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Optimization Of Cylindrical Grinding Process Parameters On Material Removal Rate Of En21am Steel

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ABSTRACT *Grinding is the machining processes, which improve surface quality and dimensional accuracy of the work piece. Various process parameters, which affect the cylindrical grinding operation, are depth of cut, material hardness, and work piece speed, grinding wheel grain size, number of passes, material removal rate and grinding wheel speed. Speed and feed are critical factors because increasing the both speed, and feed has an adverse impact on surface roughness but high material removal cause reduction in surface roughness. Cylindrical grinding is one of the important metal cutting processes used extensively in the finishing operations. Metal removal rate and surface finish are the important output responses in the production with respect to quantity and quality. In this thesis, is to arrive at the optimal grinding conditions that will minimize surface roughness and maximize metal removal rate when cylindrical grinding of EN21AMsteel is done for the optimization of grinding process parameters. During an experimental work input process parameters i.e. speed, feed, depth of cut is optimized using Taguchi method. 3D modeling done by CREO parametric software.*

LITERATURE REVIEW

1. Review of Analysis & Optimization of Cylindrical Grinding Process Parameters on oEn15AM Steel Grinding process is surface finishing process generally used to smoothen the surfaces by removing the limited quantity of material from the already machined surfaces. Cylindrical grinding or abrasive machining is the most popular machining process of removing metal from a work piece surface in the form of tiny chips by the action of irregularly shaped abrasive particles. In the present study, Taguchi method or Design of experiments has been used to optimize the effect of cylindrical grinding parameters such as wheel speed (rpm), work speed, feed (mm/min.), depth of cut and cutting fluid on the Material Removal Rate of EN15AM steel. Material removal rate measurements were carried out during the machining process on the

work piece. EN15AM steel is generally known as free cutting steel and consists of higher machinability. It has several industrial applications in manufacturing of engine shafts, connecting rods, spindles, connecting components etc. The results indicated that grinding wheel speed, work piece speed, table feed rate and depth of cut were the significant factors for the material removal rate. The optimized parameters for material removal rate are grinding wheel speed 1800 rpm, work piece speed 155 rpm, feed rate 275 mm/min. and depth of cut 0.04 mm.

2. Optimization of Cylindrical Grinding Process Parameters on C40E Steel Using Taguchi Technique Surface finish and dimensional accuracy play a vital role in the today‘s engineering industry. There are several methods used to achieve good surface finish like burnishing, honing and lapping, and grinding. Grinding is one of these ways that improves the surface finish and dimensional accuracy simultaneously. C40E steel has good industrial application in manufacturing of shafts, axles, spindles, studs, etc. In the present work thecylindrical grinding of C40E steel is done for the optimization of grinding process parameters. During this experimental work input process parameters i.e. speed, feed, depth of cut is optimized using Taguchi L9 orthogonal array. Analysis of variance (ANOVA) concluded that surface roughness is minimum at the 210 rpm, 0.11mm/rev feed, and 0.04mm depth of penetration.

3.Optimization of Cylindrical Grinding Process Parameters of OHNS Steel (AISI 0-1) Rounds Using Design of Experiments Concept. OHNS steel is a widely preferred material for manufacturing of Die blocks, fasteners, automotive components and cutting tools. Metal removal rate is an important performance factor to be considered in grinding process. Research activities that include experimental work and statistical analysis help in improving quality standards of manufacturing of components. Surface quality of OHNS steel after cylindrical grinding process is proposed to be studied in this experimental work using L9 orthogonal array selected for three levels and three input parameters. The inputs parameters are considered in this Experimental study are work speed, depth of cut and number of passes and response parameter is metal removal rate (MRR) during cylindrical grinding process. Higher metal removal rate is the main objectives of this machining process. The different machining parameters of OHNS steel of cylindrical grinding process are optimized by Signal to noise ratio and analyzed by Analysis of variance (ANOVA‘s).

METHODOLOGY & PROBLEM DESCRIPTION Objective of Present Investigation: To analyze the effect of cylindrical grinding process parameters like grinding wheel speed, work piece speed, table feed, depth of cut, conditions and optimize for enhancement of surface finish and effect on material removal rate on EN21AM steel In order to obtain applicable and practical predictive quantitative relationships, it is necessary to model the grinding responses and the grinding variables. These models would be of great use duringoptimization of the cylindrical grinding of EN21AM steel.In this work, experimental results are used to calculate the analysis of variance (TAGUCHI) which explains the significance of the variables on the responses. A commercially available statistical toolMINITAB is used to provide the TAGUCHI results.

EXPERIMENTAL INVESTIGATION The experiments are done on the cylindrical grinding machine with the following parameters: WORK PIECE MATERIAL – EN 21 Am Tool Steel FEED –0.075mm/min, 0.095mm/min, 0.120mm/min CUTTING SPEED – 1000rpm, 700rpm, 500rpm, DEPTH OF CUT – 0.02mm, 0.03mm, 0.04mm

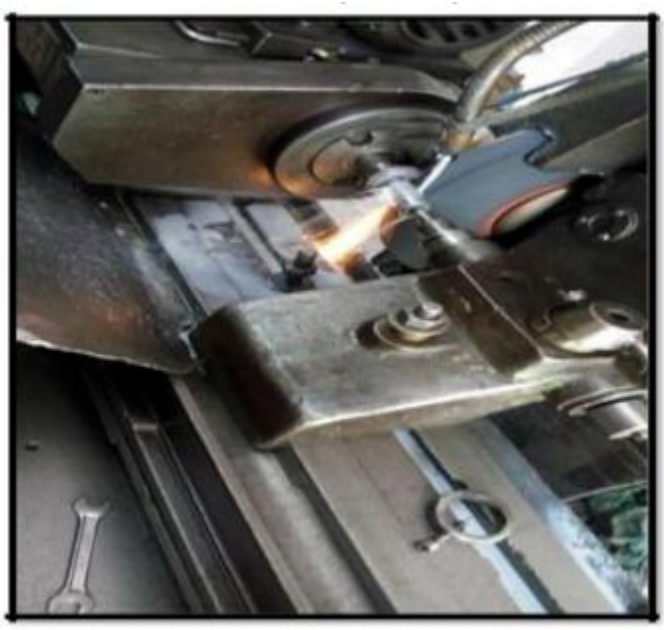

Fig. 1 Machining process of grinding

PROCESS PARAMETERS	LE VEL1	LEVEL2	LEVEL3
CUTTING SPEED(rpm)	600	1200	1800
FEED RATE (mm/rev)	200	250	300
DEPTH OF CUT(mm)	0.4	0.5	0.6

Table No. 1 Process Parameters

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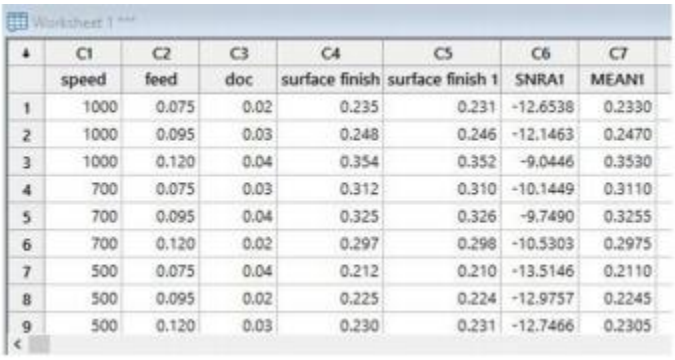
Speed (Rpm)	Feed (mm/min)	Depth of cut(mm)	Weight (before grinding)	Weight (after grinding)	Time (sec)
1000	0.075	0.02	108.23	108.19	38
1000	0.095	0.03	108.29	108.23	38
1000	0.120	0.04	108.42	108.435	38
700	0.075	0.02	108.51	108.491	60
700	0.095	0.03	108.24	108.19	60
700	0.120	0.04	108.39	108.36	60
500	0.075	0.02	108.40	108.36	70
500	0.095	0.03	108.432	108.41	70
500	0.120	0.04	108.631	108.33	70

Table No. 2 Machining process parameters of MRR

RESULTS Taguchi method stresses the importance of studying the response variation using the signal–to– noise (S/N) ratio, resulting in minimization of quality characteristic variation due to uncontrollable parameter. The cutting force is considered as the quality characteristic with the concept of "the smaller-the-better". The S/N ratio for the smaller-the-better is:

$$S/N = -10 * \log(\Sigma(Y^2)/n))$$

Where n is the number of measurements in a trial/row, in this case, n=1 and y is the measured value in a run/row. The S/N ratio values are calculated by taking into consideration above Eqn. with the help of software Minitab 17. The force values measured from the experiments and their corresponding S/N ratio values are listed in Table



	C1	C2	C3	C4	C5	C6	C7
	speed	feed	doc	surface finish	surface finish 1	SNRA1	MEAN1
1	1000	0.075	0.02	0.235	0.231	-12.6538	0.2330
2	1000	0.095	0.03	0.248	0.246	-12.1463	0.2470
3	1000	0.120	0.04	0.354	0.352	-9.0446	0.3530
4	700	0.075	0.03	0.312	0.310	-10.1449	0.3110
5	700	0.095	0.04	0.325	0.326	-9.7490	0.3255
6	700	0.120	0.02	0.297	0.298	-10.5303	0.2975
7	500	0.075	0.04	0.212	0.210	-13.5146	0.2110
8	500	0.095	0.02	0.225	0.224	-12.9757	0.2245
9	500	0.120	0.03	0.230	0.231	-12.7466	0.2305

Fig2 Final result in Taguchi

Material Removal Rate: MRR can be defined as the ratio of volume of material removed to the machining time. MRR= (Wb-Wa)/Tm Wb =weight of work piece material before grinding Wa = weight of work piece material after grinding

Speed (Rpm)	Feed (mm/min)	Depth of cut(mm)	Weight (before grinding)	Weight (after grinding)	Time (sec)	MRR
1000	0.075	0.02	108.23	108.19	38	0.04
1000	0.095	0.03	108.29	108.23	38	0.06
1000	0.120	0.04	108.42	108.435	38	0.07
700	0.075	0.02	108.51	108.491	60	0.019
700	0.095	0.03	108.24	108.19	60	0.05
700	0.120	0.04	108.39	108.36	60	0.03
500	0.075	0.02	108.40	108.36	70	0.02
500	0.095	0.03	108.432	108.41	70	0.18
500	0.120	0.04	108.631	108.33	70	0.031

Table 3 Material Removal Rate

CONCLUSION

In this thesis an attempt to make use of Taguchi optimization technique to optimize cutting parameters during cylindrical grinding of EN 21 steel using.The cutting parameters are cutting speed, feed rate and depth of cut for turning of work piece EN 21 tool steel. In this work, the optimal parameters of cutting speed are 1000rpm, 700rpm and 500rpm, feed rate are 0.075mm/min, 0.095mm/min and 0.120mm/min and depth of cut are 0.02mm, 0.03mm and 0.0.04mm. Experimental work is conducted by considering the above parameters. material remove rate and surface finish are validated experimentally.By observing the experimental results and by taguchi, the following conclusions can be made: • To get better surface finish, the optimal parameters are speed – 1000rpm, feed rate – 0.12mm/min and depth of cut – 0.04mm. • To maximize material removal rate, the optimal parameters speed – 1000rpm, feed rate – 0.12mm/min and depth of cut – 0.04mm. By observing the analysis results, the stress values are less than the yield stress values.

REFERENCES

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