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Effect of Rack Angle in Orthogonal Turning for Different Material

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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. The work piece material used in this research work are EN 31, Mild steel, Aluminum specimens as work piece materials and High Speed Steel, Carbide tools are used as tool materials. Total 45 experiments per material type and per tool type have been performed in order to measure the main cutting force (Fc). The experiments have been obtained with constant cutting speed (550 rpm) and feed rate (0.2 mm/r.e.v.), nine different cutting depths (0.2 – 5 mm) and five different tool rake angles (00 -160). In EN 31 material cutting forces decrease when increase rake angle (0,4,8,12,16) and cutting force increases with increases of depth cut from 0.2 to 5 mm. with HSS & Carbide cutting tools. For EN 31 material the depth of cut more than 3 mm cannot be turned with HSS tool and not exceed more than 4 mm depth of cut with Carbide tool. When depth of cut increases above 3 mm in EN31 material noise and vibration has been observed. 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.

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

1. INTRODUCTION

Turning is a machining process to produce parts in cylindrical in shape by a single point cutting tool on lathes. The tool is fed either linearly in the direction parallel or perpendicular to the axis of rotation of the work piece, or along a specified path to produce complex rotational shapes. The primary motion of cutting in turning is the rotation of the work piece, and the secondary motion of cutting is the feed motion. Turning is a metal cutting process used for generation of cylindrical surfaces. Typically, the work piece is rotated on the spindle and the tool is fed into it radically, axially or both the ways simultaneously to give required surface. The term turning, in general sense refers to generation of any cylindrical surface with a single-point cutting tool. More specifically it is often applied just to the generation of external cylindrical surfaces oriented primarily parallel to the work piece axis. The generation of surfaces oriented primarily perpendicular to the work piece axis is called facing. In turning the direction of the feeding motion is predominantly axial with respect to the machine spindle. In facing a radial feed is dominant. Tapered contoured surfaces require both modes of tool feed at the same time, often referred to as profiling. The principle used in all machine tools is one of generating the surface required by providing a suitable relative motion between the work piece and the cutting tool. In turning process the work piece material is rotated and the cutting tool will travel, removes a surface layer (chip) of the work piece material, producing three cutting forces components, i.e. the tangential force (F_y), which acts on the cutting speed direction, the feed force (F_x), which acts on the feed direction and the radial force (Fz), which acts on the direction normal to the cutting speed.

2. PROBLEM STATEMENT

Machinability is an important parameter to understand cutting mechanism for any given material. It is related with the cutting forces developed during machining process. Therefore, the knowledge of the corelationship of varies parameters such as cutting speed, feed rate, cutting depth, tool angles, nose radius, tool material, work piece material with cutting force is a subject of research.

3. OBJECTIVE OF WORK

Rake angle is a parameter used in various cutting and machining processes. It describes the angle of the cutting face relative to the work. Effect of various depth of cuts, work and tool materials on cutting forces is also studied.

The objectives of the present work are as follows: -

- To analyse the cutting forces for varying depth of cuts and constant rake angle at constant cutting speed.
- To analyse the cutting forces for different work materials.
- To analyse the cutting forces for different tool materials.

4. RESULT

In this research work During the experimental procedure, the main cutting force Fc was measured, on three different work piece materials i.e. EN31, MS and Aluminum with two cutting tool materials i.e. HSS and Carbide.

The experiments were conducted using nine different cutting depths, five different rake angles and constant cutting speed and feed rate.

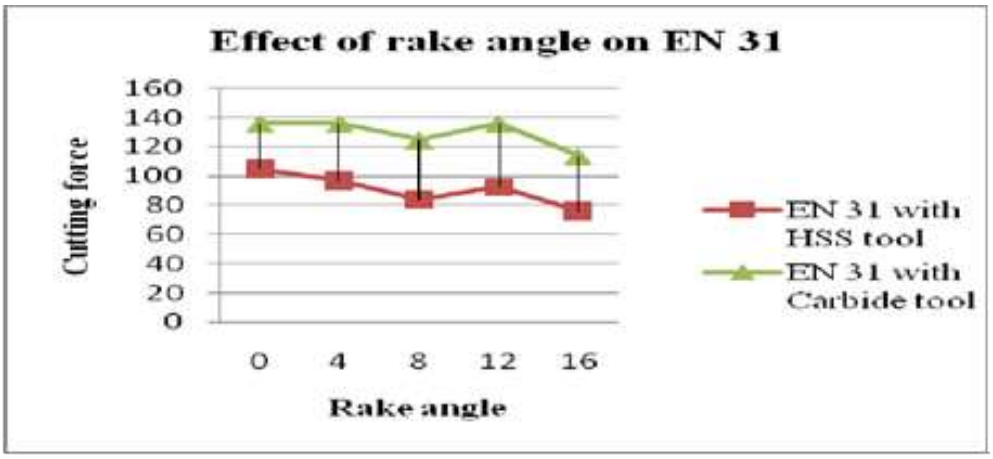

Figure 4.1 Effect of rake angle on EN 31

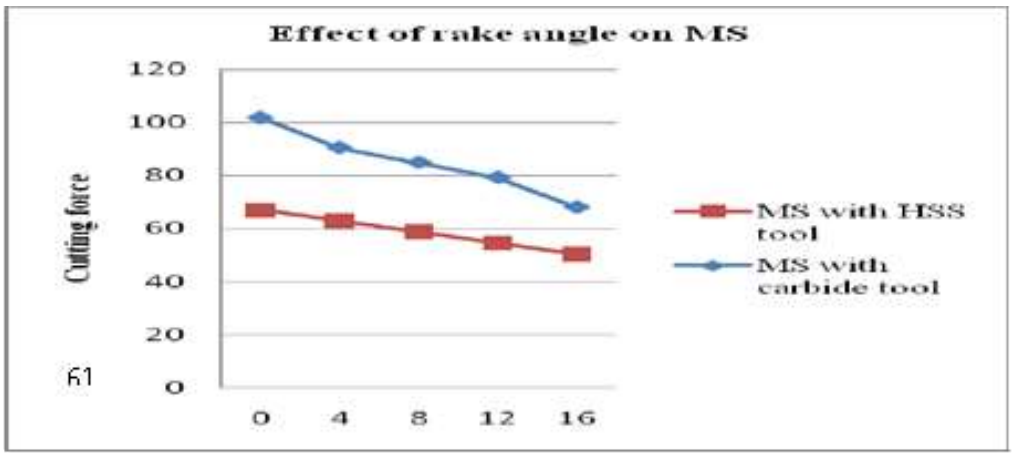

Figure 4.2 Effect of rake angle on Mild Steel

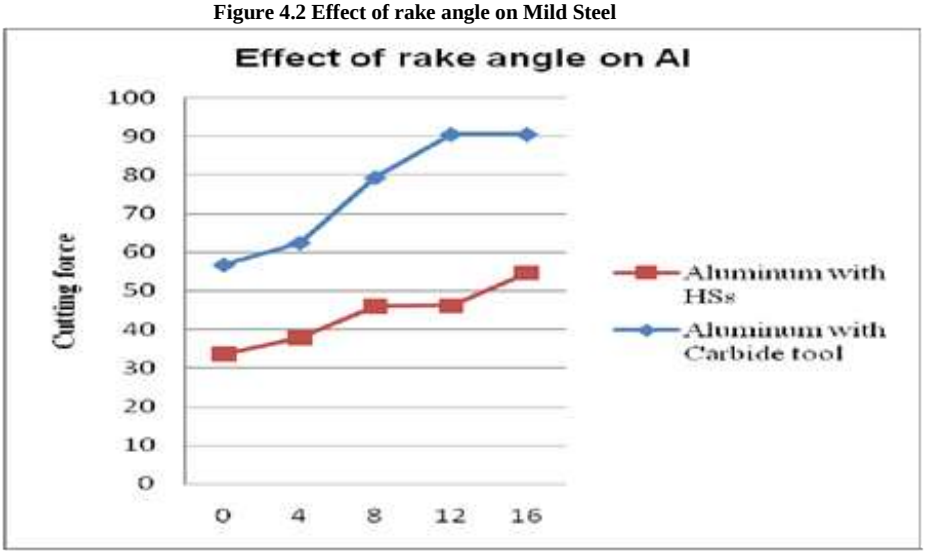

Figure 4.3 Effect of rake angle on Al

HSS tool			
Rake angle	**EN-31**	**M.S.**	**Aluminum**
0	147	84	50.4
4	172.2	105	63
8	117.6	71.4	63
12	126.6	67.2	67.2
16	100.8	84	67

Table 4.1 Effect of rake angle on AL, MS, EN 31 with HSS tool

5. CONCLUSION

The results obtained in this study has been drawn from experimental data evaluation. The findings are as follows: -

1. The effect of tool rake angle on main cutting force for EN 31and Mild Steel specimen decreasing trend as the rake angle increases from 00 to 160. On the other hand, for the Aluminum material the main cutting force is increased as the tool rake angle increases for small cutting depth values (0.2 and 0.8 mm), while for depth of cut 1.5 mm to 5 mm, the main cutting force is normalized and is kept all most unchanged with HSS tool and Carbide tool.
2. Main cutting force exhibits linear increasing trend, with the cutting depth increasing from 0.2 to 5 mm, for all work piece material types with HSS tool and Carbide tool.

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