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Performance Analysis of Coated and Uncoated Carbide Tool While Turning Operation (Aisi4140 Alloy Steel)

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Abstract: ***Hard coating are well known to improve the performance of cutting tool in machining application, such as high speed machining. Unfortunately the development of cutting tool for high speed machining of hard and difficult to cut material has remains a problem for quality and economy of production. The present work studied the performance of coated and uncoated carbide tool in machining of AISI 4140 steel. The influence of cutting parameter (cutting speed, feed rate and depth of cut) on surface roughness and harden ability has been analyzed under the different cutting condition (coated and uncoated carbide tool). For design of experiment we had done three levels of cutting speed, feed rate and depth of cut.***
Keywords*:AISI 4140 steel, Coted and Uncoated Carbide Tool, Surface Roughness, Hardenability.*

I. INTRODUCTION

The recent developments in science and technology have put tremendous pressure on manufacturing industries. The manufacturing industries are trying to decrease the cutting costs, increase the quality of the machined parts and to machine more difficult materials. Machining efficiency is improved by reducing the machining time with high speed machining. When cutting ferrous and hard to machine materials such as steels, cast iron and super alloys, softening temperature and the chemical stability of the tool material limits the cutting speed.

Finish hard turning is a new machining process that enables manufacturers to machine hardened materials to their finish part quality without the aid of the productivity enhancement of manufacturing processes imposes the acceleration of the design and evolution of improved cutting tools with respect to the achievement of a wear resistance. . Because of the highly non-linear nature of metal cutting and the complex coupling between deformation and temperature fields, a complete understanding of the mechanics of metal cutting is still lacking and is thus the topic of great deal of current research. High speed machining has been the main objective of the Mechanical Engineering through ages. The trend to increase productivity has been the instrumental in invention of newer and newer cutting tools with respect to material and designs. Grinding, hard turning with multilayer coated carbide tool has several benefits over grinding process such as, reduction of processing costs, increased productivities and improved material properties. This process enables manufacturers to increase product quality and efficiency, while decreasing the cost and processing time. Hard turning is also very attractive to manufacturers because this process is possible without the use of cutting fluid or other lubricants. Dry cutting is beneficial because of the elimination of the cost of the cutting fluid s well as the high cost of fluid disposal.

In addition to increasing the tool life, hard coating deposited on cutting tools allows for improved and more consistent surface roughness of the machined work piece. The surface roughness of the machined work piece changes as the geometry of the cutting tool changes due to wear, and slowing down the wear process means more consistency and better finish. The machining of hard and chemically reactive materials at higher speeds is improved by depositing single and multilayer coating on conventional tool materials to combine the beneficial properties of ceramics and traditional tool materials.

II. LITERATURE SURVEY

A. *R.A.MAHADAVINEJAD AND S.SAEEDY,* (2011), discussed the effect of influential turning parameters of cutting speed and feed rate on turning of AISI304 stainless steel under two conditions dry and wet machining. Turning test have been performed in three different feed rates (0.2, 0.3, 0.4mm/rev) at the cutting speeds of 100,125,150,175 and 200m/min with and without cutting fluid. They used design of experiment (DOE) and an analysis of variance (ANOVA) tool to determine the effects of each parameter on the tool wear and the surface roughness. They concluded that the process parameters of cutting speed and

feed rate have significant effect on the quality of turning of AISI304 stainless steel. Tool flank wear is closely related to cutting speed, so that I decreases significantly by increasing the cutting speed upto 175m/min. The main reason foe flank wear is the lack of efficient heat removal due to low conductivity of AISI304 alloy, the shape and the size of the chips formed. Surface roughness is mostly affected by the feed rate, so that the surface finish can be improved by decreasing the feed rate as well as increasing the cutting speed. Since, at higher speed and lower feed rates built up edges decrease. the application of cutting fluid results in longer tool life compare to dry cutting. It is observed that the optimum condition of cutting speed of 175m/min and feed rate of 0.2mm/rev exhibits superior turning properties provided the cutting fluid is used.

B. S. R. DAS *et. Al,* (2013), concluded that during turning of hardened AISI4340 steel with CVD multiplayer coated carbide insert, during experimentation the effect of various machining parameter on surface roughness was studied with the help of full factorial design of experiment (DOE) and determine best combination of machining parameter such as depth of cut, feed and cutting speed. It is observed from the ANOVA that feed (60.85%) is the most significant factor followed by cutting speed-feed (6.23%) and depth of cut-feed (2.62%) on surface roughness. From the experimentation it was found that, depth of cut did not impact the surface roughness in the studied range, significantly. The most optimal result for surface roughness was observed when cutting speed was set at 150 m/min and feed of 0.05 mm/rev.

C. S. THAMIZHMANII *et. Al, (2007),* concluded that depth of cut is only significant factor which contribute to surface roughness is 14.467%. The second factor which contributes to surface roughness is feed having 9.764%. It is recommended from the result that depth of cut of 1 to 1.5mm can be used to have lower value of surface roughness. Taguchi gives systematic simple approach and efficient method for optimum operating condition. A Hass make CNC machine was used for experimentation having spindle speed of 6000rpm and power of the machine is 35 KW/HP. The cutting tool was CBN, manufactured by Mitsubishi having code MB8025 with three cutting edges.

III.PROBLEM IDENTIFICATION

Nowadays, it is very difficult to get the desired properties on the job easily and on cheap rate as well. May be it was because of the old technology and unsatisfactory theories over the tool, material and process. So our project is providing a practical theory to overcome the below problems:

A. The major problem earlier was the technology; the old technology was quite unable to get the accuracy as it can get at the current days.

B. Without knowing the speed of the spindle at which high production rate can be achieved.

C. New theories are able to provide more accuracy than the old one but they might be costly.

IV.OBJECTIVE

The lots of problems were noticed in earlier production, so to avoid all them we are objectively working over. The major objectives are as follows:

A. To investigate effect of cutting speed, feed rate, depth of cut, surface roughness, material removal rate and micro hardness beneath the machine surface.

B. To compare the performance of coated and uncoated carbide tool.

C. To check surface roughness with different cutting speed and feed rate.

V. METHODOLOGY

As told earlier we are dealing with the most widely used material AISI4140 alloy steel in industries this day. In our research we are going to inspect tool which is coated and uncoated carbide tools in turning process. By using main parameters of turning process which is feed rate, depth of cut, speed and this all process in going to take place on lathe CNC.

Firstly we, are going to inspect coated carbide tool for that we have to fit our job on lathe chuck of CNC machine for turning process and then we have to note down the parameters depth of cut, feed rate, speed. Similarly we have to do this process for 3 times in a row but have to change the parameters every time. for ex:- if we are taking 200rpm for the first time than for the second time we will take 300rpm for turning process than for the third time we have to increase it for 350rpm. Similarly we will do same for the other parameters (depth of cut & feed rate) and have to note it down carefully.

Now, we will do same process on other job of same material but by using uncoated carbide tool. We will again note done those three parameters and do this for 3times . After that we are having 6 different jobs from which we have to take out 6 different

specimen. Now we have to check surface roughness of this 6 specimen by TT100 surface roughness tester. Finally we have to check all the results and analyse it to give a perfect tool & process to achieve highest and finest possible productivity.

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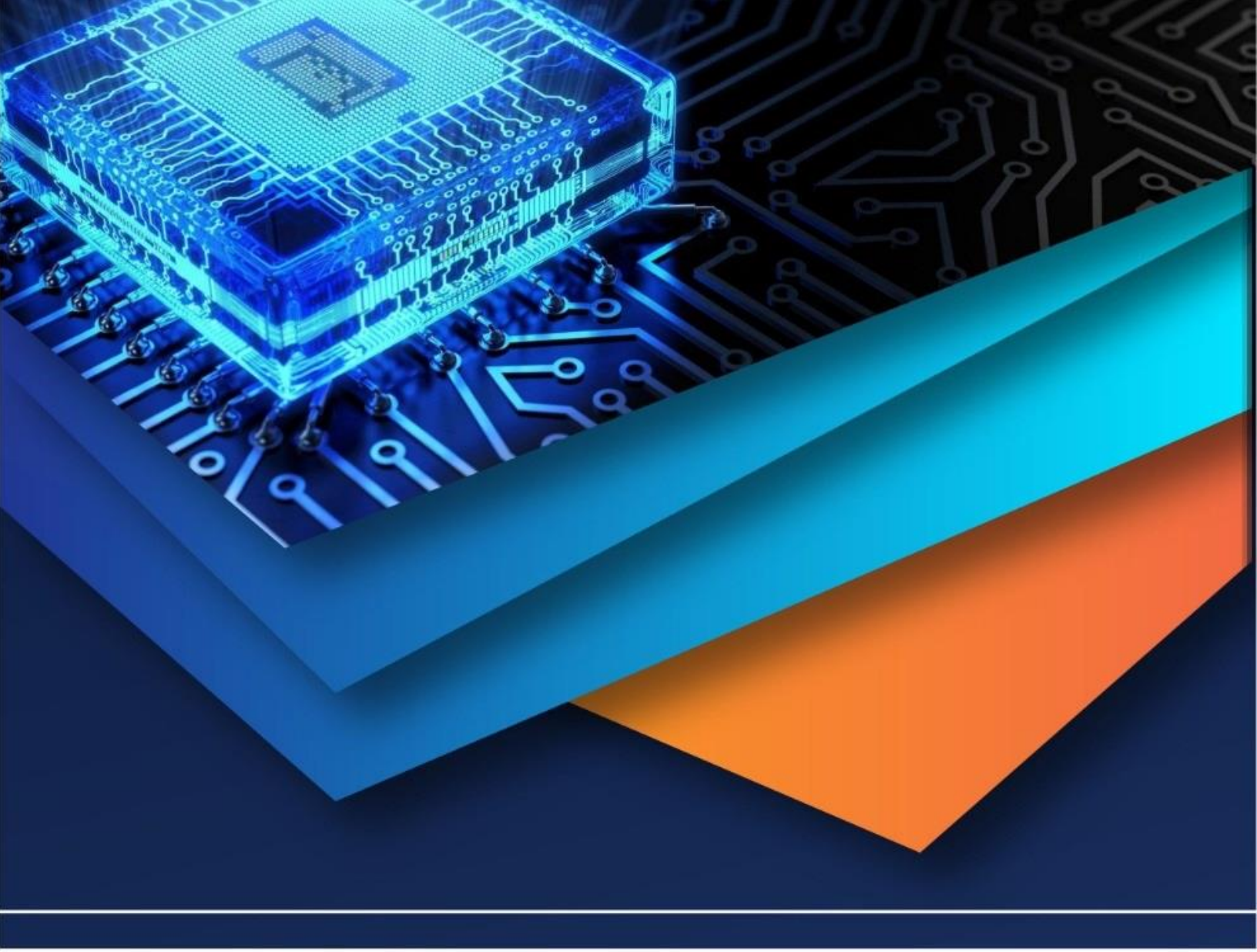

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