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"COMPARATIVE STUDY OF EXPERIMENTAL RESULTS AND STATISTICAL APPROACH FOR VALIDATION OF SURFACE ROUGHNESS USING GRINDING OPERATION "

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ABSTRACT

Grinding is an important metal cutting technique that is widely utilised in finishing activities. Surface finish is a crucial output reaction in production in terms of quantity and quality. Experiments are carried out on a universal tool and cutter grinding machine with a L9 orthogonal array and input machining factors such as work speed, grinding wheel grades, and material hardness. Grinding is an important metal cutting technique that is widely utilised in finishing activities. Surface finish is a crucial output reaction in production in terms of quantity and quality. Experiments are carried out on a universal tool and cutter grinding machine with a L9 orthogonal array and input machining factors such as work speed, grinding wheel grades, and material hardness. The developed model can be used by the different manufacturing firms to select right combination of machining parameters to achieve an optimal surface roughness (Ra).The results reveals surface roughness (Ra).The predicted optimal values for Ra for Cylindrical grinding process is 1.09 Ra respectively. The results are further confirmed by conducting confirmation experiments.

Key Words: *Surface Finish, Grinding, Machining*

I. INTRODUCTION

Grinding is a finishing process, broadly used in manufacturing of components requiring fine tolerances, good surface finish and higher dimensional and geometrical accuracy. Compared with other material removal processes as an example of turning, milling and boring, the grinding process is more complex and more difficult to control. In addition to the static parameters of the grinding machine tool, there are many dynamic factors that contribute to resulting dimensional accuracy. Surface finish is very important for parts which will be in contact with other metal surfaces. The lower value of surface roughness causes less wear and friction. The lowest value of surface roughness gives the best surface finish [1]. The surface quality produced in surface grinding is influenced by various parameters such as [2], [3]: i.e. wheel parameters – abrasives, grain size, grade, structure, binder, shape and dimension; ii. Work piece parameters – fracture mode, mechanical properties and chemical composition; iii. process parameters – wheel speed, depth of cut, table speed and dressing condition; iv. machine parameters – static and dynamic characteristics, spindle system, and table system. The present paper takes the following input processes parameters namely material hardness, work piece speed and grinding wheel grain's . The main objective of this paper is to show how our knowledge on grinding process can be utilized to predict the grinding behaviour and achieve optimal operating processes parameters. The knowledge is mainly in the form of physical and empirical models which describe various aspects of grinding process. The main

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objective in any machining process is to minimize the surface roughness (Ra). In this paper, Grain size, work piece speed and the Material hardness is selected as the input parameters. Other process parameters were constant. Most of the surface grinding manufacturers produce surface grinding machine with constant spindle speed. Hence, the speed of the surface grinding is not included as the variable parameter. The average surface roughness (Ra) is taken as the output parameter. Taguchi method and Response Surface Methodology (RSM) were used to optimize the parameters for minimum surface roughness. Minimum surface roughness indicates good surface finish. Confirmation experiments were conducted to verify the effectiveness of optimization.

II. EXPERIMENTAL SETUP AND CUTTING CONDITIONS

2.1 Work piece material

The work piece material selected for investigation is EN 24, EN31 and Die steel. This steel can be hardened and tempered to provide a greater strength.

2.2 Machining Process

The cutting tests were performed on universal tool and cutter grinding machine and Aluminum oxide white grinding wheel. The experiments were conducted as per the orthogonal array and roughness for various combinations of parameters was measured using Deviate DH 5 tester.

2.3 Plan of Experiment

The experiment was planned using Taguchi's orthogonal array in the design of experiments, which help in reducing the number of experiments. The L9 orthogonal array.

2.4 Experimental Details

A set of experiments were conducted on tool and cutter grinding machine on different alloy steel of different hardness material to determine effect of parameters namely),Work speed (rpm),material hardness and grinding wheel on surface roughness Ra(μm). Three levels and three factors L9 Orthogonal array used to design the orthogonal array by using design of experiments (DOE) .Grinding wheel used results From main effects plotted, it is observed that there is decreases surface roughness as material hardness increased. The roughness decreases when speed is changed from 100 to 160 rpm and again decreases when speed changed to 200 rpm, similarly when grinding wheel grain's change from G46 to G60 surface roughness decreases, but as again change to G80 roughness increase considerably.

S. No.	Symbol	Process Parameter	Levels		
			Low	Medium	High
1.	H	Material Hardness (HRA)	70	90	110
2.	W	Work piece speed (rpm)	150	200	250
3.	G	Grinding wheel grains	G50	G70	G90

Fig.1. Process parameters and their level

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S. No	Exp. No	Hardness (HRA) (H)	Work piece Speed (rpm) (W)	Grinding wheel Grains (G)
1	1	70	150	G50
2	2	70	200	G70
3	3	70	250	G90
4	4	90	150	G50
5	5	90	200	G70
6	6	90	250	G90
7	7	110	150	G50
8	8	110	200	G70
9	9	10	250	G90

Fig.2. Design of Experiments

Exp. No	Surface roughness (Ra)	S/N ratio (dB)
1	2.3	-6.85
2	1.95	-4.35
3	1.2	-0.83
4	1.79	-4.03
5	2.1	-5.58
6	2.05	-0.59
7	2.31	-2.35
8	1.46	-3.29
9	1.91	-6.49

Fig. 3. S/N Summary sheet

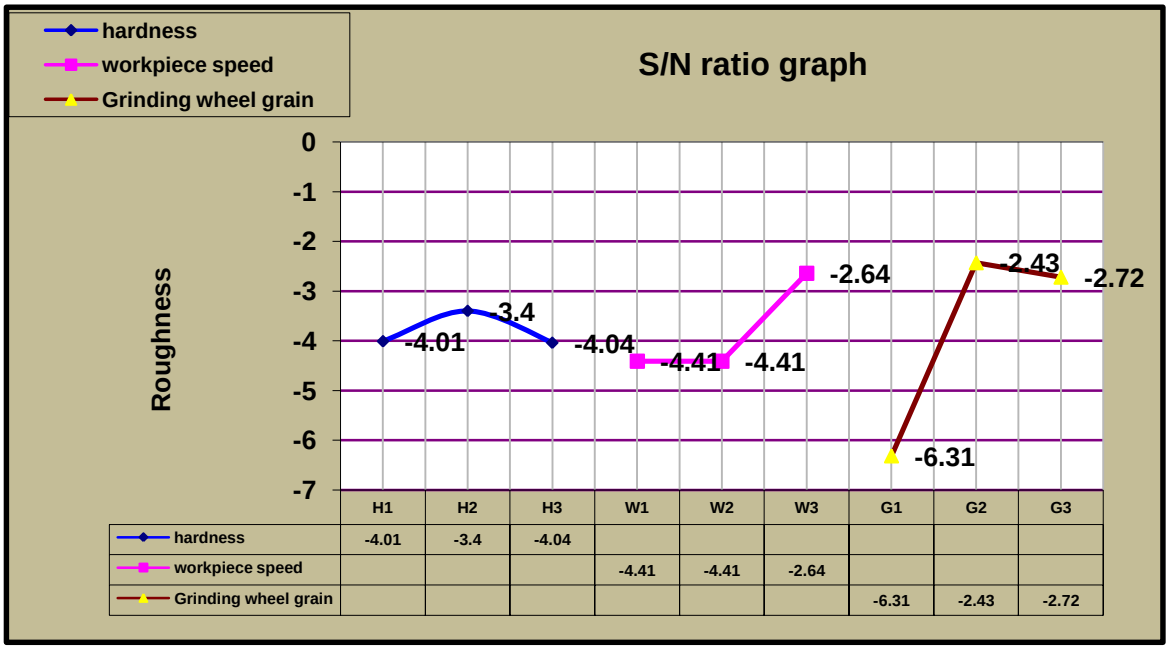

Fig. 4. S/N Ratio Graph

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Results	Prediction (Taguchi Method)	Actual Experimental Value
Level	H2-W3-G2	H2-W3-G2
Surface Roughness (Ra)	1.09	2.05
S/N Ratio (dB)	-0.83	-0.59

Fig. 5. Results

III. CONFORMATION OF EXPERIMENT

To validate the optimum grinding conditions (H2, W3, G2) the combination of Medium Hardness (H2), Larger Wokpiece speed (W3) and Medium Grain's (G2) , then the Surface Roughness is minimum obtained.

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