International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 04 | Apr 2021 www.irjet.net p-ISSN: 2395-0072

OPTIMIZATION OF CYLINDRICAL GRINDING PROCESS PARAMETERS ON EN 24 STEEL

R.Shanmuganathan[1] M.Sudhakar[2] TTM.Kannan[3] P.Vijayakumar[4] S.Sukumar [5]

[1] *M.Tech Student, Department of Mechanical Engineering, PRIST Deemed to be University, Thanjavur-613403*
[2]*Assistant Professor, Department of Mechanical Engineering, PRIST Deemed to be University, Thanjavur-613403*
[3-5]*Associate Professor, Department of Mechanical Engineering, PRIST Deemed to be University, Thanjavur-613403*

Abstract - *Cylindrical grinding machine is employed in machining of components for smooth surface finishing and to urge close tolerances. To improve surface properties and mechanical properties with extended life time of object optimal conditions are necessary for manufacturing. Although grinding operation has great importance in total manufacturing process still there optimal parametric values aren't accounted by many manufacturers. Work speed, feed rate and depth of cut are the input process parameters of cylindrical grinding process. The objective of this work is to predict the grinding behavior and is available through best operational processes parameters on EN 24. Surface roughness is an important output response within the production with reference to quantity and quality respectively. In this work experimental work surface roughness is greatly influenced with depth of cut is the most significant parameter*

Key Words: *Grinding process Roughness average Material removal rate, orthogonal array*

1. INTRODUCTION

1.1 Grinding process

Grinding is that the process of removing metal by the appliance of abrasives which are bonded to make a rotating wheel. During the abrasive particles contact the work piece, they act as a cutting tools, each particle shear a small chip from the raw material. The grinding machine supports and rotates the grinding abrasive wheel and sometimes supports and positions the work piece in proper reference to the wheel. Many work can be achieved the grinding machine is employed for roughing and finishing flat, cylindrical, and conical surfaces; finishing internal cylinders or bores; forming sharpening cutting tools and can be buffing the rough surfaces. Once strictly a finishing machine, modern production grinding machines are used for complete roughing and finishing of certain classes of work. Various types of grinding machines used for finishing processes are explained below.

1.2 Cylindrical grinding machine

The cylindrical grinder may be a sort of grinding machine wont to shape the surface of an object. In cylindrical grinding, the work piece rotates about a fixed axis and the surfaces machined are concentric to that axis of rotation. This includes but isn't limited to such shapes as a cylinder, an ellipse, a cam, or a crankshaft. It has four important works:

1. The work (object) must be constantly rotating
2. The emery wheel must be constantly rotating
3. The emery wheel is fed towards and faraway from the work
4. Either the work or the emery wheel is traversed with reference to the opposite.

Cylindrical grinding machine is employed to supply external cylindrical surface. The surfaces could also be straight, tapered, steps or profiled. Broadly there are three differing types of cylindrical grinding machine as follows:

1. Plain centre type cylindrical grinder
2. Universal cylindrical surface grinder
3. Centre less cylindrical surface grinder

1.3 Problem statement

Generally surface finish must be within certain limits otherwise it will induce many problem during the services. Therefore, measuring surface roughness is significant to internal control of machining work piece. Surface roughness is also great concern in manufacturing industrial environment. Parts like automobile, aerospace, and medical component need high precision in surface finish. So there are problems in plan to get top quality surface finish of product. With the help of single objective function optimize the output responses can enhance maximize production rate, reduce cost and production rate.

1.4 Objectives of work

The objectives of this study

1. Perform experiment using Cylindrical Grinding Machine.

2. Investigate the effect of parameter that influences the surface roughness on steel.

3. Determine optimum cylindrical grinding process parameters.

2. EXPERIMENTAL DETAILS

2.1 Design of Experiment

DOE is one of the best powerful techniques used for exploring new processes, gaining the knowledge of existing process and optimizing this processes for achieving world class performance. DOE is experimental strategy in which effect of multiple factor are studied simultaneously by running tests at various level of the factor. What level should we take how to combine them, and how many experiment should we run, are discussed in DOE. The design of experiment is used to develop layout of different conditions to be studied. An experimental design must satisfy two objectives. First, the number of trial must be determined; second, the conditions for each trial must be specified.

2.2 Work material details

In this experimental work,EN 24 steel cylindrical rods are used as material for find minimum surface roughness and cylindricity error during cylindrical grinding process. The chemical composition (Table 2.1) and Mechanical properties (table 2.2) are given below.

- Work material –EN24steel
- Work material size–25mm dia 100 mm Length

2.3 Chemical composition of EN 24 steel

Table 2.1 Chemical composition of EN 24 steel

C	Mn	Si	S	Ni	Cr	Mo
0.36	0.45	0.10	0.12	1.30	1.00	0.20
0.44	0.70	0.35	0.04	1.70	1.40	0.35

2.4 Mechanical properties of EN24 steel

Table 2.2 Mechanical Properties of EN 24 steel

Sl.No	Properties	Value
1.	Ultimate Tensile strength (Mpa)	1000
2.	Yield Stress (Mpa)	650
3.	Elongation (%)	13
4.	Density(Kg/m^3)	7833.413
5.	Hardness(HRC)	62

Work piece length is 100mm, grinding length is 60 mm and diameter is 25mm.

2.5 Applications of EN 24 steel

The grade may be a nickel chromium molybdenum combination - this offers high tensile steel strength, with good ductility and wear resistance characteristics. Good toughness properties at minimum temperatures, EN24 is additionally suitable for maximum of elevated temperature applications. The specification of cylindrical grinding process is presented in table 2.3

Table: 2.3 Cylindrical grinding specification

model	Specification
Capacity for work piece mm 1.Swing 2.Length	 800 mm 3000mm
Max grinding diameter	700mm
Steady rest capacity 1.Max 2.min	 400mm 100mm
Centre height	410mm
Grinding width	70mm
Max table averse	3500mm
Table swivel either side	4
Grinding wheel speed	2800 rpm

Series of experiment are conducted to gauge the influence of grinding process parameters on surface roughness and material removal rate in cylindrical grinding. The test has got to be administered on high precision cylindrical grinding machine with vitrified Al_2O_3 emery wheel and water miscible coolant with 5 a degree was supplied in all grinding experiments. The coolant supply is made through flexible segmented hose nozzle at different angles up to 20 tolerances and coolant is penetrated in the cutting zone. The flow rate of coolant is varied by the help of flow regulating valve. With the single point diamond dresser the

grinding wheel dressed after every 10 experiments. EN24 grade steel material used for experiments having 25 mm Dia and 70 mm length. It involves several variables like depth of cut, work speed, feed rate, grit size, sort of abrasive, chemical composition of wheel, etc. The present work takes the following input parameters namely depth of cut, Hydraulic feed and work speed by keeping other process parameters constant. The main objective of this experimental work is to arrive at the optimum process parameter condition that will minimize the surface roughness values when grinding EN24steel material.

2.6 Process parameters levels and factors

Process parameters and their levels responses for all noise factors for the given factor level combination is shown in table 2.4

Table: 2.4 Process parameters and their levels and Factors

Levels	**Process parameters**		
	Work Speed (*N*) (rpm)	**HYD. Feed (*f*) (mm/rev)**	**Depth of cut**
1	120	0.02	0.1
2	212	0.03	0.2
3	380	0.04	0.3

3. METHODOLOGY

The proposed work approach and methodology has been elaborately shown in the fig 3.1

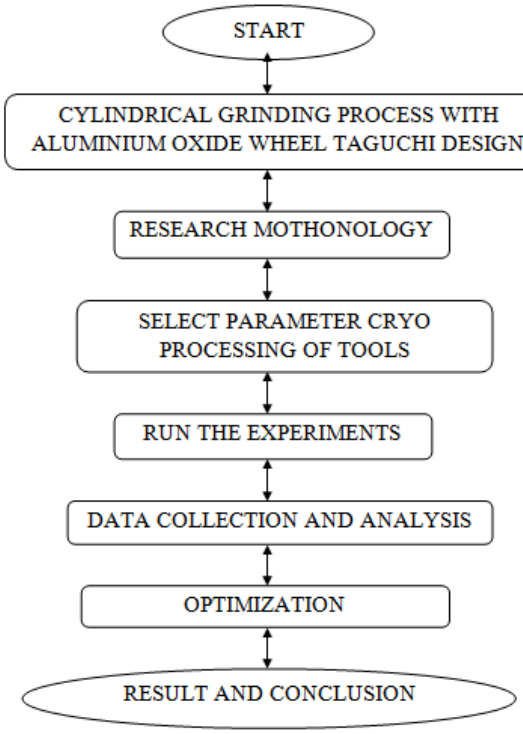

Fig 3.1 Flow chart of Experimental work

3.1 L_9 orthogonal array

Table 3.1 L_9 orthogonal array of cylindrical grinding process parameters

The experimental procedure is designed to L_9 orthogonal array which contains 3 levels and 3 factors and conducted by cylindrical grinding machine. The process parameters of cylindrical grinding is shown in table 3.1

SL.NO	Work Speed (*N*) (rpm)	Feed(*f*) (mm/rev)	Depth of cut (mm)
1	120	0.02	0.1
2	120	0.03	0.2
3	120	0.04	0.3
4	212	0.02	0.2
5	212	0.03	0.3
6	212	0.04	0.1
7	380	0.02	0.3
8	380	0.03	0.1
9	380	0.04	0.2

3.2. Experimental data and response analysis of surface roughness of EN24 steel

The cylindrical grinding process was conducted on EN24 steel rod using L_9 orthogonal array design procedure and response parameter of surface roughness values are given in table 3.2

Table: 3.2 Surface Roughness and S/N Ratios Values for the Experiments

S.No	Design	Work speed (rpm)	Feed (mm/rev)	Depth of cut (mm)	Ra (Micrometer)	SNRA1
1	$A_1B_1C_1$	120	0.02	0.1	0.625	4.08240
2	$A_1B_2C_2$	120	0.03	0.2	0.489	6.21382
3	$A_1B_3C_3$	120	0.04	0.3	0.530	5.51448
4	$A_2B_1C_2$	212	0.02	0.2	0.475	6.46613
5	$A_2B_2C_3$	212	0.03	0.3	0.480	6.37518
6	$A_2B_3C_1$	212	0.04	0.1	0.511	5.83158

7	$A_3B_1C_3$	380	0.02	0.3	0.560	5.03624
8	$A_3B_2C_1$	380	0.03	0.1	0.592	4.55357
9	$A_3B_3C_2$	380	0.04	0.2	0.521	5.66325

3.3 Response table for surface roughness of cylindrical process parameters

Table: 3.3 Response Table for surface roughness (Smaller is better)

Level	**Work speed**	**Feed**	**DOC**
1	5.270	5.195	4.823
2	6.224	5.714	6.114
3	5.084	5.670	5.642
Delta	1.140	0.519	1.292
Rank	2	3	1

Table 3.3 denotes (Rank 1) depth of cut is the most influencing process parameter of for achieving lower surface roughness during cylindrical grinding process of EN 24 steel rods

Table: 3.4 Analysis of Variance for Surface roughness of EN 24 steel rods

Source	**DF**	**SEQ SS**	**ADJ MS**	**F**	**P**	**% of contribution**
Work speed	2	0.008375	0.004187	11.48	0.080	39
Feed	2	0.002156	0.001078	2.96	0.253	10
Doc	2	0.010138	0.005069	13.90	0.067	47
Error	2	0.000730	0.000365	-	-	4
Total	8	0.021398	-	-	-	100

Table 3.4 shows that analysis of variance values of cylindrical grinding process while achieving lower surface roughness value. The higher value of F test denotes the most influencing process parameter of EN 24 steel rods of Cylindrical grinding process.

4. RESULT & CONCLUSION

The various Input parameters were selected for cylindrical grinding process for EN24 steel. The work piece had grind with various parameters like speed, feed DOC so as to realize the high degree surface finish. In this experimental work, the results of 9 work specimen independent variables viz. work speed, Hydraulic feed, depth of cut, concentration of cutting fluid and number of passes have been studied surface finish using DOE method. It has been found that surface roughness was mainly influenced with depth of cut of input process parameter of cylindrical grinding process on EN 24 steel rods.

REFERENCES

[1] C. Thiagarajan, R. Sivaramakrishnan, S. Somasundaram, Modeling and Optimization of Cylindrical Grinding of Al/SiC Composites Using Genetic Algorithms, 32 / Vol. XXXIV, No. 1, January-March 2012

[2] V. Saravana Kumar, Hridul Pavithran, Sachin K. V Optimization of Process Parameters on SS410 in Cylindrical Grinding Process, Vol. 3 Issue 4, April – 2014

[3] Chandrasekaran, M.a,*, Devarasiddappa, D.b Artificial neural network modeling for surface roughness prediction in cylindrical grinding of Al-SiCp metal matrix composites and ANOVA analysis, Volume 9 | Number 2 | June 2014

[4] Hemant S. Yadav, Dr. R. K. Shrivastava, Effect of Process Parameters on Surface Roughness and Mrr in Cylindrical Grinding using Response Surface Method, Vol. 3 Issue 3, March - 2014

[5] Rajani Sharma1, Promise Mittal2, Kuldeep Kaushik3, Pavan Agrawal4, Optimization of Surface Roughness in cylindrical grinding, Volume: 03 Issue: 12 | Dec -2016

[6] Taranvir Singh, Parlad Kumar, Khushdeep Goyal, Optimization of Process Parameters for Minimum Out-of-Roundness of Cylindrical Grinding of Heat Treated AISI 4140 Steel,vol. 2, no. 2 (2014): 34-40.

[7] M. Aravind, Dr. S. Periyasamy, Optimization of Surface Grinding Process Parameters By Taguchi Method And Response Surface Methodology, Vol. 3 Issue 5, May - 2014

[8] Mr. Rupesh J. Karande, Mr. Kshitij R. Patil, Optimization of Cylindrical Grinding Machine Parameters for Minimum Surface Roughness and Maximum MRRVolume 2 | Issue 5 | April 2017

[9] K Mekala1*, J Chandradas2, K Chandrasekaran2, T T M Kannan3, E Ramesh3 and R Narasing Babu4, OPTIMIZATION OF CYLINDRICAL GRINDING PARAMETERS OF AUSTENITIC STAINLESS STEEL RODS (AISI 316) BY TAGUCHI METHOD, Vol. 3, No. 2, April 2014

[10] *Naresh Kumar, **Himanshu Tripathi, Sandeep Gandotra, Optimization of Cylindrical Grinding Process Parameters on C40E Steel Using Taguchi Technique, Vol. 5, Issue 1(Part 3), January 2015.