Study of Various Cutting Parameters on The Cutting Force And Power During Turning Operation

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Abstract- *The purpose of this paper is to study the factors affecting the cutting forces and power consumption. The factors selected were cutting speed, feed and depth of cut and setting them to a different level and determining the power required along with the factors influencing the power are determined.*

Keywords- cutting forces, turning operation, lathe, cutting power.

I. INTRODUCTION

Metal cutting is the process to cut the various material using machine tools to the desired shape. The cutting parameters are important to determine the process parameters such as machining precision, surface finish, power requirement and temperature [1]. The growing industries are much interested in the high- speed machining process as the material removal rates are greater and good finished work-piece are machined [2]. At higher feed rate and cutting speed the cutting tool wear and machining power are linear [3].

The process parameters play an important role on surface finish and the process capability. The geometry of tool such as rake angle, nose radius, end cutting edge and side cutting edge influences the surface roughness [4-6]. The total power consumption results the cost of machining process. Hence, the process parameters should be selected based on the geometry of tool and power consumption, since, these directly affect the overall operating cost [7-10].

Rajarajan. S and Sivaprakasam. R presented the work based on the affect of mean cutting force to obtain the optimum cutting power by Taguchi's L25 orthogonal array [11]. Orra. K and Choudhury. S. K developed a model to determine the affects of cutting force on tool wear and formation of chip based on the tool nose radius [12]. Shashidhara Y.M and Jayaram S. R. analyzed the turning operation using the vegetable oil as cutting fluid and cutting power was compared along with the cutting speed and the cutting depth [13].

II. EXPERIMENTAL DETAILS

- Work Material Used: Mild Steel (diameter 38mm x 120mm).
- Tool Material Used: High Speed Steel (HSS).
- Machine Tool: All geared lathe (Centre turning Lathe)
- Machining Condition: under dry condition.
- Output Response: Power consumption.

The turning operation is done on Mild-Steel using HSS as tool material. The cutting parameters (speed, feed and depth of cut) are varied at three levels, the cutting forces (feed force, thrust force and cutting force) are recorded using tool dynamometer for varied levels of cutting parameters.:

III. RESULTS AND DISCUSSIONS

1. The values are tabulated and represented in the form of the table 1.1., given below.
2. From the table it was observed that the cutting parameters such as depth of cut and feed rate have more effect on the cutting forces and which results in greater consumption of power. At constant feed rate it is observed that the depth of cut is more influencing the cutting forces compared to the speed.
3. It is observed that at constant depth of cut, the feed rate has much effect on the cutting forces comparable to the speed parameter. At constant speed it was observed that both feed and depth of cut influence the cutting forces.
4. From the tabular column it was observed that the maximum power consumed at a high speed and depth of cut (112 rpm and 1mm respectively).

IV. CONCULSION

The experimentation was conducted to determine the power requirement for turning process of Mild Steel material on the lathe machine. The following conclusion were drawn from the experimentation:

- It was observed that the feed was much influencing the cutting forces, that is, as feed increased the cutting forces increased.
- At constant feed the depth of cut has much effect on the cutting forces and cutting power, subsequently by the speed.
- The maximum power was consumed at 0.5 mm/min feed, 1 mm depth of cut and 112 rpm speed.

Table 1.1 Experimental Values for Different cutting parameters

Sl No.	Speed in rpm	Feed in mm/min	Depth of cut in mm	Feed Force Px in Kgf	Thrust Force Py in Kgf	Cutting Force Pz in Kgf	Power in cutting (in hp)
1	45	0.18	0.5	7	2	24	0.022
2	45	0.315	1.0	22	8	100	0.090
3	45	0.5	1.5	12	7	82	0.074
4	71	0.18	1.0	15	5	55	0.078
5	71	0.315	1.5	35	9	126	0.179
6	71	0.5	0.5	12	6	83	0.118
7	112	0.18	1.5	22	5	66	0.148
8	112	0.315	0.5	09	8	50	0.112
9	112	0.5	1.0	30	10	125	0.280

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