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The influence of Cutting Parameter of Surface Grinder on the Surface Finishing and Surface Hardness of Structural Steel

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Abstract: *The grinding and finishing processes are used for final finish and super finish. Out of various types of grinding, the most common one is surface grinding. This process is accompanied by certain amount of metal removal. This process can give a surface finish in a range of 1.25µm to 0.25µ. Grinding is a metal cutting operation performed by means of a rotating abrasive tool Called grinding. Surface grinding is the method of grinding designed to carry out the removal of metal from a part or parts less expensively and with greater precision than could be achieved by machining processes with cutting tools of steel, or by hand or machine filing. Surface grinding is particularly effective for parts having hard spots that would seriously blunt or impede a cutting tool, or where a hard superficial scale causes similar trouble in machining proper. The type of grinding finish resulting is often so good that a later polishing operation can be dispensed with, but for this to be so well designed machine is essential. This paper show the effect of cutting parameters of grinding process on the surface finishing and hardness of structural steel. The cutting parameter includes such as work speed, feed, depth of cut and coolant flow etc. The influence of the cutting parameter toward surface roughness and surface hardness had been determined. Therefore,*
this study work has been propose in order to determine the optimum parameter and correlation between good surface roughness and the surface hardness of the work piece. [2]

Keywords: *Speed, Cross feed, Depth of cut.*

1. INTRODUCTION

Grinding is a complex metal cutting process, which for many centuries has been perfected via study and complex analytical approach. It is well known that this machining process consume more energies compare to another machining methods. Grinding is traditionally a finishing process employed to apply high quality surfaces to a work piece. This was possible due to the increased number of cutting edges present on a grinding wheel over that of conventional single point cutting tools. . The relationship between cutting condition and the surface finish of the work piece has been establish and verified through series of studies. Grinding wheel consist of power driven grinding wheel driven at the required speed and a bed with a fixture to guide and hold the work piece. The grinding head can be controlled to travelled across the fixed work piece or the work piece can be moved whilst the grind head stay in fixed position. Grinding, as a complex machining process with large numbers of parameters influencing each other, can be considered as a process where the grinding wheel engage with the workpiece at a high speed. To achieve better process control a model is required to predict and demonstrate the whole life cycle performance in relation to the process input parameters. Grinding machine remove material from the work piece by abrasion. Which can generate substantial amount of heat. They therefore incorporate a coolant to cool the work piece so that it does not over heat and go outside it tolerance. In spite of that, a question related to the optimum grinding cutting parameters which can induced superficial hardening together with great surface roughness were never being answered. [3}

Therefore, this study work have been propose in order to determine the optimum parameter and co relation between good surface roughness and the superficial hardness of the work piece.

2. LITREATURE REVIEW

In the past few decades, there has been an increase in research on grinding due to it ever increasing application in manufacturing industry. Also the complexity of the grinding process demands more and more attention to understand the grinding process better. In this section relevant research work on grinding is reviewed. Grinding is a material-removal process in which abrasive particles are contained in a bonded grinding wheel that operates at very high surface speeds.[7]. The grinding wheel is usually disk-shaped, and is precisely balanced for high rotational speeds. Surface grinding involves grinding flat surfaces and is one of the most common grinding operations (Fig. 1.1). Typically, the work piece is secured on a magnetic chuck attached to the work table of the grinder (Fig. 1.2). Nonmagnetic materials generally are held by vises, special fixtures, vacuum chucks, or double-sided adhesive

tapes. . The rotating grinding wheel consists of many cutting teeth (the abrasive particles), and the work is fed relative to the wheel to accomplish material removal. A straight wheel is mounted on the horizontal spindle of the grinder. Traverse grinding occurs as the table reciprocates longitudinally and feeds laterally after each stroke. In plunge grinding, the wheel is moved radially into the work piece, as it is when grinding a groove (Fig. 1.1 & 1.2). (S. Malkin, 1984)

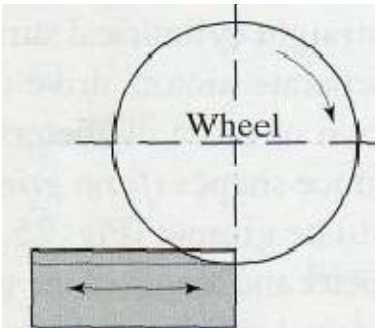


Fig. 1.1

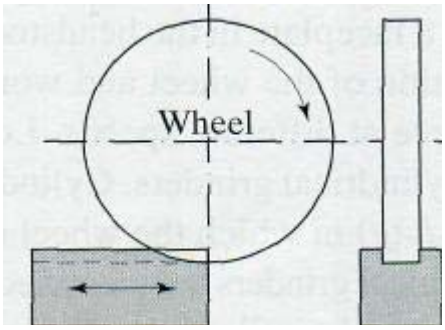
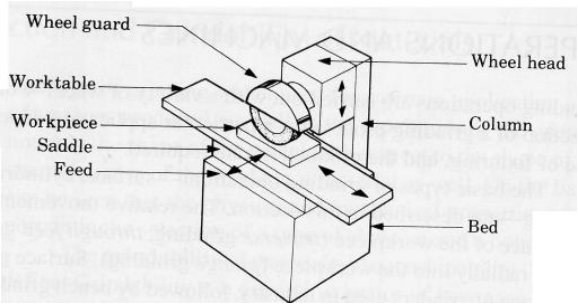


Fig. 1.2

1 Schematic illustration of various surface grinding operation (a) Horizontal- spindle surface grinder: traverse grinding (b) Horizontal-spindle surface grinder: plunge grinding (S. Malkin, 1984)



(S. Malkin, 1984) **Fig. 1.3** Schematic illustration of a horizontal spindle surface grinder

Grinding has been with us from. earliest times when it was used to grind stones to the required shape for cooking and eating utensils (Malkin, 1989). It can be described as a Machining process that utilizes hard abrasive particles as the cutting medium, Whitehouse (1994) categorizes his into three main types of processes namely: Grinding: Fixed grain, high speed. The review cover three area in grinding process namely ,ground surface topography generation, modeling of the grinding system and dynamic analysis of the grinding process.**J.Kopac and P.Krajnik[1]** (2006) proposed the high performance that grinding is essential to achieve high dimensional accuracy and surface integrity of ground component at optimum cost efficiency at increased grinding cutting speed is the most important factor in achieving improved quality tool life and productivity. In this way the advantages of HSG (high speed grinding) refer to a reduction in the grinding forces, the grinding wheel wear and work piece surface roughness. An increase in temperature in the grinding zone that in turn can cause thermal subsurface damage.[6]

3. PROBLEM DEFINATION

Although the grinding process has been a topic of extensive research for the last 20 year, a complete understanding of the process has yet to be achieved. As we all known, grinding is complex cutting process with large number of interacting parameters. the concern parameters in this study include wheel speed, feed and depth of cut .Several information has been extracted from previous study. a carbon content is crucial to induce the superficial hardening process to take place in grinding. It is also suggested that the severe cutting condition will assist in martensite formation in microstructure level of work piece. In addition, a good surface finish is also a response to the experiment done. How the cutting parameters influence the value of the surface roughness and the surface hardness will be determine through the study work.[5]

4. METHODOLOGY

It is an extremely versatile machine used to perform a variety of grinding operation, surface ,cylindrical or complex shapes The image shows a manually operated setup. However highly automated computer numerical control machine are becoming increasingly common due to the complexities involved in the process. The operation of the machine required high level of skill. The two main skills needed understand of the relationship between the grinding wheel and the metal being cut and knowledge of tool geometry. All experiments were conducted with the surface grinder and the specified grinding wheel and the dimension given. It is to guarantee that work piece was in the best condition (i.e. with a very sharp plane cutting surfaces to guarantee equal conditions for all the experiments). The grinding will be done in 1cm depth of the work piece.

5. WORKPIECE SPECIFICATION

The components material is a medium carbon steel EN-18. It is a relatively high machinable carbon steel with good mechanical strength. For chemical properties; it is contain C (0.35%-0.45%), Si(0.10%-0.35%), Mn(0.60%-0.95%), Cr (0.85%-1.15%) S(0.050%) and P(0.050%). The normal usage of the material are connecting rod, die forging, guide plates, jigs, fixtures ,die block ,axles ,gears and simples structural components. The dimension of the work piece is 6cm X 4cm X 3cm.

6. SURFACE GRINDER SPECIFICATION

. Max. Table grinding W XL	200 x 450 mm
. Max. Travel	250 x 500 mm
Max. Grinding Hight under Wheel	225 mm
. Grinding Wheel Size	180x 13x31.75mm
. Power of Spindle Motor	1 HP
. R.P.M.	2800 RPM
. Hydraulic Pressure	12 kg/cm2
. Hydraulic Pump Motor	1 HP
. Tank Capacity	35 Ltrs.
. Longitudinal Table Speed Max.	15 m/min.
. Power Cross Feed	2000 mm/min
. Least Count of Micro feed	.002
. Net Weight (Approx.)	1100 kg
.Wooden Case Dimension (Approx.)	1050 x 1500 x 1 700

7. EXPERIMENTAL DESIGN TABLE

GRINDING FACTORS	SYMBOLS	UNIT
SPEED	v	m/min
CROSS FEED	f	mm/pass
DEPTH OF CUT	t	mm

8. EXPERIMENTAL PROCEDURE

Design of experiment is required if we wish to extract meaningful conclusions from the measured responses. Adequate experimental design requires competent process knowledge for selection of their factors and their levels had could possibly significantly influence the response. Therefore, the experimental design appointment has been performed with the reference to previous experiment by O. Zurita et. al. (2002). 68

Measuring equipment used in this experiment are given below

1. Surface Roughness Measurement
2. Superficial Hardness measurement
3. Dial guage

9. EXPERIMENTAL DESIGN MATRIX

RUN	v	f	t
1	12.8	7.5	0.03
2	25	12	0.03
3	12.8	7.5	0.03
4	25	3	0.06
5	25	3	0.06
6	0.6	3	0.06
7	0.6	3	0.09
8	0.6	12	0.06
9	0.6	12	0.09
10	25	3	0.09
11	25	12	0.09
12	25	3	0.06

It is important to conduct the experiment under chatter free condition, same dressing condition (cross feed rate 0.1 mm/rev) and the use of single point diamond. The coolant flow will be ensuring constant throughout the cutting process. The spark out time will be 0.1 s. the depth of dressing will be 0.02mm. The experiment run and the measurement process will be managed in same day

10. RESULT AND CONCLUSION

The grinding operation parameters and the value of surface roughness and surface hardness obtain

RUN	v	f	t	µm Roughness	HB Hardness
1	12.8	7.5	0.03	0.51	252
2	25	12	0.03	2.04	260
3	12.8	7.5	0.03	0.28	258
4	25	3	0.06	1.34	271
5	25	3	0.06	0.8	263
6	0.6	3	0.06	0.21	232
7	0.6	3	0.09	0.64	258
8	0.6	12	0.06	0.68	251
9	0.6	12	0.09	1.23	260
10	25	3	0.09	0.41	252
11	25	12	0.09	2.46	271
12	25	3	0.06	0.68	265

On the basis of present study following conclusion can be drawn

1. When the depth of cut, cross feed and speed increase, the superficial hardness of the grounded EN-18 medium carbon steel also increase.
2. There were interaction between cross feed and speed & depth of cut and speed; however, generally, in the interaction, the surface hardness increased as the both parameters increased.
3. When comparing the grinding parameters, the speed and the depth of cut has the most effect onto the surface hardness of EN-18 medium carbon steel.
4. Speed and Cross feed were the most significant grinding parameters toward the surface roughness of grounded EN-18 medium carbon steel.
5. Generally, the surface roughness was increase as the value of the speed and cross feed increase.

11. ACKNOWLEDGMENT

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