ANALYSIS OF SURFACE ROUGHNESS FOR IMPROVING THE QUALITY- A CASE STUDY

[1]Sagar Anil Gawade, [2]Dr. Arun Kumar
[1]P.G. Student, [2]Principal
[1]Dept. of Mechanical Engineering
[1]VIVA Institute of Technology, Maharashtra, India

Abstract- Surface grinding is a very complex process while improving the quality of product which helps it to control the performance of equipment and machine tools. Thus it is important to analyze the process parameter by performing various experiments. This is the main objective of this researcher paper in which, we have tried to analyze the effect of varying the different parameter of surface grinding to check the surface roughness of M.S by using aluminum oxide (Al_2O_3) grinding wheels. The main input parameters taken into consideration in this paper were depth of cut, wheel speed, & wheel grain size. Result was analyzed by ANOVA and result is shown in form of comparison graphs.

Keywords- Surface grinding, surface roughness, M.S, Al_2O_3, Grinding parameters, Grain size, Depth of cut, Wheel speed.

I. INTRODUCTION

Today in modern scenario technology is developing day by day. With this development of technology, designers & manufacturers are facing more & more challenges. So more & more researches are going on machining processes and further more researches are required. Machines, tools, materials and processes need to be improved. In machining, raw material is converted into finished goods. Manufacturer spends money, machinery, manpower and most precious time for converting raw material to useful goods. If finished product is not as per customer requirements, then whole efforts go waste. Also these days, competition is increasing. If any organization wants to be in market, it requires continuous improvement as per customer needs. It is a fact that with the increase in material removal rate surface finish goes down. Increased rate of material removal result in low time consumption but at the same time surface finish is also important. Machining processes need to be optimized for more material removal and higher surface finish. Surface texture is property of a material which needs to be optimum.

II. LITERATURE REVIEW

Avinash S Jejurkar & Vijay L. Kadlag, [2016**]**. They have presented optimization of surface grinding process parameter specifically work speed, speed rate & depth of cut. The objective is to predict grinding behavior & get best result from this process parameter. Prediction from this process are analyzed by standardization & related knowledge. On that paper they used ANOVA method for optimization.

Amandeep Singh Padda, Satish Kumar, Aishna Mahajan [2015]. They have worked to analyze the effect of various process of varying surface grinding parameters on the surface roughness of Stainless Steel using white aluminum oxide grinding wheels. The main input parameters taken into consideration in this study are depth of cut, wheel speed and wheel grain size.

Sandeep Kumar, Onkar Singh Bhatia [2015]. They have presented in this paper that as per the industrial requirement, higher surface finish mechanical components & mating parts with close limits & tolerances is one of the important requirement. Abrasive machining processes are generally the last operations performed on manufactured products for higher surface finishing and for fine or small scale material removal. Higher surface finish and high rate of removal can be obtained if a large number of grains act together. This is obtained by using bonded abrasives as in grinding wheel. In this they had use the design of experiment to optimize the grinding parameter such as wheel speed (rpm), work feed (mm/min), depth of cut on surface roughness. Surface roughness measured by the Talysurf surface roughness tester. After this they conclude that The various input parameters of l grinding such as the work piece speed, grinding wheel speed and feed rate has more significant effect for surface roughness and depth of cut has least effect on surface roughness.

Kamaldeep Singh, Dr. Beant Singh, Mandeep Kumar [2015]. The work and study presented in this paper is Experimental Investigation of Machining Characteristics of AISI D3 Steel with Abrasive Assisted Surface Grinding. In this work Taguchi method is applied to find optimum process parameters for abrasive assisted surface grinding of AISI D3 tool steel. Experiments are conducted on horizontal spindle reciprocating table surface grinding machine with L18 orthogonal array with input machining variables as type of wheel, depth of cut, table speed, grain size and slurry concentration. After conducting the experiments, MRR is calculated and surface roughness is measured using surface roughness tester. Results are optimized by S/N ratio and analyzed by ANOVA. This study demonstrates that c-BN grinding wheel is preferred for higher MRR and Al2 O3 grinding wheel for better surface finish. Depth of cut is the most significant factor for both MRR and surface roughness. It has been observed from experiment work that input parameters setting of grinding with aluminum oxide wheel, depth of cut 0.05 mm, and table speed 8.75 mm/sec; abrasive grain size 1200 and slurry concentration 25% have given the best results for surface roughness.

Nitin Sohal, Charanjeet Singh Sandhu, Bidyut Kumar Panda [2014]. They have presented in this paper the various parameters of machining were studied and optimized to obtain the quality finish upon the surface of machined surface. After an exhaustive literature survey, two different types of EN range of steels have been selected for the examination in terms of surface roughness and material removal rate The machining parameters such as Grinding Table speed, Depth of cut and Feed rate were analyzed and found that best results of percentage improvement in surface roughness as 0.39 and 0.47 for EN24 and EN353 at a table speed of 14m/min keeping feed rate and depth of cut constant and MRR as 1.05 and 1.16 for EN24 and EN353 keeping the feed rate and depth of cut constant at table speed of 14m/min.After the experment they conclude that By varying the feed rate and keeping the table speed and depth of cut constant, the surface roughness increases, the surface finish decreases and the material removal rate increases.

Ramesh Rudrapati, AsishBandyopadhyay, Pradip Kumar Pal [2013]. The paper work said that effects of grinding parameters on surface roughness (Ra and Rq) in traverse cut cylindrical grinding process, while grinding of stainless steel. Experiments have been conducted as per L9 orthogonal array of Taguchi method. Grey based Taguchi method has been used to optimize the grinding parameters to minimize surface roughness parameters Ra and Rq simultaneously. The analysis of signal to noise ratio has been applied to investigate the effects of grinding parameters and optimize them. From the results of this study, longitudinal feed is identified as the most influential grinding parameter on surface roughness. The optimization methodology used in the present study of cylindrical grinding process is very useful to determine the optimum grinding parameters for minimum surface roughness.

III. METHODOLOGY

In this research paper there are three process parameters is to be taken of Surface grinding process i.e. Wheel Speed (rpm), Wheel Grain size and Depth of cut on Surface Roughness with reference to Mild Steel as work piece material & remaining process parameters of surface grinding operation are kept constant. Mild steel is widely used in industry machinery, precision tools, automobiles and household products and these applications require different part surface finish values in order to achieve maximum performance and working life period. Therefore this analysis is done to study the effect of input parameters on surface finish of mild steel in surface grinding operation. An automated surface grinder, White Aluminum Oxide grinding wheels and an average table speed (up grinding) of 0.15 m/s is used throughout the experiment.

Water soluble oil (oil to water ratio of 1:25) is used as cutting oil. A total of 27 experiments are done by varying the process parameter and then surface roughness of each specimen is checked using Mitutoyo (SJ-201P) Surface roughness tester.

1. Machine description: -

The following content gives the description and specification of the machine on which we were conducted the test for the experiment. The specifications were listed below:

Brand Name : DMT
Model Name : HYD 208
Make : INDIA
Manufacturing : 2014
Table size : 450 X 200 MM
Guide-ways : V & Flat
Axis Travel : 500/250/400 mm
Spindle Nose : 50.8 mm
Spindle speed : 2800 rpm

2. Material Composition:-

The following composition is given for the selected material of Mild Steel i.e. MS.

Table 1 Material Composition

C	**Si**	**Mn**	**P**	**Ni**	**S**
0.16-0.18%	0.40	0.70-0.90%	0.040%	0.25-1.25%	0.040%

IV. RESULT & CONCLUSION

A. Experimental results:

For understanding the objective of the research the following reading were taken by changing the various parameter of the surface roughness of all 27 specimens is measured using the Mitutoyo Surface Roughness Tester and given in Table 2 below.

Table 2 Experimental Results for Mild Steel

Run No.	*Grain Size*	*Spindle Speed(rpm)*	*Depth of cut (mm)*	*Surface roughness(μm)*
1	46	1400	0.03	0.300
2	46	1400	0.02	0.293
3	46	1400	0.01	0.281
4	46	2000	0.03	0.263
5	46	2000	0.02	0.251
6	46	2000	0.01	0.238
7	46	2800	0.03	0.228
8	46	2800	0.02	0.224
9	46	2800	0.01	0.223
10	60	1400	0.03	0.219
11	60	1400	0.02	0.212
12	60	1400	0.01	0.206
13	60	2000	0.03	0.190

14	60	2000	0.02	0.184
15	60	2000	0.01	0.183
16	60	2800	0.03	0.175
17	60	2800	0.02	.0171
18	60	2800	0.01	0.169
19	120	1400	0.03	0.157
20	120	1400	0.02	0.152
21	120	1400	0.01	0.148
22	120	2000	0.03	0.140
23	120	2000	0.02	0.136
24	120	2000	0.01	0.131
25	120	2800	0.03	0.129
26	120	2800	0.02	0.128
27	120	2800	0.01	0.116

B. Experimental Graph:

i. Graph drawn by changing cutting speed.

Graphs detecting the comparative results of effect of varying wheel grain size for a specific value of wheel speed on surface roughness on Mild Steel:

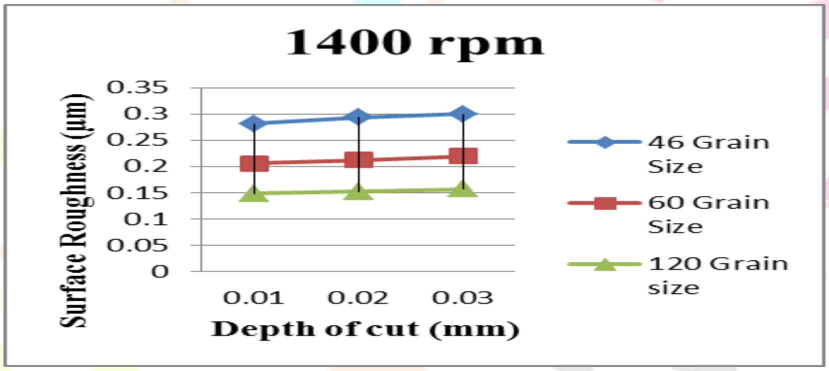

Fig. 1 Depth of cut Vises Surface roughness at 1400 RPM

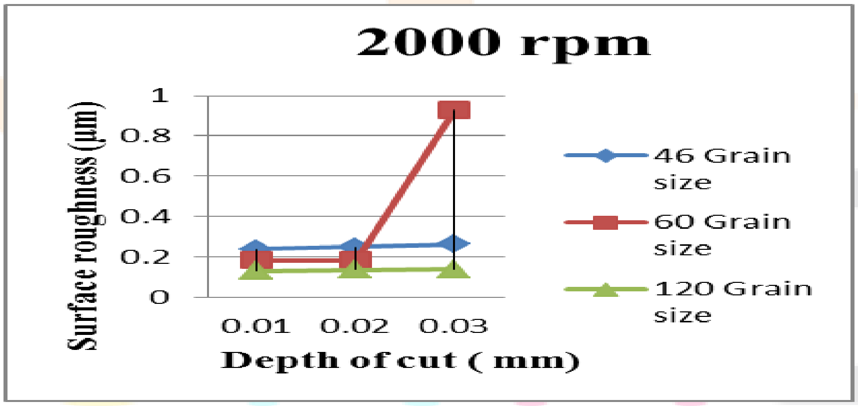

Fig. 2 Depth of cut Vises Surface roughness at 2000 RPM

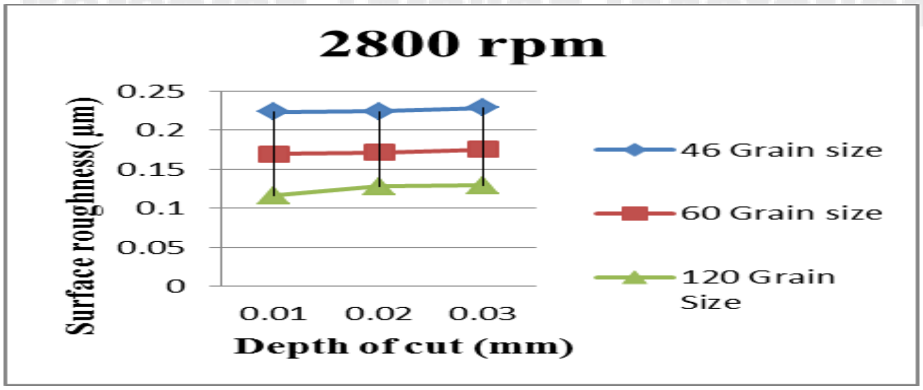

Fig. 3 Depth of cut Vises Surface roughness at 2800 RPM

Surface finish of stainless steel decreases with increase in speed of Al2O3 wheels. On an average at every speed better surface finish is shown by grain size 120. Only at 2800 rpm, grain size 60 shows better finish as compared to 120 grain size. Surface finish varies largely with small grain size but less with large grain size wheel. Fig. 3.1d shows comparative results for surface finish.

ii. Graph drawn by changing the grain size of the grinder wheel

Graph depicting the comparative result of effect of varying wheel speed (rpm) for a specific value of wheel grain size on surface roughness of mild steel.

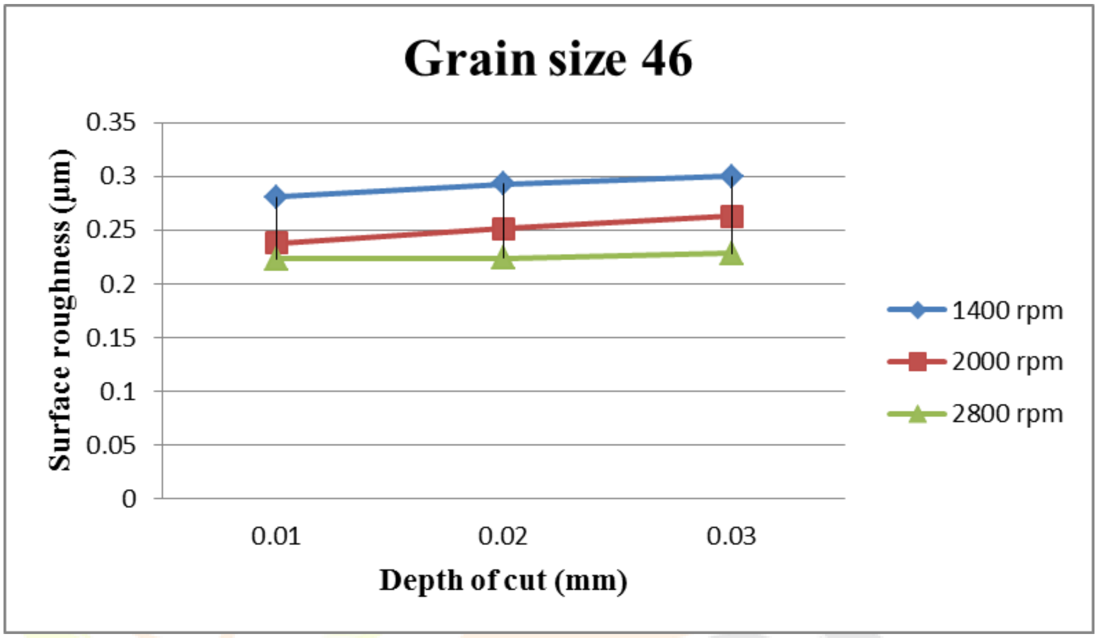

Fig. 4 Depth of cut Vises Surface roughness of grain size 46

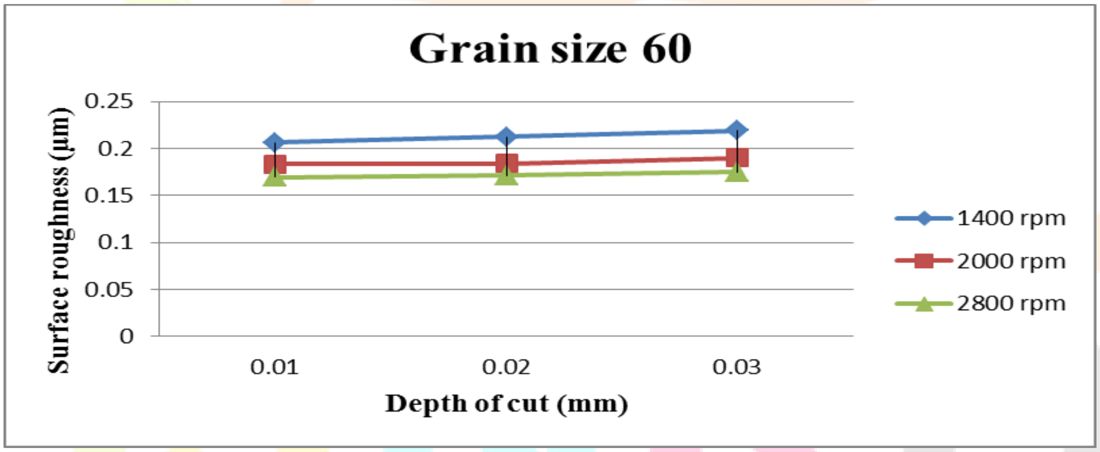

Fig. 5 Depth of cut Vises Surface roughness of grain size 60

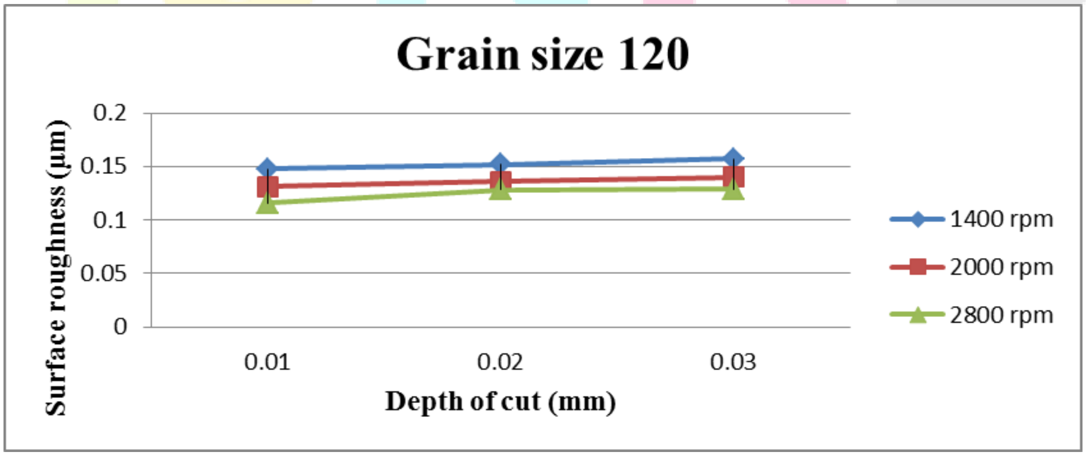

Fig. 6 Depth of cut Vises Surface roughness of grain size 120

Mild steel shows better surface finish at lower speed of Al_2O_3 grinding wheel for almost every grain of mild steel, there is lot of grain wear & fracture at high wheel speed. But at large depth of cut, the grains are able to shear the surface better thus allowing more cutting action. As shows comparative result for surface finish.

C. Experimental Conclusion:-

Out of the three process parameters under study, most significant factor in surface grinding is wheel speed followed by grain size and depth of cut. Increasing wheel speed increases the tangential cutting force on material surface thus allowing more cutting and less of plowing and rubbing of grains. But this also increases stresses on Al_2O_3 wheel grains because of hardness and toughness of stainless steel, , thus leading to high grain wear and abnormal fracture. This reduces the cutting action and causes more of plowing and grain rubbing against the metal surface.

Considering all the results we can say that in order to achieve minimum surface roughness with Al2O3 wheel, we need to choose an optimum value of grain size and depth of cut and a higher wheel speed or lower wheel speed for a certain material.

V. FUTURE DEVELOPMENT

The further expansion of ANOVA method will help to gain optimum results in Industries by practically performing the designed experiment on different material with different number of trials. Thus by applying above technique industries will benefit with efficient machining, reduced machining time, improved quality of surface finish and higher productivity.

VI. ACKNOWLEDGMENTS

The authors would like to express his deep gratitude to Prof. Dr. Arun Kumar, Prof. Niyati Raut, Asst. Prof. Flora for their guiding on such a good topic.

REFERENCES

[1] Avinash S. Jejurkar , Vijay L, "Optimization of surface grinding process parameter for AISI 321 by Using Taguchi Method", IJARIIE-ISSN(O)-2395-4396, Vol-2 Issue-4 2016.

[2] M.Melwin Jagadeesh Sridhar1, P.Sathish Kumar," Effect of process parameter on surface roughness of cylindrical grinding process on OHNS steel rounds using ANOVA", IJETT, Vol-33, March 2016.

[3] Sandeep Kumar , Onkar Singh Bhatia , "Experimental analysis & optimization of cylindrical grinding process parameter on surface roughness of En15AM steel", IJERA Vol-5, Issue-July 2015.

[4] T. V. Mahajan , A.M. Nikalje, J.P. Supale, "Optimization of surface grinding process parameter for AISI D2 Steel" , IJESRT, ISSN:2277-9655, Issue July 2015.

[5] Ranganath M. S., Vipin, R. S. Mishra, Prateek, Nikhil, "Optimization of surface roughness in CNC turning of aluminium 6061 using Taguchi technique", IJMER-ISSN: 2249-6645 , Vol-5, Issue 5 May 2015.

[6] R.R. Chakule, Prof. S. M. Choudhary, P. S. Talmale, "A review on optimization of grinding process using computational fluid dynamics for surface roughness", IJSTM-ISBN :2394-1237, Vol-4, Issue 01 February 2015.

[7] Kamaldeep Singh, Dr. Beant Singh, Mandeep Kumar , "Experimental investigation of machining characteristic of AISI D3 steel with Abrasive assisted surface grinding", IRJET- ISSN: 2395-0056, Vol-2, Issue 04 July 2015.

[8] G J Pavan Kumar and R Lalitha Narayana, "Prediction of surface roughness in turning process using soft computing techniques", IJMERR- ISSN: 2278-0149, Vol-4, Issue 01 January 2015.

[9] B. Dasthagiri , Dr. E. Venu gopal Goud, "Optimization studies on surface grinding process parameter", IJIRSET-ISSN: 2319-8753, Vol-4, Issue 7, July 2015.

[10] Aswathy V G, Rajeev N, Vijayan K, "Effect of machining parameter on surface roughness, material removal rate, & roundness error during the wet turning of Ti-6Al-4V alloy", IJASER- ISSN:2277-9442, Vol 4, Issue 01, 2015.

[11] Amandeep Singh Padda, Satish Kumar, Aishna Mahajan, "Effect of Varying surface grinding parameter on the surface roughness of stainless steel", IJERGS-ISSN: 2091-2730, Vol-3, Issue 06 November 2015.

[12] Subhajit Dangar, S Mukherjee, "Optimization of cutting parameter for improving surface roughness in turningoperation using Taguchi method & ANOVA", IJRET-ISSN: 2321-7308, Vol-03, Issue 06 Jan 2014.

[13] Rajendra Singh ,Rahul kr.Gupta ,Jitendra Kr. Tripathi, "Surface roughness analysis & compare prediction & experimentqal value for cylindrical stainless steel pipe in CNC lathe turning process using ANN method for reoptimization & cutting fluid", IJES-ISSN : 2319-1805, Vol-3, Issue 7, Pg 58-71, 2014.

[14] Praveenkumar.V.Kolhar, Dr.R.G.Mench, "Optimization of process parameter in grinding process to reduce the rework in case of piston using Taguchi technique", IIJME-ISSN: 2321-6441, Vol-2, Issue 10, October 2014.

[15] Nitin Sohal, Charanjeet Singh Sandhu, Bidyut Kumar Panda," Analyzing the effect of grinding parameter on MRR & surface roughness of EN24 & EN 353 steel", Mechanica confab, ISSN: 2320-2491, Vol-3, Issue 05, October 2014.