A Review on Experimental Investigation of Surface Roughness & Material Removal Rate of EN-31 Alloy Steel

M.Tech. Scholar Rahul Singh, Asst. Prof. Abhishek Singh Roha
Department of Mechanical Engineering,
CBS Group of Institutions
Jhajjar, Haryana

Abstract- This paper investigates the influence of machining parameters on MRR and surface roughness during CNC turning of EN-31 Steel using tungsten carbide inserts. Three machining parameter were taken. Taguchi robust design of technique is used. L9 orthogonal array was used. S/N ratio and ANOVA method were used to find mean response and percentage contribution. From the experimental result it is concluded that cutting speed is most significant effect on surface roughness and MRR.

Keywords- HSM, MRR, ANOVA.

I. INTRODUCTION

In manufacturing sector reducing the cost of production without decreasing the quality of product is major concerns in order to sustain competition in the market. For producing the product, surface finish is the major requirements of the customer. Surface roughness influence by wear resistance, fatigue strength, corrosion resistance, coefficient of frication and dirt on the surface.

Also higher material removal rate is desirable without decreasing the quality of the parts. Higher MRR is obtained by increasing the machining parameters like feed rate, spindle speed and depth of cut. At the same time power consumption and temperature in the cutting zone increase therefore built-up-edge formation starts and damage the surface quality. So selection of suitable machining parameters plays an important role to achieve higher MRR. EN-31 steel is one of the most widely used materials.

This material has high carbon percentage, hardness, compressive strength and wears resistance therefore used in wide range of applications like punches and dies, roller and ball bearing, gudgeon pins, and heavy duty gear and ejector pins. Hard turning (above 45 HRC) the temperature induce in the cutting zone is very high, excessive heat cause tool wear and hence reduce tool life. So the selection of proper machining parameters to achieve the goals of the manufacturing industry is one of the major concerns.

In manufacturing, the removal of undesirable material from the work piece in the form of chips is known as machining. Machining is divided into five elements of manufacturing process namely casting, joining, machining, forming and powder metallurgy.

Machining is the operation in which unprocessed material is removed to obtain desired dimensions by a control material removal process. In machining the energy required is summations of total energy required in plastic deformation to break crystal structure and in overcoming the friction.

The following research paper is designed as follows. Section II describes the overall previous research work whereas Section III gives idea of problem formulation. Performance parameter defines in section IV and last but not the least Section V concludes paper.

II. LITERATURE SURVEY

In this section, we will discuss basic introduction and high points of influence, explanations and issues in the research work by researchers in different field. Researchers have tried a lot in recent times to attain the max tensile strength.

Vishnu Vardhan Chandrasekarn et al (2013) Studied the effect of various cutting situations on a superficial level completion, powers and apparatus wear during tube turning of AISI 1020 steel. The cutting boundary were cold compacted air and nitrogen utilized against the dry machining. For each analysis one moment of cutting time is fixed at two diverse feed 0.02"/fire up and 0.04"/fire up and consistent profundity of cut of 0.125" width of cut. HSS is utilized as a cutting device material.

Device wear on the rake face is to assess with the assistance of Keyence magnifying lens. The cutting power and push powers during the machining procedure are to be estimated with the assistance of dynamometer. This examination presumes that the cutting and push powers increment with noteworthy increment in the feed rate.

It clarified by the way that with noteworthy increment in the feed rate, vitality required to cause plastic distortion will increment. At the point when the vitality required for the distortion of work material is increment therefore increment device powers. By the expansion the estimation of rake point from 0° to 15° the cutting powers and push powers decline quickly [20].

Rajesh Kumar Bhushan et al (2013) discussed the impact of procedure boundaries of turning on MRR and surface harshness. Al compound Sic composite and tungsten carbide instrument blend were utilized during turning (single pass). Multi target method was utilized for getting the ideal boundaries. From advancement results it is inferred that ideal level at 0.42mm profundity of cut, 210m/min cutting velocity and 0.16 mm/fire up feed separately [21].

Sujit Kumar Jha et al. (2014) Describes the test study concerning the impact of cutting boundary to be specific feed rates, profundity of cut, and cutting rate on the MRR during CNC turning of aluminum. Taguchi powerful DOE procedure dependent on L9 symmetrical cluster is utilized.

S/N proportion and ANOVA technique was utilized to discover rate commitment. The S/N proportion for MRR is to be determined utilizing bigger is the better models. This investigation infer that the ideal procedure boundary, as per greatest S/N proportion for the MRR feed has most critical factor after that profundity of cut and cutting rate [22].

Vikas et al (2014) completed tryout for MRR for EN 19 and EN 41 material in pass on sinking electric release machining. In this work different procedure boundary like heartbeat off time, voltage, current and heartbeat on time were considered as information handling boundaries. While MRR was considered as the reaction. Taguchi technique, L27 symmetrical cluster is utilized for expansion or predication of best mix of information boundary over material evacuation pace of two unique materials in particular EN19 and EN41.

This investigation presume that the ideal boundaries for most extreme material rate for EN 19 were current 24 amps, voltage 40v, and beat on time 400μs and beat off time 2300μs where as MRR for EN 41 are current 24 amps, beat on time 400 and beat off time 2100 μs.

from the trial information it is seen that the estimations of MRR in any blend of procedure boundary was higher for EN 41 than if there should arise an occurrence of EN 19, the purpose behind that decline the % of carbon from EN 19 to EN 41 which increment the MRR [23].

Sunil J Raykar et al (2014) carried out test study to dissect surface harshness during dry machining of EN-8 steel. Relapse scientific models for surface boundary to be specific Ra, Rq and Rz were created. From these scientific models surface harshness can assess within the given scope of machining boundary. Exploratory qualities and mathematical model worth are thought about by relapse model.

From the exploratory and relapse model outcome it is reasoned that Feed has most prominent impact on surface unpleasantness for all surface harshness boundaries for example Ra, Rq and Rz and Cutting rate has most extreme impact on surface completion after that feed for surface harshness boundaries as Ra and Rq. It was seen that profundity of cut has most prominent impact after that feed for surface harshness boundary Rz [24].

Sayak Mukherjee et al. (2014) concentrated to streamline machining boundary to be specific feed, cutting velocity and profundity of cut. Material evacuation rate was chosen as a yield reaction.

SAE 1020 steel bars were utilized for CNC turning activity. Taguchi L25 symmetrical exhibit is utilized. From the trial results dependent on S/N proportion examination presumed that profundity of cut was most persuasively on MRR followed by feed. The ideal cutting boundary setting for MRR were seen at 64 m/s cutting pace, 0.3 mm profundity of cut and 0.35 mm/fire up feed [25].

Khaider Bouacha et al (2014) contemplated the impact of cutting boundaries on execution qualities 'device wear, surface unpleasantness and MRR' during hard turning. The work piece chose for this investigation is AISI52100 bearing steel and CBN utilized as a cutting apparatus embeds. Taguchi, GA, and reaction surface procedure is utilized to improve execution attributes [26].

Md. Maksudul Islam et al. (2015) utilized Taguchi strategy for getting ideal procedure during turning of ASTM A48 Gray cast iron. L9 symmetrical cluster is utilized. HSS is utilized as a cutting device. ANOVA was applied and material evacuation rate were examined. Ideal cutting boundaries and hugeness of boundaries were resolved utilizing ANOVA strategy [27].

Deveshpartap singh et al (2016) contemplated the impact of cutting boundary on surface harshness. The material chose was Aluminum. Taguchi strategy was utilized for the streamlining of procedure boundaries.

Three diverse machining boundaries at three unique levels were taken. L9 symmetrical cluster is utilized. Minitab 15 was utilized for investigation. ANOVA was utilized to confirm the outcome.

In light of the Minitab 15 it is reasoned that feed rate most effect on a superficial level harshness while profundity of cut has less impact. Ideal outcomes were gotten at 0.5 mm

profundity of cut, 40 mm/min feed rate and 800 rpm axle speed.

ANOVA presume that feed rate was the most extreme contributed factor 54.65 % to the surface unpleasantness. While commitment of different boundaries likes cutting velocity 34.67% and profundity of cut just 10.47 % [28].

Sujan Debnath et al. (2016) did exploratory investigation to decide the impact of cutting liquid and procedure boundaries on apparatus wear and surface unpleasantness were considered. Gentle steel was chosen for turning activity and covered carbide embed is utilized for instrument.

From the exploratory outcome it was infer that feed rate had the most significant factor with 34.3 % commitment on surface harshness and the cutting velocity most elevated commitment (43.1%) to the device wear. The cutting stream condition LFHV was the most ideal slicing condition to lessen the device wear and surface harshness [29].

S. Sakthivelu et al. (2017) examined the impact of machining boundaries on MRR and surface unpleasantness during CNC turning of Aluminum 6063 utilizing tungsten carbide embed. Three machining boundary were taken. Taguchi strong plan of procedure is utilized.

L9 symmetrical cluster was utilized. S/N proportion and ANOVA strategy were utilized to discover mean reaction and rate commitment. From the exploratory outcome it is reasoned that cutting velocity is most critical impact on surface unpleasantness and MRR.

For least surface harshness ideal boundaries are 0.15 mm/min feed rate, 2000 rpm speed and 0.6 mm profundity of cut. Additionally ideal boundaries for MRR were 0.3 mm/min feed rate, 1600 rpm speed, 0.6 mm profundity of cut [30].

III. PROBLEM FORMULATION

From the writing study we can see that there are various open doors in examination of impact of procedure boundaries, instrument math and cutting condition for material evacuation rate, surface harshness, device life, cutting powers and force utilization during turning of various sort of work material utilizing different enhancement strategies like Taguchi approach, hereditary calculation and reaction surface system.

Additionally from the writing overview, it has been seen that there is restricted exploration done which considers the impact of procedure boundary on material evacuation rate and surface harshness during CNC turning activity for EN-31 composite steel utilizing tungsten carbide cutting

device with rhombus calculation isn't investigated at this point.

So I had accepted this open door to dissect the impact of procedure boundary on surface unpleasantness and material expulsion rate during turning of EN-31 amalgam steel utilizing Taguchi technique.

IV. PERFORMANCE PARAMETER

To set off the FSW experiment a vertical milling machine is used. The tool is fix inside the vertical arbour using the perfect collates. The plates to be connected are clamped to the horizontal bed with nil root gaps.

The clamping of the check pieces are executed such that the strength of the plates is definitely constrained beneath each plunging and translational forces of the FSW tool.

1. S/N Ratios for Tensile Test:
For the calculation of S/N ratios 'Bigger the Better' is selected and is given by formula:

$$\frac{S}{N(\text{bigger})} = -\log\frac{(\sum(1/y))}{n}$$

2. Confirmation Test:
Largest the best characterization

$$\frac{S}{N(\text{bigger})} = -\log\frac{(\sum(1/y))}{n}$$

Where yi are the responses and n is the number of tests in a trial. The level of a factor with the highest S/N ratio was the optimum level for responses measured.

In order to test the predicted result, confirmation experiment has been conducted by running three trials at the optimal setting of the process parameters determine from the analysis i.e. A2, B3, C3 for tensile strength.

V.CONCLUSION

This work incorporates the proficient technique for deciding the ideal procedure boundaries for CNC turning utilizing solidified carbide cutting device. Three diverse machining boundaries chose in present work and impact of these boundaries on yield reaction is broke down utilizing Taguchi strategy.

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