International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 06 | June-2016 www.irjet.net p-ISSN: 2395-0072

ANALYSIS OF TRIBOLOGICAL PROPERTIES OF VARIOUS LOW FRICTION COATINGS WITH HSS AS A SUBSTRATE

TUSHAR A PATIL[1], PRASHANT N ULHE[2], DR. DHIRAJ S DESHMUKH[3]

[1] TUSHAR A PATIL, S.S.B.T.C.O.E.T, JALGAON
[2] ASST PROF. PRASHNT N ULHE, DEPTARTMENT OF MECHANICAL ENGINEERING, S.S.B.T.C.O.ET, JALGAON
[3]DR.DHIRAJ S DESHMUKH, HEAD OF DEPARTMENT MECHANICAL ENGG, S.S.B.T.C.O.E.T, JALGAON

Abstract: *Cutting is very important process in fabrication industry and tools used for cutting application are more prone to wear and tear. In this project base material is HSS and various coating are to be done on this base material, specially low friction coating material like TIALN, ALCRN, TIN, TICN are used in thesis and to analyze all these materials Experimental set up of friction and wear controller machine is used , pins with high speed steel as a base material and coated with respective wear resistant material are to be tested on this machine. The readings of the experiments like wear, coefficient of friction are then analyzed on minitab software so that we will get regression equation for various materials for different parameters. and With the help of software results as well as experimental results we can compare all the coating materials and also we can find out the best material for coating so that the tool wear will be minimized for cutting processes*

Key Words: **HSS, COATING, WEAR, FRICTION**

1.INTRODUCTION

Depositions of surface coating materials is one of the important approaches in improving friction and wear properties of the surface, there is a growing demand for low friction coatings that allow contacting surfaces to rub against with reduced friction and wear. Hence, the use of low friction coatings like TiN, TIALN and ALCRN is to improve the tribological properties of tools for metal cutting, forming and machine elements e.g. sliding bearings, seals and valves etc. It is therefore of strong scientific interest to conduct fundamental tribological research on the materials that exhibits low friction and can be used for surface coating on surfaces to rub against with reduced friction and wear. The reasons to coat cutting tools in a production situation are to increase tool life, to improve the surface quality of the product, and to increase the production rate. The advantages of this coating include high hardness, good ductility, excellent lubricity, high chemical stability and tough resistance to wear, corrosion and temperature. With the growing popularity of coated tools and new development of coating process, there is need to compare various coatings to select the most suitable one. This report deals with the study of the performance of coated tools in machining hardening steel under dry conditions.

1.1 The Parameters considered during experiment are:

1. Wear analysis of various coatings (TIN, TIALN, TICN, ALCRN, WC) with HSS as substrate for effective cutting operation.

2.To study frictional properties of various coating (TIN, TIALN, TICN, ALCRN, WC) with the help of tribometer.

3.Tribological analysis of various low friction coating materials (TIN, TIALN, TICN, ALCRN, WC) for varying experimental parameters (speed, sliding distance, load)

1.2 OBJECTIVES OF THE PRESENT WORK

1. To apply various coatings on HSS samples to get increased hardness.
2. To check wear of (TIN, TIALN, TICN, ALCRN, WC) coated HSS samples using friction and wear test.
3. To perform experimentation with suitable parameters using Taguchi approach on pin on disc machine.
4 To perform ANOVA and regression analysis to determine most affecting parameter on wear by using minitab software.
5. To compare results of wear for various coatings to obtain suitable coating material

2. BASE MATERIAL AND COATING MATERIAL

High speed steels offer higher bend strength than any other cutting materials.

High bend strength allows:

- Better cutting resistance to edge chipping
- Extended cutting depth, i.e. fewer cuts
- Increased feed per tooth

Thanks to the unique strength of high speed steels, tool manufacturers can produce super sharp edges. A sharp cutting edge has many advantages

1. Better quality

2. Longer tool life

3. And economy

4. Resist vibrations

Are suitable for special and difficult machining conditions

Resist thermal shocks, and are adaptable to all lubrication conditions

COATING MATERIALS

Coatings considerably improve tool life and boost the performance of HSS tools in high productivity, high speed and high feed cutting or in dry machining, and machining of difficult-to-machine materials

Titanium Nitride (TiN)

Color: Gold

Nano-hardness: 24

Thickness [um]: 1-7

Friction-(fretting): 0.55

Maximum usage temperature: 600

Applications & Characteristics: Universal & Decorative purposes; Classical base coating

CUTTING: Universal

FORMING: Molds and dies

Titanium Carbo-Nitride (TiCN)

Color: Blue-Grey

Nano-hardness: 37

Thickness [um]: 1-4

Friction-(fretting): 0.20

Maximum usage temperature: 400

Applications & Characteristics: Classical basic coating based on TiN with carbon, high hardness, low friction coefficient, low heat resistance

CUTTING: Tapping and punching; Milling for HSS and HM with coolant

FORMING: Molds and dies, punching

Titanium Aluminium Nitride (TiAIN)

Color: Violet-Black

Nano-hardness: 28

Thickness [um]: 1-4

Friction-(fretting): 0.60

Maximum usage temperature: 700

Applications & Characteristics: Universal, especially for drilling, coating for cutting with HSS in the 90's, high heat resistance

CUTTING: Drilling and universal use, also for weak machines

Aluminium Titanium Nitride (AlTiN)

Color: Black

Nano-hardness: 34

Thickness [um]: 1-4

Friction-(fretting): 0.70

Maximum usage temperature: 900

Applications & Characteristics: Universal for drilling, milling, hobbing, dry machining, coating for cutting with carbide in the 90's, with higher Al content and heat resistance CUTTING: Milling, hobbing, high performance machining.

3. EXPERIMENTAL SET UP

WEAR TESTING MEASUREMENT

EXPERIMENTAL PROCEDURE OF WEAR TEST:-

Dry sliding wear tests for different number of specimens was conducted by using a pin-on-disc machine (Model: Wear & Friction Monitor TR-20) supplied by DUCOM is shown in following Figure.

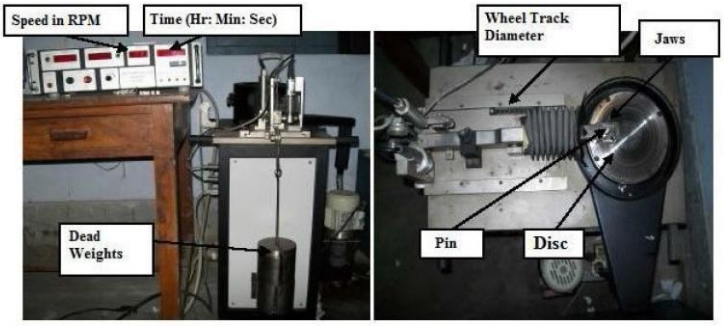


Figure 6.1 Wear testing machine

The pin was held against the counter face of a rotating disc (EN31 steel disc) with wear track diameter 100 mm. The pin was loaded against the disc through a dead weight loading system. The wear test for all specimens was conducted under the normal loads of 1kg, 3kg, 5kg and a sliding distance of 2 km,4km and 6km and with a speed of 500rpm, 750rpm, 1000rpm .The pin samples were 30 mm in length and 6 mm in diameter. The surfaces of the pin samples were slides using emery paper (80 grit size) prior to test in order to ensure effective contact of fresh and flat surface with the steel disc. The samples and wear track were cleaned with acetone and weighed (up to an accuracy

of 0.0001 gm using microbalance) prior to and after each test. The wear rate was calculated from the height loss technique and expressed in terms of wear volume loss per unit sliding distance. In this experiment, the test was conducted with the following parameters:

1. Load

2. Speed

3. Distance

Parameter taken during sliding wear test

Pin material	TIN,TIALN,TICN,ALCRN,WC
Disc material	EN 31 steel
Pin dimension	Cylinder with diameter 12 mm height 30 mm
Sliding speed	500RPM, 750RPM,1000RPM
Normal load	1kg, 3kg,5kg
Sliding distance	2km. 4km. 6km

PIN-ON-DISC TEST

In this study, Pin-on-Disc testing method was used for tribological characterization. The test procedure is as follows

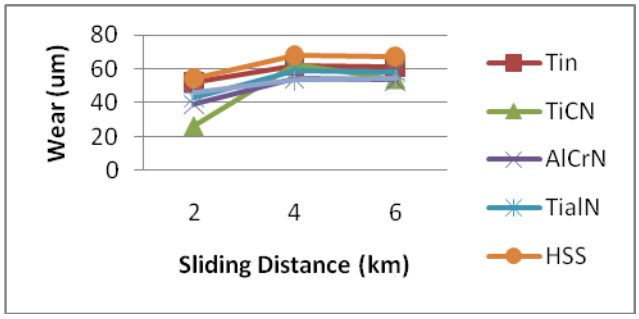
Initially, pin surface was made flat such that it will support the load over its entire cross-section called first stage. This was achieved by the surfaces of the pin sample ground using emery paper (80 grit size) prior to testing.

Run-in-wear was performed in the next stage/ second stage. This stage avoids initial turbulent period associated with friction and wear curves.

Final stage/ third stage is the actual testing called constant steady state wear. This stage is the dynamic competition between material transfer processes (transfer of material from pin onto the disc and formation of wear debris and their subsequent removal). Before the test, both the pin and disc were cleaned with ethanol soaked cotton.

Before the start of each experiment, precautionary steps were taken to make sure that the load was applied in normal direction. Following Figure represents a schematic view of Pin-on-Disc setup.

Chart -1: graph of wear vs sliding distance.



Graphs are obtained by the values of wear given with the help of pin on disc machine also the correlation between varying parameter is obtained with the help of minitab software in the form of regression equation. And by using this regression equation % error in the values of wear is obtained. By using all these values we can conclude which is the best material among the other materials used during the test.

3. CONCLUSIONS

Coating of high speed steel with various low friction material increases its hardness and finally it also increases the wear resistance. By comparing various wear rate of a coated hss sample we can conclude that TICN is the base material for cutting application as compared to other coated materials as it shows lower range of wear during pin on disc test with considering variable experimental parameters like variable speed, load and sliding distance. next to the TICN, ALCRN is the suitable alternative option to use for wear resistance.

REFERENCES

[1] D. Kornack and P. Rakic, "Cell Proliferation without Neurogenesis in Adult Primate Neocortex," Science, vol. 294, Dec. 2001, pp. 2127-2130, doi:10.1126/science.1065467.

[2] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

[3] R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.

[4] K. Elissa, "Title of paper if known," unpublished.