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FABRICATION AND MECHANICAL PROPERTIESOF AL6061,BC&SIC

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Abstract. In recent years, aluminum alloy-based metal matrix composites (MMC) are gaining importance in several aerospaceand automobile applications.Aluminum has been used as matrix material owing to its excellent mechanical properties coupled with goodformability and its wide applications inindustrial sector Addtion of B4CANDSIC and SICasrein force-mentin-Al6061alloysystemsimprovesitshardness,tensilestrengthandwearsresistance.Inthepresent in-vestigationAl6061–B_4C&SICcompositeswerefabricated by liquid metallurgy route with per-centages of B_4C and SIC varying from 2weight% to 8 Wt.% in steps of 2 wt.%. The cast ma-trix alloy and its composites have been subjectedto solution zing treatment atatempera-tureof500°Cfor1h followed by quenching indifferent mediasuchasair,waterandice.The quenchedsamplesare then subjected to both naturalandartificial-ageing.Microstructuralstudieshavebeencarriedoutto under standthenatureofstructu-tu-re.Mechanicalpropertiessuchasmicrohardness,Heattreatment,andabrasiveweartestshavebeenconductedbothonmatrixAl6061andAl6061–B_4C&SICcomposite sbeforeandafterheattreat-ment.However,underidentical heat treatment conditions, adopted Al6061–B_4C& SIC compo-sites exhibitedbetter micro hardness and tensile strength reduced wear loss when compared with Almatrix alloy

Keywords: Fabrication, Sic, Al 6061, Liquid Metallurgy.

1 Introduction

Composites are man-made materials consisting of one or more discontinuous phases having intimate contact with each other, with are cognizableinterfacebetweenthem.Thesearemultifunctionalmaterialssystemsthatprovidecharacteristics not obtainable from individual phases. Further, composites are tailormadeto cost effective, propertyeffectiveandapplication oriented.

In general, composites are classified according to the type of matrixmaterial andthen nature of reinforcement at two distinct levels. The first classificationincludes ceramic matrix compo-sites (CMCs), organic matrix composites (OMCs) andmetal matrix composites (MMCs). The term organic-matrix composite is generallyassumedtoincludepolymerMatrix compo-sites(PMCs)andcarbonmatrixcomposites.

Literature Review

Gopal Krishna U, Sreenivas Rao K V written a journal in waterstones havereportedthat-thealuminummatrixcanbestrengthenedbyreinforcingwithhardceramicparticles like SiC, Al2O3, B4C etc. An effort is made to enhance the mechanicalproperties like tensile strength and hardness of AMCs by reinforcing 6061Al matrixwith B4C particles. The microstructure and mechanical properties of the fabricatedAMCswasana-lyzed.Basedontheresultsobtainedfromtensilestrengthtestofthemetalmatrixcompositesofdifferen tparticlesizes,105sizeB4Cwaschosen.Theyconcludedthat from the micro structure analysis increase the grain size, increase in the materialweightincreasein tensilestrength.

Zhao et.al. studied the microstructures and mechanical properties of equal-channelangularpress-ing(ECAP)processedandnaturallyagedultrafinegrained(UFG)andcoarsegrained(CG)Al7075all oysandtheirevolutionsduringheattreatment.Theirstudies established that after the tests, natural aging, tensile yield strength, ultimatestrength and micro hardness of UFG samples were high-er by 103%, 35% and 48%respectively than those of the CG samples. Their studies show that severe plasticdeformationhasthepotentialtosignificantlyimprovethemechanicalpropertiesofage-hardeningAl alloys.

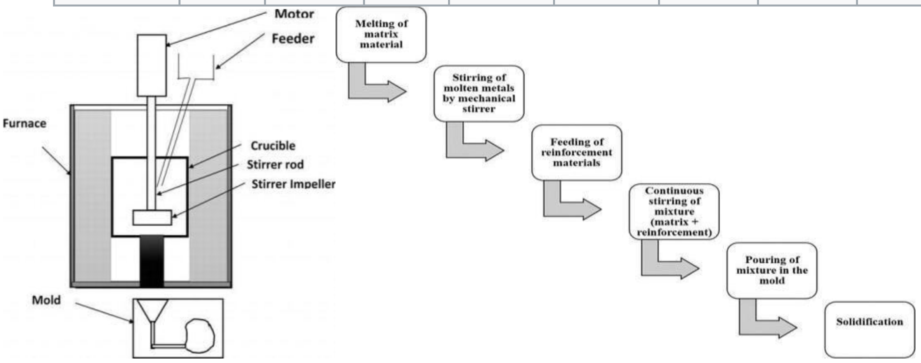
Anand Kumar et.al research work carried out by Addition of reinforcementsuch as TiC, SiC, Al2O3, TiO2, Tin, etc. to Aluminum matrix for enhancing themechanicalproper-tieshasbeenawell-establishedfact.In-situmethodofreinforcementoftheAluminummatrixwithceramicphase-likeTitaniumCarbide(Tic)iswellpreferred over the Exist method. In the present investigation, Al- Cu alloy (series of2014 Aluminum alloy) was used as matrix and reinforced with TiC us-ing In-situprocess. The Metal Matrix Composite (MMC) material, Al-.5%Cu/10%TiC devel-opedexhibitshigheryieldstrength,ultimatestrengthandhardnessascomparedtoAl-4.5%Cualloy. Percentage increase in yield and ultimate tensile strengths were reported to beabout15% and 24%.

Methodology and Experimental Work

Stir casting is a type of casting process in whicha mechanical stirrer is introduced toform vor-tex to mix reinforcement in the matrix material. It is a suitable process forproduction of metal matrix composites due to its cost effectiveness, applicability tomassproduc-tion,simplicity,almostshapingandeasiercontrol ofcompositestructure.

6061AluminumAlloyCompositionbyMass% [4]

Al	Mg	Si	Fe	Cu	Cr	Zn	Ti	Mn	Remainder
95.85 - 98.56	0.8-1.2	0.40-0.8	0.0-0.7	0.15-0.40	0.04-0.35	0.0-0.25	0.0-0.25	0.0-0.15	0.05each, 0.15total



Mechanicalstircastingisaliquidstatemethodforthefabricationofcompositematerials, in which a dispersed phase is mixed with a molten matrix metal by means ofmechanical stirring. Stir Casting is the simplest and the most cost-effective method ofliquidstatefabrica-tion.Thestircastingset-upisshowninFigure1.Threecombinationsof reinforcement are fabricated with aluminium metal matrix. The metal matrix isreinforced with SiC particle having average particle size (APS) -25µm. Silicon carbideis preheated at 473 K for 1 h prior to introduction into the melt. In liquid metal stircasting, the Al 6061 was placed in specially designed Muffle furnace with top pouringmechanism

Results

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S.NO	COMPOSITION
1	**Al6061+2%B4C+2%SiC**
2	**Al6061+4%B4C+4%SiC**
3	**Al6061+6%B4C+6%SiC**
4	**Al6061+8%B4C+8%SiC**

Table: Composition Names

Compositions	Trail1			Trail2			[illegible]
	D1	D2	VHN	D1	D2	VHN	
Al 6061+2%B4C +2%SiC	87	78	370	57	85	373	[illegible]
Al 6061+4%B4C+4% SiC	79	97	386	79	97	384	385
Al 6061+6%B4C+6% SiC	79	97	392	67	68	398	395
Al 6061+8%B4C+8% SiC	80	89	402	68	89	399	400.5

Table: Hardness Values

Compositions	Trail1			Trail2			VHN
	D1	D2	VHN	D1	D2	VHN	
Al 6061+2%B4C +2%SiC	98	98	393	86	87	399	396
Al 6061+4%B4C +4% SiC	68	98	405	87	84	402	403.5
Al 6061+6%B4C +6% SiC	68	96	426	88	87	432	429
Al 6061+8%B4C	68	95	446	93	97	456	451

+8% SiC							

Table: Heat Treatment of Water

Compositions	Trail1			Trail2			VHN
	D1	D2	VHN	D1	D2	VHN	
Al 6061+2%B4C +2%SiC	76	86	420	78	82	423	421.5
Al 6061+4%B4C +4% SiC	67	78	434	79	87	436	435
Al 6061+6%B4C +6% SiC	66	78	444	77	92	456	450
Al 6061+8%B4C +8% SiC	78	87	465	70	94	456	460.5

Table: Heat Treatment of ICE

S.no	Material	Initial weight	Finalweight	Lossofweight
1	**Al6061+2%B4C +2%SiC**	15.674	14.551	1.123
2	**Al6061+4%B4C +4% SiC**	15.690	14.456	1.234
3	**Al6061+6%B4C +6% SiC**	14.789	13.444	1.345
4	**Al6061+8%B4C +8% SiC**	14.345	12.912	1.433

Table: Wear at 1Kg load 200mts

S.no	Material	Initial weight	Finalweight	Lossofweight
1	**Al6061+2%B4C +2%SiC**	14.551	12.206	2.345
2	**Al6061+4%B4C +4%SiC**	14.456	11.999	2.457

3	**Al6061+6%B4C +6%SiC**	13.444	10.765	2.679
4	**Al6061+8%B4C +8%SiC**	12.912	10.036	2.876.

Table: Wear at 1Kg load 400mts

S.no	Material	Initial weight	Finalweight	Lossofweight
1	**Al6061+2%B4C +2%SiC**	12.206	9.079	3.127
2	**Al6061+4%B4C+4 % SiC**	11.999	8.862	3.137
3	**Al 6061+6%B4C+6%SiC**	10.765	7.307	3.458
4	**Al6061+8%B4C+8 %SiC**	10.036	6.469	3.567

Table: Wear at 1Kg load 600mts

Conclusion

TheAL6061-B4CANDSicmetalmatrixcompositematerialshavebeenfabricatedby stir casting method followed by extrusion process Fabricatedprocessfurther subjectedtovarioustesting's

TheB4CANDSicparticulatesareevenlydispersedinthematrixalloy.ThemicrohardnessofAL 6061-B4CANDSicmetalmatrixcompositematerialissuperiorthanthematrixmaterial.

As the percentage of reinforcement increases than the hardness alsoincreased

Allthecompositeshavingthehighestharnessthanthebothmatrixandnon-hybridcomposites.Hardnessarehavinghighestvalueat8%ofthebothreinforcements

Furthercomponentssubjectedtotheheattreatmentprocessinorderimproveall theproperties in differentmediums likewater, oil andice.

Asthecomposites aresubjectedto theheatingthe upto 230^{o}cinthemufflefurnaceand subjected tosoaking for2 hours

By the medium of water hardness having the value of 451 which is 12%greaterthan the normal hardness

By the medium of ice hardness having the value of 460 which is 15%greaterthan the normal hardness

In order to check the frictional behavior ofcomposites it was furthersubjected to load conditions by the pin on disc.to evaluate the results of thes hereitself-taken different speeds, rpm and load

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