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Experiment Analysis of Spur Gear Using Boron and Silicon Carbide and Al6061 Aluminum Metal Matrix Composite

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ABSTRACT: Metal-matrix composites (MMCs) are engineered combination of two or more continuous and discontinuous metal fibers in which tailored properties are achieved which cannot be achievable in monolithic materials. In general sense the piston is made of aluminum (Al), Silicon carbide (sic) and boron carbide. Sic gives strength to the piston but by adding additives to the Al, it reduces the weight of the gear and give strength to the component. In the present investigation a spur gear model is going to get analyzed and results are validated by fabricating gears by vortex method using aluminum based mmc containing 90, 10 wt. % and additive particulates in micrometers. Here we used stir casting technique to get good shape and complexity. And after casting suitable machining is done to the component to get the required shape. We improve the life time of the gear. Results shows that this technique improve the performance of the automotive applications.

KEYWORDS: Aluminium 6061, Silicon Carbide, Boron Carbide, Stir Casting Method.

I. INTRODUCTION

Gears are most complex part compared to other components in an automobile sector. Still lot of research works have been conducting regarding material composition, geometry and manufacturing technique. And hence to avoid this case gears are made up of cast aluminium alloy matrix with the combination of reinforcements in different weight percentage. For better results here I am replacing conventional gear material LM13-TF with new composite [Al6061+sic and BC]. The addition of mixtures and Alumina reinforcement particles to the Aluminium matrix improves the tensile strength, compressive strength and hardness behaviour. The reinforcement material is having more factor of safety compare to unreinforced alloy material because of more yield strength due to presence of the reinforcements in the matrix alloy.

These techniques has to ensure uniform distribution of the reinforcing material in the matrix and formation of good bond between matrix and reinforcing material, to obtain MMCs with optimum properties. Metal Matrix Composite(MMC) is one of the major renovations in recent years and is engineered combination of metal(Matrix) and hard particles (Reinforcement) to mechanical properties. the mechanical properties of MMCs increases their usage in automobile industries Metal Matrix Composites (MMC's) have very light weight, high strength, and exhibit greater resistance to corrosion, oxidation and wear.

II. RELATED WORK

[1]. Anilkumar et al. have chosen Al 6061 alloy as the matrix material and fly ash with varying weight percentage (10%, 15%, 20%) with particle size as the reinforcement to produce the composite by stir casting. By analyzing the sample, the hardness, tensile strength, compressive strength increases with increase in weight fraction of fly ash. [2]. Arun et al. investigated the characteristics of aluminium –fly ash – alumina composite with the stir casting process .Al 6061 is chosen as the matrix material and fly ash as the reinforcement. The reinforcement particulates are equally distributed in Al6061 alloys [3]. Arunkumar et al. have chosen al6061 alloy as the matrix material and 2 to 8wt% of fly ash with 2 and 6wt% of e-glass fibre as the reinforcement to produce the composite by stir casting. The hardness,

tensile strength and compressive strength increases as the wt % of fly ash increases. [4]. Bharat et al. have utilized eutectic Al-Si-alloy LM6 containing 12.2491% Si as the matrix and the cenosphere of two different types (fly ash type-A and type -B) as the reinforcement to produce the composite by stir casting. The micro hardness, tensile strength, impact strength and hardness were higher for type-B fly ash because of its micro structural differences and presence of small amount of carbon. [5]. Garg et al. have prepared a composite by using aluminium 6061 as the matrix and SiC, fly ash as the matrix material. The composite is produced by stir casting technique in which the weight fraction of the silicon carbide is varied (from 2.5%, 5%, 7.5%, 10%) by fixing the fly ash weight fraction (5%). it is clear that by increasing the weight fraction of SiC the tensile strength and hardness of the composite gets improved.

IV. METHODOLOGY

First we Collecting the literature and then we choose for the materials selection. That materials are Aluminium 6061 and silicon and boron Carbide. Then we mixing the Materials one is Aluminium and boron carbide and another one is Aluminium and silicon carbide. Then we moulding the spur gear in stir casting method. Then we fabricated the spur gear. And testing method is tensile, impact, hardness test

V. GEAR CALCULATION

No.	Item	Dimension
1	Number of Teeth	25
2	Pitch Circle Diameter	62 mm
3	Pressure angle	20 deg
4	Module	2.5 mm
5	Circular Pitch	7.80 mm
6	Addendum	4 mm
7	Deddendum	3 mm
8	Length of path of Contact	8.80 mm
9	Length of arc of Contact	9.35 mm
10	Contact Ratio	1.2

$$1. \text{ No. of Teeth (T) = 25}$$

$$2. \text{ Pitch Circle Diameter (D) = 62mm}$$

$$3. \text{ Pressure Angle} = 20 \text{ deg}$$

$$4. \text{ Module (m) = D/T+2}$$

$$= 62/25+2$$

$$= 2.5\text{mm}$$

$$5. \text{ Circular Pitch} = \pi \times D/T$$

$$= 3.14 \times 62/25$$

$$= 7.80\text{mm}$$

$$6. \text{ Radius of Addendum Circle} = R + \text{Addendum}$$

$$= 31 + 4$$

$$= 35\text{mm}$$

7. Radius of Dedendum Circle = $R + \text{Dedendum}$
 $= 31 + 3$
 $= 34\text{mm}$
8. Length of path of Contact = $\sqrt{(R_a)^2 - R^2 \cos^2 \phi} - R \sin \phi$
 $= \sqrt{(35)^2 - 62^2 \cos^2 20} - 62 \sin 20$
 $= 8.80\text{mm}$
9. Length of arc of Contact = Length of Path of Contact / $\cos \phi$
 $= 8.80 / \cos 20$
 $= 9.35\text{mm}$
10. Contact Ratio = Length of arc of Contact / Pitch Circle Diameter
 $= 9.35 / 62$
 $= 1.2$

VI. EXPERIMENTAL RESULTS**Brinell hardness test**

Test parameters	Sample ID	Observed values		
BHN(5mm ball/250 kg load)	Aluminium 6061 90 % + SIC 10%	58.6	65.0	64.8
	Aluminium 6061 90 % + B4C 10%	53.2	54.3	58.5

Charpy impact test

Specimen size (mm)	Notch type	Test parameters	Sample ID	Absorbed energy-Joules
10x10x55	V	240 C	Aluminium 6061 90 % + SIC 10%	03
			Aluminium 6061 90 % + B4C 10%	02

Table Tensile Test

Test parameters	Absorbed values	
Sample ID	Aluminium 6061 90 % + SIC 10%	Aluminium 6061 90 % + B4C 10%
Yield strength (N/mm ² or Mpa)	99	81
Ultimate tensile strength (N/mm ² or Mpa)	135	112
% Elongation in 25mm GL	1.28	3.6



(a)



(b)

Fig (a) is the Moulding box and Fig (b) Work piece of spur gear

Silicon carbide and boron carbide reinforced aluminum matrix composite were prepared by stir casting with different particles weight fraction (90% and 10%). Hardness of Al-Sic is much better than the Al-B₄C Metal. In case of increased silicon carbide content the Hardness, and material toughness are Enhanced and highest value is obtained at 10% Siccontent. More uniform distribution of Sic particle can be found if composite is prepared by powder metallurgy than stir casting; However, stir casting is more economical

VII. CONCLUSION

It is concluded that the modified model of the spur gear is giving better results than the original model. The stresses are reduced in the modified model. And also this model the weight of the spur gear is reduced and the reliability of it increases. By the different tests conducted on it give us the hardness and wear and friction factor is how it varies from normal model to the modified model.

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