iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** IV **Month of publication:** April 2018

DOI: http://doi.org/10.22214/ijraset.2018.4134

www.ijraset.com

Call: ☎ 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

Burnishing Process - A Review

Akash N. Borade[1], Pooja P. Deshmukh[2], Kiran L. Patil[3]
[1, 2, 3] *Sandip Institute of Engineering & Management, Mahiravani, Nashik. Savitribai Phule Pune University, Pune.*

Abstract: Burnishing is a cold working super finishing process. In burnishing ball or roller is pressed against the workpiece of the material due to which plastic deformation of surface irregularities takes place and surface becomes smooth. Quality of Surface plays a vital role in deciding the performance of a manufactured product. The burnishing process is a chip-less machining process which induces residual compressive stresses on the machined surface to improve surface qualities like roughness, hardness, wear resistance, fatigue strength of the material. For improving the surface qualities, there are various methods available. Burnishing can be done on ferrous as well non-ferrous materials.

Keywords: Burnishing, surface roughness, surface hardness, residual compressive stresses

I. INTRODUCTION

Machining operations are used to produce required shape and size by removing excess material. In conventional machining processes like turning, milling etc., there are lots of irregularities on the surface. At the time of machining operation, the work piece is subjected to forceful mechanical stress and sudden temporary heating by tools having one more shaped cutting edge. Each cutting edge leaves its individual mark on the material surface. When the workpiece and tool together both are in working condition they are subjected to vibratory disturbance, which affects the surface of the material.[1]

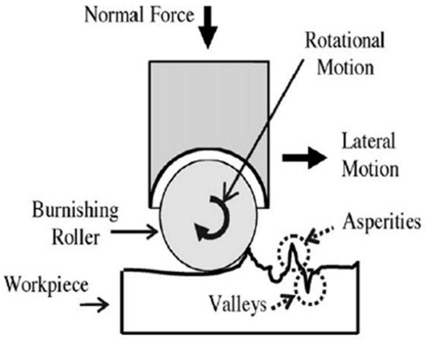


FIGURE 1 Burnishing Mechanism

It is a finishing and strengthening process. Burnishing is one of the important finishing operations carried out generally to enhance the characteristics like surface roughness, hardness, wear resistance fatigue resistance of components. During burnishing significant residual compressive stress is induced into the surface of the workpiece which improves fatigue strength and wear resistance of the workpiece.[2]

A. *Classification Of Burnishing Processes*

Burnishing process can be typically classified into two categories as follows:

1) Based on deformation element
   a) Ball burnishing
      i. Flexible
      ii. Rigid
   b) Roller burnishing
2) Based on the motion of the tool, on the surface
   a) Normal or ordinary
   b) Impact
   c) Vibratory
3) *Ball Burnishing:* In this process the deformation element is hard ball. The material used for ball are generally alumina carbide ceramic, cemented carbide, silicon nitride ceramic, silicon carbide ceramic, bearing steel. In ball burnishing there is a point

contact between ball and workpiece. Here the ball acts as tool in deformation of the surfaces layer, for the specified normal force it gives high specific pressure, additional fatigue strength, microhardness & depth of work hardening layer as compared to roller burnishing.

4) Roller Burnishing: Roller burnishing is a cold working process, which produces a superior surface finish by the pure rotation of hardened rollers over a turned metal surface. Whereas all machined surfaces consist of a sequence of up-downs (peaks-valleys) of irregular height and spacing, the plastic deformation creates a displacement of the material of the peaks which into the valleys. It results into a mirror-like finish with work hardened, wear, corrosion and fatigue resistant surface.

II. LITERATURE SURVEY

A. Aluminium Workpiece

Lv Jinlong and Luo Hongyun [1] had studied the effect of burnishing on grain texture and oxidative behavior of 2024 aluminum alloy. They used the material 2024-T3. The length & the radius of the workpiece samples were 200 mm and 46 mm, respectively. Burnishing process was performed with the help of cylindrical-ended PCD (Polycrystalline diamond) tool; with roll diameter and length of PCD tool were 2 mm and 3 mm, respectively. The tool rotating speed was 3000 rpm. The burnishing depth was 20 µm and 30 µm, respectively. The electron back scattered diffraction (EBSD) scans were conducted for Electro-chemical measure of surface quality after burnishing. They got results as improved corrosion property was due to positive grain modification of burnished surface.

A. S. Maheshwari and Dr. R. R. Gawande [2] investigated the effect of newly designed burnishing tool on surface micro hardness of AA6351. They selected aluminum alloy because it widely used in automobile & aerospace sector due to properties like corrosion resistance, high strength to weight ratio. They had chosen aluminum because of its weight to strength ratio is high and can be further improved by using burnishing process. Feed, speed, depth of penetration and number of passes are adopted as factors which fluctuate during experiments. Experiments were carried out by them based on experimental design matrix and results were evaluated for surface micro hardness of AA6351 Alloy. They got the results as, depth of penetration is the major parameter among the parameters taken during experimentation; its contribution is near about 64.517%. Number of passes also plays important role in improving surface micro hardness (30.85 %).

El-Tayeb et al.[3] found the influence of roller burnishing contact width and burnishing orientation on surface quality and tribological behavior of Aluminum 6061. In this study Aluminum 6061 used as work piece material and carbon chromium rollers with different roller contact widths (such as 1, 1.5, 2mm) was used in a burnishing tool with exchangeable adapter for ball and roller for the purpose of the experimental tests. They found best possible ranges for burnishing speed & forces are to be 250-420 rpm for 1mm roller contact thickness. They found burnishing with smaller roller contact width (1mm) is capable of improving the surface roughness up to 40%. They also found that the burnishing force above 220N is capable of decreasing the surface roughness by 35%. The authors have found that the coefficient of friction of burnished surfaces is dependent on the surface roughness. Low friction coefficient corresponds to low surface roughness. In this study the SEM examination of the damaged surface reveals that interposing lubricant during Tribo-test acts as a cooler and polishing agent, resulting in smoother surface compared to the burnished surface. Under dry contact condition, burnished surface using smaller roller contact width produces the lowest friction coefficient. Increasing burnishing force beyond particular limit has a harmful impact on the wear resistance of burnished Aluminum 6061 surfaces.

U.M. Shirsat and B B Ahujal **[4]** studied the parametric analysis of combined turning and ball burnishing process on al alloy. They had selected the Al-alloy as their working material. In this experimentation, twelve tests were carried out at these levels. For each block the model equations for surface roughness and the surface hardness are obtained by using the analysis of variance technique, F-test and regression coefficient. The authors also worked on parametric analysis of combined turning and ball burnishing process. After results they concluded that the micro hardness increased with force up to certain extent only.

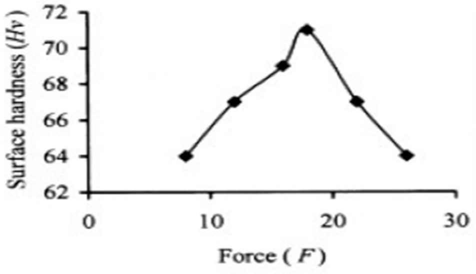


FIGURE 2 Force verses Hardness

P N. Patel et al. [5] had optimized burnishing process parameters for improving surface hardness of Aluminum Alloy 6061. They selected their workpiece and tool material as Al-alloy 6061 and high chromium high carbon with 8mm diameter. They got the optimum parameters for hardness as burnishing speed as 250 RPM, feed as 0.06 mm/rev, force as 8 Kgf, no. of passes as 5. The authors had used the Taguchi method for their analysis purpose. They found that as speed increases the surface hardness increases and if there is further increase in speed then hardness deceases. They also concluded that when feed rate was low the distance between successive traces were small.

Fathi Gharbi et al. [6] had studied ductility enhancement of aluminum 1050A rolled sheet with a newly designed ball burnishing tool device. They received workpiece material in a form of cold-rolled plates with a thickness of 3 mm. Selected material has huge scope in manufacturing industry. They observed that increase of the burnishing speed, the feed, or the force causes a decrease in mean roughness down to a minimum value. After crossing this minimum value, the mean roughness starts to increase with the increase of each of the burnishing parameters. The optimal feed rate and burnishing force for aluminum 1050A plates are 0.1 mm/rev and 100 N, resp. They also got the lowest values of surface roughness at a feed rate ranging from 0.1 to 0.15 mm/rev.

Amit Patel et al. [7] had studied effect evaluation of roller burnishing process on surface roughness of 6061 T6 al alloy using response surface methodology. Response surface methodology was employed to analyze the effect of parameters o ensure a minimum surface roughness. The authors had used the ANOVA model for analysis of their study. The usefulness of roller burnishing decreases with increase in feed rate. Surface roughness is increased with increase in no. of passes, best results were obtained with lower feed 0.06 mm/rev. They suggested that for the better results prefer the force 15-20 kgf with the no. of pass of 4.

El-Axir, Othman and Abodiena [8] had considered the improvements in beyond-roundness and micro hardness of inner surfaces by internal ball burnishing process. They used Al-alloy 2014 work piece and carbon-chromium steel balls as tool. They concluded that if there is increase in burnishing speed then it will leads to a considerable reduction in beyond-roundness; though, it has no significant effect on surface microhardness. The suggested burnishing feed that result in high surface microhardness and a considerable reduction in beyond-roundness are in the range from 0.2 to 0.35 mm/rev. In the same study, they got the best results for surface microhardness at depth of penetration in the range from 0.025 to 0.045mm, whereas for the beyond-roundness is obtained when applying high depth of penetration. A simple and adequate experimental design, response surface methodology (RSM), with the Box and Hunter method was used to investigate the effect of the burnishing process parameters.

J. A. Travieso, G. Dessein, H. A. Gonzalez-Rojas [9] had studied about improving the surface finish of concave and convex surface using a ball burnishing process. They used the workpiece with the concave and convex surface of the two different materials as aluminium A92017 and steel G10380. Both workpiece materials composed of three areas in which there are three curves of 50, 100 and 50 mm of diameter resp. Al A92017 with convex surface with a radius between 50 and 100mm, the burnishing process helps to improve the surface roughness. Steel G10380 with convex surface with a radius between 50 and 100mm, the burnishing process will again helps to improve the surface roughness. There is specific prediction for Al A92017; better results can be achieved with a smaller radius in convex surfaces and with a higher radius in concave surfaces.

M. R. Stalin John & B. K. Vinayagam [10] had investigated effect of roller burnishing process on Al 63400 material. Their burnishing tool was with interchangeable springs, designed and fabricated for the experimentation. An interchangeable spring was designed to give a load upto 1430 N. The authors had used response surface methodology for their analysis. The optimization is carried out on the surface which already having surface roughness as 0.145µm and surface hardness as 43 HRB. The optimized surface characteristics are studied for the parameters burnishing force 1200 N, feed 200 mm/min, step over 3 mm and no. of passes 2. The analysis of Al 63400 was done on a computer numerical control vertical machining center. The surface characteristics obtained were surface roughness 0.141µm and surface hardness 44 HRB.

P. Saritha [11] states that roller burnishing process is used to get good surface finish for the material such as aluminium & mild steel. The contact analysis proves about 10-15% variation in results. Their results obtained for contact stresses in a roller burnishing process were found using different theories and numerical methods. The best approach is to adopt multi scale FEM methods.

Shailesh Dadmal and Prof. Vijay Kurkute [12] had studied about finite element analysis of burnishing process. Surface finish has a long-drawn-out effect on almost every material. They had evaluated the consequences of burnishing parameters along with the surface integrity before the actual functioning. They had presented the process of developing the 2D model using transient structural analysis of the roller burnishing process. The material of the roller in the roller tool was the tool steel and high carbon high chromium steel. They found that the results of the FEA are coinciding with the experimental results with less than 10% error.

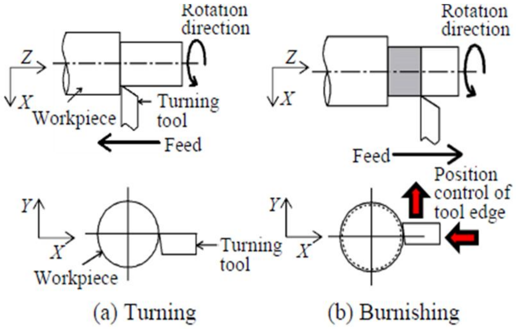
Prof. D. M. Mate and Prof. P. S. Chaudhari [13] formulated mathematical model for Al-2014 with spherical surface burnishing tool. The authors are dealing with the effect of burnishing process on the aluminium alloy 2014. The authors say that, it is essential to correlate quantitatively various independent and dependent terms involved in this very intricate phenomenon. This correlation is nothing but a mathematical model as a design tool for such situation. The author's objective behind this was to minimize processing torque; energy and time with the constraints involved were bound values of π terms. The author's formulated LPP on the basis of the computed results. The computed result on the basis of dimensional analysis provides effective guidelines to the manufacturing engineering so that they can minimize E, R_a and t for higher performances.

Anil S Maheshwari and Dr. Rupesh R. [14] had performed experiment for Improving Surface Quality by the Stiff Burnishing Technique. They used aluminum alloy 6351 as working material. They got results as the depth of penetration increases, pressure on the workpiece surface increases and plastic deformation at the surface of the workpiece takes place. Due to which, material will flow into the valleys and get the better surface finish but if it increases beyond a particular limit surface get damaged. They also observed that the Speed, Depth of penetration and number of passes are critical parameters to enhance surface hardness, But parameters should be taken up to a particular level, after that they will damage surface of workpiece.

Shailesh Dadmmal and Prof. Vijay Kurkute [15] had analyzed the roller burnishing process to evaluate effect of burnishing force on the surface roughness of aluminum alloy. As burnishing force increases, surface roughness decreases and reaches to minimum value. When the finite element analysis is carried out it is found that the results are coinciding with the values obtained from the results. The burnishing parameters used were speed, feed, burnishing force and the number of passes.

Kunal R. Patel et al. [16] had studied about the investigation of roller burnishing process parameters on surface roughness of Al-Alloy 6351 T6 by the response surface methodology. Response Surface Methodology is a collection of mathematical and statistical techniques that are useful for modeling and analysis of process parameters and optimization of response. They got the results as follows: the minimum surface roughness value 0.080µm was obtained at values of 450 rpm speed, feed rate 0.064 mm/rev, no. of tool passes 4, interference 2 mm. In this investigation, experimental design was established on the basis of 2^k factorial, where k is the number of variables, with central composit1e-second-order rotatable design to improve the reliability of results and to reduce the size of experimentation without loss of accuracy.

Manabu Iwai et al. [17] had studied the development of a new burnishing method utilizing a flank face of a turning tool and its burnishing performance. The authors had introduced, a new method using a flank face situated in a few millimeters lower part of the nose cutting edge of a tool. Workpiece material used was a carbon steel (S45C) of φ30mm and the turning insert used was a face of tool nose.



(a) Turning (b) Burnishing

FIGURE 3 Schematic Diagram of Burnishing Method Utilizing Flank Face

They used step processing on the carbon steel (S45C) round bar, height of the cutting edge was adjusted by increasing a thickness of the shim plate beneath the shank of the tool by 3mm. Burnishing was performed in the return stroke from the internal corner of the turning tool. The authors had given a fixed depth of burnishing (*t*=1, 2 and 4µm/pass), the workpiece (S45C) of φ30mm which had been turned at *V*=200m/min and *f*=0.15mm/rev was burnished. For both cases of turning as well as burnishing, water soluble cutting fluid (5% dilution) of solution type was used. They got the result as, the roughness value of *R*z≈10µm measured after turning could be improved to *R*z≈2.5µm. The surface roughness achieved slightly varied depending on the depth of burnishing per pass. They also got that using the same burnishing process; circularity of the workpiece Δr could be improved to Δr≈2µm from Δr≈4µm measured after turning.

B. Steel Work Piece

Fang-Jung Shiou and Chien-Hua Chen [18] had investigated about freeform surface finish of plastic injection mold by using ball-burnishing process. They used PDS5 tool steel as work piece material and gone for three types of ball materials with diameter of 10mm, specifically tungsten carbide ball (WC), steel ball coated with chromium (CrC), and tungsten carbide ball coated with titanium nitride (TiN). They selected four burnishing parameters, as the ball material, burnishing force; burnishing speed and feed for the experimental factors of Taguchi’s design of experiment to determine the most favorable burnishing parameters. The combination for the tungsten carbide ball was burnishing speed of 200mm/min, the burnishing force of 300N, and the feed of 40µm. The surface roughness of the workpiece can be improved from about 1 to 0.07µm by using the optimal burnishing parameters for flat surface burnishing. The surface roughness improvement of the injection part on plane surface was found upto 62.9% and that on freeform surface was near about 77.8%.

Sanchez L.E.A. et al. [19] carried research about the effect of hot burnishing aided by infrared radiations on the modification of surface and subsurface of AISI 1045 Steel. The authors proposed a study of low cost heating source made of quarts electrical resistance. They used the AISI 1045 steel workpiece for experiment. Three quarts resistance of 500 W each was used to heat the workpiece material. After continuous heating upto 8 minute, the surface stabilizes at 210^0C. They got the optimum range for the change in microstructure of workpiece as force of 850 N and speed of 560 RPM. This optimum value produces the minimum surface roughness.

Malleswara Rao J. N. et al. [20] had studied the effect of roller burnishing on surface qualities such as hardness, roughness on mild steel specimen. They used the roller tool. The Roller has the chemical composition: Fe 97.003, Si 0.18, Mn 0.26, Ni 0.12, Cr 1.44, C 0.99, and S 0.007. The roller had surface roughness value as Ra=0.12 µm, Hardness=61 HRC. Their roller tool having outside diamante of 40 mm and 12 mm width is used for roller burnishing. They conducted their experiments on turned mild steel work piece. They observed that the surface hardness increases with increase in the burnishing force. They observed from results that maximum reduction in surface roughness in first five passes. They concluded, there is not much improvement in surface finish after a certain number of passes.

Dinesh Kumar and Alok Kumar [21] had worked on improving surface finish and hardness for M.S. cylinder using roller burnishing. They had selected mild steel cylinders for their experiments. Their tool material is SAE 60 bearing with hardness of the tool material is 64HRC. They are using tool with Diameter of roller is 43mm and shank thickness is 28mm. Burnishing speed impact on surface roughness & surface hardness has been examined with increase in interference the asperities are affected more & increase in surface finish is obtained. They got the results as average improvement in surface finish with interference 120µm was 93.4%, also maximum hardness is obtained with interference 80µm.

Jayakrishnan J., Suraj R. [22] had studied about effect of roller burnishing process on HCHCr tool steel (35HRC) material on CNC lathe. The tool material is tungsten carbide (69HRC). The minimum surface roughness obtained was 0.122 µm and the maximum micro hardness was 589HV. Their workpiece material is high-carbon high-chromium tool steel. Optimum parameters determined during experimentation are: Burnishing force: 1000N, Burnishing speed: 250 RPM, Burnishing feed: 0.06rev/sec, No. of Passes: 5 and Roller Width: 2mm.

They got results as when burnishing force is increasing, surface roughness is decreasing and correspondingly surface hardness is increasing. When burnishing speed is increasing, surface roughness increases and microhardness reduces.

Dr. M. Satya Narayana Gupta et al. [23] had investigated about effect of roller burnishing parameters on surface roughness and hardness. They used the roller material steel en 24 with hardness value 40 HRC and maximum stress 850-1000 N/mm^2. They got the results as, 1)at low feed as the no. of passes increases the surface roughness is increasing and at high feed reverse case is occurred, 2) At high feed with minimum no. of passes and with maximum no. of passes as the speed increases the surface roughness increasing, 3)At minimum no. of passes and maximum no. of passes as the speed increases there is maximum increase in surface roughness value, 4)At low speed and high speed as the no. of passes increases there is minimum decrease in surface roughness value.

Zabkar B. and Kopac J. [24] had worked on roller burnishing process. They used the workpiece material as AISI 52100(100Cr6) bearing steel in normalized condition of hardness 220 HV. Their tool consists of radial roller bearing INA NUTR 1542X and thrust roller bearings INA 81104-TV. Their experimental parameters were as follows:

1) Constant parameters:

Clearance angle= 1.3^0, Roller diameter= 42mm, Roller fillet= 1mm, Burnishing speed= 150 m/min, No. of passes= 1

2) Variable parameters:

Burnishing force= 600, 1200, 1800 N, Feed rate= 0.1, 0.2, 0.3 mm/rev, Input surface roughness= 0.39, 0.96, 3.44.

They got the best results at the lower value of burnishing feed. They concluded that the feed rate is also most significant factor in roller burnishing process.

Davinder Saini et al. [25] had studied about the parametric analysis of mild steel specimens using roller bearing process. Roller burnishing produced superior surface finish with absence of feed marks of the burnishing tool on the burnished surface. The average surface roughness Ra obtained was 0.39µm in burnishing, finest Ra value observed was 0.21µm. The process was useful in improving the quality of burnished surface by selecting proper input parameter. A best value of hardness obtained was 66 HRB at spindle speed of 550 RPM and feed rate of 0.4 mm/rev.

Binu C. Yeldose and B. Ramamoorthy [26] had worked on tin-coated rollers in burnishing process. In their experiment they used the material workpiece AISI 4340 EN24 steel, and tool with the rollers EN31 material of a size of 20mm with outer diameter and internal hole of diameter 8mm. Process parameter used as Burnishing speed, S 40 ,60 , 80 rpm, Burnishing force, F 100, 300, 600 N, Feed f 0.028, 0.04, 0.6 mm/rev. The authors had used Taguchi’s experiments and ANOVA analysis and they found the conclusion as follows: The burnishing speed, feed, burnishing force and number of passes are the influencing parameters on the final quality of the components, namely the surface finish. The performance of the coated rollers is similar to the uncoated rollers at higher speeds, feeds, burnishing force and at more number of passes due to the reason that the coating was peeling off. The Taguchi’s experiments and ANOVA analysis indicate that the speed, burnishing force and number of passes are having almost equal importance in burnishing, particularly with reference to the surface finish of the components produced.

C. Brass Work Piece

T. A. El-Taweel and M. H. El-Axir [27] had worked on optimization of the ball burnishing process with the help of the Taguchi technique. The authors used a new purpose of Taguchi’s method is employed to explore the influences of some burnishing parameters such as; speed, feed, force and number of passes on the surface roughness (SR), surface micro-hardness (Hv). They used workpiece material as brass with 65 mm diameter. They had used Ball burnishing tool such that, the first part of tool was a base held on the lathe tool post whereas the other part is made to hold both the active ball (8 mm in diameter) and the backing-up balls (3 mm diameter). Active ball are taking part in the burnishing operation. Backing-up balls are used to decrease the friction and makes easy rolling action of the burnishing active ball with the aim of eliminating the fit and/or adhesion effects.

J. N. Malleswara Rao et al. [28] had investigated the influence of burnishing tool passes on surface roughness and hardness of brass specimen. In this experiment they are using both the roller and ball burnishing tools. They analyzed both the types of processes i.e. with roller and with ball tool to get the results. They got the results as the surface roughness decreases with the increase in no. of passes to the minimum value. After that, the surface roughness increases with the increase in no. of passes. This minimum value of surface roughness for brass material is nearly same for both ball and roller burnishing for fourth pass.

D. Non-Ferrous work Piece

S. Thamizhmanii et al. [29] had studied about a multi-roller burnishing on non-ferrous metals. Their research condition forced them to make a new tool for their experimentation. Their tool is vertical tool with 8 rollers fitted. The rollers are freely rotating in the horizontal axis. Their maximum depth is of 1 mm. The authors had used three types of non ferrous work pieces such as Aluminum, Brass and Copper. They concluded the results as the surface roughness can be increased with increasing the burnishing force or by no. of passes to certain limit. The surface hardness increases with increase in spindle speed, feed and depth of penetration.

Mahmood Hassan and Mohammad Maqableh [30] had worked on effects of primary burnishing parameters on non-ferrous components. They had used ball material as Carbon-chromium and non-ferrous work piece materials, namely free machining Brass and cast Al-Cu alloy. They got the primary burnishing parameters such as primary surface roughness and hardness of the work piece, the ball diameter of the burnishing tool, use of different lubricants have major effects on the burnishing process. As a result they concluded that the use of a lubricant in the burnishing process causes a general reduction in surface roughness and in the amount of the increase in surface hardness, but change in the viscosity of the lubricant seems to have no significant effect on either of the above-mentioned properties. They had concluded that an increase in primary surface roughness will be a reason for an increase in the final surface roughness of the ball burnished work pieces. The authors had concluded that an increase in ball diameter will cause a decrease in the final surface roughness, the total amount of the increase in hardness and the wear resistance.

E. Optimization of process parameters

Jignesh R. Patel and Prof. S. M. Patel [31] had studied the effect of process parameters on surface roughness & surface hardness in roller burnishing process. In this process both force and speed are affected and feed also affected but less affecting than other parameters. The authors got the results as when burnishing speed is low, the surface roughness is low and surface hardness is high. When speed increases both of them are decreases and after a limit as the speed increases the surface roughness value decreases. They got the results about the burnishing feed that, as there is increase in feed, the surface roughness increases and the surface hardness decreases.

P. S. Kamble &V. S. Jadhav [32] had studied Experimental study of Roller burnishing process on plain carrier of planetary type gear box. The authors were used an internal roller burnishing tool for burnishing the drilled hole. Speed, feed and no. of passes had been varied as per taguchi's method. They used ANOVA method for analysis. In the paper, an effort is being completed to understand the improvement in the surface finish & microhardness of burnished surface together with the control of the process parameter with EN-8 material. They observed that as feed increases the roughness value decreases, microhardness also decreases. Max roughness is at 0.21 mm/rev and max microhardness is at 0.04 mm/rev. Effect of no. of passes: As no. of passes increases the roughness value increases but the microhardness decreases. After the experiment they got improved surface finish from 2.44µm upto 0.13µm.

Salman Al-Saeedi et al. [33] had investigated the surface tribology of roller-burnished polymer using the Fuzzy ruled-based approach. They used the roller burnished polyurethane as their working material. With the fuzzy rule-based system, they predicted roughness value R_a. They got the results as lowest roughness value is 1.78µm for dry burnishing and the 2.026µm for lubricated burnishing. They also got that the highest reduction of burnishing roughness were achieved at lower burnishing speeds for dry & high burnishing speeds in the fluid condition. They concluded, there is 95% accuracy between the fuzzy predicted roughness values and experimental results.

P. S. Pa [34] had studied the continuous finishing process using a combination of burnishing and electrochemical finishing on bore surfaces. They developed an original finishing tool with the help of two finishing processes, burnishing and electrochemical finishing. The authors had followed the rules to create an effectual design with an annular form electrode and a burnishing-tool to carry out the continuous process of electrochemical finishing and burnishing. They had selected the workpiece material as SKH57. The electrode was $NaNO_3$ of 20 wt%. The temperature of the electrolyte was maintained at 35 ± 5^0C. Taguchi's method was implemented to measure and analyze the optimum operational parameters of the continuous process of burnishing and electrochemical finishing. The finishing was improved with longer off-time because release of the polishing residue becomes easier.

Pascale Balland et al. [35] had investigated about working of roller burnishing from first to last finite element recreation and experiments. The quality of the obtained results in a logical recreation time demonstrates the possibility to efficiently use full 3D recreation for the burnishing process. The material used is an alloy steel with industrial designation as 11SMn30 with a carbide cutting tool (0.8 mm radius). The machining parameters are: feed rate=0.15 mm/turn and cutting speed=200 m/min. The burnishing tool in employment is an Ecoroll EG-5 which is a single roller tool. They had promoted a 3D model recreation to study the process of roller burnishing. Measurements are made on a precise case of manufacturing ball burnishing of metallic part.

Anil S Maheshwari and Dr. Rupesh R. Gawande [36] had worked on the importance of Burnishing Process in Manufacturing Industry. The key driving forces for newer production technologies and material development are strength to weight ratio of materials, performance and reliability improvement. They tried to review the research papers of last four decades and progress of burnishing process is discussed. They mentioned the results as various kinds of burnishing tools had developed for burnishing. Burnishing can be used for internal as well as external surfaces. Burnishing can be done by the unskilled worker and it is cost effective and environment-friendly process with less chip removal. Most of the researchers used the term burnishing in their research, burnishing is used to get the better surface finish only. Burnishing is less effective when the surface requirement is surface finish as well as surface hardness, fatigue strength, wear resistance need to be improved and residual compressive stresses are to be induced, deep rolling is to be done.

Anil S Maheshwari and Dr. Rupesh R. Gawande [37] had worked on specially designed high-stiffness ball burnishing tool on surface quality of Titanium alloy. Experimental investigation was carried on titanium alloy (Ti-6Al-V) in dry condition. They used design Expert-8 software to analyse and decide mathematical model. They observed that stiff ball burnishing is effective in reducing surface roughness of titanium alloy. They got maximum surface finish at speed 1050 rpm, depth of penetration 0.35 µm, feed 300 mm/min and number of passes 3.

III. DISCUSSION AND CONCLUSION:

A. Aluminum Alloy

1) Lots of work has been done on Al-60 and Al-70 series.
2) All the authors preferred the speed, feed, force and number of passes for their analysis point of view.
3) Ball or roller material is usually carbide ball or harden steel ball for burnishing operation.
4) Optimum parameter for achieving finished surface are force 300 N, feed near about 0.03-0.05 mm/rev and no. of passes about 3-5.

B. Steel

1) In case of steel the roller or ball material was either of tungsten carbide ball (WC), steel ball coated with chromium (Cr C), or tungsten carbide ball coated with titanium nitride.
2) They usually got the optimum parameters near about:
   Burnishing force: 1000N
   Burnishing speed: 250-300 RPM
   Burnishing feed: 0.04-0.06rev/sec
   No. of Passes: 3-5
   Roller Width: 2mm.
3) Molding Steel, Heat treated-Tempered steel and Hardened Steel are also taken as a working material.

C. Brass

1) In all brass related experiments authors had used Taguchi's method for analysis.
2) In brass speed, feed and number of passes affects the workpiece in much more extent.

D. Optimization

1) It is observed that in most of the cases the major affecting parameters were speed, feed, force and number of passes.
2) In case of brass, depth of penetration is less influencing parameter in improving surface roughness.

REFERENCES

[1] Lv Jinlong, Luo Hongyun (2013), "Effect of surface burnishing on texture and corrosion [5]behavior of 2024 aluminum alloy", Surface & Coatings Technology 235 (2013) 513–520
[2] A. S. Maheshwari, Dr. R. R. Gawande (2016), "Effect of Newly Designed Burnishing Tool on Surface Micro hardness of AA6351", Jordan Journal of Mechanical and Industrial Engineering Volume 10 Number 4, December.2016 ISSN 1995-6665 Pages 245-251
[3] El-Tayeb, K.O. Low and P.V. Brevern, (2007), "Influence of roller burnishing contact width and burnishing orientation on surface quality and tribological behavior of Aluminum 6061", Journal of Materials Processing Technology 186 272-278.
[4] U.M. Shirsat, B.B. Ahuja (2004), "Parametric Analysis of combined turning and ball burnishing process", International journal of engineering and material science, Vol. 11, PP-391-396
[5] P. N. Patel, N. B. Patel, T. M. Patel (2014), " Parametric Optimization of Ball Burnishing Process Parameter for Hardness of Aluminum Alloy 6061", ISOR Journal of Engineering, vol. 4, Issue 08 ISSN(e):2250-3021, ISSN(p): 2278-8719
[6] Fathi Gharbi, Salem Sghaier, Hedi Hamdi, Tarek Benameur (2011)," Ductility improvement of aluminium 1050A rolled sheet by a newly designed ball burnishing tool device", Int J Adv manuf Technol DOI 10.1007/500170-011-3598-6
[7] Amit Patel, Dipteshkumar Patel, Kapil Banker (2014), "Effect Evaluation of Roller Burnishing Process on Surface Roughness Of 6061 T6 Al Alloy Using Response Surface Methodology", International Journal of Research and development, vol. 2, Issue 08, ISSN: 2321-0613
[8] El-Axir, Othman and Abodiena, (2008) "Improvements in out-of-roundness and micro hardness of inner surfaces by internal ball burnishing process", Journal of Materials Processing Technology 196 120-128.
[9] J. A. Travieso, G. Dessein, H. A. Gonzalez-Rojas (2014), "] had studied about improving the surface finish of concave and convex surface using a ball burnishing process", material and manufacturing processes, 26:12, 1494-1502
[10] M. R. Stalin John & B. K. Vinayagam (2011), "Investigation of roller burnishing process on Al 63400 material", Australian J of Mechanical Engineering, 8:1, 47-54
[11] P. Saritha (2017), "Optimization of Roller Burnishing Process Parameters for High Strength En19 Alloy Steel", Allipallli swamy, Int. Journal of Engineering Research and Apllication ISSN: 2248-9622, vol. 7, Issue 8, (Part-4) August 2017, pp. 76-7
[12] Shaiesh Dadmal, Prof . Vijay Kurkute, (2017), "Finite Element Analysis of Roller Burnishing Process", Int Research J of Engg. And Technology vol. 4 Issue 6
[13] Prof. D. M. Mate and Prof. P. S. Chaudhari (2014), "formulation of experimental data based on mathematical model for Al-2014 with spherical surface burnishing tool", Int J of Research in mechanical engineering, vol. 2, Issue
[14] [14]A. S. Maheshwari and R. R. Gawande (2016), "Improving surface quality of AA 6351 by the stiffburnishing technique," *Jordan J. Mech. Ind. Eng.*, vol. 10, no. 4, pp. 245–251
[15] Shaiesh Dadmal, Prof . Vijay Kurkute, (2017), "Finite Element Analysis of Roller Burnishing Process", Int Research J of Engg. And Technology vol. 4 Issue 6
[16] Kunhal R. Patel, Nirav Patel, Kiran Patel, (2014), " Investigation of Roller Burnishing Process Parameters on Surface Roughness of Al-Alloy 6351 T6 by response Surface Methodology", Int J for Scientific Research and development vol. 2, Issue 9
[17] Manabu Iwai, Hideaki Hashimoto and Kiyoshi Suzuki (2016), "development of a new burnishing method utilizing a flank face of a turning tool and its burnishing performance", Adv Manuf Research, ISSN: 1662-8985, vol. 1136, pp 227-232
[18] Fang-Jung S, Chih-Cheng H (2008)," Surface finishing of hardened and tempered Stainless tool steel using sequential ball grinding, ball burnishing and ball polishing processes on a machining centre," J Mater Process Technol 205:249-258
[19] Sanchez L.E.A., Giaretta F., Nogurira L.G., Ingraci Neto R.R. (2017), "Effect of hot burnishing aided by infrared radiations on the modification of surface and subsurface of AISI 1045 Steel", Science Direct, open access article

[20] Malleswara Rao J. N., Chenna Kesava Reddy A., Rama Rao P. V., (2011), “The Effect of Roller Burnishing on Surface Hardness and Surface Roughness on Mild steel Specimens”, Int J of Applied Engg. Research, Dindigul vol. 1, no. 4

[21] Dinesh Kumar, Alok Kumar,(2014), “Improving Surface Finish and Hardness for MS cylinder using Roller Burnishing”, Int J of Scientific Research Engg. And Technology, ISSN: 2278-0882 vol. 3, Issue 1

[22] Jayakrishnan J., Suraj R. (2014), “Effect of roller burnishing process on tool steel material using CNC lathe”, Int J of Design and Manuf tech, vol. 5, Issue 3

[23] Dr. M. Satya Narayana Gupta, D. Ramana Reddy, G. Thirupathi Reddy (2015), “Effect of roller burnishing parameters on surface roughness and hardness”, Int J of Engg Research and Application ISSN: 2248-9622

[24] Zabkar B., Kopac J. (2013), “An investigation into roller burnishing process”, Journal of Production Engg., vol. 16, No. 2

[25] Davinder Saini, Manish Kapoor, Dr. C. S. Jawalkar,(2017), “Parametric Analysis of Mild steel specimens using Roller Burnishing process”, Int Refereed J of Engg. And Science vol. 6, issue ,pp. 45-51

[26] B. C. Yeldose and B. Ramamoorthy (2008),-An investigation into the high performance of TiN-coated rollers in burnishing process,‖ J. Mater. Process. Technol., vol. 207, no. 1–3, pp. 350–355

[27] T. A. El-Taweel & M. H. El-Axir (2009), “Analysis and optimization of the ball burnishing process the help of the Taguchi technique”, Int J Adv Manuf Technol, 41:301-310

[28] J. N. M. Rao and A. C. K. Reddy (2011), “Evaluation of Optimum Values of Surface Roughness on Aluminum Work Piece using Roller Burnishing”,‖ vol. 4, no. 3, pp. 293–303, 2011.

[29] S. Thamizhmnaii, B. Bin Omar, S. Saparudin, and S. Hasan (2008), -Surface roughness investigation and hardness by burnishing on titanium alloy,‖ Manuf. Eng., vol. 28, no. 2, pp. 13–14

[30] A. M. Hassan and A. M. Maqableh (2000), Effects of initial burnishing parameters on non-ferrous components,‖ J. Mater. Process. Technol., vol. 102, no. 1, pp. 115–121

[31] Jignesh R Patel, Prof. S. M. Patel, (2014), “Effect of Process Parameters on Surface Roughness and Surface Hardness in Roller Burnishing Process”, Int. J of Science and Research vol. 3, Issue 5

[32] P. S. Kamble, V. S. Jadhav (2012), “Experimental study of roller burnishing process on plain carrier of planetary type gear box”, International Journal of Modern Engineering Research (IJMER), Vol.2, ISSN: 2249-6645, PP- 3379-3383

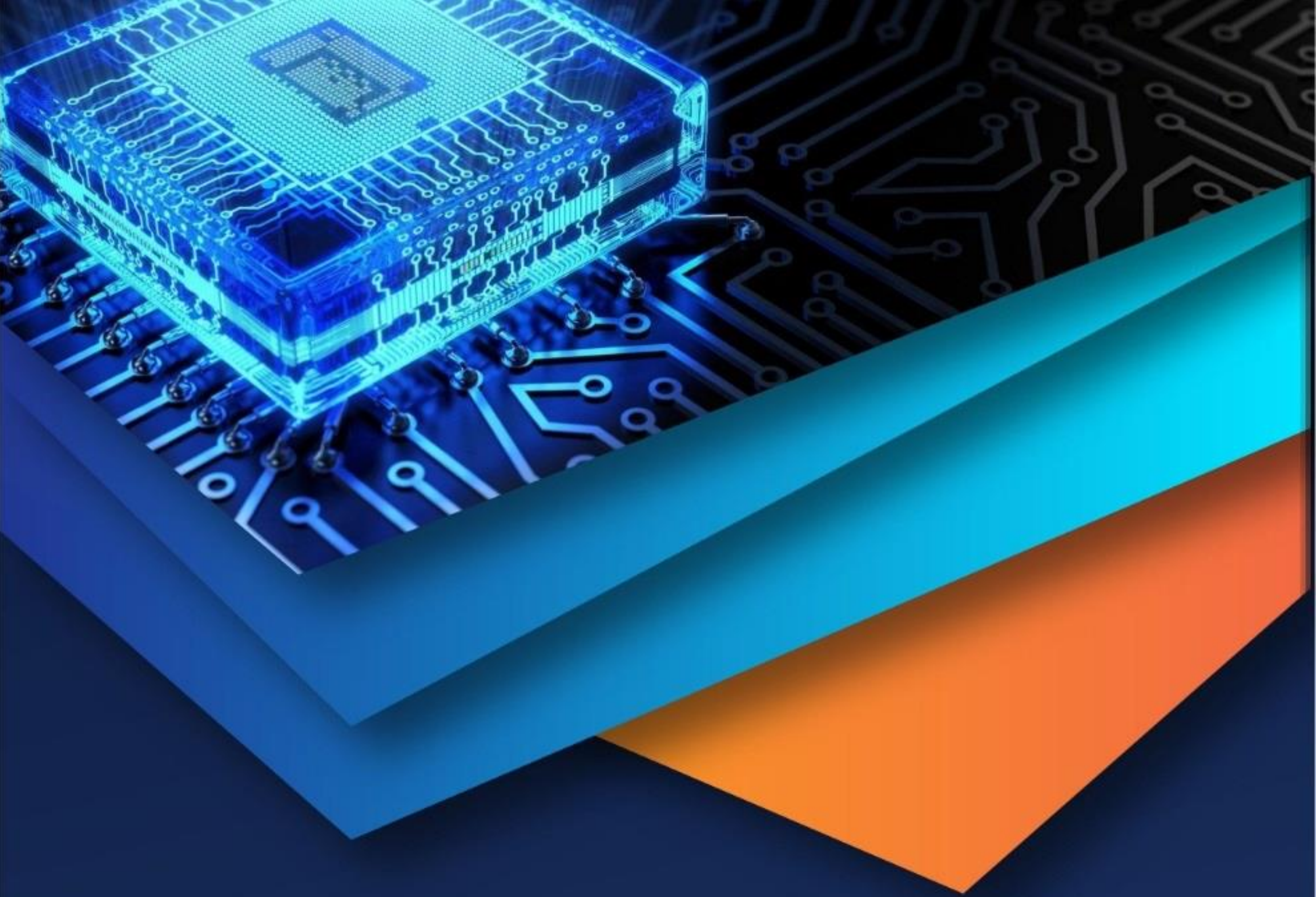
[33] Salman Al-Saeedi, Ahmed A. D. Sarhan and A. R. Bushroa (2014), “Investigating the surface tribology of roller-burnished polymer using the Fuzzy ruled-based approach", tribology transaction DOI: 10.1080/10402004.2014.962205

[34] P. S. Pa (2010), “Continuous finishing process using a combination of burnishing and electrochemical finishing on bore surfaces”, Int J Adv Manuf Technol 49:147-154

[35] Pascale Balland, Laurent Tabourot, Fabien Degre, Vincent Moreau (2013),“An investigation of the mechanics of roller burnishing through finite element simulation and experiments”, Int Jof Machine Tools & Manufacture 65, PP-26-36

[36] A. S. Maheshwari and R. R. Gawande (2017), “The Role of Burnishing Process in Manufacturing Industry, Int.J of Engg research and development” vol. 13, no. 6, pp. 50-60

[37] Maheshwari A S and Gawande R R (2017), “Influence of specially designed high-stiffness ball burnishing tool on surface quality of Titanium alloy,” *Mater. Today Proc.*, vol. 4, no. 2, pp. 1405–1413



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)