A Literature Review on Experimental Investigation of Parameters in Turning of AISI 52100 Steel using Coated and Uncoated Tools

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ABSTRACT
The experimentalinvestigation during machining of any steel material is by considering parameters, like true rake angle and side cutting edge angle, feed rate, cutting speed, depth of cut, nose radius, machining time etc. Here we have done literature review of effect of these parameters on different steel material considering CBN inserts. Different types of coating for dry machining is analyzed to obtain results. These results are comparable and will help us to find a methodology to improve tool life as well as productivity of high strength steel material.

Keywords :CBN Tool , Parameters, turning, Insert etc

1. INTRODUCTION
Nowadays, carbide tools are used with low cutting speeds for machining of case hardened steel. But as the speed is low ,the result is that the productivity is low and in consequence the parts are very expensive. The requirement for a cutting tool is the most important factor for achieving optimum quality products for machining hardened steel. So there is a real demand to increase the productivity and new types of tools like CBN-CNMA and CBN-TNMA are in demand for machining of case hardened steel at higher cutting speed. Due greater hardness and wear resistance CBN tool inserts have more wear resistance than conventional tool materials like carbide and ceramic. The performance of CBN inserts at higher speed is rarely explored due to significant reduction in tool life time. But the wear of the tools is inevitable due to rubbing action between work material and tool edge at higher speed. Basically the tool wear in CBN is caused by diffusion, thermal softening, and notching at higher cutting speeds. The flank wear and crater wear is a serious problem in the machining of materials irrespective of their proper conditions . However, this tool wear can be minimized and life of the tool can be increased byfocussing on wear behaviour of CBN cutting inserts with respect to the type of material machined. In the turning of case hardened steel by CBN inserts , parameters such as cutting speed, feed rate, and depth of cut etc. significantly influence the crater wear.

So, if these parameters can be studied under different cutting conditions an optimum value of tool life can be achieved. This will not only improve it's cost per component, but also the quality and productivity of final component. Hence the overall production cost for machining the component as well as the tool performance will be enhanced.
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2. ORIGIN OF RESEARCH PROPOSAL
Focussing on the same issue a manufacturing organization based in nasik, want to improve their productivity per component for manufacturing metal spacer using CBN tool inserts. Presently they are using CBN tool insert of grade TNMA 160408 and CNMA 120408 for machining of high speed case hardened mild steel material. The actual production per component is less as compared to required for a CBN tool insert. So there is a need to improve the tool life and hence the cost per component. For this a suitable analysis of tool wear mechanism is required taking into consideration high speed turning of case hardened steel materials. The available materials presently used is SAE 1018 and 20mNCR5. Proper combination of each tool insert for machining each material is required with suitable cutting conditions and parameters to get the optimum value of tool life . This will not only help to improve tool life of CBN inserts but also productivity per component will increase.
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3. REVIEW OF RESEARCH AND DEVELOPMENT IN THE SUBJECT
3.1 Effect of Machining Parameters and Machining Time on Surface Roughness in Dry Turning Process by NexhatQehaja, KaltrinJakupi, AvdylBunjaku, MirlindBruci, HysniOsmani, ELSEVIER, 2014.

Study – This paper describes the various parameters affecting the surface roughness in dry turning of coated carbide inserts. When tool wear reaches a certain value, increasing cutting force, vibration and cutting temperature and it causes bad surface finish and dimension error greater than tolerance. In this paper, surface roughness criteria Ra for various combinations of feed rate (f), nose radius (r) and cutting time (T) is given. Minimal surface roughness criteria Ra=1.0127 µm was obtained at f = 0.285 mm/rev, r = 1.2 mm, T = 1700s. It is found that increasing of nose radius with lowest feed rate and cutting time leads to decreasing of surface roughness. The investigation of this study indicate that the feed rate has the most significant effect on surface roughness, followed by nose radius and cutting time.

3.2New Generation Coating for High Speed Cutting Tools by Devi P. Saini and M Ali, Faculty of Engineering and

Information Sciences, University of Wollongong, Australia, 2003.

Study - From this research paper it could be concluded that, Turning operations typically involve huge strains, high interface (tool-chip, tool work-piece) temperatures ranging from 700-1250°C. Coatings have been observed to reduce cutting forces and provide longer tool life resulting in greater productivity. The author observed that the thickness of the coatings influence the coating adhesion as well as tool life at high turning speeds. Amongst the various coatings investigated in the research, TiC coating was found to provide the longest tool life and the multilayer composite coating Ti/TiN/TiCN/TiC showed good promise for high speed turning operations. However, it requires further development to enhance and optimize the tool life at high cutting speeds.

3.3 New hard/lubricant coating for dry machining by V. Derflinger, H. Brandle, H. Zimmermann, ELSEVIER, 10 Dec. 1998.

Study - In this paper, Author has discussed that the benefits of cooling lubricants in machining processes. But the use, maintenance and disposal of coolant lubricants entail enormous costs. Investigations show that sometimes the costs for using a coolant lubricant are many times higher than the tool costs. So, the deposition of a hard/lubricant coating on cutting tools seems to be a very interesting alternative to reduce the enormous amounts of cooling emulsion in metal cutting and to work with minimal or no lubrication in a number of applications. Possible fields of use may include machining of alloyed steel, aluminum alloys and cast iron.

3.4 Frictional and wear performance of TiAlN/TiN coated tool against high strength steel by GuangmingZheng, Guoyong Zhao, Xiang Cheng, RufengXu, Jun Zhao, Huaqiang Zhang, ELSEVIER, 2018.

Study - This paper focuses on the TiAlN/TiN coated carbide tool material. The frictional and wear performance of the coated tool against high strength steel are investigated to reveal the wear mechanisms. The coated tool surface roughness also affects its wear resistance. It is concluded that, during the dry sliding process, the sliding friction run through the initial stage and stable wear stage with the sliding time. At the higher applied load, the running-in time was shortened, and the small fluctuation of the friction coefficient was presented. As the sliding speed and applied load rose, the wear volume of the disk specimen improved, but the wear rate reduced. The build-up layer formed on the coated tool material worn surface can prevent the direct contact of the friction pair, which played a positive role in lubrication and anti-friction. During the dry turning process, the combined action of the peeling off, chipping, adhesion, mechanical scratch, element diffusion and oxidation was the main wear mechanism of the TiAlN/TiN coated tool. Especially, on the rake face, the titanium oxide (e.g. TiO2) was formed and can improve the cutting performance.

3.4 Coated Tool Performance in Dry Turning of Super Duplex Stainless Steel by Rajaguru J and Arunachalam N, ELSEVIER, 2017.

Study - In this study, the performance of different coated tools were investigated while machining super duplex stainless steel (SDSS). The tool wear study showed that [MT-TiCN]- Al2O3 coated tool provided good wear resistance among all coatings. The higher hardness of MT-TiCN and oxidation stability of Al2O3 at the interface provided increased wear resistance among other coatings. AlTiN coating generated higher temperature because of high friction and low thermal conductivity. The residual stress on the machined surface showed that the stresses were tensile for all the coatings studied, which can lead to failure.The machined surface by TiN-[MT-TiCN]-Al2O3 coating showed less tensile residual tensile stress among the other surfaces due to the relatively dominance of plastic deformation by mechanical loads over the high temperature effects. The surface Roughness profile showed the [MT-TiCN]-Al2O3 coating exhibited lower roughness (Ra) values because of their higher resistance to abrasion along the cutting edges and surface had less residues in comparison with other surfaces. From the study it is suggested that [MT-TiCN]-Al2O3 coating provided relatively better performance in-

terms of tool wear, cutting force, cutting temperature and surface integrity.

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4. . Methodology:-

1 .Critical Literature Survey.

2. Selecting suitable uncoated tool for experimentation.

3. Selection of suitable coating for tools.

4. Design of experiments.

5. Experimentation with different parameters..

6. Data collection through the execution of the experiment.

7. Optimization of parameters.

8. Correlation of input and output parameters.

9. Results and discussion.

5. Scope & Expected Outcomes of the Study

1. Experimental study- To study behavior of coatings during machining of AISI 52100 steel. Optimization of parameters using suitable method.

2. Formulation of regression Model - To develop regression models that can be used to predict the expected values before experimentation.

6. REFERENCES

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