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RESEARCH ARTICLE

MANUFACTURING AND PERFORMANCE ANALYSIS OF CONNECTING ROD MADE OF AL2014 WITH SIC

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ABSTRACT

The connecting rod is the most important part of an automotive engine. It is intermediate member between the piston and the crankshaft. Usually connecting rod is made of using steel for production engine, or cast iron for application such as motor scooters. By changing the material we can increase the performance of the engine and reduce the weight of the connecting rod. The present work has been carried out to replace the existing connecting rod made of forged steel with Al2014 with sic material. A parametric model of conrod is designed using CREO software. Analysis is carried out by using ANSYS software. Prototype of connecting rod is manufactured by using die casting. Testing done for chemical compositions, hardness and tensile strength. Compared to the former material the new material found to have less weight and better stiffness. It results in reduction of weight and displacement.

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INTRODUCTION

Connecting rod forms an integral part of internal Combustion engine. It is the link between the piston Crank shafts. The main function of conrod is to transmit the translation motion of piston to rotation rotational Motion of crank shaft. Connecting rod of vehicles are generally manufactured by made of the process of forging or Casting (either wrought steel or powdered metal). A high production component the weight and design of the connecting rod have an influence on use of light materials can increase the performance of an Automobile engine. Farm and construction equipment like tractors, bulldozers, road rollers also use con rods. In modern automotive ic engines, con rod are most usually steel for production engines, cast iron for motor scooters.
The cross section of con rod designed by using Rankin formula

Specificationof connecting rod 150ccpetrol engine

Suzuki GS 150 R	specifications
Engine type:	air cooled 4-stroke SOHC
Displacement =	149.5CC
Maximum power =	13.8bhp @8500rpm
Maximum torque =	13.4Nm @ 6000 rpm
Compression ratio =	9.35/1
Density of petrol =	0.00000073722Kg/mm3
T = 60F =288.855K =	15.55^0C

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CREO/ENGINEER

CREO/ENGINEER is a feature based, parametric solid modeling program. Its use is significantly different from conventional drafting programs. In conventional drafting (either manual or computer assisted), various views of a part are created in an attempt to describe the geometry.

There are generally two types of analysis that are used in industry: 2-D modeling, and 3-D modeling.

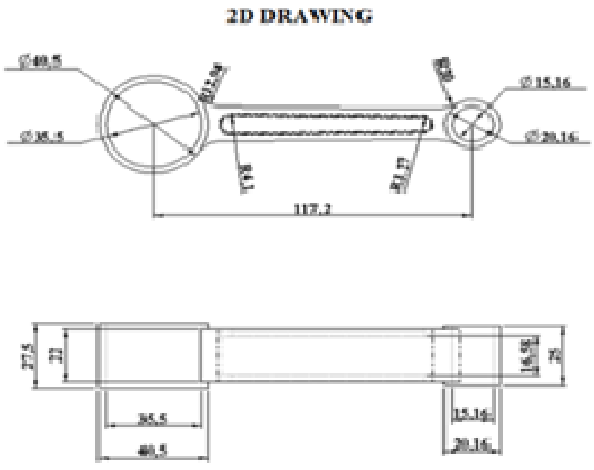

Fig. 1. 2D Model of connecting rod

Fig.2. 3D model of connecting rod

ANSYS

ANSYS is general-purpose finite element analysis (FEA) software package. These results then can be presented in tabulated, or graph forms. Analysis software used in these model is ANSYS PRODUCTS V14.5. Specific capabilities of ansys are structural, thermal. We modeled a conrod using creo software. To save that model we have to use .iges format. Saved model is imported through ANSYS software for further results. To structural analysis of connecting rod imported model to analysis. Double click on geometry then edit material giving. Select structural steel and give right click to mesh .it automatically generated mesh.Analysis purpose we compared with two materials i.e. steel & al2014-sic. By using ansys software we done the structural and thermal analysis for connecting rod. For structural analysis we have taken these considerations below.

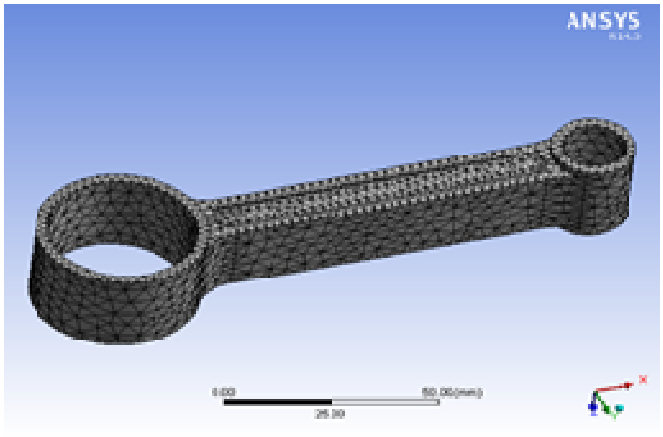

Fig.3. Meshed model

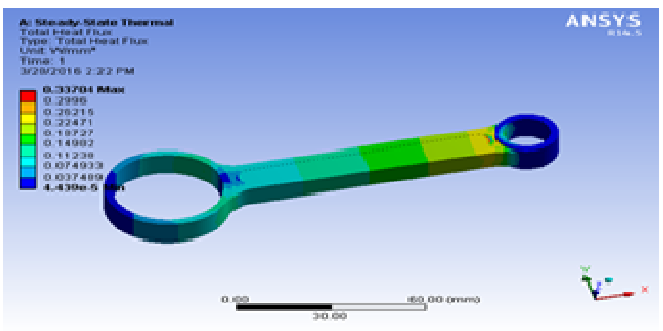

Fig.4. Temperature and heat flux of two materials

RESULTS

By using deformation, stress, strain values for steel and al2014-sic we draw a graph to compare the values between two materials.

Table 1. Material properties for steel & AL 2014 with SIC

Material properties	Steel	Al2014 with sic
Density	7.87g/cc	2.72g/cc
Young's modulus	200Gpa	6290Mpa
Poisson's ratio	0.29	0.33

Table 2. Structural comparison

Structural	Deformation	Stress	Strain
Steel	0.003525	73.653	0.00036841
Al2014-sic	0.00073964	53.378	8.0235e-5

Table 3. Thermal comparison

	Temperature (^{0}C)	Heat Flux (W/mm2)
Structural steel	260	0.23932
AL014 with sic	260	0.33704

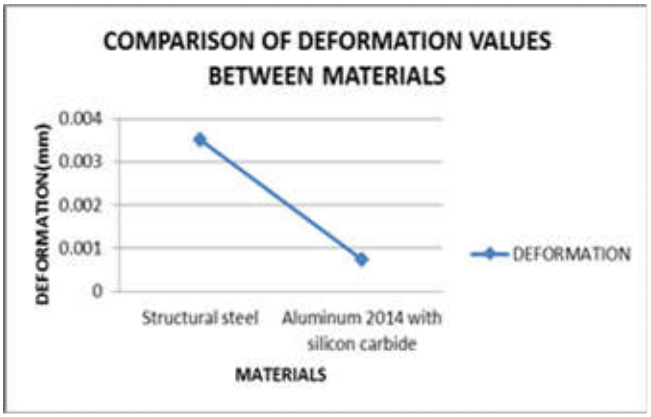

Fig.5. Deformation b/w two materials

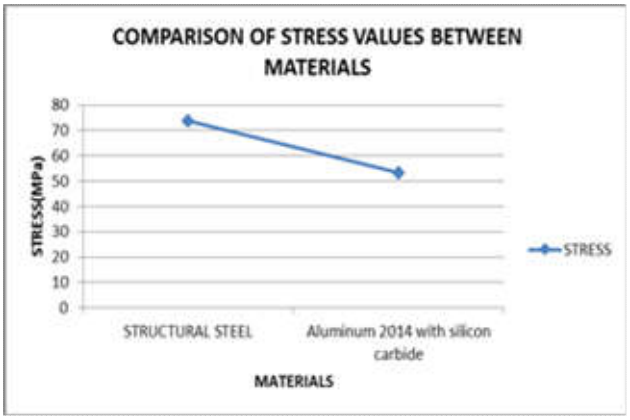

Fig.6. Stress comparison graph

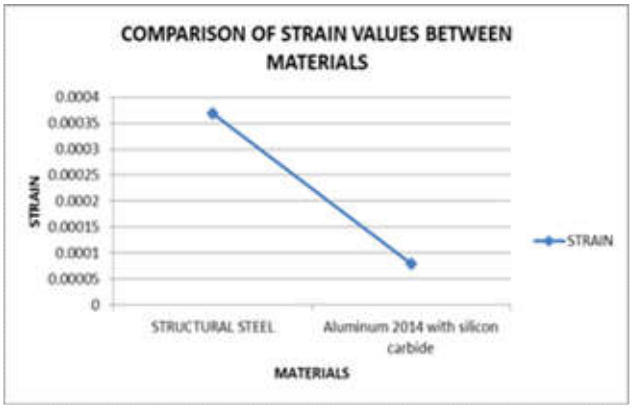

Fig.7. Strain comparison graph

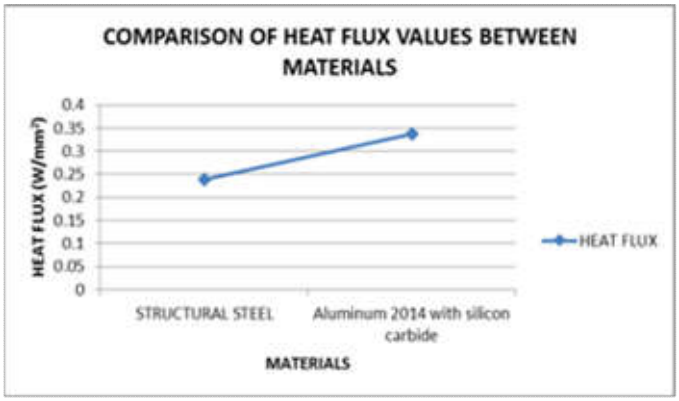

Fig 8. Heat flux comparison graph

Thermal analysis shows temperature constant for two materials only heat flux is changed. Heat flux is compared by using a graph.

Method used in manufacturing of connecting rod

Casting processes basically involves the introduction of molten metal into a mold cavity solidified, the metal takes on the shape of the mold cavity. The mould may be made of refractory grains (sand moulds) or metal (metal moulds).The mold cavity is created using two hardened tool steel dies which have been machined into shape and work similarly to an injection mold during the process.

CNC Milling machine

Milling machines are tools designed to machine metal, wood, and other solid materials. Often automated, milling machines can be positioned in either vertical or horizontal orientation to carve out materials based on a pre-existing design. Milling machines are capable of dynamic movement; both of the tool and the work piece, and many milling machines can perform multi-axis machining. If a milling machine uses a tool bit that is not strong enough to machine steel, the tooling and even the machine itself can be damaged. Tooling that is too strong for softer materials can damage the work piece.By using CNC milling machine core and cavity of conrod is obtained. Material used for these die process is high strength steel.

Fig. 9.CNC milling machine

Material selection

For manufacturing of connecting rod we used two materials al2014 soft material and sic hard material.2014 aluminum alloy is an aluminum-based alloy often used in the aerospace industry. It is easily machined in certain tempers, and among the strongest available aluminum alloys, as well as having high hardness. Silicon Carbide was originally produced by a high temperature electro-chemical reaction of sand and carbon. Low density, High strength, Low thermal expansion, High thermal conductivity, High hardness, High elastic modulus.

Production of connecting ROD

For these casting purpose we used 1kg of al2014 mix with 5% of sic. Both materials are powdered and taken it into a bowl. It is heated up to 800 degrees i.e. 45 mints approximately. Material melted at certain temperature is taken out and poured in a die we manufactured by using cnc vertical milling machine. Die is having hole on upside to pour material into it. After cooling the die it opened and taken out the con rod. But it is not ready to use because we didn't done the machining to that part. To remove the extra material we using machining to the conrod.

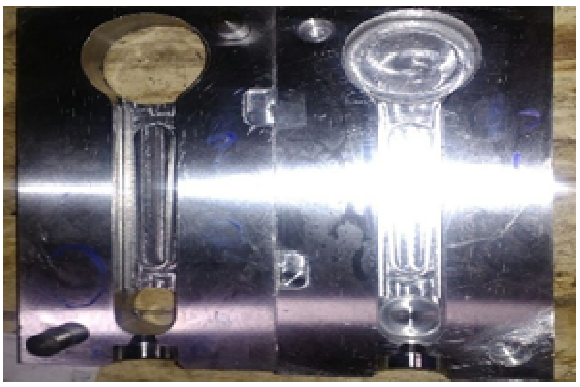

Fig. 10. Core and cavity of connecting rod

Fig. 11. Required material melted at certain temperature

Fig.12. Heated material poured into die

Fig. 13. Material removal processes

Testing reports

Sample – Aluminum Silicon Carbide Connecting Rod
Specification – AL2014/HE-15 and AL2014 with sic
Equipment Used – Optical Emission Spectrometer

Hardness

Hardness for AL 2014 - 66.0HV

AL2014 WITH SIC IS- 81.33HV.

By using Lathe machine we prepared the sample models through turning operation. Specimen is fixed to the universal testing machine (utm) by using fixtures.

Fig. 15. Cup and Cone shape shown in sample model

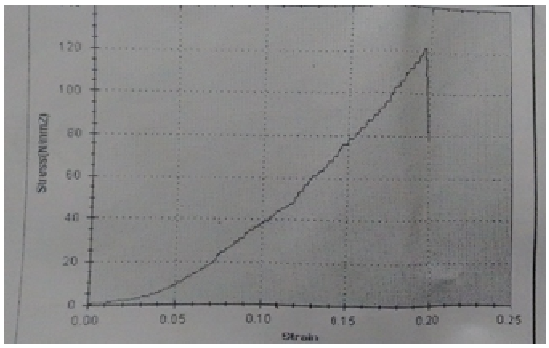

Fig. 15. Stress and strain for AL2014

Table 4. Tensile test reports

Results	AL2014	AL2014- SIC
Ultimate load kN	14.580	21.00
tensile strength N/mm2	121.515	185.676
Elongation%	2.18	2.180
Yield load kN	11.52	15.640
Yield stress N/mm2	96.012	138.285

Table 5. Chemical composition of AL2014 and AL2014 with SIC

Elements		Cu%	Fe%	Cr%	Si%	Mn%	Zn%	Mg%	Ti%	Al%	Sic%
Spec	Min	3.9	-	-	0.5	0.4	-	0.4	-	-	-
Requirement	Max	4.5	0.5	0.1	0.9	1.10	0.25	1.20	0.2	Rem	-
AL2014	Sample Piece	4.19	0.25	0.027	0.8	0.608	0.013	0.721	0.01	Rem	-
AL2014-SIC	Sample piece	4.19	0.25	0.027	0.8	0.608	0.013	0.721	0.01	Rem	0.5

Tensile test

For these tensile test purpose used a sample models made of same material we manufactured al2014 –5% sic and al2014.It looks like a dog bone shape.

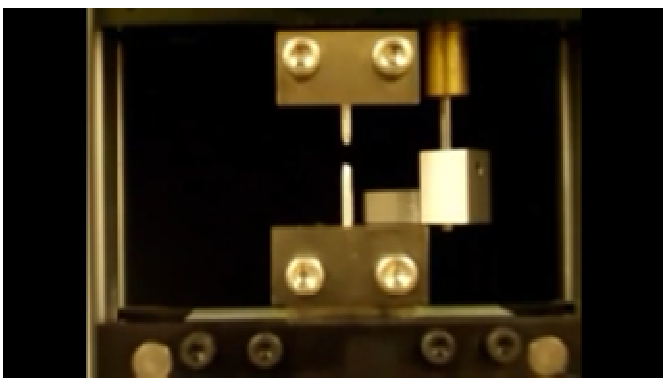

Fig. 14. Sample model is fixed to UTM

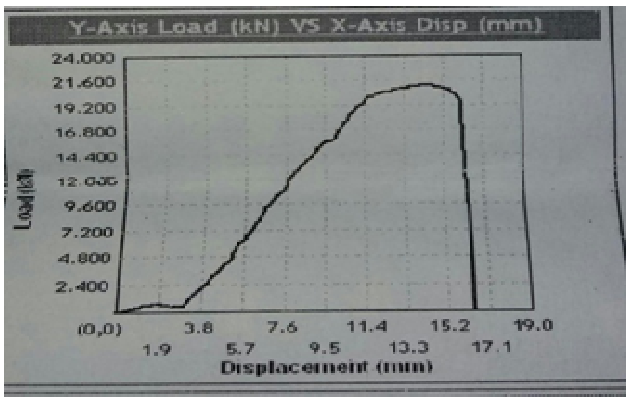

Fig.16. Stress and strain for AL2014-SIC

Force applied on UTM for elongation is shown figure. Model is stretched by applying load on it .load is increased then middle of the sample model necking is happen. After some

time model is broken into two pieces. And broken parts are look like cup and cone shape.

Conclusion

In these work, forged steel connecting rod composition is replaced with AL2014 reinforced with sic. It is modeled by using creo 2.0. Analysis is done by using ANSYS PRODUCTS V14.5 software using materials steel & AL2014 with sic. After validating the analysis results for two materials AL2014 with sic is selected for manufacturing. Connecting rod is then die casted. When compared with forged steel connecting rod weight of AL2014 with sic is decreased by 80grms. Than we done the chemical test, hardness and tensile test to the AL2014 AND AL2014 with SIC. Output data of test is to know load at yield, yield stress, load at peak, and yield Strength and % elongation for two materials. When Compared materials hardness, strength and stiffness is better in AL2014 with SIC. If future not only AL2014 with SIC other composite materials will come into existence for manufacturing of connecting rods to high Performance engines.

REFERENCES

Kuldeep B1. and Arun L.R2, 2013. Mohammed Faheem3ISSN 2319-8753. Vol.2, Issue 6, *SSJUNE*, 2013.

Naveen Lohan* and Sandeep Nandal2 ISSN:2277-9655 Lohan 3(10): October 2014

Pathade, V. C., B. Patle, A. N. Ingale, 2012. *International Journal of Engineering and Innovative Technology*, 1.

Pravardhan S. Shenoy and Ali Fatemi, 2005. Technical Paper 2005-01-0987.

Sharma, P. K. and B. Rajendra, 2012. *International Journal of Advance Research in Science and Engineering*, 1.

Shenoy, P. S. and A. Fatemi, 2014. SAE International by Automotive Research Association of India, 1-8.

Singh I.B. *et al*. 2009. Corrosion science 51; 234-241.

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