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Investigation on Metal Removal Rate by changing various Parameters like RPM, feed, Depth of cut on mild steel by Taguchi Method

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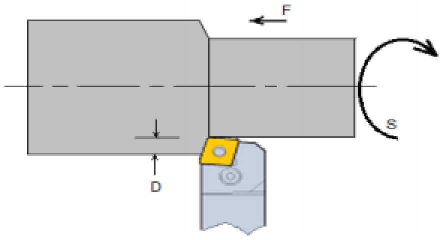
Abstract - *In a manufacturing industry lead time is very crucial fact to maintain to survive in the competitive market in today's era. Manufacturing industries can achieve maximum productivity by reducing lead time. Using latest technologies and advance machining process industries are constantly trying to reduce cost of cutting operation, wastage of material which ultimately leads to improve productivity and quality industry. The objective of this paper is to seek out the optimum machining parameters thus on minimize the input of the resources and to maximize the output of the process. The present work involved an experimental study of turning on alloy steel of ISI875-15C8 grade*

Key Words: Mild Steel (MS) Material Removal rate (MRR) Material Removal Time (MRT) Rotation PER Minute (RPM)

1. INTRODUCTION

In manufacturing process feed rate, lead time, tool life, cutting forces material removal rate and power consumption are most important factor to improve productivity of any manufacturing process. So it is essential to choose the most suitable machining condition in order to improve cutting efficiency. In turning operation MRR is the key aspect so MRR need close attention.



Over the years the demands of economic competition have Motivated a lot of research in the field of metal cutting leading to the evolution of new tool materials of remarkable performance and vast potential for an impressive increase in productivity. In actual practice, there are various parameters like tool material, rake angle, cutting edge geometry, work piece material, cutting speed, feed and depth of cut which affect these factors. So it is essential to choose the most suitable machining condition in order to improve cutting efficiency. In turning operation, material removal rate is key aspect, which has need of attention both from industry as well as researcher. In recent industry one of the trends is to manufacture low cost, high quality production less time. On the other hand, material removal rate is another main factor that greatly affects production rate and cost. The purpose of this research work is to find the influence of cutting parameters on material removal rate in turning operation. This paper presents a Taguchi's L9 orthogonal array for the optimization of the material removal rate for turning operation of mild steel as work piece material by high speed steel as tool material. ANOVA (Analysis of variance) is used to find the most and least significant parameters. Present work focus on maximize material removal rate with the purpose of improving the performance of turning operation. In this research determining cutting parameters like rake angle and feed that maximize material removal rate is a main task for achieving overall economy of machining. Statistical design of experiment refers to the process of planning the experimental so that the proper data can be analyzed by statistical methods, resulting a in valid and reliable outcome.

2. Materials and methodology

In present mild steel is used as work piece material as mild steel is very common and useful material in today's time .Specimen is taken in cylindrical shape with size of material taken for machining are 50 mm as diameter and 40 mm in length.

The traditional experimental design methods are too Complex and difficult to use. Additionally, large numbers of experiments have to be carried out when the number of machining parameters increase. Therefore, the factors causing variations should be determined and checked under Laboratory conditions. Taguchi method is an experimental design technique, which is useful in reducing the number of experiments dramatically by using orthogonal arrays and also tries to minimize effects of the factors out of control. The basic philosophy of the Taguchi

method is to ensure quality in the design phase. greatest advantages of the Taguchi method are to decrease the experimental time, to reduce the cost and to find out significant factors in a shorter time period.

Table -1: Chemical Composition of Mild steel (Specimen)

CHEMICAL COMPOSITION							
C	Mn	P	S	Si	Al	Cr	CE
%	%	%	%	%	%	%	%
0.190	0.720	0.022	0.007	0.300	0.018	0.012	0.312

Table -2: Mechanical properties and Grade of MS

MECHANICAL PROPERTIES				GRADE	
YS	UTS	%EL	RA	IS GRADE	EQUIVALENT
N/mm2	N/mm2	%	%		
319.00	488.00	31.00	34.00	ISI875-15C8	SAE1018

Material removal rate was calculated using Eq. for all the experimental conditions.

$$\mathrm{MRR} = \frac{(W_1 - W_2) \times 1000}{\rho \times t}$$

where W1 and W2 are the weight of work piece before and after machining respectively (grams), q is the density of work piece in (gm/cc), t is the machining time in minutes. Density of Mild Steel Is 7.85 g/cc

3. Result and discussion

As the changes in various parameter like feed rate , RPM, depth of cut time for material removal decreases and Material removal rate increases as shown in table below . Increases in RPM and Depth of cut decrease the machine time but it affect the surface roughness which may decrease the quality of product. So RPM increases only to some extent up which it does not damage the material and tool . Increase the value of depth of cut may leads to change of continuous chip to discontinuous chip which mean increase in temperature during machining which leads to brittleness in machining. So Change of all the above parameter help in better machining but upto a point after that it may harm both work piece and tool. This table help us to find the Optimum parameter for machining to increase better productivity.

Table -1: Result obtained from experiment

S.No	RPM	FEED RATE	DEPTH OF CUT (RADIAL)	TIME (SECOND)	MATERIAL REMOVAL RATE (mm3/min)
1	800	0.05	0.2	44	1215
2	900	0.07	0.3	29	3430.1
3	1000	0.09	0.5	21	10181.8
4	1200	0.11	0.7	16	19138.7
5	1400	0.13	0.9	15	25510.2
6	1600	0.15	1.0	14	42622.9
`7	1800	0.17	1.2	13	58823.5

Figure.1: Work piece before machining

Figure.2 : Work piece after machining

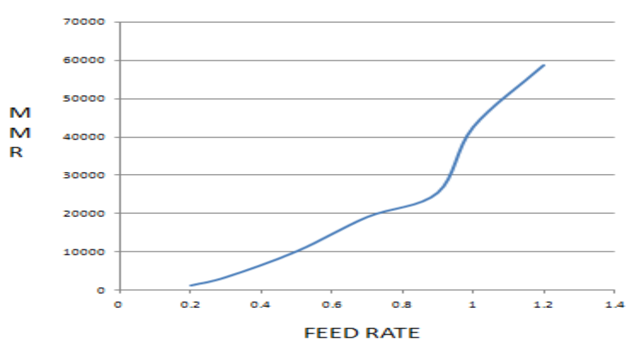


Chart -1: Feed MRR vs Feed rate Graph

Above Graph Show that as the Feed rate increases MRR also increases

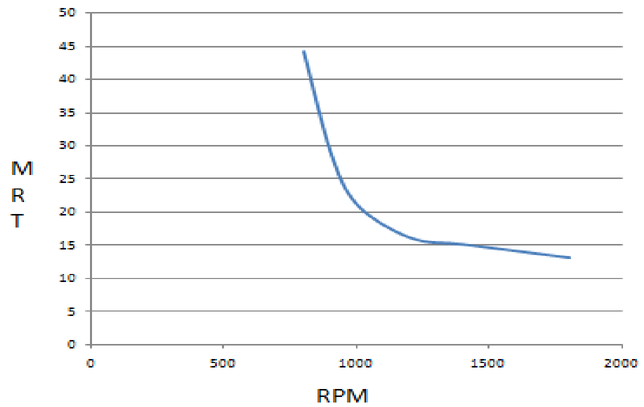


Chart -2 MRT vs RPM Graph

Above graph show that as the RPM increases Material Removal time decreases but time remains constant after 1800 rpm .

Figure 3: CNC machine

Fig -4: CNC Machining on Specimen

4. CONCLUSIONS

In this work, Investigation on material removal rate and time of material removal of mild steel by changing various parameter like RPM, feed rate, depth of cut on CNC Machine is done . The following conclusions are drawn from this study.

1. As the RPM, feed rate and depth of cut increases material removal rate increases.
2. After a extent of time increase in these factor affect the surface roughness
3. Time of material removal decreases as the RPM increases but at a point increase in parameter does not affect the time .
4. Initially continuous chips formed but as the feed rate and depth of cut increases , continuous chips changes to discontinuous chips
5. As the RPM increases after 1400 colour of chips changes to blue colour.

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