OPTIMIZATION OF PARAMETERS IN TURNING FOR INCONEL 718 USING TAGUCHI METHOD

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***Abstract*- In this paper the cutting of inconel 718 material using lathe by taguchi methodology. Taguchi optimization methodology is applied to optimize cutting parameters in turning inconel 718 material with carbide tipped tool under dry conditions. The lathe machine is used to conduct experiments based on the taguchi design of experiments (DOE) with orthogonal (L_9) array. The orthogonal array signal to noise ratio (S/N) and analysis of variance were employed to find the minimum surface roughness. Optimum results are finally verified with the help of conformation experiments.**

Keywords Turning process, speed, feed, depth of cut, inconel 718 material, taguchi method , Anova.

I. INTRODUCTION

Productivity plays significant role in manufacturing market. The manufacturing industries are continuously challenged for achieving higher productivity with lesser time with high quantity products. In current state of economy and consequent market pressure has formed manufactured to simultaneously decrease the surface roughness affects wear resistance, ductility, tensile strength, fatigue strength etc. Cutting parameters (speed, feed, depth of cut) cutting speed has the highest impact on the surface roughness. Cutting speed is defined has the speed at which the work piece progress with respect to the cutting tool. Feed rate is defined as the distance the tool travels during one revoluation of part. Depth of cut is the distance that tool bit moves into the work. Usually measures in the thousands of an inch in millimetres. Turning process is used in the experimentation. Turning is one of the common metal cutting operation used for machining parts in manufacturing industry. In turning process surface quality is one of the most important performance measures. Surface roughness (Ra) is a widely index of product quality and in most cases a technical requirement for mechanical products.

Taguchi method was developed by DR.GENICHI TAGUCHI. This method involves three stages. They are system design, parameters design, and tolerance design. The taguchi method is a statistical method used to improve the product quality. It is commonly

used in improving industrial product quality due to the proven success with the taguchi method, it is impossible to significantly reduce the number of experiments. The taguchi method is not only an experimental design technique, but also a beneficial technique for quality system design.

STEPS INVOLVED IN TAGUCHI METHOD ARE FOLLOWS:

1. Identification of main function, side effects and failure mode.
2. Identification of noise factor testing condition and quality characteristics.
3. Identification of the main function to be optimized.
4. Identification of the control factor and their levels.
5. Selection of orthogonal array and matrix experiments.
6. Conducting the matrix experiment.
7. Analyzing the data, prediction of the optimum level and performance.
8. Performing the verification experiments and planning the future.

ANALYSIS OF VARIANCE (ANOVA)

Since there are a large number of variables controlling the process, some mathematical models are required to represent the process. However there models are influencing the process rather than including all the parameters. In order to achieve this statistical analysis of the experimental results will have to be processed using the analysis of variance (ANOVA). ANOVA is a computational of the control factor to the overall measured response.

II. LITERATURE REVIEW

Literature study is measured to understand the correct objective of the project work. The past research work gives the better idea and clear contain of cognition. It helps us to reach to a particular destination. The goal is optimization of turning parameters for inconel 718 using taguchi method.

Narender kumar varma, Ajeet singh sikarwar 2015 [1] Investigated optimizing the turning process under various machining parameters by taguchi method to develop the quality of machined product. Taguchi optimizing methodology is applied to optimize cutting parameters in turning AISI1045 steel with coated cemented carbide tool under dry cutting conditions. In this CNC turning machine is used to conduct experiments based on the taguchi design of experiments DOE with orthogonal L_9 array. The orthogonal array, signal to noise ratio (S/N) and analysis of resistance were employed to find the maximum material removal rate, minimum surface roughness. Optimum results are finally verified with the help of confirmation experiments. It has been found that feed rate is found to be the most significant factory& its contribution to surface finish achieved AISI1045workpiece is machined at spindle speed of 620 rpm, feed rate of 0.3mm/rev and depth of cut 0.7mm with 95% confidance interval. S.thamizhmanil's; Saparudin hasan 2007 [2] This research paper is focused on the analysis of optimum cutting conditions to get lowest surface roughness in turning SCM 440 alloy steel by taguchi method. They used taguchi method and 18 experiments were designed by this process and experiments conducted. In this experiments

cutting speed has lesser role on surface roughness from the test compare to depth of cut feed rate.

III. EXPERIMENTATION

The specimen used for experimentation was inconel 718 material and cutting tool is carbide tipped tool.The composition and metallic properties of inconel 718 are as fallows.

Carbon	0.08	Nickel	50-55	Boron	0.006max
Manganese	0.35	Molybdenum	2.80-3.30	Copper	0.30max
Phosphorus	0.015	Columbium	4.75-5.50	Tantalum	0.05max
Sulphur	0.35	Aluminium	0.20-0.80	Iron	Balance
Chromium	17-21	Cobalt	1.00		

PHYSICAL PROPERTIES OF INCONEL 718

Density	0.29 lb/in^3(8.192 g/cm^3)	0.299 lb/in^3(8.22 g/cm^3)
Specific gravity	8.19	8.22
Melting range	2500-2600^{0}F	1370-1430^{0}F

As L_9 array is selected in '1'specimen where used for the experimentation. The tool was initially adjusted in such a way that its axis should be exactly perpendicular to the specimen axis.

MACHINING PARAMETERS AND LEVELS

MachiningParameter	Level-1	Level-2	Level-3
Speed	40	65	106
Feed rate	0.25	0.5	0.75
Depth of cut	0.05	0.10	0.15

L_9 ORTHOGONAL ARRAY AND ASSIGNING FACTORS:

S.NO	SPEED (rpm)	FEED (mm/rev)	DEPTH OF CUT (mm)
1	1	1	1
2	1	2	2
3	1	3	3
4	2	1	2
5	2	2	3
6	2	3	1
7	3	1	3
8	3	2	1
9	3	3	2

DATA COLLECTION

S.NO	SPEED (m/min)	FEED (mm/rev)	DEPTH OF CUT (mm)	SURFACE ROUGHNESS (Ra) µm	S/N RATIO
1	40	0.25	0.05	1.53	-3.6938
2	40	0.50	0.10	3.43	-10.7059
3	40	0.75	0.15	3.62	-11.1742
4	65	0.25	0.10	0.98	-0.1755
5	65	0.50	0.15	1.82	-5.2014
6	65	0.75	0.05	2.33	-7.3471
7	106	0.25	0.15	3.03	-9.6289
8	106	0.50	0.05	3.97	-11.9758
9	106	0.75	0.10	5.23	-14.3700

CONFIRMATION TEST

S.NO	SPEED(m/min)	FEED(mm/rev)	DEPTH OF CUT(mm)	SURFACE ROUGHNESS(Ra) µm	S/N RATIO
1	65	0.25	0.10	0.98	0.1755

IV. CONCLUSION

- In this present study experiments are conducted on Inconel 718 to investigate the effects of machining parameters on surface roughness.
- As carbide insert is used as cutting tool for turning operation, the surface roughness values obtained are less which indicates smooth finishing of surface.
- The chips formed in this study are continous.
- When speed increases surface roughness decreases at constant feed depth of cut.
- When feed increases surface roughness increases at constant speed and depth of cut.
- When depth of cut increases surface roughness increases at constant speed and feed.
- Best parameters found for finished surface are: spindle speed 65 rpm; feed 0.25mm/rev; depth of cut 0.10 mm.
- The surface roughness value for inconel 718 after performing confirmation test is 0.98µm.

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