INVESTIGATION ON MACHIBALITY OF TURNING ON ALUMINIUM ALLOYS

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Abstract

Aluminium alloys have excellent mechanical properties and low weight. This aluminium alloys (AA6061) are used in the process of analysing the cutting force by providing different parameters cutting speed, cutting force and depth of cut and also analysis surface roughness in turning operation. A multiple spindle speed, feed rate and depth of cut as independent variable in cutting force, cutting speed and surface roughness to be given in different parameters on the work piece. This paper is an attempt to give of recent work to predict cutting parameters and surface roughness generated on work piece.

1. Introduction

The turning operation is one of the most widely used material removal process in the industry. The cutting operations by the single point cutting tool are employed for finishing the machining sculptured surface such as core pins, pillars in press tool, are moulds and some other specifications.¹ The demanding specifications in the surface quality factors such as influence in the spindle speed, feed rate and depth of cut are easily controllable factors such as cutting speed feed rate and the depth of cut are considered.² In this study the surface roughness and cutting force is measured at various levels of the factors. The surface roughness determines and evaluates the quality of the product.³⁻⁴ In order to control a surface roughness after plastic deformation, a better understanding of the relationship between changeable material parameters, pre-treatment process and surface roughness is needed.⁵⁻⁶ The conditions of such fine machining can be practically and effectively realized by precision micro-
cutting process. 6061 is a precipitation hardening aluminium alloys, containing manganese and silicon as its major alloying elements originally called “alloys 61s,”. It has good mechanical properties and exhibits good weld ability. It is one of the most common alloys of for aluminium generally purpose use. It is commonly availability in pre-tempered grades such as 6061-0 (annealed) and tempered.

<table>
<thead>
<tr>
<th>Table: 1.1 Mechanical Properties Of 6061</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness (BHN)</td>
</tr>
<tr>
<td>Ultimate tensile strength</td>
</tr>
<tr>
<td>Tensile yield</td>
</tr>
<tr>
<td>Elongation at break</td>
</tr>
<tr>
<td>Mould of elasticity</td>
</tr>
<tr>
<td>Density</td>
</tr>
</tbody>
</table>

1.1 Cutting Force:
Before finding the cutting force, various parameters like depth of cut, feed, cutting speed, power required are to be known. All the parameters considered on a lathe machine with a dynamometer to done.

1.2 Cutting Speed:
It is defined as a speed at which the work moves with respective tool. Usually measured in metre per minute (m/min), denoted by “V” or “C”

1.3 Feed:
Feed rate is defined as the distance the tool travels during one revolution of the part measured in mm per revolution (mm/rev) and denoted by “f”. Power required is measured by dynamometer which gives initial and final wattmeter reading. The power required is shown in terms of kilowatts (KW) and denoted by “P”.

Cutting Speed, \( V = \frac{\pi d N}{60} \) m/min; \( d \) = Diameter of the part, \( N \) = Speed.

By using above parameters, cutting force is calculated using basic formula,

\[
\text{Cutting Force (F c)} = \frac{P \times 1000}{d \times f \times v} \text{N/mm}^2
\]

1.4 Surface roughness:
Surface roughness also known as surface profile-RA- is a measurement of surface finish it is topography at a scale. The might considered “texture” on the surface. Surface roughness is a
calculation of the relative roughness of a liner profile of area, expressed as single numeric parameters (Ra)

Arithmetical mean roughness (RA) section of standard length is simple from the mean line on the roughness charts. The mean line is laid on a Cartesian coordinate system where in the mean line runs in the direction of the X-axis and magnification is the Y-axis. The value obtained with the formula on the right is expressed in micrometre (μ).

\[ Ra = \frac{NoofPeaks + NoofVallay}{Samplelengt} \]

\[ Ra=\frac{(R1+R3+R5+R7)-(R2+R3+R6+R8)}{samplelengt} \]

2. Experimental procedure:

2.1 Work Piece Material

The materials used for the experiment 120mm length and 25mm diameter of aluminium alloy. The aluminium alloys are used (fig1). In turning operation using different parameter by producing the plain turning operation. By using three different speed and feed rate at a 0.5 (constant) depth of cut. Experimental conditions are given below in table -2

<table>
<thead>
<tr>
<th>Cutting tool</th>
<th>HSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed RPM</td>
<td>500-750-1200</td>
</tr>
<tr>
<td>Feed rate(mm/rev)</td>
<td>0.3-0.6-0.8</td>
</tr>
<tr>
<td>Depth of cut(mm)</td>
<td>0.5(constant)</td>
</tr>
</tbody>
</table>

Fig 2.1 Before machining
3. Results and discussion

In present investigation turning operation have performed to evaluate the cutting force. When the tool is in cut, a tangential and a radial component at the cutting force will attempt to deflect the tool away from the centre line. The machining of aluminium alloys of the results shows the cutting speed increases the Cutting force increases at constant speed and different depth of cut. At different spindle speed cutting force are find out from the cutting speed are watt meter reading in dynamometer.

While increasing the cutting speed at constant depth of cut the cutting forces are decreasing. Increasing the feed rate simultaneously cutting forces decreasing. In 750 r.p.m the cutting force are decreases comparative to previewer lower r.p.m in all feed rates.

3.1 Results for cutting speed and cutting force:

<table>
<thead>
<tr>
<th>Speed (RPM)</th>
<th>Feed (mm/Rev)</th>
<th>Depth of Cut (mm)</th>
<th>Wattmeter Readings</th>
<th>Cutting Speed (m/min)</th>
<th>Cutting Force (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Initial</td>
<td>Final</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>0.3</td>
<td>0.5</td>
<td>0.14</td>
<td>0.17</td>
<td>654.375</td>
</tr>
<tr>
<td>750</td>
<td>0.3</td>
<td>0.5</td>
<td>0.17</td>
<td>0.20</td>
<td>961.931</td>
</tr>
<tr>
<td>1200</td>
<td>0.3</td>
<td>0.5</td>
<td>0.20</td>
<td>0.26</td>
<td>1507.2</td>
</tr>
<tr>
<td>500</td>
<td>0.6</td>
<td>0.5</td>
<td>0.14</td>
<td>0.18</td>
<td>1615.112</td>
</tr>
<tr>
<td>750</td>
<td>0.6</td>
<td>0.5</td>
<td>0.17</td>
<td>0.21</td>
<td>903.037</td>
</tr>
<tr>
<td>1200</td>
<td>0.6</td>
<td>0.5</td>
<td>0.20</td>
<td>0.29</td>
<td>1413.45</td>
</tr>
</tbody>
</table>
### Table: 3.2 Surface Roughness

<table>
<thead>
<tr>
<th>Speed (RPM)</th>
<th>Feed Rate (m/mm)</th>
<th>Average peak (Ry)</th>
<th>Deepest values (Rz)</th>
<th>μ (+/-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>0.3</td>
<td>0.032</td>
<td>0.036</td>
<td>0.0248</td>
</tr>
<tr>
<td>750</td>
<td>0.3</td>
<td>0.046</td>
<td>0.042</td>
<td>0.0376</td>
</tr>
<tr>
<td>1200</td>
<td>0.3</td>
<td>0.054</td>
<td>0.056</td>
<td>0.0428</td>
</tr>
<tr>
<td>500</td>
<td>0.6</td>
<td>0.046</td>
<td>0.057</td>
<td>0.0346</td>
</tr>
<tr>
<td>750</td>
<td>0.6</td>
<td>0.058</td>
<td>0.062</td>
<td>0.0456</td>
</tr>
<tr>
<td>1200</td>
<td>0.6</td>
<td>0.062</td>
<td>0.069</td>
<td>0.0482</td>
</tr>
<tr>
<td>500</td>
<td>0.9</td>
<td>0.034</td>
<td>0.032</td>
<td>0.0276</td>
</tr>
<tr>
<td>750</td>
<td>0.9</td>
<td>0.049</td>
<td>0.053</td>
<td>0.0384</td>
</tr>
<tr>
<td>1200</td>
<td>0.9</td>
<td>0.068</td>
<td>0.063</td>
<td>0.0554</td>
</tr>
</tbody>
</table>

### Graph 3.1 Cutting Speed Vs Cutting Force

![Graph of Cutting Speed vs Cutting Force](attachment:image.png)
3.2 Surface Roughness

Graph 3.2.1 Speed-500, 750, 1200 (0.3 feed)

Graph 3.2.2 Speed-500, 750, 1200 (0.6 feed)
Conclusion:

From the present investigation the following conclusion were made:

1) The cutting force is decreasing with increasing the cutting speed at constant depth of cut.
2) The cutting force is decreasing while increasing the feed rate.
3) When the cutting forces are increasing with increasing the feed rate.

References


[2] Harbin University Of Science And Technology, Nagang District, Heilongjiang Province Harbin And150080 “Surface Roughness Analysis And Parameters”


[8] Fraunhofer-Institute For Production Technology IPT Stein Bach Stress E17, Aachen, 52074.” Target-Oriented Analysis “.