WEAR RESISTANCE OF HARD CHROME COATINGS FOR PISTON RINGS

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Abstract - This paper deals with the resistance behavior of ion plasma hard chromium coating, which is used for piston ring. Wear resistance tested by the pin-on-disk method. Coating for pin-on-disk deposited on a steel plate. Cast iron ball used for the counterpart. The evaluation performed by Simple Electron Microscope (SEM). The hard chromium shows low wear rate as compare to parent material and the wear rate calculated by weight loss method

Key Words: Piston Rings, Coatings, PVD, Pin on disc Tribometer, WINDCUM 2008.

1. INTRODUCTION

Fuel economy is the primary reason, for increasing performance of modern combustion engine. To reduce CO_2 emission. In a combustion engine operating conditions, up to 50% of frictional losses due to piston assembly friction[1-3].The frictional contact between the piston rings and cylinder liner plays a central role because a substantial amount of friction losses within a combustion engine linked to the piston ring package[4].Hard chrome ion plating of Piston Ring introduce during World War II. This coating firstly used in an aircraft engine. The reason is that significant reduction of wear and friction in piston ring. At present hard chromium coating was used for surface treatment of the working surface of piston ring for both gasoline and diesel engine and also for the compressor. The advantages of Cr coating apply only to own thermal and mechanical loads of piston ring[5]. Exceed of this condition there is a risk of lubricating film disorder. To improve the property of chromium coating we use porous chrome. The microscopic pores are helpful in lubricant hold. Another improvement addition of hard filler in chrome matrix. Firstly used Al_2O_3.Their chrome ceramics surface treatment (CKS) is the typical solution for medium-duty engines today. Gas pressures in some diesel engines already exceed the value of 20MPa, which taken as a boundary for the applicability of the CKS.

1.1 Testing of coatings for piston rings

The testing of coatings for piston rings directly in a combustion engine in the vehicle. This testing is very time consuming and costly. A cheaper variant is testing on a dynamometer. The dynamometer is a device for stationary testing of the combustion engine. These test can perform for short term (40-60h). Short term test verifies the influence of component on the engine parameter. Long term test used to track the life of Engine component. Tribological methods "pin-on-disc" also used But compared with engine test are not as accurate. Their advantage is the cost and test speed.

The aim of this work to determine the wear behavior of chromium in combustion engine by test on a pin-on-disk and predict the life of the engine.

2. Experimental Details

2.1 PVD coating

Thermal Physical Vapour Deposition is a form of physical vapor deposition in which a target node bombarded with an electron beam given off by a charged tungsten filament under high vacuum. The electron beam causes atoms from the target to transform into the gaseous phase[6]. These atoms then precipitate into solid form, coating everything in the vacuum chamber (within line of sight) as a thin layer of coating material. Coatings deposited on the plate.

2.2 Pin on disk Tribometer

Pin on disc wear method used because of cost and time effective, easy to use, and board wear tracks to understand wear performance. The Pin on disc machine was attached to the computer with software WINDCUM 2008. The sample disc fastened on the machine with the help of screws shown in fig.2. The coating surface and pin initially washed with methyl alcohol so that, moisture should not be present on the coating surface. The load was applied on a pin by dead weight through pulley cord arrangement. The system had a maximum loading capacity of 200 N. The test performed under dry, unlubricated condition. The wear rate calculated by weighing the disc and pin before and after the wear test regarding grams of an electronic balance of least count 0.00001g.There were two parameters-Load &Speed which were taken into consideration to determine the wear rate and coefficient of friction

The dimension of the sample was 70x80 mm. The thickness of the coating was about 250μm.

Fig -1: Pin-on-disk tribometer

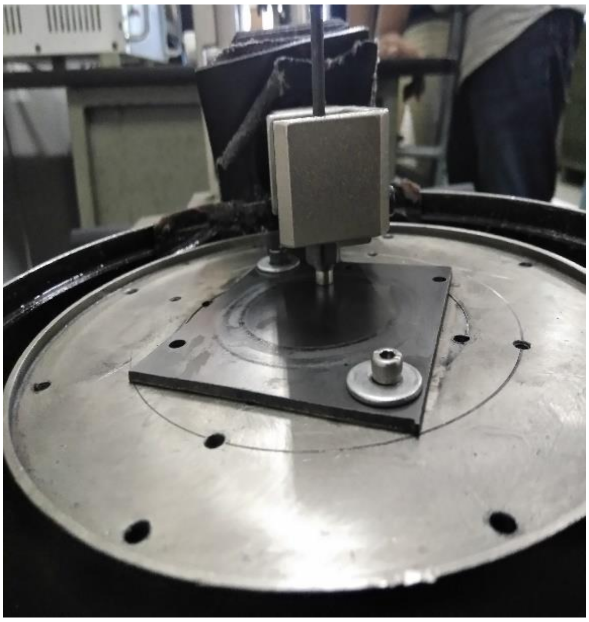

Fig -2: Fixing the sample

During the wear test, some amount of chips got deposited on the pin in the form of a tribolayer. After each test, chips deposited on the pin were cleaned to ensure that there was always a direct contact between the pin and the coating surface. The parameters required are speed in rpm and load in Kg. Based on the parameters the system will generate the values of coefficient of friction and values of frictional force for the given time-period.

2.3 Specification

Pin diameter :6mm

Applied load :5,6,7kg

Pin length :50mm

Velocity :1m/s

Track diameter :60,50,40mm

Total time for each track :42min

Disk thickness :10mm

Speed :318,382,478rpm

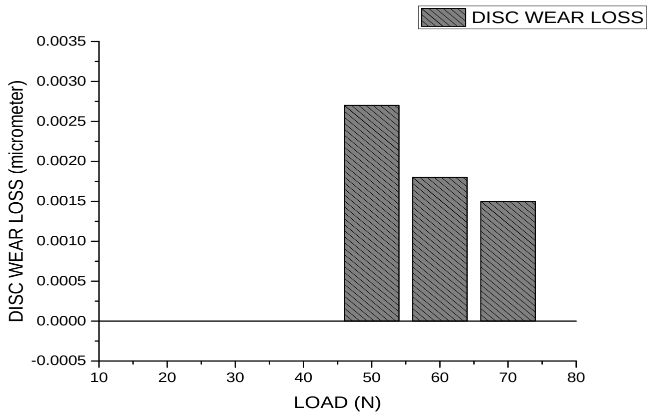

Fig -3

On rubbing between pin and disc, friction heat generated due to which there is a loss of both material i.e. wear loss.

In this experiment, the wear loss of disc is decreased on increasing the load while sliding distance is same as shown in fig-3.

On increasing the load, the wear loss of pin also increases for same sliding distance as in fig-4.

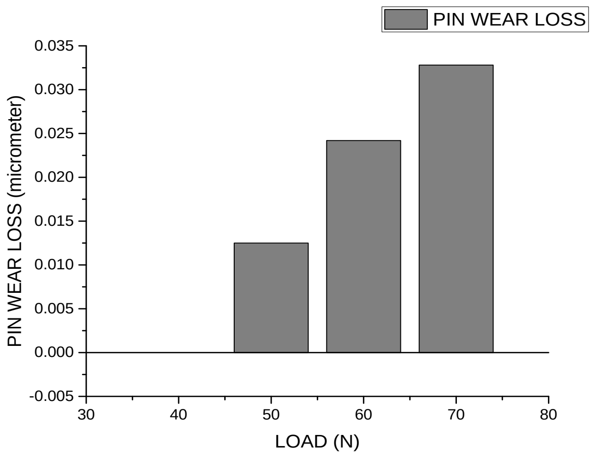

Fig -4

S.No.	DIAMETER (mm)	LOAD (N)	DISC RPM	PIN WEIGHT (gm)		DISC WEIGHT (gm)		FRICTION COEFFICIENT
				INITIAL	FINAL	INITIAL	FINAL	
1.	60	50	318	12.1482	12.1357	82.7675	82.7648	0.26
2.	50	60	382	12.1357	12.1115	82.7648	82.7630	0.35
3.	40	70	478	12.1115	12.0787	82.7630	82.7615	0.36

3.0 Results and Discussion

Experimental values of the coated specimen

Table for coated Disc and Pin:

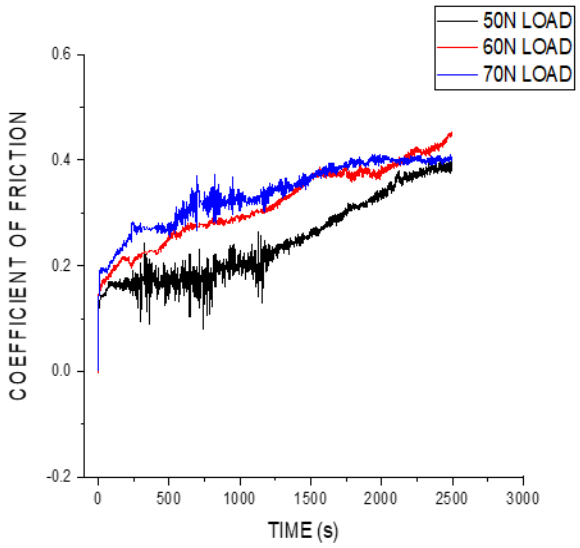

Fig-5

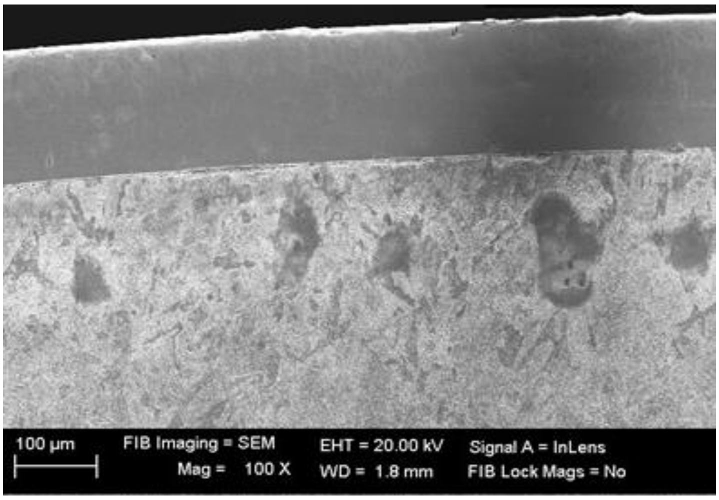

Fig-6 SEM image of coated plate

4. CONCLUSIONS

The following conclusions can be drawn from the present study:

1. The wear rate of the coatings can be found with the help of pin on disc test under dry sliding conditions.
2. The design of experiment was such that the variable chosen load (50, 60 & 70 N) with ion Cr coated disc and increasing sliding speed (318, 382 &478 rpm) and their interaction was significant.
3. The wear rate dependent on the load and the sliding speed. With the increase in load, the wear rate was found to be decreased. The wear rate was also found dependent on the pin material.
4. The wear resistance increased with the chromium ion coating on the substrate.
5. The coefficient of friction increases with increasing the load.

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BIOGRAPHIES

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