IARJSET

ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 8, Issue 11, November 2021

DOI: 10.17148/IARJSET.2021.81124

ENHANCEMENT OF SURFACE FINISH FOR CNC TURNING CUTTING PARAMETERS BY USING TAGUCHI METHOD

Velmurugan.P[1], Dr.S.Ayyappan[2]

1PG Scholar, Department of Manufacturing Engineering, Government College of Technology, Coimbatore.

2Assistant Professor, Department of Mechanical Engineering, Government College of Technology, Coimbatore.

Abstract: The turning operation includes a lathe machine conventional or CNC turning centre, a lubricant, tool, operator and a raw material for accomplishing the production. The parameters for machining like the speed, feed, and depth of the cut should be set to perform the desired rate of production, longer tool life and a desired surface finish over the component. To handle these varying requirements, the variables for machining should be optimized for recommending a best mix for realizing, for example, surface finish. Achieving a higher rate of production for the considered surface finish would be the objective of this project. For experimentation over this proposed work, a CNC turning centre would be engaged for machining the different work piece material is stainless steel (SS410)with different types of cutting tool inserts (CARBIDE and CERAMIC) with a set of values for the given parameters. The procedure would be continued for various values of the parameters while keeping the other constant.Taguchi method is used for finding the optimized solution.

Keywords: CNC turning, stainless steel (SS410), CARBIDE and CERAMIC, surface finish.

1. INTRODUCTION

In modern industry the impartial is to manufacture low cost, high quality products in short time. Automated and flexible manufacturing systems are employed for that goal along with computerized numerical control (CNC) machines that are accomplished of achieving high accuracy and very low processing time. Turning is the most common method for cutting and mostly for the finishing machined parts. Moreover, in order to produce any product with desired quality by machining, cutting parameters should be selected properly. In turning process limitation such as cutting tool shape and materials, the depth of cut, feed rates, cutting speeds as well as the use of cutting fluids will affect the material removal rates and the machining standard like the surface roughness, the roundness of circular and dimensional deviations of the product. Turning is the removal of material from the outer diameter of a rotating cylindrical work piece. Turning is used to reduce the diameter of the work piece, generally to a specified dimension, and to produce a smooth finish on the metal. Often the work piece will be turned so that adjacent sections have separate diameters. Turning is the machining operation that constructs cylindrical parts. In its basic form, it can be defined as the machining of an outer surface: With the work piece rotating, with a single-point cutting tool, and with the cutting tool feeding parallel to the axis of the work piece and at a distance that will take out the outer surface of the work. Three cutting parameters, i.e., cutting speed, feed rate, and depth of cut, must be set on in a turning operation. Common methods of estimate machining performance in a turning operation are based on the following performance characteristics: tool life, cutting force, and surface roughness. Basically, tool life, cutting force, and surface roughness are strongly correspond with cutting parameters such as cutting speed, feed rate, and depth of cut. Turning constitutes the majority of lathe work. Thus, it was the process of machining straight, conical surfaces, external cylindrical, curved and grooved work pieces. The cutting tool was attached to the tool post, which is operating by the lead screw, and detaches material by travelling along the bed.

OBJECTIVES

To study the consequence of different machining parameters for turning operation over the surface roughness of the selected variants of Steel work piece SS410. Illustrate a systematic procedure of using Taguchi parameter design in process control of turning machines. To optimize these limitations for surface roughness. The objective of this investigation is to study the effect of cutting speed, feed, depth of cut, machining time on surface roughness. Taylor showed that an optimal or economic cutting speed exists which could maximize material removal rate.

ISSN (O) 2393-8021, ISSN (P) 2394-1588
IARJSET
International Advanced Research Journal in Science, Engineering and Technology
Vol. 8, Issue 11, November 2021
DOI: 10.17148/IARJSET.2021.81124

2. TAGUCHI METHOD AND EXPERIMENTAL SETUP

Taguchi defines as the quality of a product, in terms of the loss relate by the product to the society from the time the product is shipped to the customer. Some of these losses are due to difference of the products functional characteristic from its desired select value, and these are called losses due to utility variation. The uncontrollable element, which source the functional characteristics of a product to diverge from their target values, are called noise factors, which can be categorize as external factors (e.g. unit to unit difference in product parameters) and product deterioration. The overall aim of quality engineering is to make products that are robust with approval to all noise factors. Taguchi has establish that the two stage optimization procedure involving S/N ratios, indeed gives the parameter level combination, where the standard difference is minimum while keeping the mean on target. This implies that engineering systems behave in such a way that the manipulated production element that can be divided into three categories:

1. Control factors, which influence process variability as measured by the S/N ratio.
2. Signal factors, which do not influence the S/N ratio or operation mean.
3. Factors, which do not influence the S/N ratio or operation mean.

In practice, the select mean value may change during the process evolution applications in which the concept of S/N ratio is useful are the development of quality through variability reduction and the development of measurement. The S/N ratio characteristics can be divided into three groups when the characteristic is continuous: nominal is the best, smaller is the better and larger is the better characteristics.

CUTTING TOOL INSERTS AND WORK PIECE

The two different types of cutting inserts are used in this experimentation and they are carbide and ceramic. Also type of material is used Stainless Steel (Type 410).Insert used in TNMG 16 04 04 KORLOY radius 0.4mm.Work piece outer diameter 20mm and total length of 15mm.

FINISHED WORKPIECE MATERIAL

IARJSET
ISSN (O) 2393-8021, ISSN (P) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
Vol. 8, Issue 11, November 2021
DOI: 10.17148/IARJSET.2021.81124

3. EXPERIMENTAL PROCEDURE

The work piece was mounted using a hydraulic chuck in CNC turning centre and the clamping pressure was set as 10 bar. The machining variables like feed, depth of cut, cutting speed, etc. were selected based on the manufacturer's recommendations. Only the cutting speeds, feed, depth of cut and cutting tool inserts was changed.

PARAMETER	CARBIDE/CERAMIC			
SPEED (RPM)	1000	1400	1600	2000
FEED (MM/REV)	0.05	0.10	0.15	0.20
DEPTH OF CUT (MM)	0.2	0.4	0.6	0.8

4. RESULT AND DISCUSSION

CARBIDE INSERTS SURFACE ROUGHNESS

Sl No	Spindle speed (rpm)	Feed rate (mm/rev)	Depth of Cut (mm)	Surface Roughness (µm)
1	1000	0.05	0.2	0.61
2	1000	0.10	0.4	0.69
3	1000	0.15	0.6	0.71
4	1000	0.20	0.8	0.78
5	1400	0.05	0.2	0.68
6	1400	0.10	0.4	0.63

IARJSET

ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 8, Issue 11, November 2021

DOI: 10.17148/IARJSET.2021.81124

7	1400	0.15	0.6	0.60
8	1400	0.20	0.8	0.61
9	1600	0.05	0.2	0.60
10	1600	0.10	0.4	0.63
11	1600	0.15	0.6	0.64
12	1600	0.20	0.8	0.60
13	2000	0.05	0.2	0.51
14	2000	0.10	0.4	0.54
15	2000	0.15	0.6	0.56
16	2000	0.20	0.8	0.58

CERAMIC INSERTS SURFACE ROUGHNESS

Sl No	Spindle speed (rpm)	Feed rate (mm/rev)	Depth of Cut (mm)	Surface Roughness (µm)
1	1000	0.05	0.2	0.51
2	1000	0.10	0.4	0.60
3	1000	0.15	0.6	0.61
4	1000	0.20	0.8	0.70
5	1400	0.05	0.2	0.50
6	1400	0.10	0.4	0.58
7	1400	0.15	0.6	0.56
8	1400	0.20	0.8	0.63
9	1600	0.05	0.2	0.48
10	1600	0.10	0.4	0.52
11	1600	0.15	0.6	0.53
12	1600	0.20	0.8	0.60
13	2000	0.05	0.2	0.45
14	2000	0.10	0.4	0.48
15	2000	0.15	0.6	0.51
16	2000	0.20	0.8	0.52

CARBIDE INSERTS S/N RATIO

Sl No	Spindle speed (rpm)	Feed rate (mm/rev)	Depth of Cut (mm)	Surface Roughness (µm)	S/N Ratio
1	1000	0.05	0.2	0.61	32.70
2	1000	0.10	0.4	0.69	33.77
3	1000	0.15	0.6	0.71	40.10
4	1000	0.20	0.8	0.78	40.91
5	1400	0.05	0.2	0.68	39.72
6	1400	0.10	0.4	0.63	39.07
7	1400	0.15	0.6	0.60	32.55
8	1400	0.20	0.8	0.61	32.70
9	1600	0.05	0.2	0.60	38.65
10	1600	0.10	0.4	0.63	39.07
11	1600	0.15	0.6	0.64	39.20
12	1600	0.20	0.8	0.60	38.65
13	2000	0.05	0.2	0.51	37.25
14	2000	0.10	0.4	0.54	37.74

Vol. 8, Issue 11, November 2021

DOI: 10.17148/IARJSET.2021.81124

15	2000	0.15	0.6	0.56	38.05
16	2000	0.20	0.8	0.58	38.35

CERAMIC INSERTS S/N RATIO

Sl No	Spindle speed (rpm)	Feed rate (mm/rev)	Depth of Cut (mm)	Surface Roughness (µm)	S/N Ratio
1	1000	0.05	0.2	0.51	31.14
2	1000	0.10	0.4	0.60	38.64
3	1000	0.15	0.6	0.61	32.69
4	1000	0.20	0.8	0.70	33.89
5	1400	0.05	0.2	0.50	37.07
6	1400	0.10	0.4	0.58	38.53
7	1400	0.15	0.6	0.56	38.05
8	1400	0.20	0.8	0.63	32.97
9	1600	0.05	0.2	0.48	36.72
10	1600	0.10	0.4	0.52	37.41
11	1600	0.15	0.6	0.53	37.57
12	1600	0.20	0.8	0.60	38.64
13	2000	0.05	0.2	0.45	36.17
14	2000	0.10	0.4	0.48	36.75
15	2000	0.15	0.6	0.51	37.24
16	2000	0.20	0.8	0.52	37.41

CALCULATION FORMULA

- Smaller is better - $S/N = -10 * \log(\Sigma(Y^2)/n))$
- Larger is better- $S/N = -10 * \log(\Sigma(1/Y^2)/n)$
- S/N –Signal to Noise Ratio
- Where ‘n’ is observation number,
- ‘Y’is observation value.

5. CONCLUSION

This paper has discussed an application of the Taguchi method for optimizing the cutting parameters in turning operations in smaller is better. This study discusses machining parameters, including different cutting tools for depth of cut, cutting speed and feed rate. The conclusions of this effort to be summarized as follows:

1. Taguchi’s robust design method is fit to optimize the surface roughness in Turning.
2. It is found that the parameter of the taguchi method gives a simple, systematic, & efficient method for the optimization of the machining parameters.
3. The significant factors for the surface roughness in Turning were the spindle speed and the tool grade respectively.
4. CERAMIC Tools gives better surface finish compare to carbide tools at all speeds, feeds and depth of cut.

6. REFERENCES

1.Norfadzlan Yusup, Azlan Mohd Zain, Siti Zaiton Mohd Hashim, Overview of PSO for Optimizing Process Parameters of Machining, 2012 International Workshop on Information and Electronics Engineering (IWIEE).

2. Chorng-Jyh Tzenga, Yu-Hsin Linb, Yung-Kuang Yanga,, Ming-Chang Jengc,Optimization of turning operations with multiple performance characteristics using the Taguchi method and Grey relational analysis, journal of materials processing technology(2009) 2753–2759.

3.Q. Meng, J.A. Arsecularatne , P. Mathew , Calculation of optimum cutting conditions for turning operations using a machining theory, International Journal of Machine Tools & Manufacture 40 (2000) 1709–1733.

4.Mustafa Gunay , Emre Yucel , Application of Taguchi method for determining optimum surface roughness in turning of high-alloy white cast iron, Measurement 46 (2013) 913–919.

5.N.Muthukrishnan, J. Paulo Davim, Optimization of machining parameters of Al/SiCMMC with ANOVA and ANN analysis, journal of materials processing technology(2009) 225–232.

6.S.Arunachalam, “Investigation on the Turning Parameters for Surface Roughness using Taguchi Analysis” Journal of Selection and peer-review under responsibility of Institute of Technology, Nirma University, Ahmedabad.

7.Pruthviraj Arora, “Investigation Of Machining Parameters On Output Characteristics In CNC Turning Using TaguchiTechnique” (24/02/2004).

DOI: 10.17148/IARJSET.2021.81124

8.Mustafa Gunay, "Application of Taguchi method for determining optimum surface roughness in turning of high-alloy white cast iron" journal homepage: www.elsevier.com/measurement. (2013).

9.Nur,R., Nasrullah,B., Suyuti,MA ., Apollo. (2018). Sustainable manufacturing by calculating the energy demand during turning of AISI 1045 steel. J of Physics: Conf. Series 953, 012028.

10.Arun Vikram,K., Krishna Kanth,TV., Shabana., Suresh,K. (2018). Experimental evaluation for multi-response optimality on AISI 316L materials with coated carbide inserts using GRA and VIKOR methods. Int. J of Mechanical & Production Engg Research & Development, 8(2), 1197-1206.

11.Gilbert W W (1950) "Economics of machining. In Machining" – Theory and practice. *Am. Soc. Met.*476–480

12.Armarego E J A, Brown R H (1969) "*The machining of metals"* (Englewood Cliffs, NJ:Prentice Hall) ASME 1952 Research committee on metal cutting data and bibliography. *Manual on cutting of metals with single point tools* 2nd edn.

13.Brewer R C, Rueda R (1963) "A simplified approach to the optimum selection of machining parameters".*Eng. Dig.* 24(9): 133–150[4] Brewer R C (1966) "Parameter Selection Problem in Machining".*Ann. CIRP* 14:11

14.Bhattacharya A, Faria-Gonzalez R, Inyong H(1970) "Regression analysis for predicting surface finish and its application in the determination of optimum machining conditions". *Trans. Am. Soc. Mech. Eng.* 92: 711

15.Walvekar A G, Lambert B K (1970) "An application of geometric programming to machining variable selection". *Int. J. Prod. Res.*8: 3