FORCE AND TEMPERATURE ANALYSIS OF SINGLE POINT ALCrN COATED HSS CUTTING TOOL UNDER DRY CONDITION

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ABSTRACT

. In this Paper, the wear behaviour of High Speed Steel (HSS) Single Point Cutting tool with Aluminium chromium nitride (AlCrN) coated by physical vapour deposition method (PVD), HSS single point cutting tools in dry condition ofsimple turning process is investigated and compared with respect to its chip tool Interface temperature, turning time, upcoming forces, on each tool is studied and analyzed. The present work involves the study of tool wear caused by the change in hardness of single point cutting tool for a turning operation to predict the tool life in turning process based on temperature and force, stress analysis using Ansys workbench 14.0. Experiments were performed with M.S bar as workpiece and HSS coated, uncoated tool bits as a tool material and the single point wear of tool has been measured experimentally.

The present work calculate the machining time required is very less for coated tool as compared to the non-coated tool also cost required for making an AlCrN coated tool is very less and increased tool life, reduces the cost to buy a new tool. Also we found that wear or percentage weight loss of uncoated tool and AlCrN coated tool should be noted from present investigation. Efficiency of each tool comparatively with other tool as Uncoated Vs AlCrN coated tool is to be found by performing the experiment in dry conditions only.

Keyword: - *Aluminium chromium nitride (AlcrN), coating of tool, Turning, Coated tool, hardened steel Key word1, Key word2, Key word3, and Key word4 etc….*

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1 .INTRODUCTION

Aluminium chromium nitride(ALCrN) as a coating for tool steels has been available widely since the last decade and is enjoying increasing attention and application in tool industries. The reasons are simple yet important the advantages of ALCrN coatings of tool steels include a noble appearance, excellent adhesion to substrates, high chemical inertness, resistance to elevated temperatures, hard surfaces.

(2400HV) to reduce abrasive wear, a low coefficient of friction with most work piece materials which increases lubricity and results in excellent surface finish and decrease of horsepower requirements, improved ability to hold tolerances and high temperature stability and low maintenance cost and high productivity. In practice, the degree of extended tool life and increased productivity attained with coated tools depends primarily on the tool and its application, the work piece material and the operating parameters. Keeping all these conditions equivalent, tool life improvement can be evaluated by comparing the increase in number of work pieces machined by a ALCrN-coated tool with the number of work pieces machined by an uncoated tool while the cost of coating is usually 20 to 30% of the base price of the tool, or as little as a 15% rise in the total price.

A. Review Stage

It is found by F Akbar in 2008 [P T Mativenga et al. [1], Weiguang Zhu [2]]. that the use of AlCrN-coated tools causes a reduction in heat partition into the cutting tool compared with the uncoated tool about 17 percent at conventional cutting speed and 60 percent in the HSM region. It may be concluded that, compared with uncoated carbide tools, ALCrN coatings significantly improve the tribological phenomena by reducing the tool chip contact area, providing a lower thermal conductivity for the tooling systems, and ultimately reducing heat partition into the cutting tool. Seshadri.R et al.[3]. Aluminium chromium nitride(ALCrN) coating improves the tool wear by increasing the wear resistance, thereby protecting the tool. Initial Flank wear is observed after machining the material continuously for 250 seconds. Specific power consumption is low at higher cutting speeds which supports that this material posses good machinability. Hardness of the material is more, hence machining at high speed

[5] advanced coating technology has significantly improved the tool life expectancy. Titanium Nitride (TiN), Titanium Carbo-Nitride (TiCN), Titanium Aluminum Nitride (TiAlN or AlTiN), Chromium Nitride (CrN), and Diamond coatings can increase overall tool life, decrease cycle time, and promoted better surface finish. K. Aslantas et al. [6] in coated mixed ceramic tool, the thermal conductivity value of TiN coating material increases with increases in temperature. Therefore, the heat flow to the cutting tool increases and the temperature at the tool–chip interface decreases. The temperature difference between the upper and lower sides of the chip decreases and the chip up-curl radius increases. J. Nickel et al.[7] The nature and the underlying wear mechanisms of TiN-coated tools and the role of TiN in improving wear resistance and increasing tool life have been the subject of many investigations. For example, the wear modes of TiN-coated HSS, from the results of sliding pin-on-disc wear tests, were found to include adhesive and abrasive wear of the coating w12,13x. TiN-coating fragments were found to be the dominant wear mechanisms in actual machining tests w8x. The latter wear mechanism was attributed to insufficient adhesion. Abdul Kareem Jaleel et al. [8] Hard coating such as TiN, TiC and AL2O3 have been used. High-speed machining is constantly increasing in importance. These new techniques can be applied in place of conventional machining methods for manufacturing of various components at low cost or even making entirely new type products, e. g. machined from brittle materials.

B. RAMAMOORTHY et al.[9] The sputter deposition conditions for DLC/TiN/ Ti/Cu/Ni multilayer coatings are identified to achieve improved quality with particular reference to adhesion and surface finish. Y. BIROL et al.[10] The stable and protective oxide surface layer on AlTiN and AlTiON coatings provide an enhanced resistance to high temperature wear. M.A. Kamely et al. [11] Force difference is observed when using the same type of tools, but with different thermal properties. For example, under the same cutting condition there is force difference between using low CBN content tools coated with TiAIN and CBN-Low coated with TiN/AI2O3/TiCN. This was the case when turning with uncoated CBN-High and CBN-High coated with TiN/AI2O3/TiCN.

Y. C. Chim1 et al. [12] TiN, CrN, TiAlN and CrAlN coatings were deposited by vacuum arc. Their thermal stability and oxidation resistance were investigated after annealing in air at different temperatures (500°C-1000°C). TiAlN and CrAlN showed better oxidation resistance than their binary counter parts TiN and CrN. Cr-based coatings exhibited much better oxidation resistance than Ti-based coatings.

K. Subramanyam et al. [13]. In the present work the performance of coated tools in machining hardening steel under dry conditions is studied. The experimental results showed with increase in feed the surface roughness is observed is very poor. The effect of cutting velocity on surface roughness is relatively low when compared to feed rate. With increase in depth of cut the surface roughness is increased. Here experimental results shows by selecting the proper cutting parameters the coated tools are suitable to produce fine surface finished components

MUBARAK and PARVEZ AKHTER Pakistan Council of Renewable Energy Technologies (PCRET), 12 November 2007 [A. Mubarak et al. [15]].Titanium nitride (TiN) widely used as hard coating material, was coated on tool steels, namely on high-speed steel (HSS) and D2 tool steel by physical vapor deposition method. The study concentrated on Cathodic arc physical vapor deposition (CAPVD), a technique used for the deposition of hard coatings for tooling applications, and which has many advantages. It is used to analyze and quantify the following properties and parameters surface morphology, thickness, hardness, adhesion, and coefficient of friction (COF) of the deposited coatings. Surface morphology revealed that the MDs produced during the etching stage, protruded through the TiN film, resulting in film with deteriorated surface features. The coatings deposited on HSS exhibit better adhesion compared to those on D2 tool steel.

Stan Veprek et al.[14]. Hard coatings, such as TiN, TiC, TiCN, Al2O3 deposited by thermal chemical vapour deposition (CVD) on machining tools have been used since 1960 in order to increase their life time. However, because of the requirements of the uniform high plasma density, complex reaction kinetics and mechanism and gas transport within the reactor, plasma CVD is difficult to scale up.

Audy J et al. [16]. Nowadays, the use of coated tools has advanced to the stage when surface coatings of increasing complexity are being routinely deposited on HSS tools. It is generally accepted by industry that popular TiN and Ti(C, N) coatings are now under increasing competition from TiAlN, TiAlCrN and more complex coatings based on TiN/TiAlN and or TiAlCrYN. These coatings are claimed firstly to increase the tool life due to improved tool wear resistance, and secondly to reduce the forces, power and tool temperature due to improved tool surface roughness and its resistance to built-up-edge formation and reduced friction at the tool-chip interface.

L.B.ABHANG and M. HAMEEDULLAH [L.B.Abhang et al. [17]] International Journal of Engineering Science and Technology Vol. 2(4), 2010, 382-393 research has been undertaken into measuring the temperatures generated during cutting operations. The main techniques used to evaluate the cutting temperature during machining are tool-chip thermocouple, embedded thermocouple, and thermal radiation method. Tool-work thermocouple has become a popular tool to be used in temperature measurements during metal cutting. In this paper the tool-work thermo couple technique was used to measure the chip-tool interface temperature during machining of EN-31 steel alloy.

J.D. Bressan et al. [18] A comparison of the lost mass rate for HSS, HSS coated with TiCN (HSS\TiCN) and WC pins are plotted as functions of the sliding distance. The benefit of the TiCN coating is very clear. The wear resistance comparison between HSS\TiCN and the hard metal WC

H. Wang et al. [19]. We investigated mechanical properties of TiN as a function of microstructure varying from nano crystalline to single crystal TiN films deposited on (100)

silicon substrates. By varying the substrate temperature from 25 to 700 °C during pulsed laser deposition, hardness of TiN films decreased with decreasing grain size. This behavior was modeled recently involving grain boundary sliding, which is particularly relevant in the case of hard materials such as TiN.
the excellent heat insulation between chips and tools, the TiAlN or AlTiN coatings are the most used coatings for modern high performance cutting.

CONCLUSION

In the present work ,the performance of coated tools
In machining hardening steel under dry condition is Studied .The effect of coating is to reduce wear and Tear of tool tip point as well as more heat dissipiation to surrounding. Hence the increase in tool life and surface Finish of the product to be machine .With increase in depth of cut ,the surface roughness is increased .Here experimental result shows by selecting the proper cutting parameters the coated tools are suitable for producing good surface finished components .The result shows that the (ALCrN) coated tool perform better as compared to uncoated cutting tool.

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This paper deal with the various concepts of High Speed Steel Single Point Cutting Tool mainly the temperature distribution along the length of tool when tool is turning the work piece and removing the material from the work piece. Author would like to thank to shri shankarprasad College of engineering for support and motivation.

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