TEST Engineering & Management

January - February 2020
ISSN: 0193 - 4120 Page No. 4196 - 4200

Optimization by Crowning Piston and Protection of Sleeve by application of Heat Resistant insulation in super finishing Lathe Attachment

[1]sayyad Layak B., [2]ch. Sanjay.,[2]satya Devi A
[1]Asstt. Professor Theem College ofEngg,Boisar, Mumbai University,MH.
[2]Professor,DepartmentMechanical Engineering,GITAM SoT, Hyderabad.
[3]Professor,Department ofAerospace Engineering, GITAM SoT, Hyderabad
Email: [1]syed.layak@gmail.com, [2]sanjay.chintakindi@gitam.edu,[3]satyadevi.ambadipudi@gitam.edu
Contact:[1]+91 9975584278,[2]+91 9502932499,[3]+91 9490458841.

Article Info
Volume 82
Page Number: 4196 - 4200
Publication Issue:
January-February 2020

Article History
Article Received: *18 May 2019*
Revised: *14 July 2019*
Accepted: *22 December 2019*
Publication: *21 January 2020*

Abstract
The problem in super finishing lathe attachment solved by applying a coat of Ebonite (Hard Rubber) from inside of the sleeve. This avoids the expansion of the sleeve above 5 microns and restricts it to 2 microns only, which is necessary for the smooth, uninterrupted and continuous operation of super-finishing lathe attachment. Now the challenge faced during the assembly of the sleeve into the Cylinder is that the assembly is a transition fit and the cylinder is heated (for expansion purpose) and the sleeve is inserted into it, this heat is transferred to Ebonite coating, which spoils the Ebonite coating and hence cannot maintain a gap of 5 micron between the Sleeve and the piston. A hightemperature insulated coat of 64C1-2-A is applied from outside of the sleeve, this acts as a barrier between the heatedcylinder and the ebonite coating. Further the friction in these two the OHNS piston and the ebonite coated sleeve is reduced by the process of crowning the piston. Crowning reduces the surface contact, resulting in further smooth and continuous operation while used in Super-finishing lathe attachment.

Keywords: Friction, generatedheat, Superfinishing, OHNS, Ebonite rubbercoat, Insulation coating, Pin and disc test

I. Introduction

Ebonite hard rubber coating doneinside the sleeve due to which reduced the friction between the OHNS piston and Ebonitecoated OHNS sleeve.Research has been made to coat the inside surface of the sleevebya material of low thermal conductivity and meager frictional rate. So for that coat of ebonite to the inner surface area of the sleevewhich having mechanical properties as follows.

- Ebonitedensity is equal to 1.150 to 1.680 g/cm3
- Young's modulus of material 2000 - 3000MPa
- Tensile Strength is 52.0to67.0 MN/m2
- Thermal Conductivity is equal to 0.17 W/m°K
- Thermal Expansion of ebonite 42.8

January - February 2020
ISSN: 0193 - 4120 Page No. 116 - 124

micro inch/inch

- Poisson's ratio of ebonite 0.39

Using the above properties of Ebonite coated on the sleeve a Coupled Field Analysis is carried. The value of the temperature increased is taken from the successful test on the tribometer with ebonite coated disc and pin made up of OHNS material after rotating the disctest runs uninterrupted up to 45 minutes. Value of temperatureriserereceived from tribometer is 37˚C

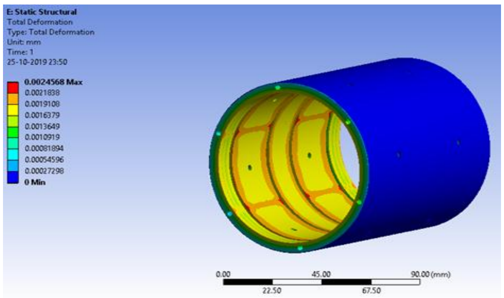

Fig1.0 Total deformation is 2 microns

Expansion of the sleeve from inside is 2microns as shown in figure above.

Ebonite coating gives a better surface which reduces the friction and even the deformation of the surface is negligible (2 micron) which is required to maintain the gap which is of 5 microns forsmooth oscillations of the piston inside sleeve.

Effects of two different methyl fuel on the routine semi-adiabatic diesel engine coated with multilayer in.

II. Coating Thermal Resistant Material Outside Sleeve.

The Sleeve is fitted into the Cylinder with an interference fit. The circular area of the Cylinder is expanded by heating the Sleeve in Furnace up to 200^{o}C. This is followed by dropping the Sleeve into the Cylinder and cooling it to room temperature, thereby getting an interference fit between the Cylinder and Sleeve. This Interference fit gives a stable bonding between the Sleeve and the piston.

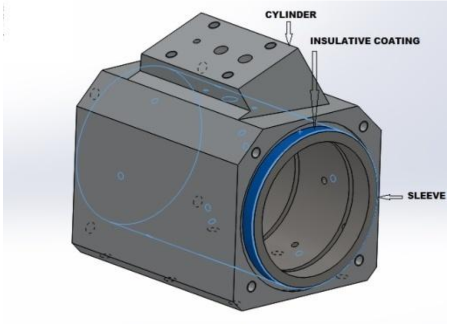

Fig2.0 Insulative coat from outside of sleeve before assembling with cylinder

In this process of getting interference fit between the cylinder and the sleeve, the heat generated for expanding the cylinder spoils the ebonite material coated from the inside of the sleeve. This spoilage of the ebonite coating will make it challenging to maintain a gap of 5 microns between the Sleeve and the Piston, which is the primary function of ebonite coating.

The heat generated during the expansion of the cylinder to achieve interference fit had to be restricted to reach the ebonite material coated in the inside of the Sleeve. A provision has to be made in the form of a barrier which protects the sleeve and the ebonite material coated from the inside of the sleeve.

A high temperature resistant, insulative coating is being applied from the outside of the sleeve to completely insulate the heat generated during the fit interference assembly of the cylinder and the sleeve.

The details of the High temperature resistant insulative Coating material are as given below:

III Material:

64C1-2-A (High-Temperature Resistant Insulative Coating)

Characteristics:

64C1-2-A is formulation for the use as a maximumtemperature insulation coat for environments with continuous exposure at the

January - February 2020
ISSN: 0193 - 4120 Page No. 116 - 124

temperatures up to 600°F and act as a fire protected barrier. The coating perfectly suited for adhesion and bonded assemblies at ahigh-temperature regionwhere either adhesion ordeterioration may occur. Since it is a one type of spray able material that cures tonormal temperatures it may be then apply for assemblies with complex configurations at thickness up to 2.54 cm or more. Usually, a thickness 1/16 to 1/4 is perfect for thermal as well as fire protection.

Application Recommendations:

Temperature: 15 –35°C or 59 – 95°F
Relative Humidity: 35 – 75%
Application Devices:

The surface quality after application of all coatswill influence with a spray machine chosen as well as the airflowof the paintapplied area, humidity, and temperature. When it appliedtoproduct at first time, it’s recommendation of test panels to be prepared in order to find out the superior equipment setting to be used in optimizationand the performance as well as smooth look of the coating.

Equipment: traditional pressure pots equipped with uninterruptedanxiety are useful to it. air cap, anxiety needle, andfluid tippreferences are in demand. Fluidpipesrequiredare made up byTeflonor nylon lined. The equipment must be used only for this coating to

Applicationsof insulationcoatings on materials to keep safety with contamination for spray:

Bink’s equipment1. Small regions - Binks 18V spray gun with Number 66fluid tipandair nozzle are similar. 2. Bigsurface areas - Binks 18V spray gun with Number. 64 fluid tip and air nozzle. Set pot pressure at 5-15 lbs. (pressure generally depends on fluid pipelengthand size) and nozzle air pressure at 35-45 psi. atomizing pressures and Pot must be set in combined, so instrument is ready todeposited a coat thickness of 10-15 mils in its one attempt. Spray applications available in marketits instrument must be pressure fed.

Bigger areas - MBC 510-gun, fluid tip AV-601E, fluid needle MBC-444E, air cap No. 704.Small surface areas - MBC 510-gun fluid tip AV601FX, fluid needle MBC-444FX, air cap No. 704. 2.

Specially for the applications of the topcoat with 1. Similar Brushes are used as per the specifications for DC-1200 primer. Caution: Brushes mustclean for use again and again only for uninterrupted applications of the RTV 560.
2. Spray instrument – feed the pressure - Use same types of instrument as specially for small regions above. 3. feedsiphon - MBC 510-gun, Number. 30 air cap, AV-601EX fluid tip, and MBC-496-EX fluid needle.
The coats aresubstantial in powder method, is out into the flame ofplasma that helps in melting because of the maximum temperature of the plasma. The atoms bombard the substrate with a very high velocity and at this time, the molten condensations solidify swiftly forming a coating film

Drying Times (25 +/- 2ºc / 77 +/- 2ºf, 55 +/- 5% RH):

The insulationcoatcancure to a 40-durometer hardness (Shore A) in 24 hoursto 27°-32°C. The cure can be speed-up by drying at 8 to 12 hours at 90°F (32°C) followed by 6 hours to 60°to 71°C. Other time/temperature bothcan be used.

Dry FilmWeight:0.45 g/m2/µm 0.0023 lbs./ft2/mil

the technology selection to modify the surface, is an essential part in designing the engineering components. The very fundamental aspect of modifying the surface is in understanding the substrate’s surface, since many times, the substrate’s surface depends on certain properties like corrosion, erosion, resistance to wear

Color: Pale brick red

January - February 2020
ISSN: 0193 - 4120 Page No. 116 - 124

The above properties of 64C1-2-A (High-temperature resistant insulationCoate) is best suited for coating the sleeve with high temperature resistant Insulative material, to avoid the spoilage of the ebonite coating, as it can resist up to a temperature of 600°C whereas in our case the temperature rise is up to 200°C of the cylinder.

IV Piston Crowning toreduce the Friction area:

coated piston engine normally has higher temperature than base engine (without coating) due to this reason the exhaust gas recovery will be an effective way of more energy extraction while using biodiesel (Manickam et al. 2015). The PSZ coated piston diesel engine with 20% blends of Karanja oil methyl ester (KOME), resulted in 8.4% increase in temperature, compared to the base engine

piston crown coating with jatropha oil (B20 and B100) on an optimum vaccination pressure and injection effectiveness engine and described improved recital and emission appearances for B20 blends for all loading circumstances. It is also reported in their study that growth in peak pressure was 4.48% and decrease in heat release as 2.26% in thermal coated piston engine with substantial reduction in explosion delay forbiodiesel fuel

A high-temperature defensive coating must meet numerous criteria: provide satisfactory environmental confrontation, be chemically and mechanically well-matched with the substrate, be applicable. Comprehensive assessments on high-temperature coatings have seemed regularly since the early. Our purpose is not to summarize the material covered therein but relatively to focus on recent trends.

Paper focused on reducing the heat generated due to friction between them piston and the sleeve. During oscillation of the Piston in the Sleeve, the peripheral area of the piston comes in contacts with the inner peripheral area of the sleeve and because of the friction between the two heat is generated and it becomes impossible to maintain a gap of 5 microns after some time as the material starts expanding.

To avoid this friction, an ebonite material coating is done on the inside of the sleeve which has a very low friction rate and produces very less amount of heat, and hence smooth operation can be obtained. To further reduce friction the contact area between the ebonite coated sleeve and the OHNS piston, is done by the crowning of the piston. Crowning will try to reduce the contact area drastically – in-fact it will reduce the area contact to line contact.

The effect of thermal obstacle coated piston crowning on an engine characteristics. A crowning of 3 microns is given on both sides of the piston as shown in the figure.3.0

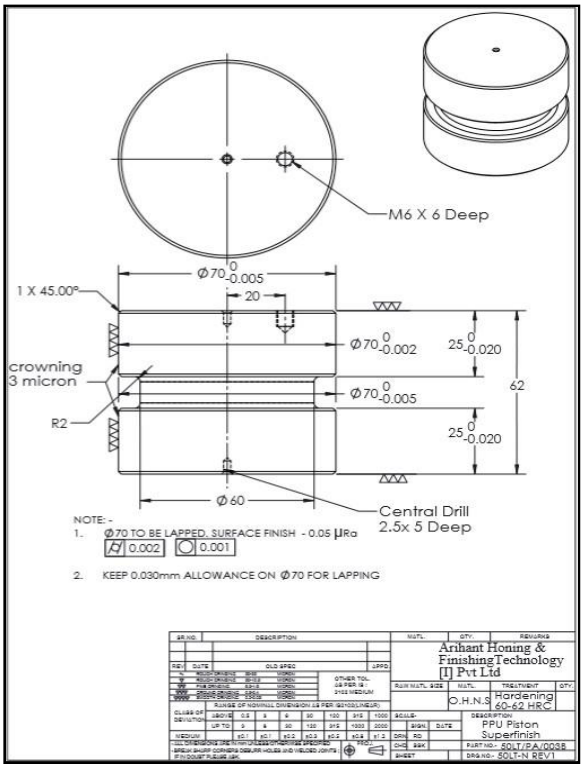

Figure.:3.0Piston specification and crowning

V . CONCLUSIONS

1. The reason for the jam between the sleeve and the piston is analyzed using Finite element analysis. The results

January - February 2020
ISSN: 0193 - 4120 Page No. 116 - 124

showed that the sleeve deforms by an amount of 6 microns.

2. Coating material Ebonite has a very low thermal conductivity of 0.17 W/mK compared to OHNS which is 60.5w/m^0 K.

3. The pin on disctest performed on the disk which is coated by ebonite rubber, and pin made up of OHNSmaterial showed a temperature rise of 37^0 C

4. It is observed from the analysis (EbonitetoOHNS)the deformation received is 2 micron which is less than 5 micron, which is required for the freely oscillate the piston inside sleeve.

5. A practical is conducted with Ebonite coated sleeve andrun the machine uninterrupted gives a very good results both the cases 1.high temperature and2. Places where the atmospheric temperature in winter are very low because this also avoids shrinkage of material. This is possible due to thevery low thermal conductivity of ebonite material.

6. The spoilage of the Ebonite coating from inside of the sleeve due to heat generated in achieving the transition fit between the cylinder and the sleeve can be avoided by coating the outer of the sleeve with 64C1-2-A (High-temperature Resistance Insulation Coating).

7. Further reduction of the friction is achieved by crowning the piston with 3 microns on both sides of the piston drums. This reduces the area contact to line contact, hence gives excellent results in workingcondition.

References

1. M Basavaraj Shrigiria, D Hebbal Omprakash & Reddy K Hemachandra 2016, ‘Performance, emission and combustion characteristics of a semi-adiabatic diesel engine using cotton seed and neem kernel oil methyl esters’, Alexandria Engineering Journal, vol. 55, no. 1, pp. 699–706.
2. Lepeshkin Alexander, Investigations of thermal barrier coatings for turbine parts, Ceramic Coatings, applications in Engineering, www.intechopen.com (accessed on 4-16-2015)
3. Bhatia, Thermal spraying technology applications and Engineering Materials, Vol. 1110, No.2, (1999) 3401.
4. MevrelR., “State of the art on high-temperature corrosion-resistant coatings, Mater. Science Engineering”, A, (year 1989) 120:13–24.
5. DA Dhananjaya,.,P Mohanan.&CV Sudhir, 2009, ‘Emission and combustion characteristics of diesel, B100 and B20 fuel on a thermal barrier coating on piston crown in direct injection Compressed Ignition engine with optimised IOP and IT’, SAE year 2009-28-0042.
6. AR Manickam.,K Rajan, Kumar KR Senthil.&N Manoharan. 2015, ‘Emission and combustion characteristics of diesel engine with effect of thermal barrier coating on the piston crown using biodiesel’, International Journal of Chem Tech Research, no. 7vol.,8. pp. 397-405.
7. Khan A. N., Lu J., Liao H., Heat treatment of thermal barrier coatings, Materials and Engineering, A 359, (year 2003) 129 – 136.
8. R Streiff,R Krutenat,.& MGaillet. (year 1989) The Reactive Element Effect in HighTemperature Corrosion, High Temperature Corrosion. No.2, pp. 129-137.
9. R, A Miller,, R.G Garlick. &J.L. Smialek, (1983). Phase Distribution in Plasma-Sprayed Zirconia-Yttria. Am. Ceram. Soc. Bull., Vol.63, No.12, pp. 1355-1358.
10. A.R Lepeshkin,.; , N.G Bychkov. &A.V. Perchin, (2005). Turbine Blade, R.U. Patent 2259481, July 27, year 2005.
11. A.R Lepeshkin,.; , N.G Bychkov. &A.V. Perchin, (2005). Flame Tube of a Combustion Chamber, R.U. Patent 2260156, 10 September2005.