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Investigation and Analysis in Engine Piston Rod Material

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Abstract- In engine, piston is an important element which is considered as the main working part. So it is important to be technical in selecting materials which are used to manufacture a piston. As it the main working part in the engine, automatically it will be subjected to more damage which depends upon the usage of the engine. Commonly the pistons are made up of aluminium alloys, because of its enormous strength and for other mechanical properties. In this project aluminium alloy is replaced with the composite of Aluminium (Lm25), Boron carbide (b4C) and Graphite (G). These hybrid composites are formed using stir casting method in three different ratios. All the three specimens with different ratios are subjected to tensile, hardness and wear tests. The observed values are tabulated and represented graphically. Those values are analysed and determined that the formed hybrid composite material is suitable for the manufacturing of piston rod.

I. INTRODUCTION

Engine pistons are most complex components among all automotive and other industry field components. The engine can be said the heart of a vehicle and the piston may be considered the most important part of an engine. There are lots of research works proposing, for engine pistons, new geometries, materials and manufacturing techniques, and this evolution has undergone with a continuous improvement over the last decades and required thorough examination of the smallest details. Notwithstanding all these studies, there are a huge number of damaged pistons. Piston endures the cyclic gas pressure and the inertial forces at work, and this working condition may cause the fatigue damage of piston, such as piston side wear, piston head cracks and so on. To recover this problem, in this project the materials which are being used to manufacture piston has been changed. The material which is commonly used in manufacturing of piston is aluminum alloy. In this project the aluminum alloy has replaced with the composite hybrid material which c Composite materials are the mixture or the combination of two or more constituents differing in form or material composition and that are essentially insoluble in each other.

All the constituents maintain their identity as they do not dissolve r melt in each other, and act in such a way that a new material results whose properties are better than the sum of the constituents. Contains aluminum (Lm25), graphite powder and boron carbide powder. All these materials are mixed with different compositions, and three different composites were formed. Stir casting method is used to form the composites of different ratios, as it is the cheapest and easiest method to form aluminum composite. Using this method, three rods of length 300mm and 25mm diameter has been casted in three different ratios. And three plates whose dimensions are (100x100x10) mm are also formed. These plates and rods are subjected to tensile, hardness and wear tests in order *to*

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find out whether the composite formed has capability to manufacture a piston rod which should have properties to withstand the working conditions of the engine. The results of these tests have been analyzed and reported as the final report of this project.

II. LITERATURE SURVEY

Prem kumar, Ijrdo-journal of mechanical and civil engineering ISSN: 2456-1479(vol1, issue 7). [1] In this work connecting rod is replaced by aluminium based composite material reinforced with Boron carbide.

R.Siva sankar, S.Maheshwaran, E.Hariharan, SSRG International journal of mechanical engineering (SSRG-IJME)-Volume 3, Issue 1-Jan 2016. [2] The conformation of Al-Si cast material are melted, and then cleaned and cast to make small size ingots. The mechanical properties and wear properties of these Al-Si alloys are vary on the heat treatment process.

Sathish wable, Dattatray, Galhe, Rajkumar, L.Mangar. Ijariie-Issn (o)-2395-4396 - International journal of innovative science, engineering & technology, vol. 2 issue 1, October 2016. [3] To get the idea about designing the connecting rod, various stresses to be considered while designing the connecting rod and different materials used and comparing the result of all materials.

Shubham tiwari, Ajay kumar kaviti. International Journal Of scientific and engineering research - Volume 6 Issue 8, august - 2015, ISSN 2229-5518. [4] In this paper, a review has been attempted on selection parameter of connecting rod like cross section, manufacturing process and material selection which can enhance the performance of engine.

N.Nanda kumar, P.Kanagaraj international Journal Of modern Engineering research (ijmer) issn-2248-9622, volume-7, and issue 6, july-august-2014. [5] The results of the research work shows that the proposed Hybrid composites are compared with Al based metal matrix composites at corresponding values of test parameter.

Suryanarayanan, Praveen, Raghuraman International journal of innovative research in science engineering and technology: vol2; dec6. [6] The present work will help to find the tool life and wear behaviour of the each coated tool and it will help to find the best tool coating applicable for the cutting tool.

Neelima devi, Mahesh, International Journal of Innovative Research in Science Engineering and Technology Issn: 3297:2007, vol4, issue 9 September 9. [7] In this context, a brief overview of the metallurgy of titanium and its alloys is also presented. Recent progresses in tool materials, appropriate tools for cutting aluminium alloys, and their dominant wear mechanisms will also be covered in this chapter.

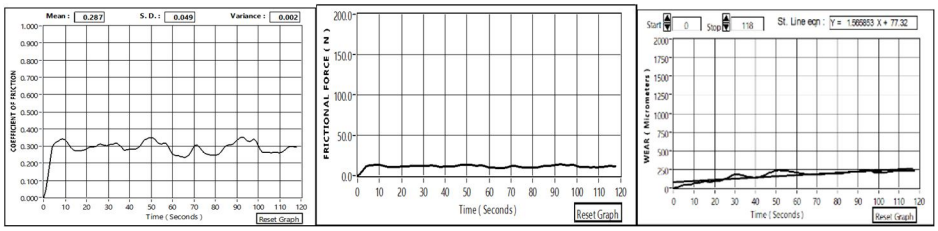
R.Vishali, S.D.Khamankar, IPASJ International journal of mechanical engineering (IIJME), Vol 3, Issue 8-Aug 2015. [8] The analysis predicts that due to temperature whether the top surface of the piston may be damaged or broken during the operating conditions, because damaged or broken parts are so expensive to replace and generally are not easily available.

III. METHODOLOGY

A. The raw materials used in to make the composite are aluminium (Lm25), boron carbide and graphite.
B. Stir casting method is used to make the composite material.
C. The formed composite is made into three different compositions of Boron carbide mixture.
D. Three different ratios of rods and plates were formed.
E. The plates and rods are machined to ASTM standards with accurate dimensions which fit within the testing machines.
F. All the three compositions of rods and plates are subjected to tensile, hardness and wear tests.

IV. RESULT AND DISCUSSION

A. Wear Test Report



Co-efficient of friction (sample1) Friction force (sample1) wear graph (sample1)

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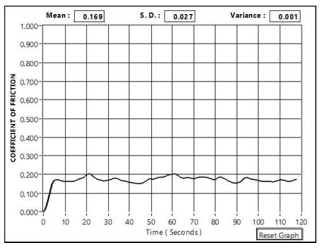
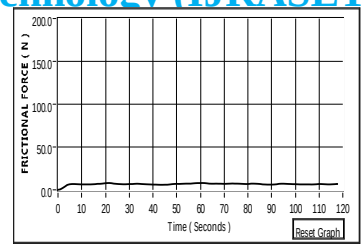
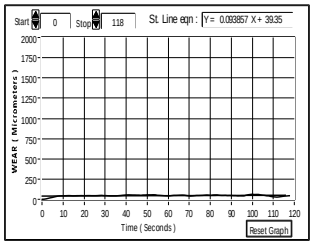


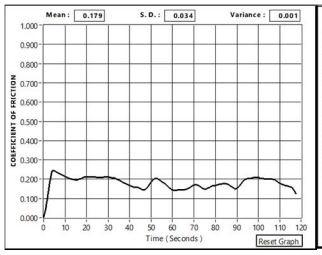
Co-efficient of friction (sample2)



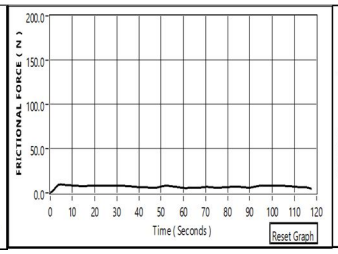
Friction force (sample2)



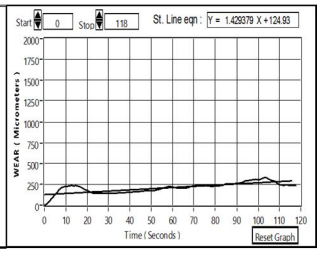
wear graph (sample3)



Co-efficient of friction (sample3)



Friction force (sample3)



wear graph (sample3)

B. Rockwell Hardness Test Report

1) Scale : HRB
2) Load : 100 Kg
3) Limit (Max) : 100 HR
4) Limit (Mini) : 1 HRB

S NO	Hardness	Status
1	23.8 HRB	Good
2	29.7 HRB	Good
3	26.5 HRB	Good
4	21.5 HRB	Good
5	31.5 HRB	Good
6	35.6 HRB	Good

For sample1

5) Scale : HRB
6) Load : 100 Kgf
7) Limit (Max) : 70 HRB
8) Limit (Mini) : 10 HRB

Serial No:	Hardness	Status
1	23.8 HRB	Good
2	33.0 HRB	Good
3	31.1 HRB	Good
4	27.9 HRB	Good
5	33.8 HRB	Good
6	32.6 HRB	Good

For sample 2

9) Scale : HRB
10) Load : 100 Kgf
11) Limit (max) : 70 HRB

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12) Limit (mini) : 20 HRB

Serial No:	Hardness	Status
1	35.8 HRB	Good
2	28.3 HRB	Good
3	38.5 HRB	Good
4	30.7 HRB	Good
5	28.3 HRB	Good
6	25.7 HRB	Good

For sample 3

C. Tensile Test Report

1) Testing Standards : ASTM
2) Sample Type : Rod
3) Sample Size : 25mm (dia)
4) No. of Samples : 3

Sn No:	Dia Mm	CSA mm2	YL KN	YS N/mm2	TL KN	TS N/mm2	IGL mm	FGL mm	%E	F.D.	%R.A.
1	20.05	315.8	4.11	13.01	33.21	105.14	80	82	2.50	19.16	8.68
2	20.05	314.2	5.37	17.09	36.21	115.21	80	81	1.88	19.43	5.62
3	20.05	314.6	8.82	28.04	40.32	128.16	80	82	2.88	19.54	4.64

For samples (1,2,3)

V. CONCLUSION

The composites which contains Aluminium (LM25), Boron carbide powder and Graphite powder are formed using stir casting method. The formed composite materials are investigated by taking tests like tensile, hardness, wear tests in real time machines to analyse the properties of the material. And the results are tabulated and reported. As per the report the form composition of hybrid composite is eligible and suitable for making of the piston.

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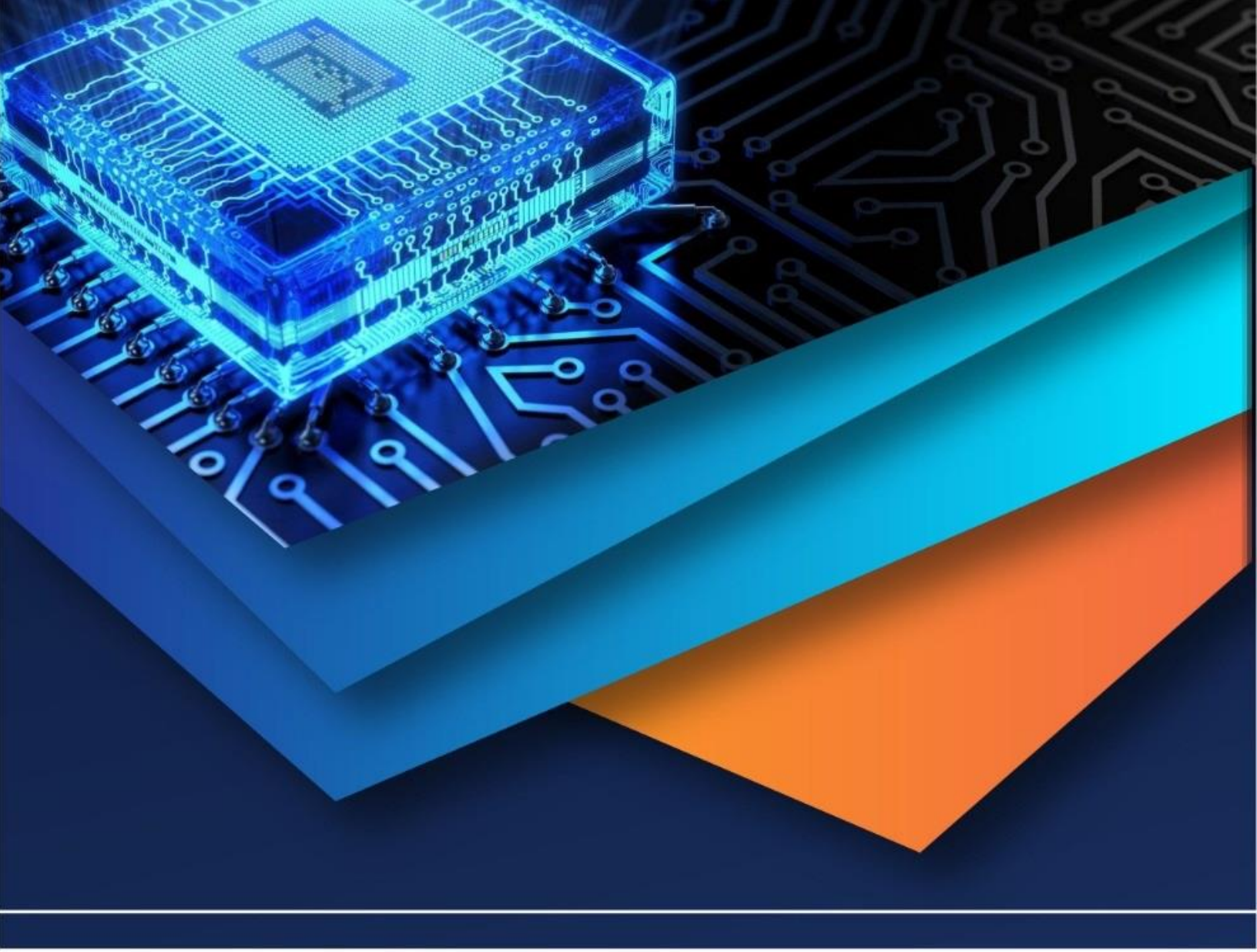

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