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OPTIMIZATION OF SURFACE TEXTURE AND MATERIAL REM OVAL RATE OF EN 24 STEEL ROD BY USING TAGUCHI TECHNIQUE IN CNC TURNING

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Abstract: *This project is to attempt on optimizing the turning process under various machining parameters by Taguchi method to develop or implement the quality of a machined product. Taguchi optimization methodology is applied to optimize cutting parameters in turning EN 24 Tool steel rod with coated cemented carbide tool. Here based on the Taguchi design of experiments (DOE) with an orthogonal L9 array the CNC turning machine is used to conduct experiments. To find the maximum material removal rate (MRR) and minimum surface Texture the orthogonal array, signal to noise ratio (S/N) and analysis of variance were employed.*

I. INTRODUCTION

Turning: This general process of turning involves rotating a part while a single-point cutting tool is moved parallel to the axis of rotation. Turning can be done on the external and internal surface of the part (the process known as boring). The starting material which is a general workpiece generated by other processes such as casting, forging, extrusion, or drawing.

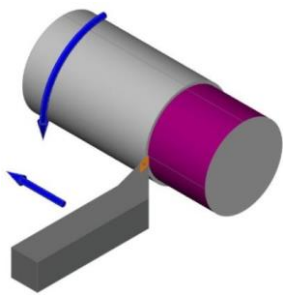


Fig: 1 turning

CNC Turning

Bars of materials are held in a chuck and rotated while a tool is fed to the piece to remove material and to create the desired shape and this is the manufacturing process which is known as CNC Turning. A turret (shown center) with an attached tooling is programmed to move to the bar of raw material and remove material to create the programmed result. since it involves material removal this is also called as "subtraction machining". If the center has both tuning and milling capabilities, as above and then the rotation can be stopped to allow for milling out of other shapes. The starting material is usually round and can be other shapes such as squares or hexagons. The bar length can be varying reliant on the bar feeder. This decides how much handling is required for volume jobs.

TAGUCHITECHNIQUE

This technique defines Quality Level of a product, as Total Loss incurred by society due to failure of a product to perform as desired when it is deviated from the delivered target performance levels. This includes costs associated with poor performance and operating costs.

TAGUCHI METHODS

Quality problems are due to Noises in the product or process system, Noise is an undesirable effect that surges variability, conduct extensive Problem and Analyses, Employ Inter-disciplinary Teams, Perform Designed Experimental Analyses, Evaluate Experiments using ANOVA and Signal-to noise techniques product ages) and any added expenses due to harmful side effects of the product in use and so this technique Help companies to perform the Quality Fix!

SURFACEFINISH

Surface finish which is also known as surface texture or surface topography is the nature of a surface and as it is defined by the 3 characteristics such as lay, surface Texture, and waviness. It comprises the small local deviations of a surface from the perfectly flat and ideal (a true plane). Among the three factors Surface texture is one of the important one that control friction and transfer layer formation during sliding. Each manufacturing process produces a surface texture. This process is usually optimized to ensure that the consequential texture is usable. If needed, an additional process will be added to modify the initial surface. The latter process may be as follows, grinding (abrasive cutting), polishing, lapping, abrasive blasting, honing, electrical discharge machining (EDM), milling, lithography, industrial etching/chemical milling, laser texturing, or other processes.

EN 24 WORK TOOL STEEL ROD

Here the Tool steel rod refers to a variety of carbon and alloy steel rods which are particularly well-suited to be made into tools. Their appropriateness comes from their distinctive hardness, resistance to abrasion, their ability to hold a cutting edge, and the resistance to deformation at elevated temperatures (red-hardness). The Tool steel rod is usually used in a heat-treated state.

To produce the required quality tool steel rods are manufactured under cautiously controlled conditions with a carbon content between 0.7% and 1.5%. The manganese content is often kept low to lessen the possibility of cracking during water extinguishing.

METHODOLOGY: In this work, the experimental results were used for Optimization of input machining parameters speed, feed, and depth of cut using Taguchi Technique for the response Surface Texture and MRR

LITERATURE SURVEY: Komson Jirapattara silpand Choobunyen Kuptanaw in presented paper on, [1] "Effect of Turning Parameters on Roundness and Hardness of Stainless-Steel rod: SUS 303". Stainless steel rod JIS: SUS 303 is widely used for automotive part. This part is generally manufactured by turning operation. However, the respective turning parameters possibly will be affected to roundness and hardness of work pieces. The purpose of this research was to study factors, which were affecting to roundness and hardness of stainless-steel rod turning. Cutting tool was inserted carbide coated TiCN+Al2O3+TiN with polycrystalline vapor deposited (PVD) cutting tools. Experimental design is conducted as two factors and three levels. The parameters were consisted of cutting speed at 100, 150 and 200 m/min. Feed rate was setting at 0.08,
0.12 and 0.16 mm./rev. Puneet Kumar, Ashwani Kumar Dhingra, and Pankaj Kumar presented paper on, [2] "optimization of process parameters for machining of mild steel rod en 18 by Response surface methodology". Present work considers the parametric optimization of CNC MAX MILL machining for Mild Steel rod (EN18) with Cemented Carbide as cutting tool under constant flow of coolant. The machining cutting parameters (cutting speed, feed rate and depth of cut) are optimized to evaluate high material removal rate and minimum surface Texture. **Wahida Nawrin,**

Tanzina Afrin, Md.Ashikuzzaman, and Md.GolamKibria presented paper on[3] "Optimization of Process Parameters for Turning of Mild Steel rod in Minimum Quantity Lubrication (MQL)" . In this experimental study, an attempt is made to obtain optimum cutting parameters for turning of mild steel rod on the basis of surface Texture and surface temperature. Optimization of cutting parameters is actually so important to gain a good machining quality of surface and to obstruct the increase of temperature. Minimum Quantity Lubrication (MQL) is introduced to avoid excessive use of cutting fluid.

INPUT PARAMETERS

TABLE 2: ORTHOGONAL ARRAY WITH PROCESS PARAMETERS

JOB NO.	SPINDLE SPEED (rpm)	FEED RATE (mm/min)	DEPTH OF CUT (mm)
1	2400	140	0.7
2	2400	120	0.6
3	2400	100	0.5
4	1600	140	0.6
5	1600	120	0.7
6	1600	100	0.5
7	800	140	0.7
8	800	120	0.5
9	800	100	0.6

EXPERMENTAL SETUP

The work piece material selected for investigation is the EN24STEEL ROD. The cutting experiments were carried out on Work piece by CNC Lathe under different cutting conditions are shown in Table 2. Experimental data of EN24STEEL ROD which was used in experiments as shown in the Table

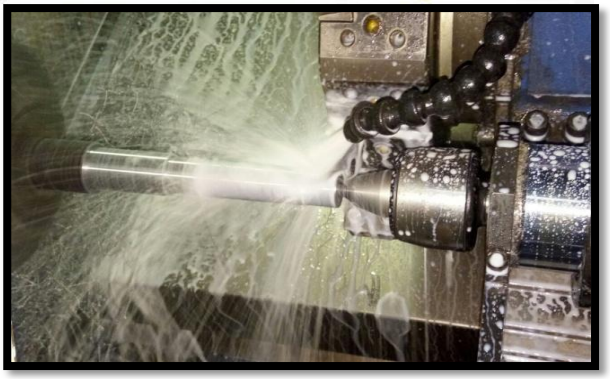


TABLE 1: PROCESS PARAMETERS AND THEIR LEVELS

PROCESS PARAMETERS	LEVEL1	LEVEL2	LEVEL3
CUTTING SPEED (rpm)	2400	1600	800
FEED RATE (mm/rev)	140	120	100
DEPTH OF CUT (mm)	0.7	0.6	0.5

TABLE 3: EXPERIMENTAL DATA FOR 3 PARAMETERS ON Rz, IS FOR CARBIDE TOOL

JOB NO.	SPINDLE SPEED (rpm)	FEED RATE (mm/min)	DEPTH OF CUT (mm)	Surface Texture (R_a) µm
1	2400	140	0.7	3.35
2	2400	120	0.6	2.62
3	2400	100	0.5	2.54
4	1600	140	0.6	3.78
5	1600	120	0.7	3.31
6	1600	100	0.5	3.12
7	800	140	0.7	4.51
8	800	120	0.5	4.11
9	800	100	0.6	4.40

MATERIAL REMOVAL RATE

Formula: MRR = mm3/min or in 3/min

=π Davg d f N

TABLE 4: EXPERIMENTAL DATA FOR 3 PARAMETERS ON Rz, FOR CARBIDE TOOL

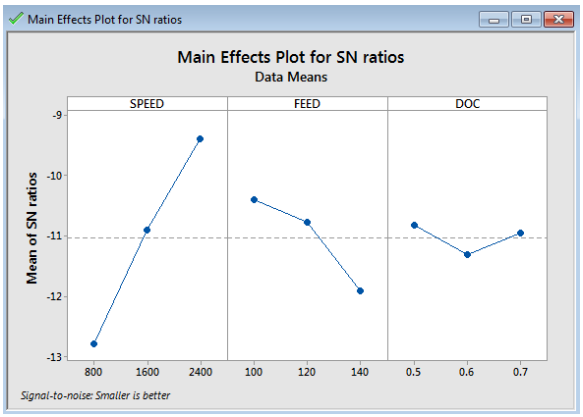
JOB NO.	SPINDLE SPEED (rpm)	FEED RATE (mm/min)	DEPTH OF CUT (mm)	MRR (mm^3/min)
1	2400	140	0.7	43.22
2	2400	120	0.6	39.13
3	2400	100	0.5	38.78
4	1600	140	0.6	24.16
5	1600	120	0.7	33.12
6	1600	100	0.5	30.12
7	800	140	0.7	29.65
8	800	120	0.5	22.12
9	800	100	0.6	24.49

RESULTS AND DISCUSSION

In this Taguchi method the results of the experiments are examined to achieve one or more of the following specified three objectives. To establish the finest or the optimum condition for a product or for a process. To Study the main effects of each of the factors identifies the optimum condition (Figures 2 and 3). This procedure involves minor arithmetic manipulation of the numerical result and usually can be done with the help of a simple calculator. The core effects indicate the general trend of the influence of the factors. Knowing the characteristic, i.e., whether a higher or lower value produces the ideal result, the levels of the factors, which are expected to produce the best results, can be foreseen. Estimate the contribution of individual factors as to estimate the response under the optimum conditions. The knowledge of the contribution of specific factors is the key to determining the nature of the control to be established on a production process.

EFFECT OF TURNING PARAMETERS ON

Surface Texture FOR S/N RATIO



CONCLUSION

The Surface Texture is principally plagued by feed rate, depth of cut and spindle speed. The surface Texture collectively will increase as there is the rise in feed rate, since the depth of cut will increase the surface Texture initially increases and then reduces because the spindle speed increase surface Texture and then decreases.

From multivariate analysis, parameters making very important result on surface Texture area unit feed rate and depth of cut. The parameters taken within the experiments area unit optimized to get the minimum surface Texture potential.

The optimum setting of cutting parameters for prime quality turned elements is as: -

1. Spindle speed = 2400rpm
2. Feed rate = 100 mm/min
3. Depth of cut = 0.5mm

The parameters thought of within the experiments area unit optimized to realize most material removal rate. The simplest setting of input method parameters for defect-free turning (maximum material removal rate) at intervals the chosen variable is as follows: -

1. Spindle speed = 2400rpm

2. Feed rate = 140 mm/min

3. Depth of cut = 0.7mm

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