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Analysis and Optimization of EN 31 by Ball Burnishing Process using Taguchi's Orthogonal Array

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ABSTRACT

Burnishing is an exceptionally basic and powerful technique for development in surface complete and can be done utilizing existing machines, for example, machine. By virtue of its high profitability, it likewise spares more on creation costs than other traditional procedures, for example, super completing the process of, sharpening and pounding. Besides, the shined surface has a high wear protection and better weariness life.

A writing overview being particularly centered around Ball Burnishing process is done .It gives a careful thought regarding different workpiece materials, different cutting instruments and machine devices, process parameters, ointments, variable estimated and strategy utilized and additionally the conspicuous levels of each, being seen in the investigates till today.

Keywords—Burnishing, Surface Finish, Ball Burnishing, Process Parameters

I-INTRODUCTION

Because of advancement in innovation desire are expanded from assembling industry. The expected existence of any part can be expanded without increment its cost. Life of components mainly depends on surface properties such as surface roughness and surface hardness. Also for concurrent manufacturing surface finish plays vital role. Machined surface by conventional process have inherent irregularities and marks .To make the surface smooth conventional finishing processes such as grinding ,honing and lapping have been employed . Burnishing is chipless surface change process in which a vast contact weight is connected on the surface of workpiece by a smooth hard roller or a ball burnishing instrument to cause plastic deformation of surface abnormalities. At the point when high shining weight surpassing the yield quality of workpiece material plastic stream of unique ill tempers happens which stifle all the surface of the harsh surface and pinnacles are changed over into valleys and it prompts smooth the surface. Polishing process disposes of optional tasks for noteworthy time and cost lessening, while at the comparable time enhancing the phenomenal nature of the item. Polishing process changes the properties of the surface, it will cause enhancements in surface hardness, wear protection, weakness protection, yield and elasticity and erosion protection. Shining can be done utilizing traditional machines, for example, machine and CNC machine.

II-PRIOR WORK

Aysun Sagbas in his work Analysis and streamlining of surface unpleasantness in the ball shining procedure utilizing reaction surface system and desirabilty work portray an advancement technique in view of allure work approach (DFA) together with reaction surface philosophy (RSM) has been utilized to improve ball polishing procedure of 7178 aluminum composite. A quadratic relapse demonstrate was produced to foresee surface unpleasantness utilizing RSM with rotatable focal composite plan (CCD). In the advancement of prescient models, shining power, number of passes, bolster rate and polishing speed were considered as model factors.The results indicated that burnishing force and number of passes were the significant factors on the surface roughness[1].

Feng Lei Li et.al worked on the smoothing mechanism of burnishing is established, in which the geometries of burnishing tool and workpiece, the microscopic topography of the machined surface and the mechanical properties of workpiece are taken into consideration. The elasto-plastic deformation law of the cross-section of a stripy asperity is established by the solutions to the Boussinesq–Flamant problem and then by the slip-line field theory. The articulations depicting the connection between surface unpleasantness and polishing power are determined utilizing the Winkler establishment presumption where the shear between adjoining cross-segments is ignored.The articulations uncover that the diminishing of surface harshness is corresponding to shining power to the 2/3 control in roller shining and to the 1/2 control in ball shining. The least surface unpleasantness is corresponding to the underlying surface harshness, and polishing can diminish the surface unpleasantness of workpiece up to around 75% to 87.5% which depends just on the semi-point of asperity[2].

Z. Pu , G.- L. Melody et.al in Grain refined and basal finished surface created by shining for enhanced erosion execution of AZ31B Mg amalgam watched Grain refinement and solid basal surface were delivered on AZ31B Mg compound surface correspondingly by a recently created serious plastic disfigurement (SPD) process, extreme pliancy polishing (SPB). The strikingly enhanced erosion protection of AZ31 in NaCl arrangement after SPB was ascribed primarily to significantly lessened grain measure and unequivocally basal-finished grain introduction. The residual stresses introduced by SPB were also found to influence the corrosion resistance to some extent. Compared with other SPD processes, SPB is fast, cost-effective, does not change material bulk properties and requires little changes to the industrial production process[3].

A. Rodríguez, L.N. López de Lacalle, A. Celaya, A. Lamikiz, J. Albizuri in Surface improvement of shafts by the deep ball-burnishing technique presents deep ball-burnishing as a mechanical surface treatment for improving productivity and quality of rotating shafts is presented. When this technique is combined and applied after conventional turning, the resulting process is rapid, simple and cost-effective, directly applicable in lathes and turning centers of production linesThis work introduces an entire examination of the vital gainful viewpoints created by the utilization of ball burnishing.To determinate the impact of each procedure parameter, a few tests were done. Once the ideal parameters were set up, a total examination of the surface qualities was performed. Surface geologies, sub-surface smaller scale hardness and leftover burdens were estimated. Results demonstrate that shining is an efficient and practical mechanical treatment for the quality change of pivoting segments, in surface harshness as well as in compressive remaining worries as well[4].

LvJinlong, LuoHongyun dealt with Effect of surface polishing on surface and erosion conduct of 2024 aluminum composite. The nano/ultrafine surface layers and diverse surface writes were effectively gotten on a 2024 aluminum amalgam by methods for surface shining procedure. The surface textures were analyzed by EBSD and corrosion resistance was evaluated. Different texture types with similar dislocation density occurred after different burnishing processes[5].

KazimieraKonefal et.al worked on Improved corrosion resistance of stainless steel X6CrNiMoTi17-12-2 by slide diamond burnishing presents an nonconventional finishing method – diamond slide burnishing. The effect of drawing, polishing and burnishing on corrosion resistance was examined by quickened electrochemical investigations using the potentio dynamic method. Microscopic observations made it possible to determine the nature of surface corrosion changes. Generally, the best corrosion resistance was found after burnishing[6].

R. Avilés, J. Albizuri , A. Rodríguez, L.N. López de Lacalle presents Influence of low-versatility ball polishing on the high-cycle weariness quality of medium carbon AISI 1045 steel. The point of this paper is to measure the change in the high-cycle weariness quality of AISI 1045 standardized steel after low-versatility ball polishing, giving building information and coefficients valuable for exhaustion examination and outline. The specimens, both non-treated and ball-burnished, were tested in a rotating bending fatigue machine up to 3.25 x 106 cycles. It is demonstrated that the fatigue strength of the ball-burnished specimens, when compared with the non-treated specimens, improves for 3 x 104 to 106 cycles, and that the bending fatigue limit is increased by 21.25%.This work also provides experimental data and analyses of the surface roughness, fractography, in-depth residual stresses, and cyclic relaxation effects[7].

Pascale Balland, Laurent Tabourot, Fabien Degre, Vincent Moreau presented Mechanics of the burnishing process.This paper detailed that Burnishing is a low-cost surface treatment process. However, scientific studies on this process have so far failed to describe how the process leads to surface hardening and improvement in the geometric quality of the material. Indeed, in spite of its apparent simplicity the process is rather complicated to reproduce by numerical simulation. This paper proposes a finite element modelling of the ball burnishing process. On account of this model, the impact of the polishing procedure on the material is examined. An edge marvel that influences the mechanics of the procedure is illustrated, considering enhanced displaying of the burnishingprocess[8].   III-Proposed Work

This paper examines the use of the roller burnishing process to give a good surface integrity for steel EN31 work material. The performance evaluation of the coated and uncoated rollers are performed by varying parameters such as speed, feed, burnishing force, Initial roughness, Depth of cut and number of passes to understand their role individually and the results are presented and analyzed.

The experimental work is carried out to investigate the effect of process parameter of ball burnishing on surface roughness, hardness and fatigue life of EN 31 alloy work material. This is most widely used alloy in wide variety of general applications in small scale industry as well as large industries. The main focus of selection of this material is the alternative for steel which has maximum chances of corrosion and having high density. The alloy is widely used in aerospace and space shuttle with high quality and good service life.

EN31 is a high carbon Alloy steel which achieves a high degree of hardness with compressive strength and abrasion resistance.

- Mechanical Properties of EN31

1. Forging

Forging at 1000°/1050°C. Warmth gradually, permitting adequate time at the manufacturing temperature for the steel to be altogether doused through. Re-warm as regularly as important to keep the temperature over 850°C. Subsequent to fashioning cool gradually, ideally in a heater.

2. Tempering

Warmth consistently to 800°C, balance, at that point heater cool. (Hardness around 229 Brinell).

3. Stress Relieving

In the event that machining activities have been substantial or if the instrument has an uneven area, expel worries before solidifying by warming up to 700°C, level, at that point cool gradually.

4. Solidifying

Warmth consistently to 800/820°C until warmed through. Permit 30 minutes for each inch of decision area and extinguish promptly in oil.

5. Hardening

Warmth consistently and completely at the chose treating temperatures and hold for no less than one hour for every inch of aggregate thickness

Hardening property of EN31

Tempering (◦c)	100	150	200	250	300	350
HRc	64/63	63/62	62/61	60/59	57/56	54/53

- Chemical Composition of EN 31 alloy steel

Chemical Composition of EN31

Material EN31	Composition in weight %						
	C	Si	Mn	Cr	Ni	S	P
	1.01	0.30	0.78	0.76	-	0.024	0.028

- Propose Methodology

1. Development of mathematical model using response surface methodology (RSM).
2. Designing of tool for selected material using AUTOCAD.
3. Simulation of burnishing parameters using minitab software.
4. Analysis with the help of Taguchi method
5. Validation of proposed approach through practical case study.
6. Implementation

- Problem Definition

From the critical discussion on literature survey and gaps identified from the survey , the problem statement for current project is to investigate the surface finishing and surface roughness of the selected material at various speed, force and depth of cut with the help of ball burnishing process.

From the previous researches it is seen that while burnishing consistently only four parameters are considers viz burnishing force, speed,feed and depth of cut. In this study, we are going to consider one more parameter i.e Initial surface roughness and along with final surface roughness of workpiece we are going to calculate final hardness of workpiece at different input parameters using Taguchi's method.

- Future Plans

1.Analysis of different burnishing process parameters using MINITAB software.
2. Experimental analysis of the burnishing process.
3.Optimization using Taguchi's orthogonal array.
4. Testing and Validation of the output obtained.
5.Result and Conclusion.

IV-CONCLUSIONS

In this work, we are further going to study the various effects of different process parameters of the Ball Burnishing process of EN31

a) The burnishing speed , Feed, Burnishing Force, Number of Passes and Initial surface roughness are the influencing parameters on the final quality of components namely surface finish
b) The Taguchi's experiment and ANOVA analysis indicate that the speed, Burnishing force, Number of passes and Initial surface roughness are having equal importance in burnishing specially with reference to surface finish of components produced

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