing (SDAS) optical micrographs at 25X and 50X Magnifications. Tensile tests were performed on a servo- hydraulic testing machine equipped with a furnace, and an Extensometer for high-temperature tensile tests was performed at elevated temperature (200^0C) according to ISO Standards at 5MPa stress rate, and Brinell hardness measurements (HB10) were performed according to American Society for Testing and Materials (ASTM) E10-08 standard, using 62.5kg of load and 2.5mm diameter steel ball, and tensile tests were performed on a servo-hydraulic Tensile specimens held at the testing temperature for 20 minutes in the furnace, before running the test [3].

Hybrid aluminum alloy composite LM13 was manufactured using stir casting with reinforcement as garnet and carbon granular. Chills of different medium such as stainless steel, cast iron and copper are accustomed to increase the rate of solidification. The combination of reinforcement changes from 3wt% to 12wt% in the steps of 3wt% carbon and Garnet reinforcement. Microstructure and Mechanical properties such as hardness, the ultimate stretching strength of hybrid composites were evaluated. The testing components were prepared and evaluated as per American Society for Testing and Materials (ASTM) standard. The Vickers hardness test was conducted to evaluate the composite hardness. The effect of chill and reinforcement tabulated and differentiated without chill composite materials. The results show that positive relationship between dispersion content and mechanical behaviour. The copper chill cast composite with 9wt. % garnet and 3 wt. % carbon was found to increase in mechanical properties.

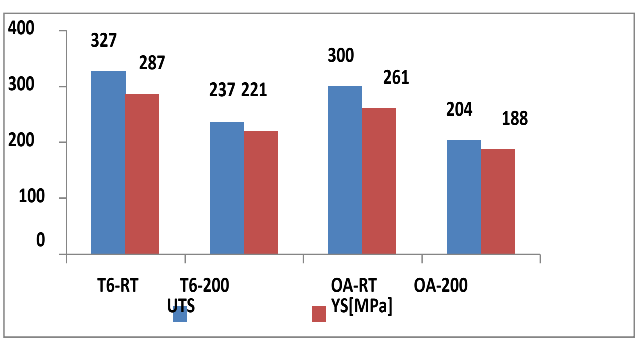

Figure 8. Influence of fine grains of *C355* alloy under *T6* and Over aging condition on Ultimate Tensile Strength (UTS), Yield strength (YS) (MPa)[3].

2.4 The Effect of Hematite Reinforcements on the Overall Performance of Composites Made of Alumnium Alloys

Al LM13 metal matrix composite was prepared with reinforcement of hematite in % ranges from 3% to 15 % in the range 3% by using stir casting method and the composites are machined according to American Society for Testing and Materials (ASTM) standards (dia 20 and length 20 mm). Specimen are made in three groups and heat treated and quenched using three modes of quenching (Air, Water and ICE) and all the specimen are heat treated in T6 conditions and mechanical testes (Tensile, Compression and hardness)are carried out and it is found that Al LM13-12% Hematite, Ice quenched, 8 hr age specimen produced more hardness compare to other specimens which are quenched in different modes and followed various hours of ageing process, maximum hardness of 133 Brinell hardness number (BHN) and Ultimate Tensile Strength (UTS) of 232 N/mm^2 identified good wear resistant property (pin on disc and sand abrasive wear)[30] and fatigue behaviour were also noted with 12% of hematite reinforced with Al LM13 and quenched in ice and 8 hours aged component[31]. The effect of hematite (iron oxide) particles on the molten composite's fluidity, as well as the tensile characteristics and fracture behaviour of solidified as-cast aluminium composites, is investigated in this research. The amount of hematite in

Table 1. Reported works in tabular form on C355.0 alloy

Authors	Matrix Material	Reinforcement	Processing Route	Stirring and Casting Parameters	Heat Treatment	Hardness	Tensile Strength	Wear test
Lorella Ceschini *et al*., (2015)[3]	C355.0	-	Stir Casting (Die and Sand Casting)	1. Two Furnace speed (0.3mm/s Fine grains/0.03 mm/s Course grains) 2. 20-25μm-die Casting /50-70 μm-sand casting3.Meting Temp=710^{0}	T6 Over aging -210^{0}-41H (both Fine and Course grains)	F-T6 = 125 F-Over Ag. = 107 C-T6 = 120 C-Over Ag. = 102	Fine T6-RT-UTS = 3 61,293MPa T6-200 = 248, 232 MPa Over Ag-RT. = 311,265 MPa Over Ag-200 = 217 ,196 MPa Course T6-RT-UTS = 327,287 MPa T6-200 = 237, 221MPa Over Ag-RT. = 300, 261MPa Over Ag.-200 = 204,188 MPa	-
Santosh MV *et al*., (2016)[5]	C355.0	-	Stir Casting (Sand Casting, Die Casting, Centrifugal Casting)	1. Melting Temp=800^{0}	-	Sand Casting = 69 BHN Centrifugal Casting = 74BHN Die Casting = 53 BHN	Die Casting = 212 MPa	Sliding distance=2500 m Sliding speed=763rpm for 10Min 3.Track dia=100mm 4. Load=10N,20 N,30N

L.Ceschini *et al.*, (2014)[8]	C355.0 andA356	-	Stir Casting	1.Samples tested from 20-700^{0}c 2.10^{0}c/min Heating rate	T6 T6+OverAg Hardness Testing temp =170-305^{0}c up to 168 H	C355.0 1.121HB at 180^{0}c And 6H Aging 2. 60HB at 305^{0}c and 1400min A356 1.76 HB at175^{0}c and 7600 min 2.at 205^{0}C C355-T6 = 80 HB and 9900 min Ageing A356-T6 = 45HB and 9900min Aging 1.C355.0-T6HB = 120 C355.0T6 + OverAg-HB = 102 2.A356-T6-HB = 115 A356-T6 + OverAg-HB = 73	UTS, YS C355-T6 = 327, 287 MPaC355- T6+OverAg = 300,261 MPa UTS,YS A356-T6 = 302, 256 MPaC355- T6+OverAg = 204,160 MPa	
G. Mrowka-Nowotnik, J. Sieniawski[7]	C355.0	-	Stir Casting	Observation temp from 489^{0}C to 621^{0}C Solidificationrate 5K/min	T6 Aging Temp 150^{0}cand 220^{0}C	At 150^{0}c and Aging 48H = 116HB At 2200C and Aging 6H = 102 HB	UTS, YS = 153.2, 148.2 MPa At 150^{0}c and Aging 3H UTS, YS = 300.6, 202.8 MPa At 150^{0}c and Aging 42H UTS,YS = 187.1,165.1 MPa at 220^{0}C and Aging3H UTS, YS = 272.0, 211.6 MPa At 220^{0}c and Aging 42H	9% and 8.2%at 150^{0}C for 3H and 42H 8.% and 8.9% at220^{0}C for 3H and 42H

Shashi Prakash Dwivedi *et al.*, (2013)[6]	C355.0	5 wt.% (SiC)	Stir Casting	Melting Temp- 700^{0}C to 790^{0}C Stir Time -200to 600 seconds 3. Stir speed 140 to 240rpm	-	-	StirTemp 790^{0}C,240rpm, time 400sec = 380MPa StirTemp 700^{0}C,190rpm, time 200 sec = 300MPa	-
Mohit Kumar Sahu and Raj Kumar Sahu (2020)[4]	AA7075,AA6 061,A A2024	-	Stir Casting	Melting Temp- 850^{0}C Impellerblade:30^0 Stirring speed 550rpm 4.Stirring speed-10Min feed rate :0.8to 1.5g/sec 5.preheating of reinforcement- 300 and 400^{0}C	AA-7075 T6 AA-6061T6 AA-2021 T6		AA-7075 UTS-570MPa, YS-505MPa AA6061 UTS-240 MPa, YS-145 MPa AA2024 UTS-470MPa, YS-325MPa.	

the composite was changed in weight increments of 2% from 1% to 7%. The composites were made using the vortex process. The results showed that as the hematite content in the composite specimens grew the composite's ultimate tensile strength and Young's modulus increased, while the liquid fluidity and solid ductility dropped. The fluidity of the liquid in a metal mould was higher than in a sand mould, and it dropped with increasing reinforcing particle size and rose with increasing reinforcing particle size. Temperature for pouring the presence of reinforcing particles significantly changed the fracture behaviour of solid composites. The composite finally fractured due to crack propagation via the matrix between there in forcing particles[32].

2.5 Output of Literature Survey

According to the literature review, less study on C355 matrix alloy reinforced with hematite particle composite has been done. For varying weight percent of the Al C355-Hematite particle composite, we are adopting the chill casting method with liquid metallurgical approach. The numerical and analytical methods were used to examine the experimental results. For both numerical and analytical analysis, Finite Element Analysis (FEA) and advanced design of experiments DOE (Taguchi's approach) were utilized.

3.0 Methodology of Proposed Research from the above Literature Survey

From the previous section, the possible methodology flowchart was made it start from casting of Aluminum C355.0 alloy reinforced with Hematite particles of size 150µm by a stir casting approach followed by sand casting via an electric resistance furnace, pouring of molten metal into sand moulds containing end chills like copper, cast iron. The prepared samples were subjected to heat treatment at T6 condition and three modes of quenching (air, water, ice and oil) will be done for the different specimens and all the specimens will be subjected to testing density, mechanical properties, Tribological, and corrosion test will be carried out and compared with Unheated Treated samples[17,21,33] and microstructure analysis will be done, Scanning Electron Microscope

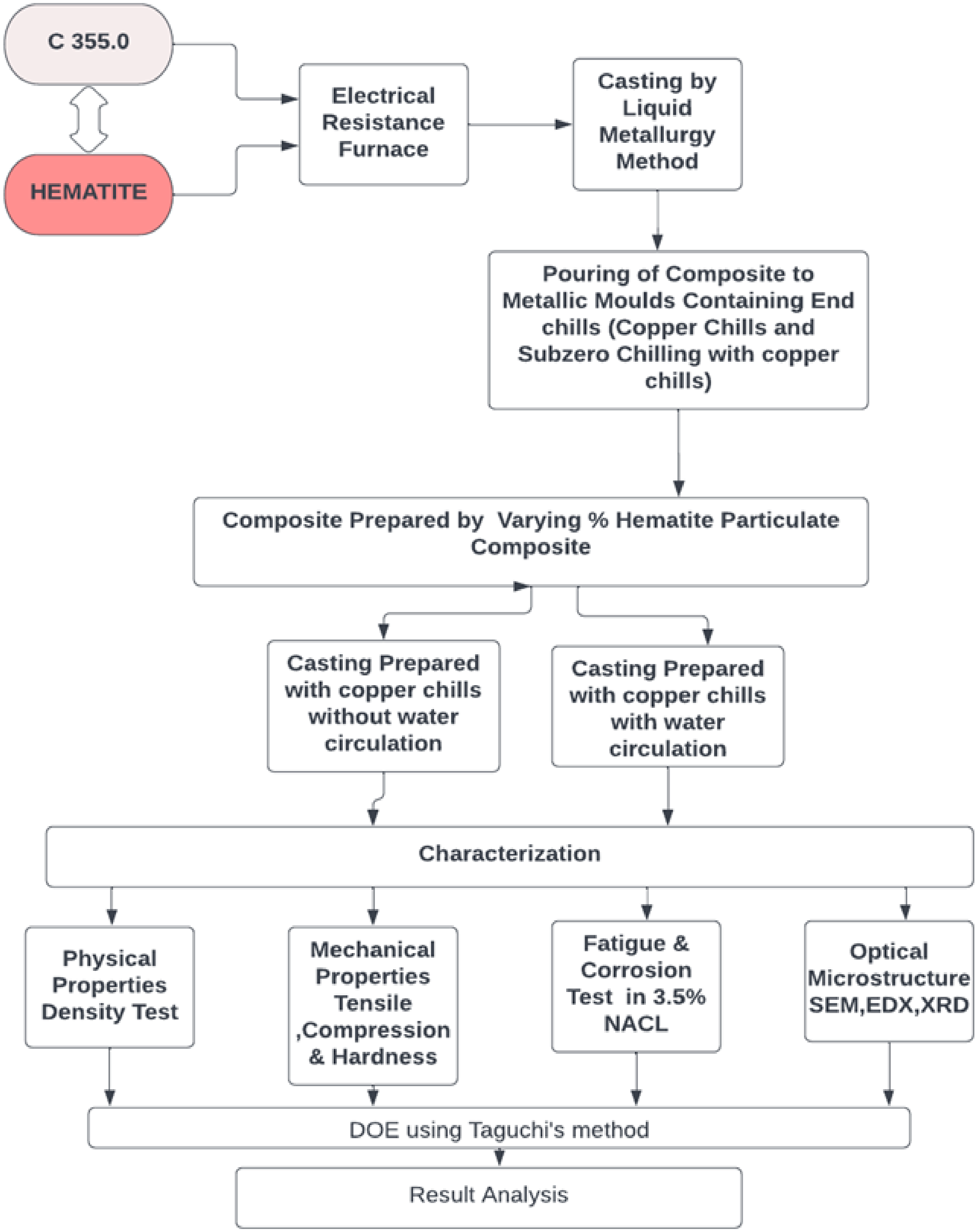

Figure 9. Process flow of the current work.

(SEM), X-Ray Diffraction (XRD) test was conducted to evaluate the Hematite phase in the C355.0 alloy and results are compared with the theoretical method by using software Taguchi's method.

4.0 Future Scope

The review of literature is to carry out my research in Development and characterization of Cast C355.0 reinforced with hematite particulate composite for automotive and aerospace applications.

5.0 Discussion and Conclusions

From the review presented in the above section, the following conclusion can be listed.

1. High mechanical and Tribological Properties of the Metal Matrix were observed in die-casting technique (Ultimate Tensile Strength (UTS)-212MPa and Hardness 73HB for C355.0 Aluminium alloy).
2. An Increase in reinforcement wtf. % will increase the mechanical and tribological property of the casting.
3. Steering parameters like steering speed impeller blade angle, the ratio of impeller blade and crucible diameter, time of steering, feed rate and preheating of reinforcement will play a major role in increasing the quality of castings.
4. Mechanical properties C355.0. alloy was tested under T-6 Condition and over-aging high-temperature exposure and compared with A356 and A357 alloy and noted that 24% Ultimate Tensile Strength (UTS and 31% Yield strength (YS) of C355.0 alloy executed were increased under the same condition.
5. Controlled cooling of the rate of 5K/min during the solidification process of C355.0 alloy followed by heat treatment and aging, observed that the highest mechanical properties along with good plastic properties (Hardness-116HB and Tensile Strength-307MPa).
6. By enhancing the properties of the aluminium C355.0 by selecting the best casting methods like chill casting using sand moulds.

6.0 References

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