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Experimental Behavior & Analysis of Connecting Rod Metal Matrix (8090-B_4c) Composite

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Abstract: *Advance composite materials of Aluminum alloys Al8090 have high Strength to weight ratio. This feature of this metal has been a matter of study among the engineers. The recent manufacturing processes have solved the misery of manufacturing using aluminum alloys. This resulted in a strong eager for Aluminum alloy application in all the fields of engineering. The development stages started in aerospace, Automobile and aircrafts in earlier stages itself. The connecting rod is a subject of study. The project here deals with application of Aluminum alloy and boron carbide in connecting rod components replacing steel with design change accompanying that can improve the material change aggressively. Design of connecting rod using ANSYS 13.0.*
***Keywords:** Stir casting, connecting rod, boron carbide, and Aluminum 8090-LM3.*

I. Introduction

In a reciprocating piston engine, the connecting rod connects the piston to the crank or crankshaft. In modern automotive internal combustion engines, the connecting rods are most usually made of steel for production engines, but can be made of aluminum (for lightness and the ability to absorb high impact at the expense of durability) or B_4C (for a combination of strength and lightness at the expense of affordability) for high performance engines.

A. Merits of Composite Connecting Rod

1. They have high specific modulus and strength.
2. Reduced weight.
3. Due to the weight reduction, fuel consumption will be reduced.
4. They have high damping capacity hence they produce less vibration and noise.
5. They have good corrosion resistance.

B. Composite Material:

A material composed of two or more constituents is called composite material. Composites consist of two or more materials or material phases that are combined to produce a material that has superior properties to those of its individual constituents. The constituents are combined at a macroscopic level and or not soluble in each other. The main difference between composite and an alloy are constituent materials which are insoluble in each other and the individual constituents retain those properties in the case of composites, whereas in alloys, constituent materials are soluble in each other and forms a new material which has different properties from their constituents. Classification of Composites

- Polymer matrix composites
- **Metal matrix composites**
- Ceramic Matrix composites

C. Material Selections

(Al8090)-LM3 Aluminum alloy having density of 2.54gm/cm^3 and prominent properties like weight, toughness etc. was chosen as the base material due to its usage of connecting rod. The aim of increasing the wear resistance, strength, stiffness, hardness etc. of this connecting rod alloy, B_4C particles of 17micron size was selected as reinforcement. This B_4C has lower density 2.52gm/cm3, higher hardness relative to SiC, and the excellent chemical composition and to improve the wear performances of the alloy.

Table 1 Aluminum alloy series

ALLOY SERIES	FEATURES	APPLICATION
Al7079	High strength alloy	Aircraft and structure, recreation equipment's.
Al8090	High strength ,corrosion resistance & good formability	Automotive parts ,aircrafts

II. Experimental Work

A.STIR CASTING

Stir casting is a liquid state method of composite materials fabrication, in which a dispersed phase (ceramic particles, short fibers) is mixed with a molten matrix metal by means of mechanical stirring. Stir casting is the simplest and the most cost effective method of liquid stat fabrication. The liquid composite material is then cast by conversional casting methods and may also be processed by conversional metal forming technogies liquid stat fabrication of metal matrix composite involves incorporation of dispersed phase into a molten matrix metal, followed by its solidification.

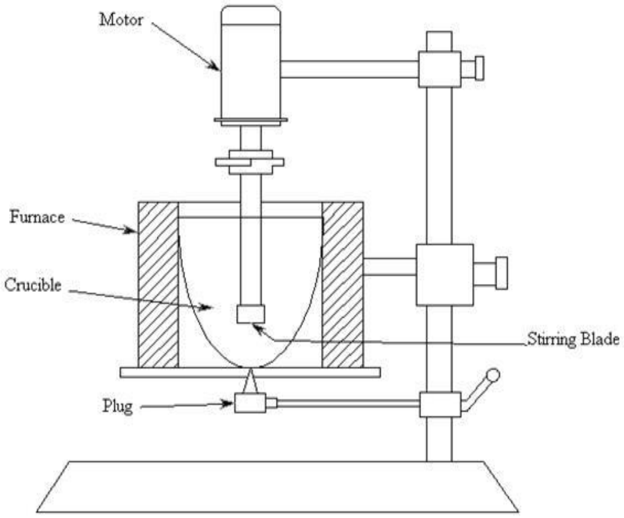


Fig 1 Stir casting set up

Fig 2 stir casting & preheat setup

Fig 3. Furnace

Fig 4.sample preparation

Fig 5 Casting specimen

Table 2 Composition of al composite for various samples

Sample	Total wt. of specimen in gm.	After casting AL8090 in gm.	% of B4C
1	750	700	-----
2	750	693.75	3%
3	750	675.00	6%

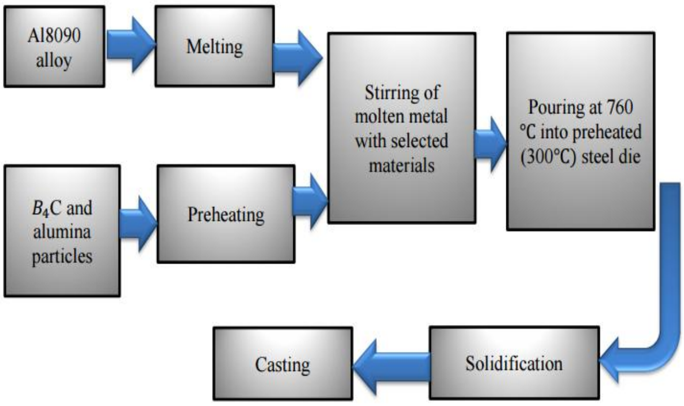


Fig 6 Synthesis of composite

III. Result And Discussion

Finite element analysis is a computer based analysis technique for calculating the strength and behavior of structural engineering. In the structure is represented as finite element. These elements are jointed at particular points which are called as nodes. The FEA is used to calculate the deflection, stress, strain, buckling behavior of the member. In our project FEA is carried out by using ANSYS 13.0. Initially we don't know the displacement and other quantities like stress, strain, deflection which are the then calculated from nodal displacement.

Fig 7 Design of connecting rod

In present work we have used FEA for the structural analysis of Aluminum/B_4C connecting rod. The SOLIDWORKS software is used to prepare the connecting rod. After completing SOLIDWORKS modeling, the model is saved in STP or IGES file then STP or IGES file is import to ANSYS 13.0 software for the finite element analysis.

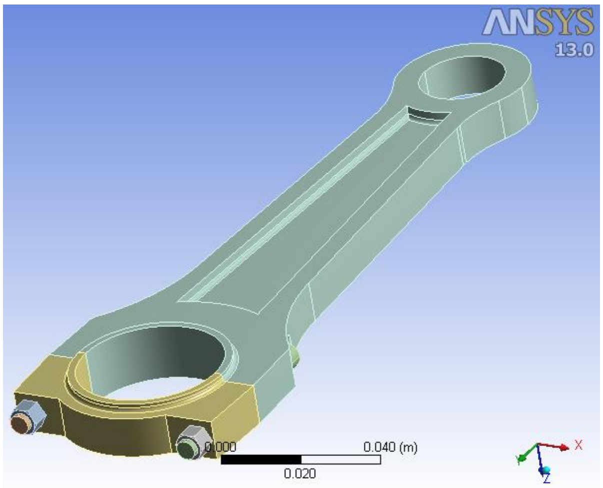


Fig.8 Connecting rod

A. Boundary Condition

The finite element model of Al-B_4C shaft is shown in figure. One end is fixed and torque is applied at other end.

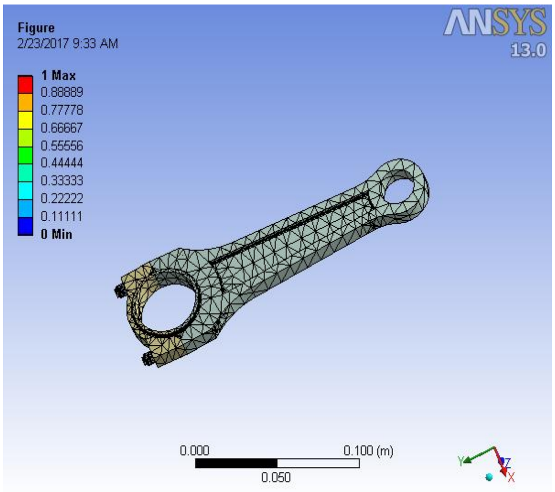


Fig 9.finite element model of AL-B_4C

B. Ansys Simulation

Static Analysis

A static analysis is used to determine the displacement, strain, von misses stress and force in structure or compounds caused by load that do not significant inertia and damping effects.

The static analysis of connecting rod is done
by ANSYS software 13.0.

Static analysis of Aluminum alloy

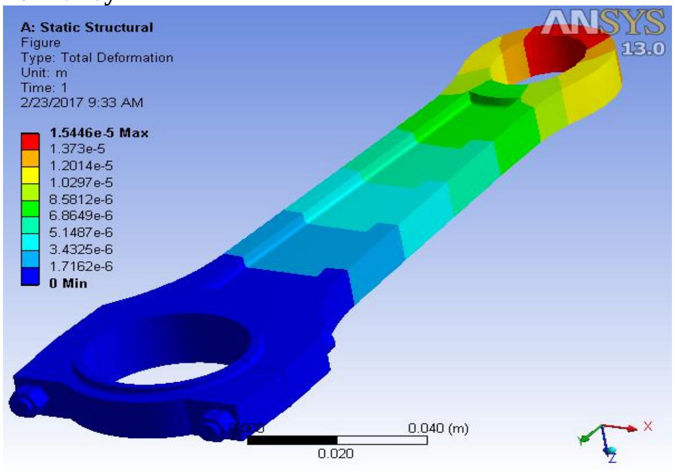


Fig 10. Total deformation Aluminum alloy 8090

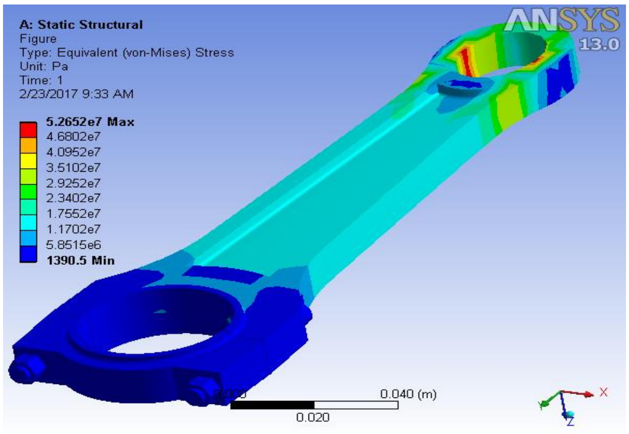


Fig 11. Von Mises stress of Aluminum alloy 8090

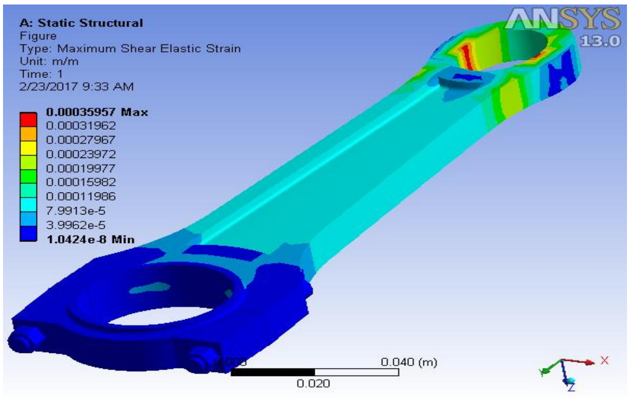


Fig 12. Shear strain of Aluminum alloy 8090

The maximum deflection induced in the connecting rod is 1.5446e- 5 mm and the von mises stress is 5.2657e7 pa.

Static Analysis of Al-B4C

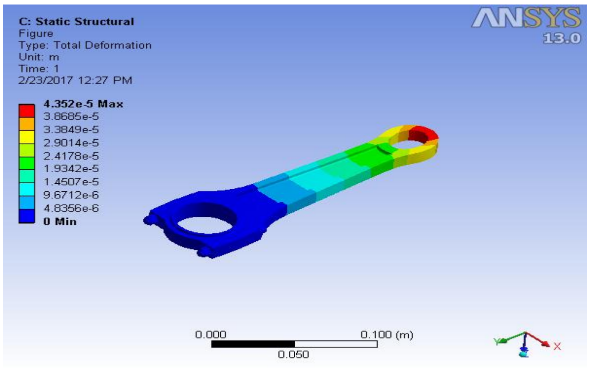


Fig 13. Total deformation of AL-B4C

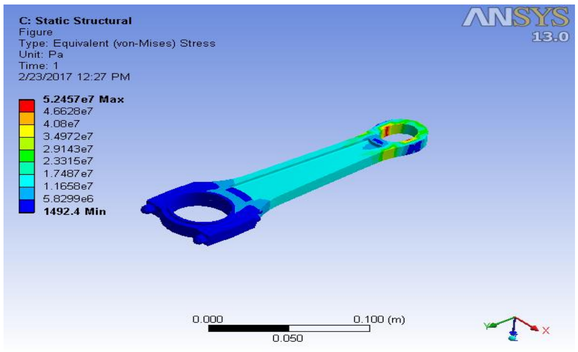


Fig 14. Von Mises stress of AL-B4C

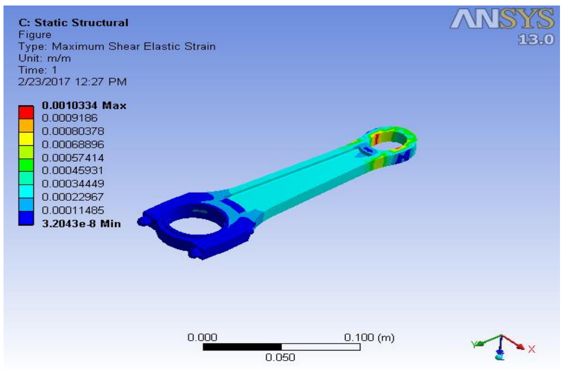


Fig 15. Shear strain of AL-B4C

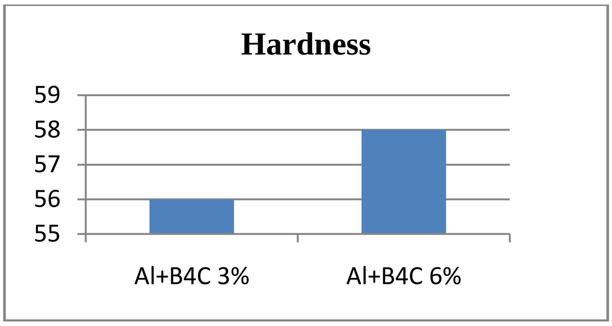
Experimental results

Table 3. Al+B4C

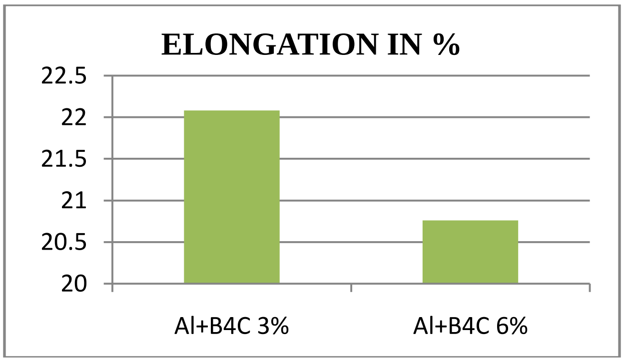
	Tensile	Compression	Normal
Von mises stress(MPa)	52.45	47.72	44.5
Max. shear stress(MPa)	27.58	26.07	25.05
Total deformation	$4.352e^{-5}$	$3.645e^{-5}$	$7.37e^{-5}$

Table 4. Al 7075

	Tensile	Compression	Normal
Von mises stress(MPa)	52.85	47.9	44.6
Max. shear stress(MPa)	27.843	26.21	25.2
Total deformation	$1.534\ e^{-5}$	$1.29\ e^{-5}$	$2.598\ e^{-5}$



Graph 1. Hardness



Graph 2. Elongation

IV. Conclusion

The mechanical behavior of Aluminum alloy 8090(LM3) and Boron carbide 6% is improving and increasing the yield strength, tensile strength, harness. The finite element analysis is used in this work to predict the deformation of connecting rod. The modeling and analysis of connecting rod is done by using ANSYS Workbench.

Reference

[1]. A.Kalaiyarasan,C.Srinivasan,S.Vijayakumar,K.Pasupathi,S.Sasidharan.,,Experimental Investigation On Vibration Characteristics Of Jute Fiber Reinforced Composite Material., International Journal For Scientific Research & Development., Volume 4 Issue 08,ISSN (Online): 2321-0613.

[2]. A.Kalaiyarasan, C.Srinivasan, R.Ramesh, S.Sasidharan, S.Palanisamy., Oxidation Of Soot Particles In Diesel Exhaust Emission Using Plasma Source., International Journal For Scientific Research & Development., Volume 4 Issue Issue 09, 2016 | ISSN (Online): 2321-061

[3]. Kalaiyarasan A, Sankareswaran N., Finite Element Analysis Of Drive Shaft Aluminium Based Metal Matrix Composite Reinforced With Sic And Al2o3., IJSRSET Volume 2 | Issue 5 | Print ISSN: 2395-19

[4]. Kalaiyarasan A, Sankareswaran N.,Design And Analysis Of Drive Shaft By Different Reinforcement Material In Metal Matrix Composite. International Journal Of Recent Scientific Research. Volume 7 | Issue 8 12921-12924.

[5]. Kalaiyarasan A,Raghupathi P, Prem J., Analysis Of Magnesium Alloy Wheel For Four Wheeler., International Journal Of Recent Scientific Research., Volume 7 | Issue 8 13126-13130.

[6]. A. Kalaiyarasan, P. Ragupathi, K. Karthikeyan, R. Ramesh.,Weight Reduction And Fatigue Life Assessment Of Light Commercial Vehicle Chassis., International Journal For Innovative Research In Science & Technology., Volume 3 | Issue 8 15-23

[7]. A. Kalaiyarasan, P. Ramesh., P. Paramasivam., Study Of Advanced Composite Materials In Aerospace Application., International Journal Of Scientific Research In Mechanical And Materials Engineering Volume 1 | Issue 1 25-34

[8]. Kalaiyarasan A, Ragupathi P, Prem J, Karthikeyan K.,Dynamic Analysis Of Drive Shaft By Using Aluminum [Al7075] Based Metal Matrix Composite Reinforcement With B4c And Al2o3., International Journal For Scientific Research & Development., Volume 4 Issue 7 | ISSN (Online): 2321-0613

[9]. Kalaiyarasan A, Ragupathi P R.Rameshexperimental Investigation Of Mechanical Behavior Of Aluminum [Al8090] Composite Reinforced With Ceramic Particles., International Journal Of Multidisciplinary Educational Research., Volume 5 Issue 12 | ISSN (Online): 36-58

[10]. A Kalaiyarasan, P Ragupathi, J Prem, M Gokul.,Aluminum Based Metal Matrix Composites: A Review Influence Of Reinforced Particles; Techniques; Factors Affecting The Composite., International Journal Of Scientific Research In Mechanical And Materials Engineering Volume 1| Issue 2 25-34

[11]. A Kalaiyarasan, N Sankareswaran.,Design And Analysis Of Drive Shaft Metal Matrix Composite Reinforced Cermaic Materials., International Journal Of Scientific Research In Mechanical And Materials Engineering.