[NCRAES-2019] ISSN 2348 – 8034
Impact Factor- 5.070

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

OPTIMIZATION ON AUSTENITIC STAINLESS STEEL ROD 317 L OF THE CYLINDRICAL GRINDING PARAMETER F BY TAGUCHI METHOD

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ABSTRACT

Cylindrical grinding is principal process for final machining of components requiring smooth surfaces and precise tolerances. In There are number of parameters which affects Material Remove rate and Surface Roughness like Speed, Feed rate and Depth of cut etc. The Cylindrical Grinding is most widely used process in industry As compared with other machining processes, grindings costly operation that should be utilized under optimal conditions. Although widely used in industry, grinding remains perhaps the least understood of all machining processes. In Present work most optimal combination in terms for maximization the Material Remove Rate (MRR) and minimization the Surface Roughness (Ra) by using Taguchi method. For this purpose S/N ratio Analysis and ANOVA is used.

Keywords: *Taguchi method, ANOVA, Speed, Feed rate, Depth of cut, Material Remove rate (MRR) and Surface Roughness (Ra).*

I. INTRODUCTION

Grinding is a process of material removal and surface area generation process used to condition and finish elements made of metals and other materials. The surface area finish and precision acquired through grinding could be up to ten times much better than with either milling or perhaps turning. Grinding employs a great abrasive product, usually a rotating wheel brought in handled contact with a work surface. The Grinding wheel is composed of abrasive grains held collectively within a binder. These types of| abrasive grains act while cutting tools to eliminating microchips of textile from the work. Because these abrasive grains use and become dull, the added resistance causes inability of the grains or perhaps weakening of their relationship. The dull pieces break away. The requirements intended for efficient grinding include:

- Abrasive elements which will be harderthan work.
- Heat-resistant and shock abrasive wheels.
- Abrasives that is friable.[1]

That is usually, most abrasives utilized in market are synthetic. Corundum can be used in three quarters of all of the grinding operations, and is usually primary used to mill ferrous metals. Next is usually silicon carbide, which can be used for grinding softer, large density materials and non-ferrous metals such as substantiate carbide or ceramics. Excellent abrasives, namely cubic boron nitride and diamond, are being used about five percent of grinding. Hard ferrous components are ground with "CBN", while non-ferrous materials and non-metals are best surface with diamond.

There are many forms of grinding, but the four major industrial grinding processesare:

- Cylindrical Grinding.
- Internal Grinding.
- Center less Grinding.
- Surface Grinding.

In cylindrical grinding, the function piece rotates about a fixed axis and the surfaces machined and they are generally concentric to that axis of rotation. Cylindrical grinding generates an external surface that may be direct, contoured or tapered. The basic elements of a cylindrical grinder include a wheel head, which incorporate the drive motor and spindle; a cross-slide that goes the wheel head to and from the work part; a headstock, which contains, locates, and drives the work piece; and a tailstock, which holds the other end from the function.

II. LITERATURE REVIEW

By referring K Mekala, et.al (2014) sates that the surface grinding parameters on Austenitic stainless steel are conducted using Taguchi design of experiments of L9 orthogonal array was selected with 3 levels with 3 factors and output parameters of Metal removal rate are measured. After conducting experiment optimized by S/N ratio and analyzed by ANOVA and predicts Cutting speed is a dominating parameter of surface grinding. The influence parameter of surface roughness is cutting speed and metal removal rate is influenced by Depth of cut. M. S. Sukumaret.al(2014) worked on Al 6061 material, according to Taguchi orthogonal array (L16) for various combinations of controllable parameters viz. speed, feed and depth of cut. The surface roughness (Ra) is measured and recorded for each experimental run and analyzed using Taguchi S/N ratios and the optimum controllable parameter combination is identified. An Artificial neural network (ANN) model has been developed and trained with full factorial design experimental data and a combination of control parameters have been found from ANN for the surface roughness (Ra) value. Taguchi S/N ratio analysis and ANN are useful to find the optimum combination of parameters for getting a good surface finish.Cheol Lee (2009) concluded a control-oriented model for the cylindrical grinding process in the state-space format. A number of experiments were conducted to confirm the dynamic relationships and determine the model coefficients. It is found that number of grinding cycles in batch production can be promptly predicted and the proposed model was analyzed. Janardhanet.al (2011), conclude that the cylindrical grinding surface finish and metal removal rate are the important responses. The Experiments were conducted on cylindrical grinding machine using EN8 material and he found that the feed rate played important role on responses surface roughness and metal removal rate than other process parameters.

III. OBJECTIVE

The main objective of this work is to maximize the Material Remove Rate (MRR) and minimize the Surface Roughness (Ra) and achieve optimal operating process parameter. It involves several variables such as depth of cut, work speed and feed rate.

Taguchi method, Regression analysis and ANOVA are used to maximization the Material Remove Rate (MRR) and minimization the Surface Roughness (Ra).

IV. METHODOLOGY

The goal of experimental work is to investigate the effect of grinding parameters with the process parameters of cutting speed, feed rate and Depth of cut influencing the metal removal rate of AISI 317L Austenitic stainless steel. The Taguchi method is usually is definitely best used when presently there are an intermediate quantity of variables, few relationships, and once just a few variables contribute considerably.

The Taguchi approach permits a comprehensive understanding of the combined and specific process parameters from a minimum quantity of simulation tests. The quality engineering approach proposed by Taguchi offers a new experimental technique in which an altered and standardized kind of style of experiment is utilized. The Taguchi method employs a generic signal-to-noise (S/N) rate to quantify the current variance. Usually, it will discover three categories of top quality characteristic in the evaluation of the S/N percentage, i.e. the-Smaller-the-better, the-higher-the better, and the nominal-the-better. The S/N ratio intended for the each level of process parameters is calculated depending on the S/N evaluation. Regardless of category of the quality characteristic, a larger S/N ratio corresponds to quality characteristics. Therefore, the maximum degree of the process guidelines is the level with the greatest S/N percentage.

Taguchi proposed the use dropping function to measure the deviation of the top quality characteristic through the desired benefit. The value of the typical the standard loss function is additional transformed into a signal-to-noise (S/N) ratio. Usually, the three types of the top quality characteristic in the evaluation of the S/N percentage, i.e. the lower-the-better, the larger-the-better, and the more-nominal-the-better. The S/N percentage for every single degree of process guidelines is computed based upon the S/N analysis.

Material general properties

Alloy 317L is a molybdenum containing, low carbon with increased additions of chromium, nickel, and molybdenum for better corrosion resistance and increased resistance to chemical attack for sulfurous, acetic, formic, citric, and tartaric acids. Due to low carbon content, 317L also provides resistance to sensitization when welded and higher creep, tensile strength and stress to rupture at elevated temperatures. It is non-magnetic in the annealed condition but may become magnetic after welding.

Applications

Alloy 317L is commonly used to handle sulfur, pulp liquor, acid dyestuffs, nitrating mixtures and acetylating bleaching solutions, severe coal and oil, and many chemical compounds. Some other applications that use alloy 317L include: Textile equipment, Fastener, Chemical and petrochemical processing equipment, Paper and pulp handling equipment's, Food processing equipment's, Condensers in fossil and nuclear fueled power generation stations. [11]

V. RESULT AND DISCUSSION

S/N Ratio Analysis: Signal-to-noise (S/N) ratio is then derived from the loss function. There are three types of S/N ratios depending upon type of characteristics Lower is better (LB), nominal is best (NB), higher is better (HB). In Material Removing Rate higher value is required. Therefore "HB" is chosen for the MRR similarly in Surface Roughness smaller value is required. Therefore "LB" is chosen for the Ra, and it is calculated as the logarithmic transformation of the loss function as shown below. With the S/N and ANOVA analyses, the optimal combination of the process parameters can be predicted.

In this study, in order to maximize the MRR higher is better S/N ratio is chosen and minimize the Ra lower is better S/N ratio is chosen.

$$\frac{S}{N} =- 10log\frac{1}{n}\sum_{i=1}^{n}\frac{1}{Yi^2} \text{....................(1)}$$

Where, n = number of repetitions or observations
yi = the observed data.[7]

Table1: Layout for experimental design.

Exp. No.	Speed	Feed	DOC	MRR	Ra
1	300	0.093	0.2	9.23	0.64
2	300	0.073	0.4	6.00	0.79
3	300	0.130	0.3	13.22	0.76
4	200	0.073	0.3	7.78	0.33
5	200	0.093	0.4	11.30	0.52
6	200	0.130	0.2	4.61	0.70
7	100	0.073	0.2	13.04	0.75
8	100	0.093	0.3	13.84	0.50
9	100	0.130	0.4	6.66	0.71

ISSN 2348 – 8034
Impact Factor- 5.070

Table 2: S/N Ratio analysis of MRR and Ra

Exp. No.	Speed	Feed	DOC	MRR	S/N Ratio	Ra	S/N Ratio
1	300	0.093	0.2	9.23	19.30	0.64	3.88
2	300	0.073	0.4	6.00	15.56	0.79	2.05
3	300	0.130	0.3	13.2	22.42	0.76	2.38
4	200	0.073	0.3	7.78	17.82	0.33	9.63
5	200	0.093	0.4	11.3	21.06	0.52	5.68
6	200	0.130	0.2	4.61	13.27	0.70	3.10
7	100	0.073	0.2	13.0	22.30	0.75	2.50
8	100	0.093	0.3	13.8	22.82	0.50	6.03
9	100	0.130	0.4	6.66	16.47	0.71	2.98

Higher value of S/N ratio corresponds to optimal level of input parameter. From table 2 it is cleared that the higher value of S/N ratio comes at Speed 100m/min, feed 0.093mm/rev and depth of cut 0.3mm. Higher value of S/N ratio corresponds to optimal level of input parameter. Also from table 2 for Ra Value it is cleared that the higher value of S/N ratio comes at Speed 200 m/min, feed 0.073mm/rev and depth of cut 0.3mm.

Table 3: Response table for S/N ratio larger the better

Level	Speed	Feed	Doc
1	20.53	18.56	18.29
2	17.39	21.06	21.02
3	19.10	17.39	17.70
Delta	3.15	3.67	3.32
Rank	3	1	2

Table 6. Analysis of variance for S/N Ratios on Ra

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Speed	2	17.774	17.774	8.887	2.51	0.285
Feed	2	9.486	9.486	4.743	1.34	0.427
Doc	2	14.284	14.284	7.142	2.02	0.331
Residual Error	2	7.071	7.071	3.536		
Total	8	48.615				

Table 4: Response table for S/N ratio smaller the better

Level	Speed	Feed	Doc
1	3.831	4.725	3.158
2	6.136	5.192	6.011
3	2.769	2.819	3.567
Delta	3.367	2.373	2.854
Rank	1	3	2

Table 5. Analysis of variance for S/N Ratios on MRR

Source	DF	Seq SS	Adj SS	Adj MS	F	P
speed	2	14.90	14.90	7.449	0.38	0.724

ISSN 2348 – 8034
Impact Factor- 5.070

Feed	2	21.12	21.12	10.560	0.54	0.650
Doc	2	18.85	18.85	9.424	0.48	0.675
Residual Error	2	39.14	39.14	19.570		
Total	8	94.01				

The results of ANOVA are shown in table 6 and table 7 it is clear that the parameters Speed Feed and Depth of Cut significantly affect the MRR and Ra.

Larger F- value indicates that the variation of process parameters makes a big change on the performance. The last column of the table shows that P-value for the individual control factors. Smaller the P-value, greater the significance of the parameter.

The ANOVA table for S/N ratio Table 5 indicate that, the Speed (P=0.724), Feed (P= 0.650) and Depth of cut (P=0.675) in this order, are significant control factors affecting MRR. It means, the Feed is the most significant factor followed by Speed and Depth of Cut.

The ANOVA table for S/N ratio Table 6 indicate that, the Speed (P=0.285), Feed (P= 0.427) and Depth of cut (P=0.331) in this order, are significant control factors affecting Ra. It means, the Speed is the most significant factor followed by feed and Depth of Cut.[7]

VI. CONCLUSION

- For Material Remove Rate (MRR) the most influencing parameter is feed followed by Depth of cut and Speed.
- For Surface Roughness (Ra) the most influencing parameter is Speed followed by Depth of cut and Feed.
- Optimal Combination for Material Remove Rate (MRR) is,Speed 100 m/min, Feed0.093 mm/rev and D.O.C.is 0.3 mm.
- Optimal Combination for Surface Roughness (Ra) is,Speed 200 m/min, Feed0.073 mm/rev and D.O.C.is 0.3 mm.

VII. ACKNOWLEDGMENT

The Author would like to express sincere thanks all the members who are directly or indirectly part of this work.

REFERENCES

1. *K Mekala1, J Chandradas. "Optimization of Surface Grinding Parameters of Austenitic Stainless Steel Rods (AISI316) By Taguchi Method".2014 IJMERR.*
2. *M. S. Sukumar, P. Venkata Ramaiah (2014), "Optimization and Prediction of Parameters in Face Milling ofAl-6061 Using Taguchi and ANN Approach", Science Direct Procedia Engineering 97 pp. 365 – 371.*
3. *Cheol W Lee (2009), "A Control-Oriented Model for the Cylindrical Grinding Process", International Journal of Advance Manufacturing Technology, Vol. 44, pp. 657-666.*
4. *Janardhan M and Gopala Krishna A (2011), "Determination and Optimization of Cylindrical Grinding Process Parameters Using Taguchi Method and Regression Analysis", International Journal of Engineering Science and Technology Vol. 3, pp. 5659- 5665*
5. *Brinksmeier E, Heinzel C and Wittmann M (1999), "Friction, Cooling and Lubrication in Grinding", Annals of the ClRP, Vol. 48.*
6. *Kruszynski B W and Lajmert P (2005), "An Intelligent Supervision System for Cylindrical Traverse Grinding", Institute of Machine Tools and Production Engineering, Poland.*
7. *Sandip K Kadu, Milind Mhaske(2014), "Experimental investigation of damping force of twin tube shock absorber", International Journal of Engineering research and applications, Vol 4,pp. 59-64.*

8. *Hassui A and Diniz A E (2003), "Correlating Surface Roughness and Vibration on Plunge Cylindrical Grinding of Steel", International Journal of Machine Tools & Manufacture, Vol. 43, pp. 855-862.*
9. *Deiva Nathan R, Vijayaraghavan L and Krishnamurthy R (1999), "In-Process Monitoring of Grinding Burn in the Cylindrical Grinding of Steel", Journal of Materials Processing Technology, Vol. 91, pp. 37-42..*
10. *An American National Standard, ASTM Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings, 2013.*
11. *Nirma Stainless Steel Catalogue, 2013.*