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Analysis of Cutting Forces on Single Point Cutting Tool of Different Materials

Yash Ray[1]*, Dr. Suman Sharma*[2]

[1] PG scholar, Department of Mechanical Engineering, SAGE University, Indore

[2] Professor, Department of Mechanical Engineering, SAGE University, Indore

ABSTRACT

In this research work we found experimentally the effect of tool rake angle, depth of cut, work piece material type and cutting tool material on the main cutting force during a turning process. In Mild Steel work material cutting forces decrease when increases rake angle (0,4,8,12,16) and cutting force increases with increase of depth cut from 0.2 to 5 mm, with HSS & Carbide cutting tools. Mild Steel material turned up to depth of cut 4 mm with HSS cutting tool and up to 5 mm depth of cut with Carbide cutting material. Aluminum specimen the main cutting force was increased as increasing the tool rake angle for the small values of cutting depth (0.2, 0.4 and 0.8 mm) when for 1.5 to 5 mm cutting depth, the main cutting force was normalized and found almost unchanged with HSS tool and Carbide tool In Aluminum material, 5 mm depth of cut can be taken with HSS cutting tool and Carbide cutting tool For same depth of cut the cutting force value is more in carbide tool as compared to HSS tool.

Keywords- Rack Angle, Depth of cut, cutting tool, Cutting force, Work Piece.

1. INTRODUCTION

In every metal cutting process, a wedge-shaped tool with a straight cutting edge and a relative velocity with respect to the work piece is used, which helps to generate chips. Cutting activities are categorised as Oblique cutting and Orthogonal cutting for analytical purposes. The most typical sort of cutting, oblique cutting is typically used in a variety of machining procedures. The cutting edge's inclination angle is the angle at which the cutting velocity vector is inclined with respect to the normal. Due to forces being created in three directions that are perpendicular to one another, this sort of cutting is sometimes referred to as three-dimensional cutting. An uncommon form of cutting called orthogonal cutting has the cutting edge parallel to the cutting velocity vector. This kind of cutting is employed in research because it is a two-dimensional problem with forces acting in two perpendicular directions, where the number of independent variables is decreased. A cutting tool with just one shank and one cutting component is called a single-point tool. They are frequently utilised in machine tools such as lathes, turret lathes, planers, shapers, boring mills, and others.The salient faces and edges of the tools at their cutting point are referred to as the tools' salient faces and edges in terms of tool geometry. The cutting tools' performance in achieving effectiveness, efficiency, and total economy of machining depend greatly on the geometry and substance of the tools.

2. OBJECTIVE OF WORK

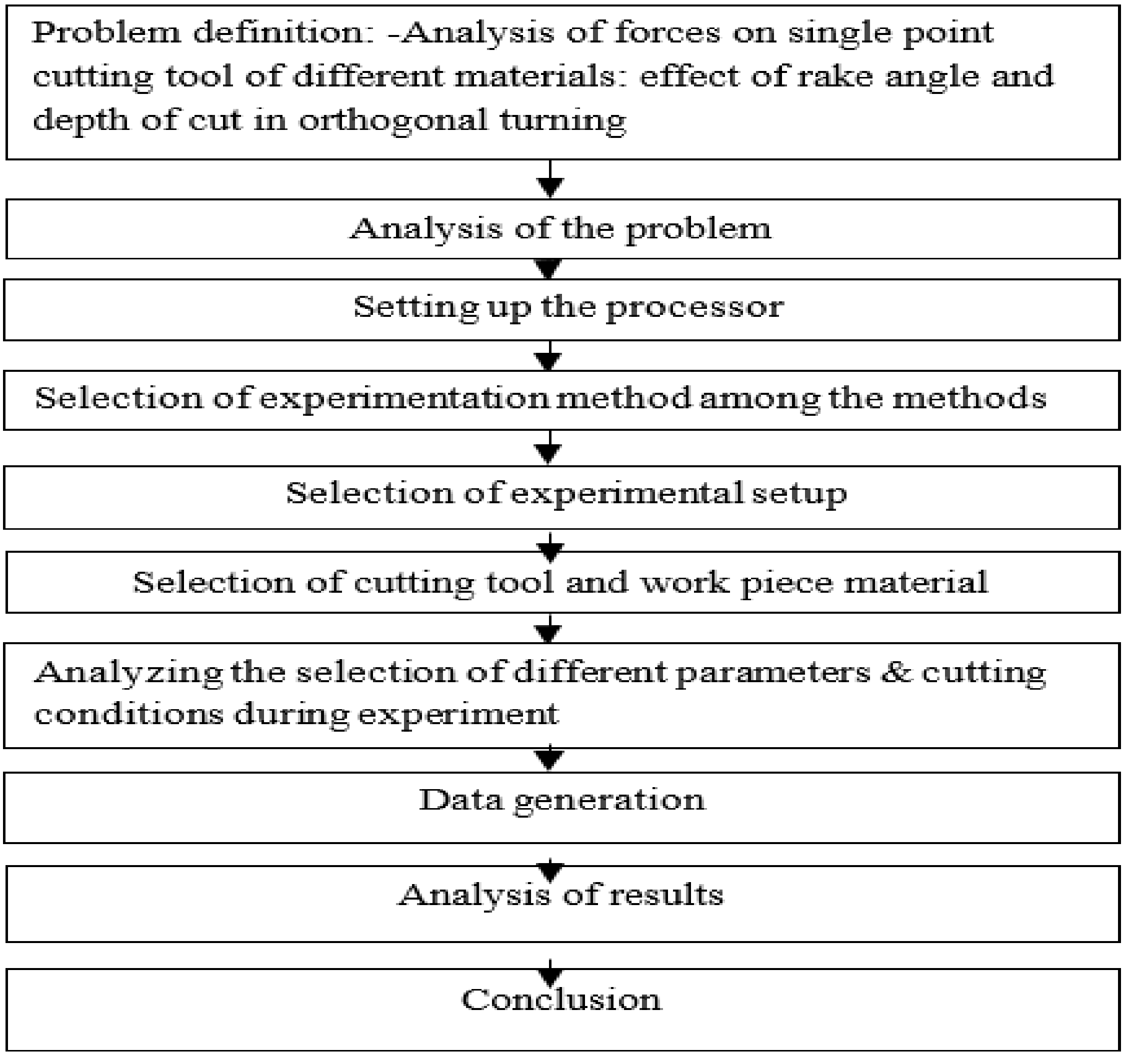
A characteristic called rake angle is employed in a number of cutting and machining operations. It describes the cutting face's angle in relation to the task. On cutting forces, the impact of different cut depths, work, and tool materials is also researched.

The objectives of the present work are as follows: -

- To examine the cutting forces for cuts with varied depths and a fixed rake angle while cutting at a fixed speed.
- In order to examine the cutting forces for various work materials.
- To examine cutting forces for various tool materials.

3. METHODOLOGY

In this study, cutting forces in an orthogonal turning process will be experimentally assessed in relation to rake angle and depth of cut. Three cylinders made of various materials, including EN 31, MS, and aluminium, will be turned with HSS (Miranda) and carbide tools at various rake angles (0, 4, 8, 12, 16 degree). For each rake angle, experiments will be run with 9 different depth cuts (0.2, 0.5, 0.8, 1.2, 1.5, 2, 3, 4,5 mm), while maintaining a constant cutting speed (550 rpm). Dynamometers will be used during the experiment to measure the forces.



4. RESULT AND ANALYSIS

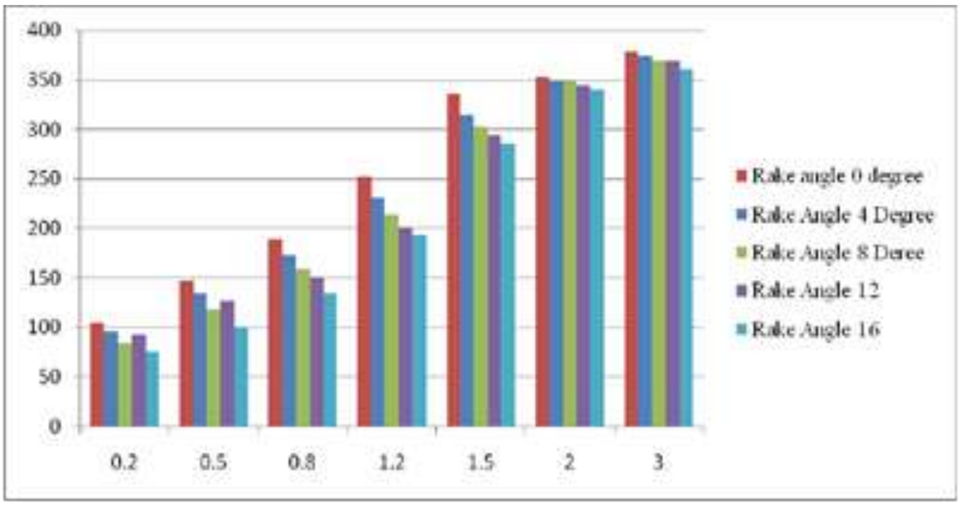


Figure 4.1 Cutting force at different Rake angle on EN 31

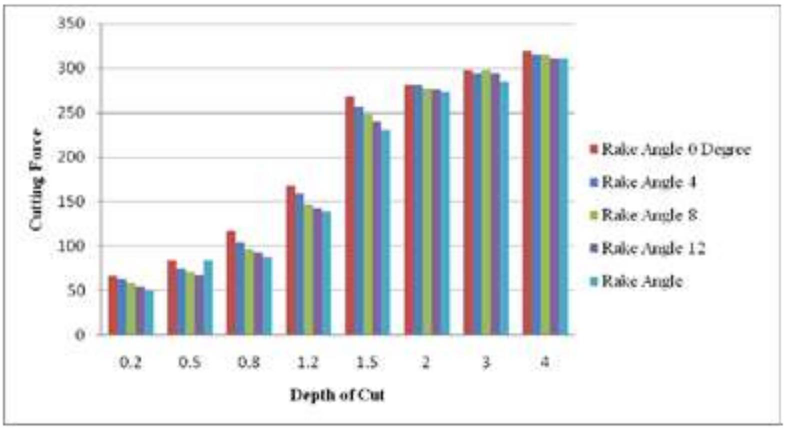


Figure 4.2 Cutting force at different Rake angle on MS

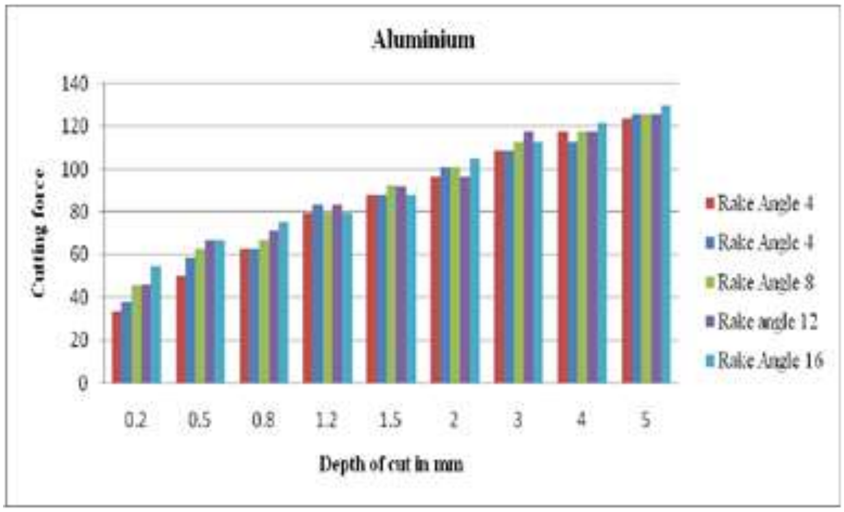


Figure 4.3 Cutting force at different Rake angle on AL

Cutting pressures on EN 31, MS decrease with increasing rake angle, but increase on aluminium for shallow cuts and remain unchanged for (1.5 mm to 5 mm). Carbide tools have a higher cutting force value for the same depth of cut than HSS tools.

5. CONCLUSION

In this research work following findings were observed

The tool rakes angle increases from 00 to 160, there is a diminishing trend in the main cutting force for EN 31 and mild steel specimens. For short cutting depth values (0.2 and 0.8 mm), on the other hand, the main cutting force is increased as the tool rake angle increases, however for depth of cut 1.5 mm to 5 mm, the main cutting force is normalised and is largely maintained unchanged with HSS tool and Carbide tool. Rake angle describes how easily materials are sliced. In actual use, it has been seen that as the rake angle is raised, tool forces are reduced and tool life is prolonged. It has been noted that as usage increases, tool life declines even though tool forces continue to decline. It is said that as the rake angle is increased, the cutting force decreases and the amount of heat produced decreases. It is the cause of the ensuing increase in tool life. The shear plane region within the work material is positioned at a roughly 900-degree angle to the tool's face. The rake angle determines the shear plane's length. The length of the shear plane will be shorter as the rake angle increases, requiring less power to shear the materials. Large positive rake angled tools, however, have lower mechanical strength, which shortens their useful lives.

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