TREND OF OVALITY, TENSION, CLOSED GAP & ANALYSIS OF CPC THICKNESS, BARREL PEAK IN CASE OF PROFILE GRINDING AND THEIR FURTHER IMPROVEMENT

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ABSTRACT

Now a day's various methods are in use on cylinder piston group for improving service life of IC Engine for reducing exhaust emission and improving engine performance. The wear resistance of thermal sprayed molybdenum applicable to the piston ring will be studied in this review. Wear resistance of molybdenum coated piston ring is high as compared to ordinary cast iron rings. Experiments on life cycle is to be performed on the compressed natural gas engine as per IS Standard for specified operating parameters. Oil lubricity test done on oil sample would give measure of wear. And wear effect on piston ring is investigated based on performance parameters like Brake specific fuel consumption, Brake power, exhaust gas temperature, Brake thermal efficiency and exhaust emissions like NOx, CO, HC, and O2. Results will be compared for both coating and non-coating condition. So by reviewing research on effect of piston ring coating, we can improve the performance of SI Engine

Internal Combustion Engine is a device in which heat is generated as a result of combustion process .This heat of combustion product is used to produce the work. To produce the work, the combustion is carried out in such a way that high pressure combustion product would be expanded through the piston. So engine life depends mainly on the part of the engine. So consequently service life of the engine can be increased by considering the part which dominates its major role in the working condition of the engine. The split piston ring was invented by John Ramsbottom who reported the benefits to the Institution of Mechanical Engineers in 1854. It soon replaced the hemp packing hitherto used in steam engines. The use of piston rings at once dramatically reduced the frictional resistance, the leakage of stream, and the mass of the piston, leading to significant increase in power and efficiency and longer maintenance intervals. Most automotive pistons have three rings: The top two while also controlling oil are primarily for compression sealing (compression rings); the lower ring is for controlling the supply of oil to the liner which lubricates the piston skirt and the compression rings (oil control rings). At least two piston rings are found on most piston and cylinder combination. Typical compression ring designs will have an essentially rectangular cross section or a keystone (right angled trapezoidal) cross section. The periphery will then have either a barrel profile (top compression rings) or a taper napier form (second compression rings or scraper rings). There are some taper faced top rings and on some old engines simple plain faced rings were used. The piston might be a fairly loose fit in the cylinder. If it were a tight fit, it would expand as it got hot and might stick tight in the cylinder. If a piston sticks (seizes) it could cause serious damage to the engine. On the other hand, if there is too much clearance between the piston and cylinder walls, much of the pressure from the burning gasoline vapour will leak past the piston (a condition known as blow-by) and into the crankcase, and the push on the piston from combustion will be much less effective in delivering power. Piston rings for current internal combustion engines have to meet all the requirements of a dynamic seal for linear motion that operates under demanding thermal and chemical conditions. In short, the following requirements for piston rings can be identified: Low friction for supporting the high power efficiency rate. Low wear of the ring, for ensuring a long operational lifetime. Low wear of the cylinder liner, for retaining the desired surface texture of the liner. Emission suppression, by limiting the flow of engine oil to the combustion chamber. Good sealing capability and low blow-by for supporting the power efficiency rate. Good resistance against mechanothermal fatigue, chemical attacks and hot erosion. Reliable operation and cost effectiveness for a significantly long time.

REVIEW ON PISTON RING COATING A. Marcus Kennedy (2012) studied on Piston ring coating reduces gasoline engine friction and developed a coating system for piston rings under the name of Carboglide which decreases wear in highly charged gasoline engines and further reduces friction losses which occur between the ring pack and the cylinder running surface. The tailored composition of the specific layer structure of the carbon-based Carboglide coating in combination with corresponding modified piston ring designs yields a potential to improve fuel efficiency by up to 1.5 %. Piston Ring coating combines extremely low friction values with high strength and durability of piston rings and cylinder running surfaces. By using this coating, the ring pack's frictional losses can be reduced by up to 20 %. It significantly protects the cylinder running surface against scoring, increased wear and scuffing during inadequate lubrication. Carboglide makes a substantial contribution to the development of high performance gasoline engines with even better fuel economy by up to 1.5 % with consequently lowering CO2 emissions. B. Yucong Wang (1999)Studied on Scuffing and wear behaviour of aluminium piston skirt coatings against aluminium cylinder bore. Various coatings, especially nickel based ceramic composite.

ANALYSIS METHODS

Root Cause Analysis

Sir Miles C. Miller Research Directorate September 1992 state the primary purpose of a Root Cause Analysis is to identify the real source (i.e., root causes) of a problem. It is someone else's job to solve the problem. A formal, systematic process is followed which identifies the root causes as well as documenting the basis for these results. There are many different techniques in use to achieve this end sometimes referred to as Failure Analyses, Problem Investigations, etc. A particular Root Cause Analysis Methodology which is employed throughout will be presented in this report.

The Root Cause Analysis includes a sequential series of steps which will both determine the root causes as well as document the basis for this determination. Some flexibility is possible, where the technique can be adapted to fit various technical situations, time, funding, etc

Handling the Finish Lapping Operation

Next, for tackling the other critical process, namely the Finish lapping operation, first an Ishikawa diagram (Montgomery, 1991, pp. 121–124) (see Figure 1.1) was prepared showing the various causes which might be affecting the axial thickness variation in the finish lapping operation. The Ishikawa diagram threw new light on the number of possible deficiencies in the machine, method and material that might be responsible for axial thickness variation in the finish lapping operation. The Ishikawa diagram narrowed down the machine-related causes to six factors. These were grinding wheel rotating speed, grinding time, grinding pressure, holding plate, holes (fixtures) within the holding plate and positions within a ring. Similarly, according to the Ishikawa diagram, two other important factors affecting axial thickness were coolant and dressing frequency of the grinding wheel. Thus, after studying the Ishikawa diagram it appeared that dimensional accuracy and the quality of surface finish, which could be achieved in a finish lapping operation, mainly depended on the following eight factors:

(1) Grinding wheel rotating speed

(2) Grinding time

(3) Grinding pressure

(4) Holding plate

(5) Holes (fixtures) within the holding plate

(6) Position within a ring

(7) Dressing of grinding wheel and

(8) Coolant

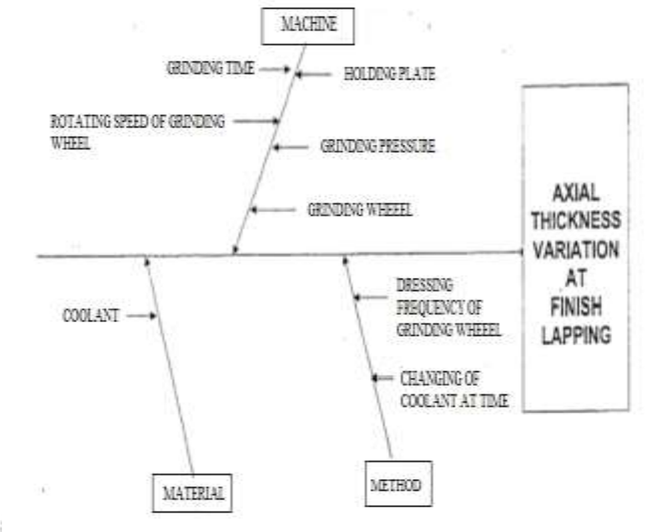

Fig-1.1 Ishikawa Diagram

Dressing of the wheel means removal of abrasive material from the cutting face and the sides of the wheel, so that it runs properly with respect to the axis of rotation. Dressing involves removing the worn out grains and loaded materials from the surface of the wheel, restoring the original geometric shape and preparing the wheel for the next grinding. Dressing of the wheel is accomplished by a single-point dressing diamond. During grinding, the surface of the rings in contact with the grinding wheel can experience considerable heat. Because of the material properties involved in the process, most of the heat generated at the contact is transferred to the rings, with only a little conducted to the grinding wheel. Hence a coolant system is used to cool the rings and flush the wheel. Thus, although coolant and dressing might affect the axial thickness, their effect is of an indirect nature. Moreover, since the effect of coolant and dressing of the wheels might only deteriorate over time, initially for the experiment with the other six factors, data were collected immediately after the wheels were dressed and the coolant was changed. However, to study the effect of these two factors, the experiment was again repeated under the optimal settings after a sufficiently long production run, details of which are provided later. For the remaining six factors, since no a priori engineering information was available about how they might be affecting the axial thickness during the finish lapping operation, it was reasoned that the only way to understand these effects would be to conduct a controlled and well-designed experiment. The design of this experiment is described in detail in the following subsection.

CONCLUSION AND RECOMMENDATION

This research project started with an aim of solving the general quality problem faced by an organization manufacturing piston rings for automobile IC engines. One of the major goals of the project was to develop and document a methodology that might be followed for tackling such quality problems from scratch. To develop this methodology, the most problematic ring was picked up as an example, using this as a case study. The main contribution of this work lies in laying down the systematic steps, outlined in the hierarchical sections and subsections of this article, that may be followed while trying to tackle similar quality problems, apart, from solving the quality problem for an interesting case. The case-specific conclusions of this study are as follows:

(1) Thickness was the critical quality characteristic leading to the lion's share of rejection for the double bevelled edge slotted oil ring of 83.0 mm diameter.
(2) There were four operations that were affecting the quality characteristic, namely rough and medium grinding and first and finish lapping.
(3) The two grinding operations were not critical but the lapping operations were.
(4) The first lapping operation could be brought under statistical control by performing it on the DFS medium grinding machine instead of the lapping machine.
(5) The finish lapping operation could be brought under control by setting the controllable factors of the operation at optimal levels, which were as follows: Grinding Speed 3000 RPM, Grinding Time 10 s and Pressure 300 daN

(6) The dressing of wheels and changing of coolant might affect the quality but the quality did not deteriorate even after machining 2000 rings, and thus wheels might be dressed and coolant might be changed after machining every 2000 rings.

(7) As a result of this study, the organization earned extra profit of more than its per annum income by scientifically controlling the quality of just one characteristic of just one of their 800 odd piston ring products.

References:

1. Victor Kane, "Process Capability Indices", Journal of Quality Technology, Jan 1986.
2. ASQ / AIAG, "Statistical Process Control", Reference Manual, 1995.
3. John Clements, "Process Capability Calculations for Non-Normal Distributions", Quality Progress, Sept 1989.
4. Forrest Breyfogle, "Measurement of Process Capability", Smarter Solutions, 1996.
5. Bissell, "How Reliable is Your Capability Index", Royal Statistical Society, 1990.
6. Chou, Owen, and Borrego, "Lower Confidence Limits of Process Capability Indices", Journal of Quality Technology, Vol 22, No. 3, July 1990.
7. Miller, M.C., Weber, D.J., Young, G.P., Hansen, C.S., Sherwood, C.M., Vanderhoff, J.A., and Magistro, A.E., Root Cause Analysis RP Payload Exnulsion/Ignition Problem XM264, 2.75-Inch Rocket. Smoke Screening Warhead, CRDEC-SP-018, U.S. Army Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD, January 1990.
8. Byrne, D. M. & Taguchi, S. (1987) The Taguchi approach to parameter design, Quality Progress, 20(12) pp. 19–26. Kacker, R. N. & Shoemaker, A. C. (1986) Robust design: a cost effective method for improving manufacturing processes, AT&T Technical Journal, 65(2), pp. 39–50.
9. Montgomery, D. C. (1991) Introduction to Statistical Quality Control, 2nd edn s(New York: Wiley). Neter, J., Wasserman, W. & Kutner, M. H. (1990) Applied Linear Statistical Models (Chicago: Richard D. Irwin).
10. Phadke, M. S. (1989) Quality Engineering Using Robust Design (New Jersey: Prentice Hall). Production Technology (1992) HMT Handbook. Ross, P. J. (1988) Taguchi Techniques for Quality Engineering (New York: McGraw-Hill). Roy Ranjit, K. (1990) A Primer on Taguchi Method (Dearborn, Michigan: Society of Manufacturing Engineers)