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STUDY OF INTERNAL ROLLER BURNISHING OPERATION ON EN8 MATERIAL

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Abstract

Burnishing is a cold working, a surface treatment process in which plastic deformation of surface irregularities occurs by exerting pressure through a very hard and smooth roller on a surface to generate a uniform and work-hardened surface. In this work, a simple internal roller burnishing tool is used to perform roller burnishing process on the holes drilled in EN8 material by varying the spindle speeds of drilling machine. The speed which produces maximum smoothness or minimum roughness on the surface is considered to be an optimal speed for carrying out burnishing operation in the drilled holes.

Keywords: EN8, Roughness, Roller burnishing

1. INTRODUCTION

Roller burnishing is a method of cold working metal surfaces to enhance surface roughness qualities. The tooling typically consists of a hardened sphere or cylindrical roller. These tools are pressed onto/across the part being processed. The part (or the tool in some applications) must be moving at a constant rate of speed. Both internal and external surfaces can be burnished using an appropriate tool. Roller burnishing improves the surface finish, surface hardness, wear-resistance, and fatigue and corrosion resistance.The effect of roller burnishing on various materials under different parameters has to be explored to get the most out of burnishing process.

P. Ravindra Babu [5] et al carried out a study to examine the effects of burnishing Parameters on the Surface Characteristics, Microstructure and Micro hardness in EN Series Steels. The study revealed a one-to-one correlation between burnishing depth, increase in average micro hardness and magnitude of compressive residual stresses and a peak in all the three at intermittent extent of burnishing (either after first or second pass) in all the three alloy steels.

Afef Bougharriou [2] et al made a study for Prediction of surface characteristics obtained by burnishing. In this work, an analytical study and a finite element modeling were performed to provide a fundamental understanding of the burnishing on an AISI 1042 work piece and it has been noted that burnishing improves surface quality and introduces compressive residual stresses. These results were successfully compared to experimental data obtained in previous works.

Y. C. Lin [4] et al studied the relationship between surface roughness and burnishing factor in the burnishing process. This investigation examines burnishing using a microscopic perspective and elucidates the mechanism of surface roughness improvement by asperity deformation.

M.H El-Axir [3] made an investigation into roller burnishing the results of an experimental program to study the influence of different burnishing conditions on both surface microhardness and roughness: namely, burnishing speed, force, feed, and number of passes elucidates how to select the burnishing parameters to reduce the surface roughness and to increase the surface microhardness. Also, it reports the relationship between residual stress and both burnishing speed and force.

Adel Mahmood Hassan [1] describes the effects of ball and roller-burnishing on the surface roughness and hardness of some non-ferrous metals the results show that improvements in the surface roughness and increases in the surface hardness were achieved by the application of both ball burnishing and roller burnishing with the non-ferrous metals under consideration.

2. EXPERIMENTAL PROCEDURE

The commercially available EN8 material (flat) is cut to size of 15x8.5x2cms. It contains rust on its surfaces to remove it surface milling is done and 2-3mm of its surface is machined. Than drilling operation is carried out over the flat pieces using 18mm drill bit followed by boring operation to enlarge the hole for about 2mm and thus the hole size of 20mm is attained. The drilled holes are usually rough and it also contains burr’s and rough edges around it to make it smooth roller burnishing operation is performed in and around the holes. The arrangement for executing roller burnishing is same that of drilling, except that drill bit is replaced by roller burnishing of 20mm size. While performing burnishing operation the spindle speed of drilling machine is varied between 100-2700 rpm to examine the speed which produce a good surface finish in the holes. A single flat piece contains 4 holes likewise 10 pieces with 40 holes are subjected to burnishing operation. Burnishing is performed with 10 different spindle speeds, i.e. specimen 1 with 4 holes have 100rpm, specimen 2 have 142 rpm likewise for the rest of the specimens.

Figure: 1 Burnishing operation in drilled holes

Figure: 2 Checking of roughness

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3. RESULTS AND DISCUSSIONS

S.No	RPM	Tolerance of hole (in mm)		Roughness (Ra)		Improvement in surface finish (in %)
		Before burnishing	After burnishing	Before burnishing	After burnishing	
1	600	-0.01	+0.008	3.33	0.08	97.6
2		-0.01	+0.005	1.06	0.04	96.23
3		-0.02	+0.00	4.76	0.15	96.85
4		-0.025	+0.00	2.98	0.03	99.00
5	142	-0.01	+0.01	3.23	0.86	73.38
6		-0.01	+0.01	3.71	0.72	80.60
7		-0.015	+0.00	4.59	0.77	83.23
8		-0.015	+0.00	4.07	0.73	82.07
9	852	-0.01	+0.005	2.8	0.29	89.65
10		-0.015	+0.008	4.4	0.03	97.05
11		-0.01	+0.007	4.7	0.49	89.58
12		-0.02	+0.005	1.8	0.13	92.98
13	210	-0.01	+0.005	2.35	0.09	96.18
14		-0.015	0.00	2.56	0.04	98.44
15		-0.01	0.00	1.20	0.04	96.67
16		-0.01	+0.005	1.96	0.04	97.96
17	1260	-0.02	0.00	1.74	0.02	98.86
18		-0.06	+0.04	6.6	0.05	99.25
19		-0.01	+0.005	2.45	0.05	97.96
20		-0.005	+0.005	2.16	0.05	97.69
21	310	-0.01	+0.006	3.45	0.06	98.27
22		-0.015	0.00	2.65	0.07	97.36
23		-0.03	+0.007	4.57	0.24	94.75
24		-0.01	+0.005	1.42	0.05	96.48
25	1860	-0.005	+0.002	1.68	0.03	98.22
26		-0.01	0.00	3.03	0.02	99.34
27		-0.015	0.00	2.98	0.05	98.33
28		-0.01	0.00	1.00	0.02	98.00
29	450	-0.005	+0.01	3.16	0.16	94.97
30		-0.01	+0.005	1.94	0.08	95.88
31		-0.01	+0.005	1.72	0.08	95.35
32		-0.005	+0.01	0.9	0.02	97.78
33	2700	0.005	0.00	4.4	0.03	99.32
34		-0.005	+0.01	1.34	0.04	97.02
35		-0.01	+0.01	2.37	0.02	99.16
36		-0.005	+0.005	4	0.02	99.50
37	100	-0.005	+0.01	6.2	1.05	83.07
38		-0.015	+0.01	5.65	0.9	84.08
39		-0.005	+0.005	3.86	0.22	94.25
40		0.00	+0.01	3.69	0.15	95.94

Table: 1 Comparison of surface finish values before and after burnishing in EN8 material

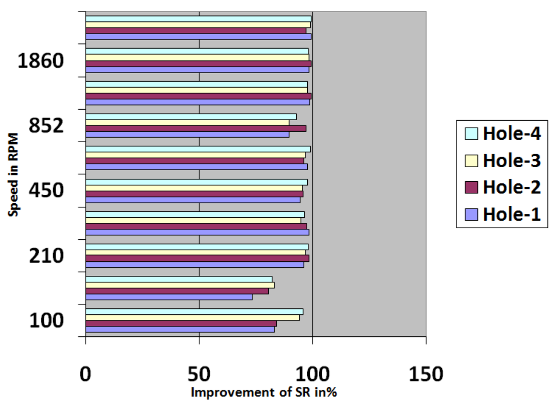

Figure: 4 Graphical representation of surface roughness of EN8 Material

4. SAMPLE CALCULATION

(For finding improvement in surface finish in %)

Hole 1:

Roughness before burnish = 3.33

Roughness after burnish = 0.08

Improvement in surface finish (%) equals,

$$[1 - (0.08/3.33)]*100 = 97.60\%$$

5. CONCLUSION

Internal roller burnishing has been performed using a vertical upright drilling machine on EN8 material. Variations of surface finish and surface roughness were observed by varying burnishing speed, keeping burnishing feed as a constant. Optimum surface finish and surface roughness was at 2700rpm. If the speed is different than optimum value, the increase in surface finish and surface roughness is less. Same study can be extended to other metals and composite materials to explore possibility of burnishing use.

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