ANALYSIS OF TOOL WEAR DURING DRY AND WET TURNING LITERATURE REVIEW

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ABSTRACT

This thesis was proposed to study and analyze the surface properties of mild steel and tool wear during dry, water, oil and mixture of oil and water cooling during turning on the lathe. The tool life and surface properties (surface roughness) of mild steel during turning with mixture of oil and water cooling found very good. In this process order to tackle a multi-objective optimization problem which seeks identification of the best process condition or parametric combination for the manufacturing processes, dry and wet turning, In the present experiment investigation on straight turning of mild-steel bar by using HSS tool. This experiment has aimed to evaluate best manufacturing process which could satisfy both productivity as well as quality with special focus on reduction of cutting tool wear. Because reduction in tool wear ensures increase in tool life. The experimental analysis showed that surface properties of mild steel improved when wet turning (mixture of oil and water) was carried out.

1 INTRODUCTION

Productivity and quality of machined parts are the main challenges of metal cutting industries. Turning is mostly used process among all the machining processes. The growing demands for high productivity and quality of turned parts in terms of surface finish and less time for machining need use of high cutting velocity [22]. Manufacturing industries faces problems of dimensional inaccuracy, short tool life & surface quality problem during machining. There are several techniques which are used to improve surface quality & protect tool life by use of coolant or cutting fluid. Cutting fluids are used for improving surface finish & tool life [1]. All machining process depends on cutting tool. All demands in production like workpiece quality, dimensional accuracy & surface roughness mainly depend on cutting and coolant [12]. Among all steels Mild steel have special place in the manufacturing sector because of its

mechanical properties like machinability, less cost and Ductility. Therefore it is mostly used as raw material in all the machining process [8].During turning operation material removed from work piece in the form of chips by the shear action of cutting tool. Heat generated due to rubbing of tool on work piece as well as shear action. Generated heat will distribute on work piece, tool and chip. This heat affects cutting process. So Temperature generated in cutting tool-chip interface is taken as one of the parameter to analyze the performance [2]. As depth of cut increases it increase cutting temperature as well as surface roughness and causes more tool wear [4].

1.1 TURNING OPERATION

Turning is the process of removal of material from outer diameter of rotating cylindrical work piece. It is used to reduce the diameter of the work piece, usually to a specified dimension and to produce a smooth finish on the metal [3]. Cutting parameters are reflected on surface texture, surface roughness and dimensional accuracy of product [17]. Turning is a material removal process in which a single point cutting tool moves axially on the surface of a cylindrical rotating work piece [8].

2 LITERATURE REVIEW

- **Kurimoto et al. (1981)**

According to Kurimoto et al. Use of straight oil did not penetrate the chip tool interface and therefore did not show lubricating action.

- **Herbert (1989)**

Hetbert used technique to analyze the chip-tool interface temperature under different cutting conditions like depth of cut, different cutting fluids and cutting speed. His results indicates that when increase in speed from 0.1m/s to 1m/s then temperatures also increased.

- **Obi (1997)**

Obi investigated use of cutting fluid like vegetable oils (palm oil, ground nut oil and cotton seed oil) for orthogonal cutting of brass and aluminium using HSS cutting tool. His result showed that performance of groundnut oil is better for aluminium machining and cotton seed oil performance is better for brass machining.

- **R.F. Avila et al. (2001)**

R.F. Avila et al. found when finish cutting at high cutting speeds, the use of cutting fluid is responsible for reducing the scatter in the surface roughness value.

- **N.R. Dhar et al. (2002)**

They did the influence of cryogenic cooling on tool wear, dimensional accuracy and surface finish in turning AISI 1040 and E4340C steels.

- **O. Caklr et al. (2004)**

According to O. Caklr et al. use of Gases in turning provided higher shear angle value than dry and wet cutting.

- **W. Belluco et al. (2004)**

They used rapeseed oil, ester oil and mineral oil as cutting fluids. According to them vegetable based oils have better results than the mineral reference oil.

- **L.n. Lopez de lacalle et al. (2006)**

They did Experimental of the effect of spray cutting fluids in high speed milling. The possibility of minimizing the consumption of cutting oil has also been analyzed. They concluded that Emulsion coolant is inefficient in high speed milling.

- **N.j. Fox et al. (2007)**

They made a review of oxidation on Vegetable oil-based lubricants. This review addresses oxidation as a limitation of vegetable oil based lubricants.

- **M. Anthony et al. (2008)**

They performed experiment by using AISI 304 material as work piece. They used three different vegetable oil based cutting fluids: 1.Coconut Oil, 2. Soluble Oil, 3. Straight Cutting Oil. According to them feed rate affects surface roughness & cutting speed affects tool wear.

- **E. Kuram et al. (2010)**

They performed Cutting Fluid Effects and Cutting Parameters on Thrust Force and Surface Roughness. They performed drilling operation with AISI 304 austenitic stainless steel. They took HSSE tool material. They performed experimentation with three vegetable oils that are 1.Refined sunflower oil, 2.Commercial vegetable cutting fluid, 3.Commercial mineral cutting fluid.

- **Y.M. Shashidhara et al. (2010)**

They performed a review on Vegetable oils as a cutting fluid. They did experimentation with three vegetable based cutting fluids that are soya-bean, sunflower and rape seed oil.

- **Babur Ozcelik et al. (2011)**

They did investigations on vegetable based cutting fluids with pressure during turning of AISI304L.they performed turning

operation b using AISI304L work piece material.

- **A.Shokrani et al. (2012)**

They concluded that the area of difficult-to-machine materials is still vague and requires further research. The major draw backs are the environmental and health impacts with the costs associated with their use, maintenance and disposal.

- **S.A. LawalI.A.Choudhury et al. (2012)**

they did review on vegetable oil Application as working fluids in machining ferrous metals.

- **Marius Wintera et al. (2012)**

They performed grinding operation on hardenable carbon alloy steel by using Cubic boron nitride as a tool material. They used 1.mineral oil 2.water miscible polymer dilution, 3.water miscible mineral oil based emulsion as a cutting fluids. They concluded that the use of cutting oil, even at high specific material removal rates leads to a good surface roughness, a low wear and a constant cutting power.

- **R. Deepak joel johnson et al. (2014)**

They concluded that the turning operation with minimum cutting fluid improves the cutting performance and gives the improved surface finish.

- **Devanand r. Tayade et al. (2014)**

Evaluation of cutting and geometric parameter is one of the most important elements for quality and productivity which play significant role in today's manufacturing market. From customers' viewpoint quality is very important because the extent of quality of the procured item (or product) influences the degree of satisfaction of the consumers during usage of the procured goods. Therefore, every manufacturing or production unit should concern about the quality of the product. Apart from quality, there exists another criterion, called productivity which is directly related to the profit level and also goodwill of the organization. In this paper,particle swarm optimization technique is used efficiently to optimize cutting and geometric parameter like cutting speed, feed, depth of cut and rake angle due to complexity of cutting and geometric parameter optimization.

- **Marius wintera et al. (2014)**

They performed the Eco-Efficiency of alternative and conventional cutting fluids in external cylindrical grinding. They did External cylindrical grinding on hardened carbon alloy steel (62 HRC). They have

taken a mineral based emulsion and a grinding oil, and polymer dilution as cutting fluids in their experimentation. They concluded that the cutting fluid composition has a major influence on the technological, environmental and cost impact and therefore on the eco-efficiency of the grinding process.

- **Maurotto et al. (2014)**

They performed a parametric study on Surface integrity in dry milling of 304L steel. They did milling operation on 304L steel. They concluded that regarding residual stress generation, although the statistical model predicted a beneficial impact from low depth of cut, low feed per tooth, and high cutting speed, in fact the measured stresses were rather more complicated due to the inter-dependence among all parameters. The most evident trend was the reduction of stresses for lower depth of cut.

- **A.Srithara et al. (2014)**

They performed Experimental Investigation and Surface roughness Analysis on Hard turning of AISI D2 Steel using Coated Carbide Insert. They concluded with results which specify that the increase of cutting speed decreases the surface roughness in machining of hardened Steel.

- **Mithun Shah et al. (2014)**

They did Review on use of Vegetable based oils as Cutting Fluid in Machining of Alloys. They concluded from the review of different journal papers that, research has not been done on 'castor oil' as vegetable based cutting fluid.

- **Matthew Grover et al. (2014)**

They did Comparison on Surface Finish, Geometric Accuracy and Tool Wear for EN8 Steel in Wet and Dry Conditions. According to them wear rate is present in dry condition.

- **Arun Nanda et al. (2014)**

They did research on Tool Wear under different Environmental Conditions in Turning of AISI D2 Steel using Taguchi Method. The results indicate that there is a considerable improvement in machining performance under solid lubrication compared to dry and wet machining.

- **B. Satheesh Kumar et al. (2015)**

They have done analysis of Vegetable Oil as Cutting Fluids with high Pressure for Machining of AISI 1040 Steel. From results coconut and sesame oils with EP additive improved machining performance compared to other lubrication conditions.

- **S. Sulaiman et al. (2015)**

The main aim is to examine the tool wear progress at wide operating cutting domain for dry turning of high carbon steel using Conventional Lathe machine with Ti-N coated carbide cutting tool. The recommended machining parameters conditions that minimize tool wear is at the lowest cutting speed of 90 rev/min and lowest feed rate of 0.13 mm/rev.

- **Mohd. Sibghatullah et al. (2015)**

The objective of the present work is to measure the surface roughness and chip thickness of the mild steel work piece in turning using vegetable oil used as a cutting fluid.

- **R. Serra et al. (2016)**

The present study investigates the use of vibration measurement to perform the evaluation of cutting tool wear during the dry turning process.

- **Onyemachi Joachim Onuoha et al. (2016)**

Taguchi method has been employed to investigate the effects of cutting fluids on surface roughness in turning AISI 1330 alloy steel, using manually operated lathe machine. Experiments have been conducted using L27 (34) orthogonal array and each experiment was repeated three times and each test used a new cutting tool, High Speed Steel (HSS), to ensure accurate readings of the surface roughness. The statistical methods of Signal-to-Noise (S/N) ratio and the Analysis of Variance (ANOVA) were applied to investigate effects of cutting speed, feed rate and depth of cut on surface roughness under different cutting fluids. Minitab 14 software was used to analyze the effect of variables on the surface roughness. Results obtained indicated that optimal variables for the minimum surface roughness were cutting speed of 35 m/min (level 2), feed of 0.124 mm/rev (level 1), depth of cut of 0.3 mm (level 1) and a cutting fluid with a viscosity of 2.898 mm2/s (level 3). Hence, the optimal parameters to obtain better surface roughness of the workpiece material were obtained when groundnut oil based cutting fluid was used. Analysis of variance shows that feed rate has the most significant effect on surface roughness.

- **Harsh Vardhan Verma et al. (2017)**

This paper presents the optimized method of machining process for improved surface finish of AISI 1080 steel which was turned under dry, wet and mist condition. In machining operation large amount of cutting fluids are used for cooling & lubrication purpose. There is necessity to use minimum amount of cutting fluid for

machining operations. In this work, to achieve that aim, Minimum quantity lubrication (MQL) method was used to reduce the cutting fluid while machining. A mathematical model will also developed to determine the surface roughness in terms of machining time and cutting tool wear function in terms of the four independent variables: the cutting depth (d), the cutting feed (f), the cutting speed (Vc) and the cutting duration (t). The results application of MQL technique will significantly helps to obtain better performance in compare to dry condition. The purpose of cutting fluid in a machining operation is to cool the work piece, reduce friction, and wash away the chips. The cutting fluid contributes significantly toward machining cost and also possesses environmental threats.

REFERENCES

1. S. Sulaiman et al. (2015),"Influence of Dry Machining Parameters in Minimization of Tool Wear", 3rd International Conference on Advances in Engineering Sciences & Applied Mathematics.
2. Shreedhar bhattarai (2015),"Performance analysis of coated single point cutting tool in turning operation", international journal of innovative technology and research, vol-3, 2234 – 2243.
3. Ravi Butola et al. (2017),"Effecton Surface Properties OF Mild Steel During Dry Turning& Wet Turning On Lathe", Materials Today: Proceedings, 7892–7902
4. P. Sivaiah et al. (2018),"Effect of cryogenic coolant on turning performance characteristics during machining of 17-4 PH stainless steel: A comparison with MQL, wet, dry machining", CIRP Journal of Manufacturing Science and Technology.
5. O. Cakır et al. (2004),"Comparison of gases applications to wet and dry cuttings in turning", Journal of Materials Processing Technology, 35–41.
6. S. Schindler et al. (2014),"Finite element model to calculate the thermal expansions of the tool and the workpiece in dry turning",6th CIRP International Conference on High Performance Cutting, HPC2014,Procedia CIRP 14 ,535 – 540.
7. Yacov sahijpaul et al. (2013),"Determining the Influence of Various Cutting Parameters on Surface Roughness during Wet CNC Turning Of AISI 1040 Medium Carbon Steel", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Vol-7,63-72

8. Mohd. Sibghatullah et al. (2015),"To Study The Surface Roughness And Chip Thickness During Machining Of Mild Steel (Aisi-1008) Using Vegetable Based Oil As A Cutting Fluid", International Journal of Science, Engineering and Technology Research (IJSETR), Vol-4.
9. Osarenmwinda et al.(2014),"Effect of Cutting Fluids on the Flank Wear of High Speed and Carbide Tipped Cutting Tools", Effect of Cutting Fluids on the Flank Wear of High Speed and Carbide Tipped Cutting tools,Vol-18, 159-163.
10. K.G Sathisha et al. (2016),"Effects of Cutting Fluids and Machining Parameter on Turning of Mild Steel", National Conference on Advances in Mechanical Engineering Science, 406-410
11. S.S. Acharya et al. (2015),"Experimental Investigation of Turning Process in Wet and MQL system on EN 31 Alloy Steel", International Journal of Scientific & Engineering Research, Vol-6, 1074-1080.
12. R. Serra et al. (2016),"Experimental Evaluation of Flank Wear in Dry Turning from Accelerometer Data", International Journal of Acoustics and Vibration, Vol-21, 50-58.
13. Sanjivanee P. Patil et al. (2016),"Analysis of Tool Life during Turning of En8 in Dry, Wet and MQL Environment – A Review", International Journal for Research in Applied Science & Engineering Technology, Vol-4, 29-35.
14. Mohamed Handawi Saad Elmunafi et al. (2015),"Tool Life of Coated Carbide Cutting Tool when Turning Hardened Stainless Steel under Minimum Quantity Lubricant using Castor Oil", 2nd International Materials, Industrial, and Manufacturing Engineering Conference, MIMEC2015, 4-6 February 2015, Bali Indonesia, Procedia Manufacturing, 563 – 567.
15. Janos Kundrak et al. (2013),"Use Of Coolants and Lubricants In Hard Machining", Technical Gazette 20, 1081-1086.
16. Harsh Vardhan Verma et al. (2017),"Experimentation of Surface Roughness of AISI-1080 in Turning Operation under Different Cooling Conditions ", International Journal of Scientific and Research Publications, Vol-7, 630-633.
17. Devanand R. Tayade et al. (2014),"Evaluation of cutting and geometric parameter of single point cutting tool for turning operation", International Journal of Innovative

Research in Advanced Engineering (IJIRAE), Vol-1, 167-171.

18. Pei Yan et al. (2015),"The effect of cutting fluids applied in metal cutting process", Jounal of Engineering Manufacture, 1-19.
19. Zeenat Fatima et al. (2013),"Effects Of Three Different Cutting Fluids In The Turning Of Mild Steel Aisi1008",International Journal of Technical Research and Applications, Vol-1, 19-22
20. J. Braz. Soc. Mech. (2001), "Application of Cutting Fluids in Machining Processes", Journal of the Brazilian Society of Mechanical Sciences, VOL-23.
21. E. Kuram et al.(2010),"Effects of the Cutting Fluid Types and Cutting Parameters on Surface Roughness and Thrust Force", Proceedings of the World Congress on Engineering, Vol-2.
22. Arif Pathan et al. (2015),"Experimental Investigation On Effect Of Cutting Parameters On Surface Roughness And Machining Time In Turning En31 Hardened Steel Under Flooded And Mql Conditions", International Journal of Modern Trends in Engineering and Research, vol-2.
23. Onyemachi Joachim Onuoha et al. (2016),"Determining the Effect of Cutting Fluids on Surface Roughness in Turning AISI 1330 Alloy Steel Using Taguchi Method", Modern Mechanical Engineering, 51-59.
24. Rushikesh Waydande et al. (2016),"Performance Evaluation Of Different Types Of Cutting Fluids In The Machining Of Hardened Steel – A Review", International Journal of Mechanical And Production Engineering, vol-4, 34-39.