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Review on Application of Taguchi Optimization in Lathe Tool Cutting Operation Using Ansys Software

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Abstract: *Various automobile and machine components are manufactured using machining operations. The machine operation is conducted with the help of single point cutting tool. The current research reviews the existing researches on machining operation and cutting tool. These researches are based on use of both experimental and numerical methods in obtaining the solution and characterization of machine tool. The researches have shown that material and geometry of cutting tool has significant effect on strength and chipping.*

Key Words: Cutting tool, machining

1. INTRODUCTION

Turning operation is one of the most effective machining processes for the manufacturing of metal and non-metal components used in different industries. Turning is a conventional machining process in which a cutting tool is fed into a rotating work piece to produce an external or internal surface that is concentric with the axis of rotation. A lathe is one of the most versatile conventional machines. A turning tool is generally held in place by a translating carriage, turret, or tailstock. The carriage or turret travels on the bed ways parallel to the part axis (Z-axis), while the mount of a cross slide or the X-axis provides motion perpendicular to the part axis. Using a chuck, collect, faceplate, or mandrel to mount the work piece, or between pointed conical centers, the work piece rotates around a rotating spindle.

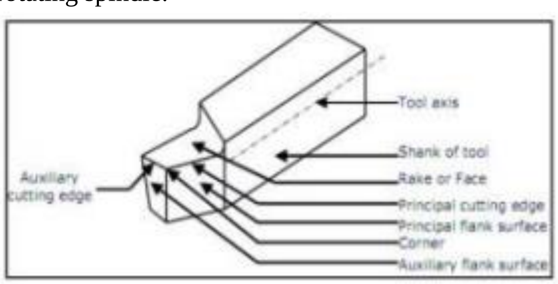

Figure 1: Geometry of cutting tool

The geometry of a cutting tool consists of the following elements: face or rake surface, flank, cutting edges and the corner. For cutting tools, geometry depends mainly on the properties of the tool material and the work material. A single point cutting tool may be either right or left hand cut tool depending on the direction of feed. The standard terminology is shown in the following figure. Angles such as rake, relief, and end are important when designing single point tools.

2. LITERATURE REVIEW

Stephenson [1] researcher recommended that the temperature distribution within the tool may well be obtained by using data concerning the changes within the hardness and microstructure of the steel tool. It is calibrate the hardness of the tool with respect to the temperature and time of heating and samples of structural changes at corresponding temperatures. These ways allow activity of temperatures to an accuracy of ± 25 0C at intervals the heat affected region.

Miller et al [2] Researcher use other technique of Experimental techniques using trendy, digital infrared imaging and successfully applied them during this study to gather cutting tool temperature distributions from orthogonal machining operations.

ABHANG L.B [3] worked to live the tool-chip interface temperature through an experiment throughout turning of EN-31 steel alloy with wolfram inorganic compound inserts employing a tool-work thermometer technique. First and second order mathematical models square measure developed in terms of machining parameters by using the response surface methodology on the idea of the experimental results. The results are analyzed statistically and graphically. The metal cutting parameters thought-about square measure cutting speed, feed rate, depth of cut and power nose radius.

S.K. Chaudhary et al. [4] Researcher Predicted cutting elongating temperatures by natural tool work thermocouple technique, when machining EN 24 steel work piece and HSS with 10% cobalt as the cutting tool. The results indicated that a rise in cutting speed and feed rate resulted in a rise in tool wear and cutting zone temperature will increase with the rise within the cutting speed. While within the whole vary of feed the temperature will increase with increase in feed rate.

Federi com Aneriro et al. [5] Investigated the influence of cutting parameters (cutting speed, feed rate and depth of cut) on tool temperature, tool wear, cutting forces and surface roughness when machining hardened steel with multilayer coated carbide tools. A standard K-type of thermocouple junction inserted close to the rake face of the tool was accustomed live the interface temperatures. They ended that the temperature close to the rake face will increase considerably once the depth of cut changes from zero.2 to 0.4 mm. The increase in grips length between chip and rake face can be accountable, since it grows, together with uncut chip cross-section. Similar trend was ascertained within the cutting forces, tool wear and surface roughness during machining of hardened steel

H. Ay and Yang] [6] seven used a way with K thermocouple junction to investigate temperature variations in inorganic compound inserts in cutting numerous materials like copper, cast iron aluminum 6061 and AISI 1045 steel. They ascertained oscillations in temperature close to the leading edge, which were more marked for ductile materials and less in the hard –machining materials.

Kashiway and Elbestawi [7] investigated the effect of cutting temperature on the integrity of machined surface. It has been shown that cutting temperature incorporates a major impact on the integrity on the machined surface. The undesirable surface tensile residual stresses were attributed to the temperature generated during machining. Therefore, dominant the generated tensile residual stresses depends on the understanding of the impact of various method parameters on the cutting temperature.

S.K. Chaudhary et al. [8] Predicted cutting zone temperatures by natural tool work thermocouple technique, when machining EN 24 steel work piece and HSS with 10% cobalt as the cutting tool. The results indicated that an increase in cutting speed and feed rate resulted in an increase in tool wear and cutting zone temperature increases with the increase in the cutting speed. While in the whole range of feed the temperature increases with increase in feed rate.

Federi com Aneriro et al.[9] Investigated the influence of cutting parameters (cutting speed, feed rate and depth of cut) on tool temperature, tool wear, cutting forces and surface roughness when machining hardened steel with multilayer coated carbide tools. A standard K-type of thermocouple inserted near the rake face of the tool was used to measure the interface temperatures. They concluded that the temperature near the rake face increases significantly when the depth of cut changes from 0.2 to 0.4 mm. The increase in contact length between chip and rake face could be responsible, since it grows, together with uncut chip cross-section. Similar trend was observed in the cutting forces, tool wear and surface roughness during machining of hardened steel.

H. Ay and Yang et. al. [10] used a technique with K thermocouple to analyze temperature variations in carbide inserts in cutting various materials such as copper, cast iron aluminum 6061 and AISI 1045 steel. They observed oscillations in temperature near the cutting edge, which were more marked for ductile materials and less in the hard –machining materials. These observations were attributed to the chip formation and its contact with the work material.

Kashiway and Elbestawi et. al. [11] investigated the effect of cutting temperature on the integrity of machined surface. It has been shown that cutting temperature has a major effect on the integrity on the machined surface. The undesirable surface tensile residual stresses were attributed to the temperature generated during machining. Therefore, controlling the generated tensile residual stresses relies on the understanding of the effect of different process parameters on the cutting temperature.

B.Findes, et al [12] Studied the influence of cutting speed, feed rate and depth of cut on cutting pressures, cutting force and on cutting temperature, when machining AISI H11 steel treated to 50 HRC work piece material with mixed ceramic tool. The results show that depth of cut has great influence on the radial cutting pressure and on cutting force. The cutting pressure and cutting force increase with an increase in depth of cut and feed rate. It is found that increase in cutting speed increases cutting zone temperature rapidly. It is also noted that cutting speed seems to influence temperature in cutting zone more significantly than the depth of cut and feed rate.

W. Grzesik et. al. [13] His work related to create a FEM simulation model in order to obtain numerical solutions of the cutting forces, specific cutting energy and adequate temperatures occurring at different points through the chip/tool contact region and the coating/substrate boundary for a range of coated tool materials and defined cutting conditions. Results showing how the tool chip interfacial friction influences the temperature distribution fields as the effect of using coated tools are the main and novel findings of this paper. The various thermal simulation results obtained were compared with the measurements of the average interfacial temperature and discussed in terms of various literature data. The finite element simulations performed demonstrate the existence and localization of the secondary shear zone. A good agreement was achieved, especially for uncoated and three-layer coated tools, between predicted and experimental values of cutting temperatures. It was documented that coatings cause that areas with the maximum temperatures are localized near the chip and work piece. In consequence, the maximum interface temperature exists in the vicinity of the cutting edge. i.e. in the first part of the tool-chip contact. Also the substrate is distinctly cooler in comparison to uncoated tools.

Kazban Roman V. et. al. [14] His work related to the machining industry for cost reduction and increases in productivity have contributed to new interest in high-speed machining. Even though, many model for machining exist, most of them are for low-speed machining, where momentum is negligible and material behavior is well approximated by the quasi-static laws. In machining at high speeds momentum could be large and the strain rate can be exceedingly high. For these reasons a fluid mechanics approach to understanding high-speed, very highspeed and ultra-high speed machining is attempted here.

3. CONCLUSION

Various researches are conducted on the machining operations using experimental and numerical methods. The researches have shown that operational parameters like machine speed, feed rate and depth of cut has significant effect on chipping and temperature distribution across cutting tool. From the FEA simulations, the chip/tool contact region and thermal behaviour of cutting tool are investigated.

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