On the Evaluation of Effect of Nose Radius of Carbide Tipped Tool Inserts on Process Parameters in Machining OHNS Steel

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ABSTRACT*: *In modern industry multi point cutting tool inserts are widely used for machining operation in general and turning operation in particular. We have used Tungsten carbide tipped tool inserts our turning experimentation carried out on Oil Hardened Non Shrinking (OHNS) Die steel.
In this research paper, a study on turning OHNS Steel using tungsten carbide tool inserts is made by varying depth of cut, feed rate and cutting speed one each at a time and keeping other two constant. Effect of nose radius of tungsten carbide tipped tool inserts on machining is analyzed.

Key Words: *Turning, Tool Inserts, OHNS Die steel, Nose radius*

I.INTRODUCTION

Machining of Oil Hardened Non Shrinking (OHNS) Steel is a challenging task for producing required surface finish and accuracy. Early researchers have analysed the influence of cutting speed, feed rate, depth of cut and machining time on mach in ability characteristics such as machining force, surface roughness and tool wear[2].

The authors of this paper have conducted experiments and evaluated the effect of variation of nose radius on turning of OHNS Steel using tungsten carbide tipped tool inserts for different combinations of machining parameters.

II.EXPERIMENTAL STUDY

The process parameters such as cutting force, surface finish, tool wear and material removal rate and temperature generated on tool tip are recorded from the experimental setup. Figure 1.1 shows the Lathe tool dynamometer with thermocouple set up used in experimental study for the measurement of forces and temperature developed during turning operation.

Figure 1: Lathe tool dynamometer with thermocouple set up.

III.RESULT ANALYSIS

The experimental results obtained for turning of OHNS Steel using tungsten carbide tipped tool inserts having different nose radii are plotted and analysed.

In turning operation, the tool comes in contact with the work piece. The area of contact varies with the variation of tool nose radius and tool orientation. This in turn results in the generation of heat in the tool insert with the variation of machining parameters.

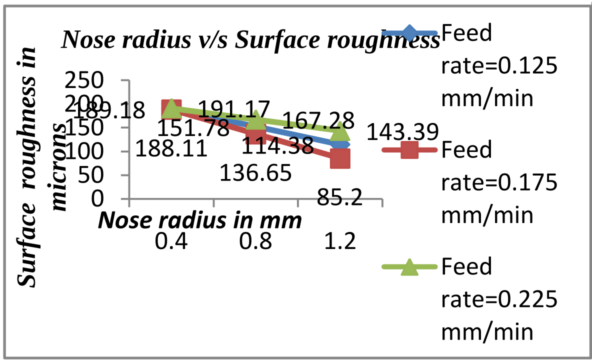

Figure2: Variation of Surface Finish with nose radius for cutting speed of 11.10m/min

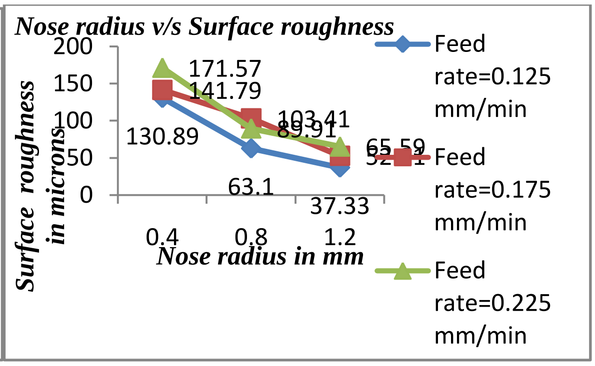

Figure3: Variation of surface roughness by varying depth of cut of cutting speed 19.47m/min

Figure 2 gives the variation of surface finish with increased nose radius for different feed rate conditions at the cutting speed of 11.10m/min. It is observed that the surface finish improves with increased nose radius at lower feed rates conditions. The surface finish improves with increased nose radius at higher feed rate conditions. The surface finish remains same at lower nose radius but improves at higher nose radius conditions for moderate feed rate conditions.

Figure. 3 gives the variation of surface finish with increased nose radius for different feed rate conditions at the cutting speed of 19.47m/min. It is observed that the surface roughness is more for higher feed rate at lower nose radius conditions. The surface finish improves with increased nose radius at higher feed rate conditions. The increased feed rate gives better surface finish for moderate nose radius higher nose radius conditions.

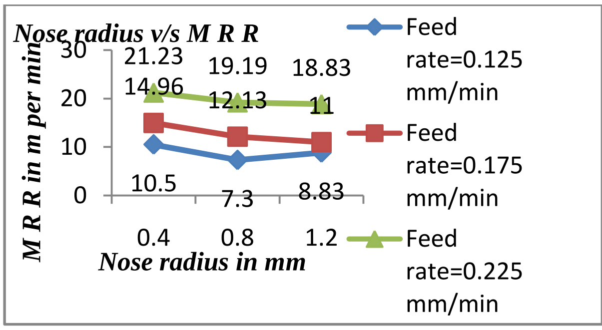

Figure.4: Variation of material removal rate by varying nose radius at speed of 11.10m/min

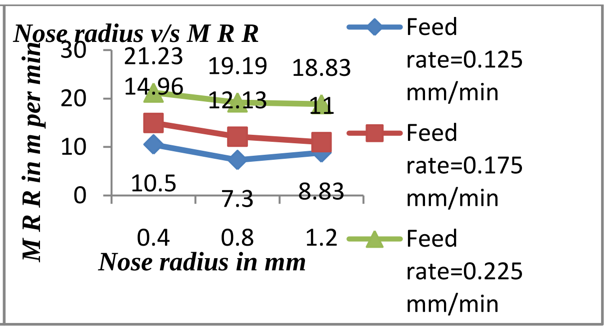

Figure.5: Variation of material removal rate by varying nose radius at 19.47m/min

Figure.4. gives the variation of material removal rate increase in nose radius for different feed rate conditions at the cutting speed of 11.10m/min. Material removal rate decreases gradually with increase in the nose radius for lower feed rate conditions. At higher feed rate the material removal rate is not affected with increased nose radius.

Figure.5. gives the variation of material removal rate increase in nose radius for different feed rate conditions at the cutting speed of 19.47m/min. Material removal rate is better at lower nose radius for lower feed rate conditions. At higher nose radius conditions, the material removal rate increases at higher feed rate and almost constant at moderate feed rate conditions and decreases for lower feed rate .

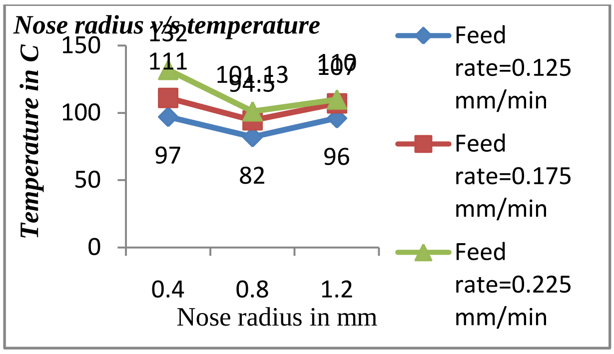

Figure.6: Variation of Temperature by varying nose radius at 11.10m/min

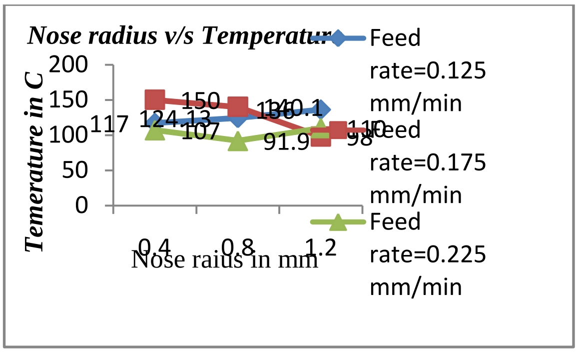

Figure.7: Variation of Temperature by varying nose radius at 19.47m/min

Figure.6. gives the variation of temperature increase in nose radius for different feed rate conditions at the cutting speed of 11.10m/min. Temperature decreases gradually by increase in the nose radius. For higher feed rate temperature will be higher at tool tip. For higher values of nose radius change in temperature is minimum for increase in feed rate.

Figure.7. gives the variation of temperature increase in nose radius for different feed rate conditions at the cutting speed of 19.47m/min. Temperature increases gradually with increase in nose radius at lower feed rate conditions. It shows decreasing trend with increase in nose radius as the feed rate is gradually increased. At higher nose radius conditions temperature shows decreasing trend for moderate feed rate conditions and shows increasing trend at higher feed rate conditions.

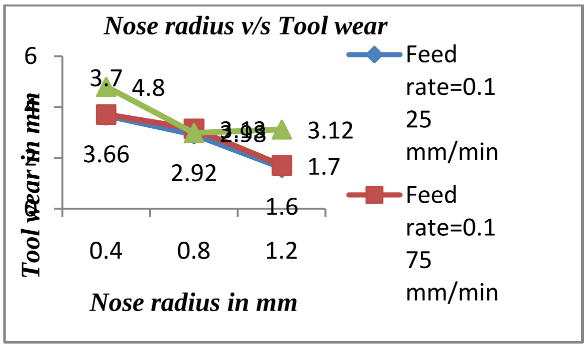

Figure.8: Variation of Tool wear by varying the nose radius at 11.10m/min

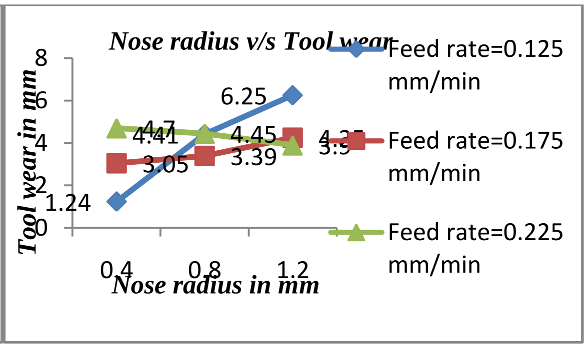

Figure.9: Variation of Tool wear by varying the nose radius at 19.47m/min

Figure.8. gives the variation of tool wear by increase in nose radius for different feed rate conditions at the cutting speed of 11.10m/min. As nose radius increases which decrease temperature therefore tool wear also decreases. For higher feed rate tool wear will decreases till moderate nose radius and gradually increases.

Figure.9. gives the variation of tool wear by increase in nose radius for different feed rate conditions at the cutting speed of 19.47m/min. For higher feed rate tool wear will decreases till final nose. Tool wear mainly depends on nose radius, depth of cut and temperature, by graph we found that tool wear is also depends on feed rate. Some conditions of material the properties are changes so tool wear also changes.

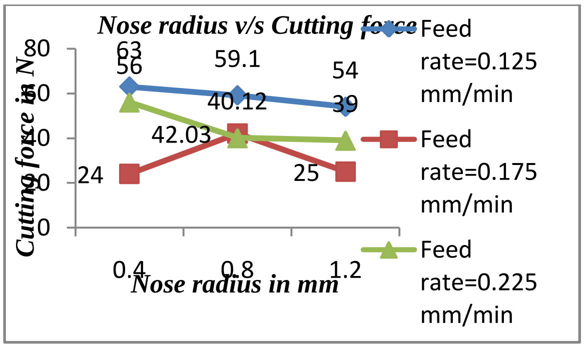

Figure.10: Variation of cutting force by varying nose radius at 11.10m/min

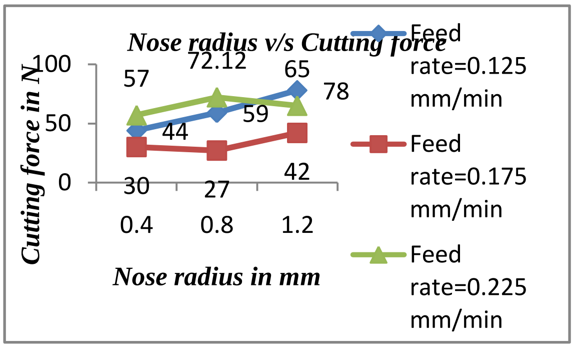

Figure.11: Variation of cutting force by varying nose radius at 19.47m/min

Figure.10: gives the variation of cutting force by increase in nose radius for different feed rate conditions at the cutting speed of 11.10m/min. For higher feed rate cutting force will be more, similarly for lower feed rate cutting force will be low. Cutting force decreases by increasing nose radius for a material.

Figure.11: gives the variation of cutting force by increase in nose radius for different feed rate conditions at the cutting speed of 19.47m/min. For higher feed rate cutting force will be more, similarly for lower feed rate cutting force will be low. Cutting force decreases by increasing nose radius.

III.CONCLUSION

The following conclusions are made from the evaluation of the experimental results.

•The surface finish improves with increase in nose radius and also high at higher depth of cut conditions. The surface finish quality will be good with increase in cutting speed.

•The material removal rate increases gradually at lower nose radius conditions but increases rapidly at higher depth of cut conditions. The increase in feed rate will increase the material removal rate.

•The temperature at the tool tip decreases with increase in nose radius and feed rate conditions. The rate of temperature raise is maximum at higher cutting speed conditions.

•The flank wear of the tungsten carbide tipped tool decreases with increase in nose radius. The rate of flank wear will be lower at higher feed rate conditions. The tool wear rate will be maximum at higher cutting speed condition.

•The cutting force exerted on the tool tip decreases with increase in nose radius. The rate of increase in cutting force increases with increased feed rate at all increased nose radius conditions.

•The thrust force decreases with increase in nose radius at different cutting speed conditions. The rate of thrust force increases with increased feed rate.

•For better surface finish with higher material removal and lower tool wear the machining conditions can be obtained from the thorough analysis of the experimental results plotted.

REFERENCES

[1] Panda, Dutta, S.K, Sahoo, A.K, Rout, A.K, Routra, B.C "Experimental investigation on surface roughness characteristics in hard turning of EN31 steel using coated carbide insert: Taguchi and mathematical modeling approach" 5th International & 26th All India Manufacturing Technology, Design and Research Conference (AIMTDR 2014) December 12th–14th, 2014, IIT Guwahati, Assam, India.

[2] Pratik L. Nagalwade1, A. V. Kale "Performance evaluation of tin coated and uncoated carbide tools in turning aisi 4140 steel" 5th International & 26th All India Manufacturing Technology, Design and Research Conference (AIMTDR 2014) December 12th–14th, 2014,IIT Guwahati, Assam, India

[3] Shivraj Singh, Harvinder Singh, Harry Garg "Study & Optimization of Parameters for Optimum Cutting condition during Turning Process using Response Surface Methodology" 5th International & 26th All India Manufacturing Technology, Design and Research Conference (AIMTDR 2014) December 12th–14th, 2014, IIT Guwahati, Assam, India

[4] Gaurav Bartarya, S. K.Choudhury "Effect of tool wear on white layer thickness and subsurface hardness on hard turned en31 steel" 5th International & 26th All India Manufacturing Technology, Design and Research Conference (AIMTDR 2014) December 12th–14th, 2014, IIT Guwahati, Assam, India

[5] Hari Singh and Pradeep Kumar Optimizing cutting force for turned parts by Taguchi's parameter design approach Indian Journal of Engineering and Materials Sciences, volume 12, 2005, pg. no. 97-103.

[6] Suresh R, Basavarajappa S., Gaitonde V.N and Samuell G.L., Machinability Investigations on Hardened AISI 4340Steel using Coated Carbide Insert International Journal of Refractory Metals and Materials, volume 33, 2012, pg. no. 75-86.

[7] Anirban Bhattacharya, Santanu Das and Ajay BatishEstimating the effect of cutting parameters on surface finish high speed machining of AISI 1045 steel using Taguchi Design and Anova Journal of Manufacturing Technology Today, Nov. 2008, pg. no. 15-22.

[8] P. Madhava Reddy, P. VijayaBhaskara Reddy, Y. Ashok Kumar Reddy and N. Naresh Optimization of machining parameter for turning of EN-16 steel using Grey based Taguchi method ARPN Journal of Engineering and Applied Sciences,vol.9, no.3,March 2014, pg. no. 215 - 222.

[9] Harisingh. Optimizing Tool life of carbide inserts for turned parts using Taguchi's Design of Experiments Approach Proceedings of the International Multi Conference of Engineers and Computer Scientists 2008", vol. II, IMECS.

[10] Y.B.Kambhar and C.A.Waghmare. Tool life and surface roughness optimization of PVD TiAlN/TiN Multilayer coated carbide inserts in semi hard turning of Hardened EN31 alloy steel under dry cutting conditions. International Journal of Advanced Engineering Research and Studies, E-ISSN 2249-8974, July-Sept. 2013, pg. no. 22-27.

[11] Panda, A, Dutta, S.K, Sahoo, A.K, Rout, A.K, Routra, B.C.Experimental investigation on surface roughness characteristics in hard turning of EN31 steel using coated carbide insert: Taguchi and mathematical modeling approach. 5th International & 26th All India Manufacturing Technology, Design and Research Conference (AIMTDR 2014) December 12th–14th, 2014, IIT Guwahati, Assam, India.

[12] Chetan, Bikash Chandra Behera, Sudarsan Ghosh, P Venkateswara Rao. Effect of Direct and Indirect Cryogen Application Methods on the Turning Forces, Tool Wear and Surface Finish of a Nickel Based Alloy (Nimonic 90). 5th International & 26th All India Manufacturing Technology, Design and Research Conference (AIMTDR 2014) December 12th–14th, 2014, IIT Guwahati, Assam, India

[13] Sunil Magadum, Arun Kumar S, Yoganath V.G, C.K.Srinivasa. Cryogenic Machining of SS304 Steel. 5th International & 26th All India Manufacturing Technology, Design and Research Conference (AIMTDR 2014) December 12th–14th, 2014, IIT Guwahati, Assam, India.

[14] Dr.Srikantappa.A.S Ph.D Thesis"A Study on performance evaluation of wire-EDM Process in cutting steel"

[15] Shivakumra C M. Srikantappa A.S VinayKumar.M.J Evaluation Of Performance Of Coated And Uncoated Carbide Tipped Tool Inserts In Turning Of Steel -A Review published in International Journal of Research in Aeronautical and Mechanical Engineering IJRAME during December 2017