EFFECT OF PVD COATING ON MECHANICAL

CHARACTERISTICS OF CAST IRON

Thirumoorthy B[1], Vijay M[2], Selvakumar M[3]

[1] U G Student Department of Mechanical Engineering, PSVPEC, Chennai, India

[2] U G Student Department of Mechanical Engineering, PSVPEC, Chennai, India

[3] Assistant Professor Department of Mechanical Engineering, PSVPEC, Chennai, India

Abstract

The aim of our project is to coat on cast iron with the use of physical vapour deposition(PVD). In PVD the coating temperature is about 400-600 c. The boron carbide(B4C) is selected to coat on cast iron to measure the surface roughnessand wear resistance.Vapour deposition coating for high-speed machining consist of multiple layers because of the requirements for high adhesion strength to the substrate,high thermalstability,hardness,A low coeffiecient friction and put compactability.

Keywords *– Emission, Inlet Air, TEG.*

I. INTRODUCTION

The project is based on PVD coating on cast iron with boron carbide (B4C).Over the past approximately two centuries, there has been significantly changing thin film deposition process. Indeed, Fraunhofe first observed generating of thin film layer over 195 years ago on the surface of glass .According to Wasa, Kitabatake a thin film is a small-dimensional material on the substrate produced by intensifying, one-by-one, and ionic/molecular/atomic species of matter. The thickness of thin film is generally less than a number of microns. In fact, there is another type of film that is called thick film, which is known as a small-dimensional material formed by accumulating great grains/aggregates/clusters of ionic/molecular/atomic species or thinning a three-dimensional material. Factually, over the past 50 years, the thin films have been used for manufacturing optical coatings, electronic devices, decorative parts, and instrument hard coatings.The aim of this project is to illustrate similarities and differences between two types of deposition process, which are physical vapour deposition (PVD) and chemical vapour deposition (CVD), for producing thin film material on the substrate. In addition, the purpose of this paper is to evaluate the most favourable methods of deposition process of thin film. Firstly, this project will not only provide a brief overview of physical vapour deposition and its types that are thermal evaporation and sputtering, but also explain advantages and disadvantages of PVD system in section one. Moreover, it

II. RELATED WORK

1.**K.Ermalitskaia etal (2016)** Double pulse LIBS is a very effective technique of a direct layer-by-layer analysis of micron PVD-coatings, enabling studies of the curved surface of samples without the preliminary chemical or mechanical treatment in the air. To control a thickness of the evaporated layer by changes in the radiant flux density, one should use the defocusing method when double laser pulses meet all the requirements to the spectrum excitation source for a direct layer-by-layer analysis of thin coatings. The developed analytical techniques may be used in quantitative and qualitative analysis in layers of PVD coatings on metal and nonmetal objects including metal and nonmetal objects, both flat blank samples and commercial products of intricate form.

2**.Sundaravadivelu etal (2016)** Distance is the highest statistical factor, in wear rate followed by sliding speed and load has very less influence. According the F table ANOVA for SWR shows that distance is significant parameter.The confirmation test shows that error associated with dry sliding wear of the GCI is less than 5%. The similar test specimens are to be coated with nano particles in the PVD machine. The similar processes and analysis to be carried out for the nano coated samples. The best samples of different wear tests are to be analyzed under Scanning Electron Microscope (SEM).

3**.Dler Adil Jameel (2015)** Generally, there is not only physical vapour deposition system to produce thin film, but there is also chemical vapour deposition. In this project, several important aspects and techniques about thin film deposition process have been presented such as a brief overview of PVD process, types of PVD system that are thermal evaporation and sputtering, a brief overview of CVD process, PECVD that is a significant technique of CVD, and advantages and disadvantages of both systems. Finally, compare and contrast PVD and CVD have been discussed. From explanation of thin film deposition processes that are PVD and CVD. It can be concluded that the thermal evaporation technique, particularly which has electron beam source, is the most favourable methods for depositing thin film for materials that have high and low melting. By contrast, sputtering method is useful for depositing thin film for polycrystalline. On the other hand, for dielectric films the PECVD system is more beneficial than other CVD systems. Moreover, according to the many research, it can be seen that PVD is more favourable than CDV technique for fabricating thin film.

4.**J.Rey etal (1989)** By using indentation technology the elastic behavior of carbides richer in boron than B4C, classically characterized, can be investigated. The "B50C2" compound was tested. Coatings prepared by L.P.C.V.D. exhibit mechanical properties strongly related to their chemical, crystallographic and micro structural characteristics which are dependent on processing conditions more specially the gas mixture composition and the substrate temperature. Hardness is more influenmd by the grain size, while elastoplastic behavior is more related to the presence of preferential crystallographic directions. The composition of the solid solution and so inter atomic bondings are important for both characteristics. YOUNG'S modulus changes can only be related to composition. This characteritation leads to the evaluation of an apparent elastic modulus which is probably inferior to the real one if we consider correction by ratio 1/(1 - v2), and that the indenter is presumed to be rigid.

5. **Imam syafa etal (2015)** In the present study, the effect of sliding distance and material hardness on wear depth, wear width and wear volume were analysed. The experimental method based on a pin disk tribotester was used. A few summaries can be made in this study. First, the material hardness greatly affects wear volume; the higher wear volume occurs on material FCD 40 and lower wear volume occurs on FCD 60. Second, increasing sliding distance increases the wear volume, wear depth and wear width

III. OBJECTIVES

The main objectives of our project are

1. To make a boron carbide powder into pellet form
2. To coat on cast iron with boron carbide.
3. To obtain wear resistance test.
4. To obtain surface roughness test.

IV. COATING PROCESS

The PVD coating is used to reduce friction or to improve oxidation resistance of a substance or to improve the hardness, etc.Hard coatings if applied by physical vapour deposition (PVD) are principally known to have the ability to reduce tool wear of high speed steel (HSS) and carbide metal cutting tools. The purpose of the physical vapour deposition (PVD) process is to protect the surface steel from corrosion and wear and then decrease their reactivity with the external medium. Availability of tools with sharp cutting edges is essential in light turning of small parts; so that smooth operation is favoured with minimal cutting forces avoiding part deformations and, consequently, dimensional errors.

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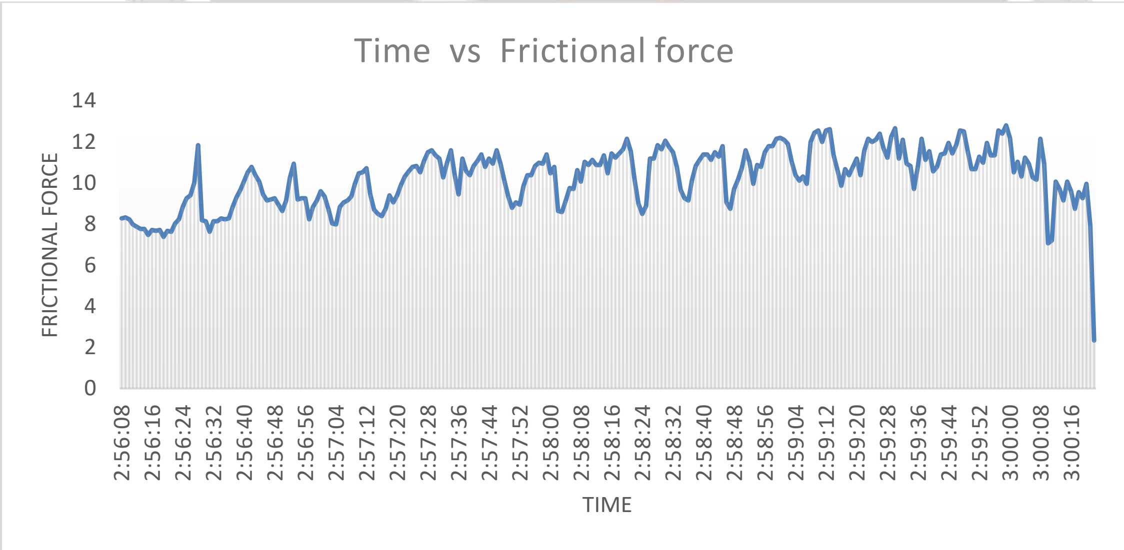
V. DIAGRAM

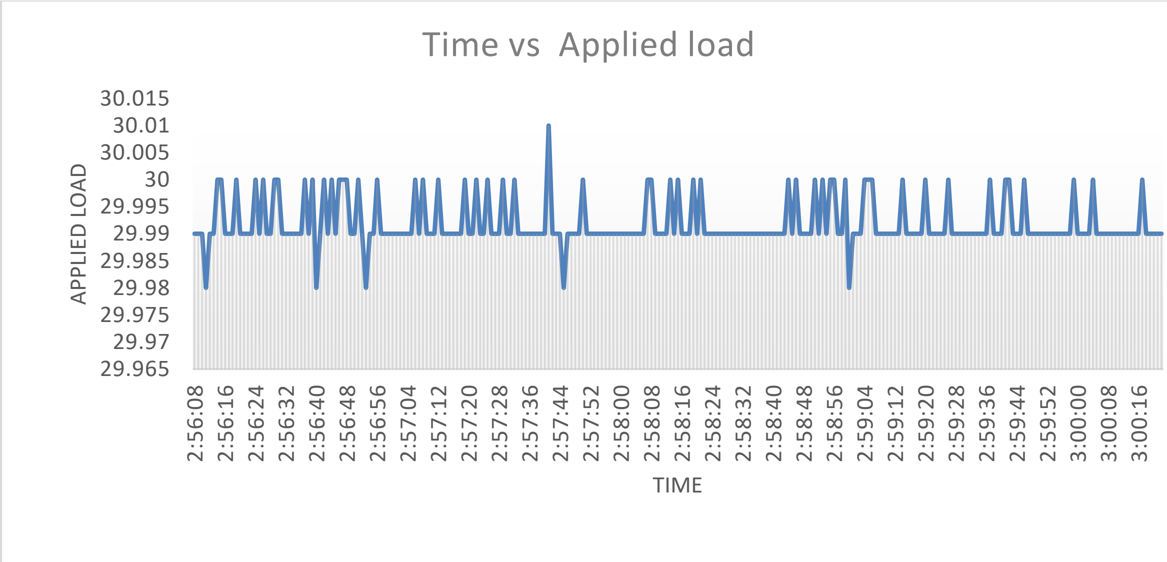
Figure 1. Coating Diagram

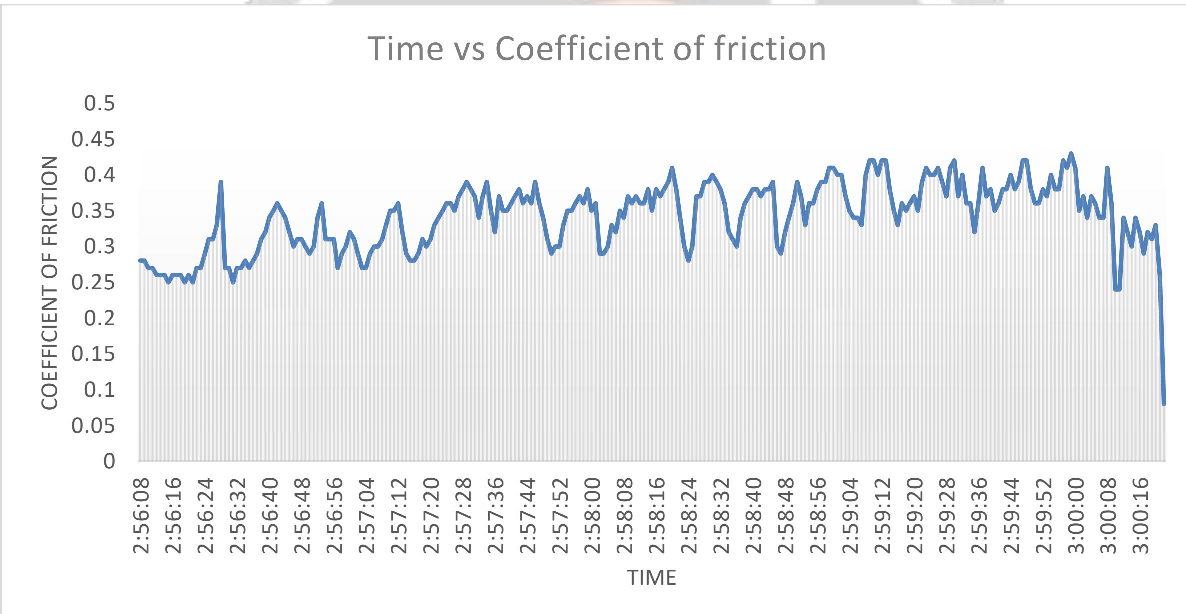
VI. SURFACE ROUGHNESS &WEAR RESISTANCE TEST

1.GRAPH OF WEAR TEST FOR UNCOATED MATERIAL

i. For 3kg load at speed of 637 rpm in 5minute



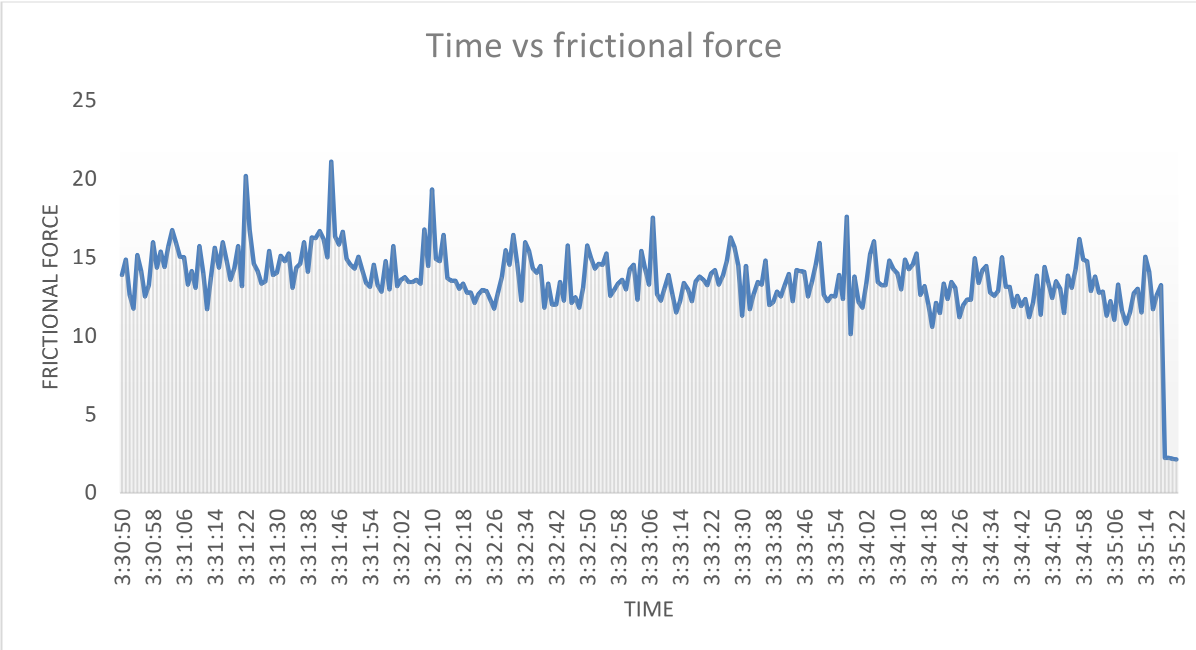




2.GRAPH OF WEAR TEST FOR COATED MATERIAL

1.Cast iron

i. For 3kg load at speed of 637rpm in 5minute


Time vs frictional force
FRICTIONAL FORCE
25
20
15
10
5
0
3:30:50
3:30:58
3:31:06
3:31:14
3:31:22
3:31:30
3:31:38
3:31:46
3:31:54
3:32:02
3:32:10
3:32:18
3:32:26
3:32:34
3:32:42
3:32:50
3:32:58
3:33:06
3:33:14
3:33:22
3:33:30
3:33:38
3:33:46
3:33:54
3:34:02
3:34:10
3:34:18
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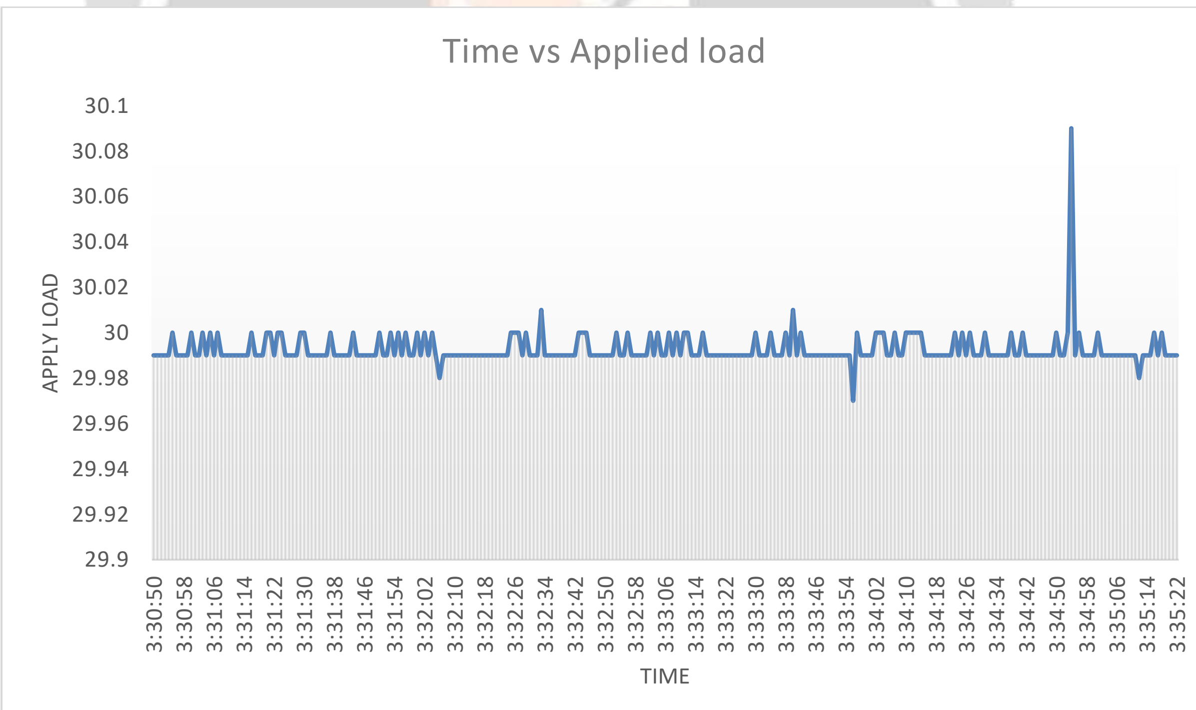
3:34:42
3:34:50
3:34:58
3:35:06
3:35:14
3:35:22
TIME


Time vs Applied load
APPLY LOAD
30.1
30.08
30.06
30.04
30.02
30
29.98
29.96
29.94
29.92
29.9
3:30:50
3:30:58
3:31:06
3:31:14
3:31:22
3:31:30
3:31:38
3:31:46
3:31:54
3:32:02
3:32:10
3:32:18
3:32:26
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3:34:18
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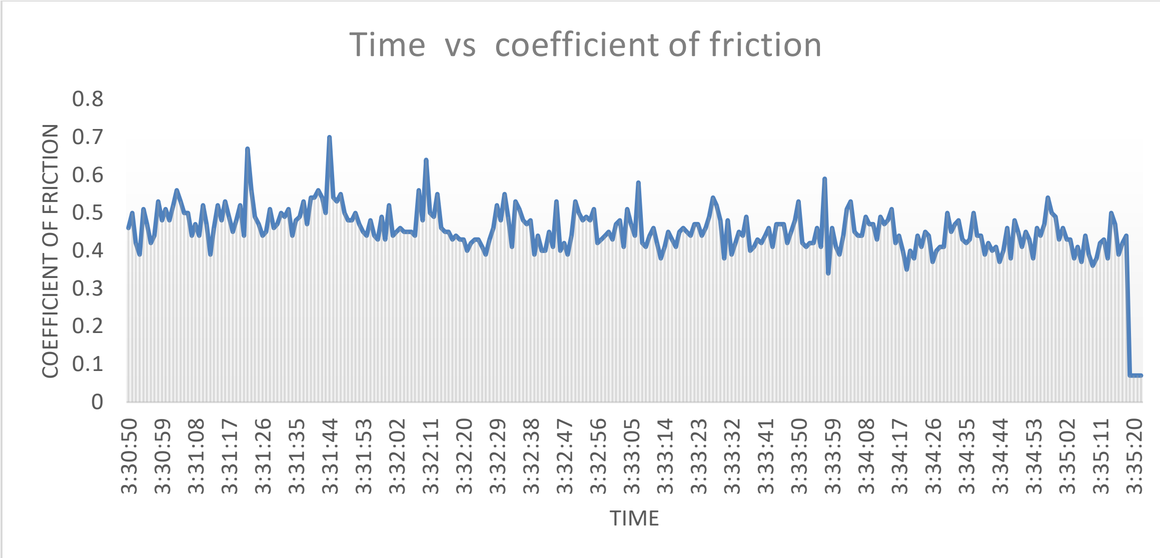
TIME



4.SURFACE ROUGHNESS TEST FOR UNCOATED MATERIAL

TIME(SEC)	FRICTIONAL FORCE(N)	SPEED (RPM)	LOAD(N)	COEFFICIENT OF FRICTION
210	18.28	637	29.99	0.38
211	19.35	637	29.99	0.31
212	10.37	637	29.99	0.45
213	20.16	637	29.99	0.44
214	22.44	637	29.99	0.48

5.SURFACE ROUGHNESS TEST FOR COATED MATERIAL

TIME(SEC)	FRICTION FORCE(N)	SPEED (RPM)	LOAD(N)	COEFFICIENT OF FRICTION
210	13.88	637	29.99	0.26
211	15	637	29.99	0.3
212	14.03	637	29.99	0.37
213	14.44	637	29.99	0.38
214	13.07	637	29.99	0.34

VII. **CONCLUSION**

The solution to the physical vapour deposition coating with boron carbide on cast iron it is experimentally explained that in wear resistance tester with same speed and same load there is a variation in decrease of coefficient of friction and frictional force in coated material when compared to uncoated material. The surface roughness for wear tested materials is poor for uncoated material when compared to coated material. we conclude that the coated material having minimum wear resistance when compared to uncoated material

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