Optimization of Turning Operation Parameters For Stainless Steel To Minimize Surface Roughness

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ABSTRACT

The present work involved associate experimental study of turning on primary solid solution chrome steel of grade AISI 202 by a TiAlN coated inorganic compound insert tool. the first objective of the following study was to use the Response Surface Methodology so as to work out the impact of machining parameters viz. cutting speed, feed, and depth of cut, on the surface roughness of the machined material. the target was to seek out the optimum machining parameters therefore on minimize the surface roughness and gear wear for the chosen tool and work materials within the chosen domain of the experiment. The experiment was conducted in associate experiment matrix of twenty runs designed employing a full-factorial Central Composite style (CCD). Surface Roughness will be measured employing and gear wear with the assistance of a Toolmaker"s magnifier. The info was compiled into MINITAB ® seventeen for analysis. the connection between the machining parameters and also the response variables (surface roughness and gear wear) were modelled and analysed mistreatment the Response Surface Methodology (RSM). Analysis of Variance (ANOVA) was wont to investigate the importance of those parameters on the response variables, and to work out an equation for the response variables with the machining parameters because the freelance variables, with the assistance of a quadratic model. Main effects and interaction plots from the analysis of variance were obtained and studied beside contour and 3D surface plots. The quadratic models were found to be vital with a p-value of zero.033 and 0.049. Results showed that feed is that the most important issue moving the surface roughness, closely followed by cutting speed and depth of cut. the highest 3 optimum settings for finishing up the machining were obtained from Response Surface Optimizer and are shown within the results section.

Keyword: - *Surface Roughness, ANOVA, Spindle Speed, Feed, Depth of Cut*

1. INTRODUCTION

The turning operation could be a basic metal machining operation that's used wide in industries managing metal cutting. the choice of machining parameters for a turning operation could be a vital task so as to accomplish high performance. By high performance, we tend to mean smart machinability, higher surface end, lesser rate of tool wear, higher material removal rate, quicker rate of production etc. The surface end of a product is typically measured in terms of a parameter called surface roughness. it's thought of as associate degree index of product quality. higher surface end will induce improved strength properties like resistance to corrosion, resistance to temperature, and better fatigue lifetime of the machined surface. additionally to strength properties, the surface end will have an effect on the useful behaviour of machined components too, as in friction, light-reflective properties, heat transmission, the flexibility to distribute and holding a lubricating substance, etc. Surface end additionally affects production prices. For the same reasons, the reduction of the surface roughness is important that successively is achieved by optimizing a number of the cutting parameters. Tool wear is associate degree inherent development in each ancient cutting operation. Researchers try towards elimination or reduction of tool wear as tool wear affects product quality moreover as production prices. so as to enhance tool life, in depth studies on the tool wear characteristics need to be conducted. a number of the factors that have an effect on tool wear and surface roughness are machining parameters like cutting speed, feed, depth of cut, etc., tool material and its properties, work material and its properties and gear pure mathematics. lowest changes within the above-named factors might induce vital changes within the product quality and gear life. In order to realize desired results, improvement is required. improvement is that the science of obtaining the foremost glorious results subjected to many resource constraints.

within the gift world situation, improvement is of utmost importance for organizations and researchers to satisfy the growing demand for improved product quality in conjunction with lesser production prices and quicker rates of production. applied mathematics style of experiments is employed quite extensively in improvement processes. applied mathematics style of experiments refers to the method of designing the experiments so applicable knowledge is analysed by applied mathematics strategies, leading to valid and objective conclusions. strategies of style like Response Surface Methodology (RSM), Taguchi‟s technique, factorial styles, etc., notice unbound use these days commutation the erstwhile one issue at a time experimental approach that a lot of pricey moreover as long. Neseli et. al used the RSM technique and Nose radius, approach angle, and rake angle because the input variables and located that the nose radius has the foremost vital impact on surface roughness. Nanavati and Makadia wont to feed, cutting speed and gear nose radius as predictors within the RSM technique. principle and Tarng used the Taguchi technique to seek out the best cutting parameters. A study conducted by Bouacha, showed that feed rate was the foremost prestigious parameter in determinant the surface end of a product followed by the cutting speed. Halim found that tool wear is most importantly laid low with the depth of cut whereas alternative factors were ostensibly insignificant. this study uses cutting speed, feed, and depth of cut because the machining parameters and also the objective is to optimize these parameters thus on notice the minimum surface roughness and gear wear.

2. THE TURNING OPERATION

The turning operation may be a basic metal machining operation that's used wide in industries handling metal cutting [1]. during a turning operation, a high-precision single purpose cutlery is bolt command during a tool post and is fed past a rotating work piece during a direction parallel to the axis of rotation of the work piece, at a continuing rate, and unwanted material is removed within the sort of chips giving rise to a cylindrical or additional complicated profile [12,13]. This operation is disbursed during an exceedingly in a very shaping machine either manually underneath an underneath direction, or by a dominant computer virus. There are a unit 2 styles of motion during a turning operation. One is that the cutting motion that is that the circular motion of the work and also the different is that the feed motion that is that the linear motion given to the tool. the essential turning operation with the motions concerned is shown in Fig one and Fig two, figures from [14]. Fig three from [15] shows one purpose cutlery and its terminology.

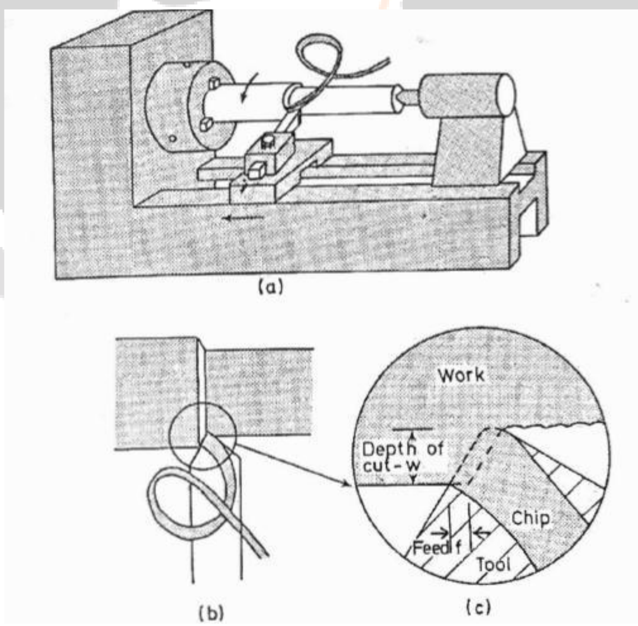

Fig 1: Basic turning operation in Lathe

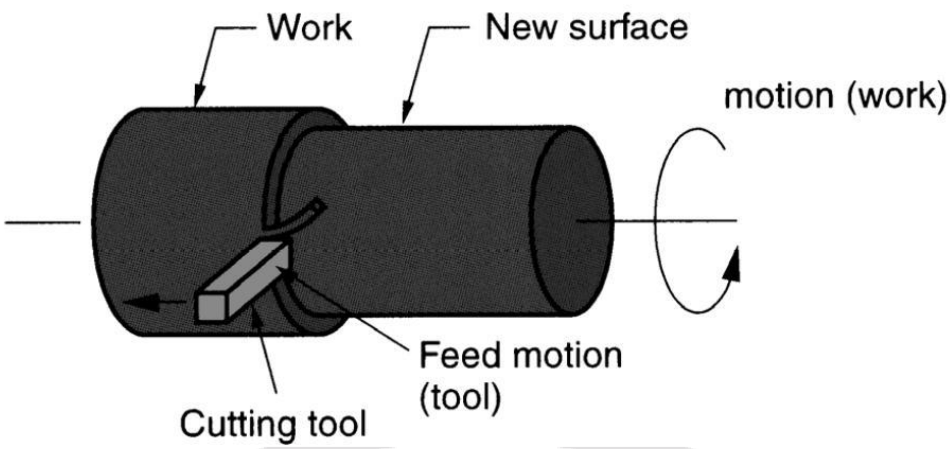

Fig 2: Motions in turning operation

Nomenclature of single point cutting tool:

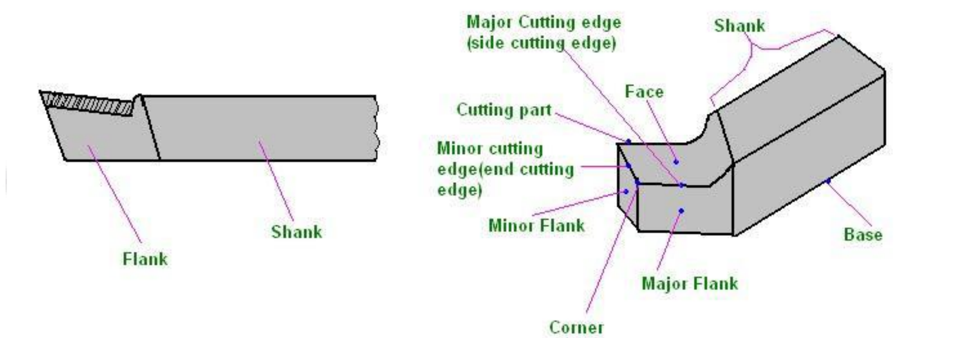

Fig 3: Single point cutting tool using in turning and its nomenclature

3. MACHINING PARAMETERS

3.1 Cutting Speed

Cutting speed could also be outlined because the rate at that the uncut surface of the work piece passes the cutter [1]. it's typically observed as surface speed and is normally expressed in m/min, though ft./min is additionally used as a suitable unit [1,16]. Cutting speed is obtained from the spindle speed. The spindle speed is that the speed at that the spindle, and hence, the work piece, rotates. it's given in terms of variety of revolutions of the work piece per minute i.e. rpm. If the spindle speed is “N” rev, the cutting speed V c (in m/min) is given as

$$V_c = \frac{\pi DN}{1000}$$

3.2 Feed

Feed is that the distance emotional by the tool tip on its path of travel for each revolution of the work. it's denoted as “f” and is expressed in mm/rev. Sometimes, it's additionally expressed in terms of the spindle speed in mm/min as

$$F_{m} = fN$$

3.3 Depth of Cut

Depth of cut (d) is outlined because the distance from the new machined surface to the uncut surface. In different words, it's the thickness of fabric being far from the work. It may be outlined because the depth of penetration of the tool into the work measured from the work surface before rotation of the work. The diameter once machining is reduced by double of the depth of cut as this thickness is far from either side thanks to the rotation of the work.

$$d = \frac{D_1 - D_2}{2}$$

4. DESIGN OF EXPERIMENTS

4.1 PROCESS PARAMETERS

The following table shows the levels of the cutting parameters chosen.

Table 5: Factors and levels for the Response Surface Study

Sr. No.	Parameter	Level (-1)	Level (+1)
1	Cutting Speed (m/min)	66	112
2	Feed (mm/rev)	0.05	0.15
3	Depth of cut (mm)	0.4	0.8

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