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Comparison of Hole Surface Finishing Processes with Roller Burnishing Method Applied in Copper Materials

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ABSTRACT

Surface finishing processes such as drilling, turning, reaming, grinding, honing and roller burnishing etc. are widely used in manufacturing as hole surface finishing process. In addition to the characteristics of hole such as the surface roughness, the surface hardness and the wear resistance, the circularity and cylindricality of hole are also effective on the performance of hole. In this paper, it is presented that different hole surface finishing processes were applied to the samples made of pure copper. As a result of all the measurements and assessments, the results of the study show that the roller burnishing method gives the best results in terms of mechanical, metallurgical properties and hole surface quality of the material.

Key Words: *Copper, hole machining processes, microstructure, surface roughness, roller burnishing method.*

1. INTRODUCTION

The part quality of industrial applications depends on the surface features obtained by surface finishing processes in addition to the material preferred. A good finishing surface quality has a positive effect on the properties of machine parts such as wear resistances, load-carrying capacity, tool life, and fatigue. On the other hand, Lin et al. [1] and Loh and Tam [2] stated that a rough finishing surface increases wear and decreases fatigue strength, and makes the production of part difficult within given tolerances. Surface finishing methods such as drilling, turning, reaming, grinding, honing, etc. are widely used in manufacturing. Because the surface quality desired through these processes is obtained by material removal, the machining traces on the surface due to the movements of cutting tool can lead to the future problems such as wear, breaks and the geometric tolerance on the surface. The usage of advanced technology has led to obtainment of the surfaces by using the roller burnishing process in producing machine parts whose surface properties are important. Akkurt [3], Akkurt and Ovalı [4] have recently shown that the usage of roller burnishing process is becoming increasingly common due to its nature of machining without material removal as well as being a method, which is a simpler process than other methods.

The roller burnishing process is a method taking attention with respect to the production and the improvement of fatigue strength of machine parts working under variable stress. The roller burnishing process is a cold surface operation applied to machine parts exposed to intensive dynamic stresses. During the roller burnishing process, the hardness occurs as a result of the residual compressive stress on the outer surface and in a thin layer close to it with strain hardening after the elastic limit is exceeded. The residual tensile stress occurs in the inner regions of the part machined. The residual compressive stresses increase the strength of the burnished surface. Denkena et al. [5] have recently shown that the effect of the residual compressive stresses increasing the fatigue

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strength is partially or completely eliminated by increasing temperature. The roller burnishing process increases surface hardness, corrosion resistance, wear resistance, and improves the fatigue strength as the residual compressive stresses on the surface of the hole. Also it is prevalently used as a surface finishing process to provide additional benefits such as increase in hardness and optimum surface roughness. The process is increasingly becoming popular to meet increasing demands of performance of machine parts. In roller burnishing method, cylindrical balls with rigid and smooth spherical tips are made to contact to the surface of workpiece under certain forces. Wick and Veilleux [6], Hassan [7] and Hassan et al. [8] have recently shown that the plastic deformation occurs on the contact surface (Fig. 1) as a result of this process.

Surface irregularities are eliminated with the deformation effect of the process. The formation of a hard layer on the surface is formed with strain hardening as a result of intense plastic deformation on the surface of material occurring during the process (Fig. 1). According to statement by Wick and Veilleux [6], Hassan [7], Hassan et al. [8], Rajasekariah and Vaidyanathan [9], this hardened layer formed on the surface leads to a significant increase in the abrasion resistance.

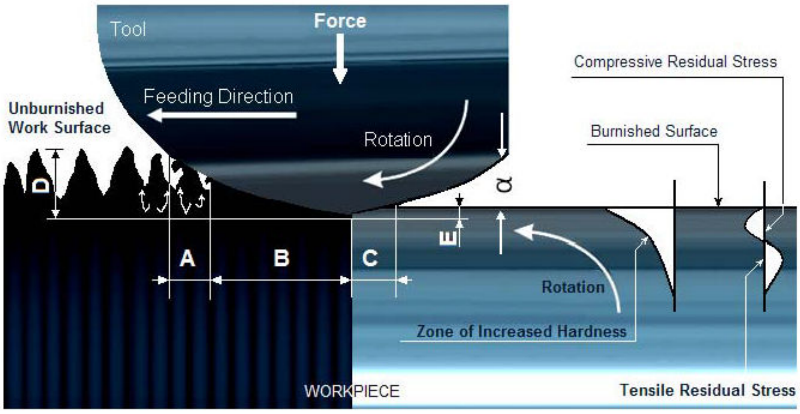


Figure 1. Schematic working principle of roller burnishing process and distribution of compressive residual stresses [3, 6, 8].

Polishing the metal surface with burnishing is provided by performing motion of rolling and feed under all conditions. The special ball or roller-ball burnishing tool design and combinations are required in burnishing (Fig. 1). The first contact with the metal surface subjected to appropriate pre-machining (turning, drilling, reaming, etc.) occurs in region A (pressing area) and the contact pressure exceeds the yield point of metal and causes local plastic deformation in region B (plastic deformation area). In region D (pressing amount), plastic deformation occurs and the material is pressed in very minor sizes. The roller element undergoes some amount of elastic restoration after plastic deformation, by contacting with the material for the last time in region C (smoothing area). After the progression of roller, the material's elasticity is restored in region E (elastic distortion) and the surface obtained is smooth and shiny. The stress generated on the workpiece during roller burnishing process decreases from the surface to the center. This stress penetrates to a specific depth depending on the material used, the number of burnishing processes, and the working method. According to the statement by Akkurt [3], Wick and Veilleux [6], Nemat and Lyons [10] and El-Tayeb et al. [11]; after the burnishing force is removed, the elastic recovery occurs under the hardened surface layer depending on the increase of dislocation and the strain hardening and the residual compressive stresses take place on the surface.

As a result of metals' and their alloys' being machined with hole surface finishing processes such as drilling, turning, reaming, grinding, honing and roller burnishing; it is very difficult to achieve the circular surfaces with desired characteristics. According to the statement by El-Ovalı and Akkurt [12] and El-Tayeb et al. [13], in particular, developments in aeronautics and automotive industry have increased the importance of hole surface finishing. The effects of the roller burnishing tool's material and the roller form, the machine and process parameters on the roller burnishing process were investigated in the literature. There has not been any study which examines a combination of the roller burnishing process with the other hole surface finishing methods and the effect of the roller burnishing process on the characteristic features of surface such as the cylindricality of hole.

Considering the developments mentioned above, this study covers two main subjects: *i*) the examination of the effects of hole surface finishing processes applied to holes on the mechanical and metallurgical properties of the material and *ii*) comparing the properties of the circularity and the cylindricality of surfaces obtained experimentally, the determination of which method is superior to the others. For this purpose, the test specimens have been prepared from the copper material preferred intensively in aeronautics and automotive industry. Because of the fact that the other surface finishing processes such as drilling, turning, reaming, grinding, honing, etc. other than the roller burnishing process are widely used in manufacturing; it has not been gone into details about these methods, and the roller burnishing process was examined in more detail to demonstrate the diversity of the other methods. The surface characteristics obtained by the roller burnishing process and the other methods were evaluated in this study.

2. EXPERIMENTAL STUDIES

2.1. Material and Specimen Preparation

The chemical composition of the copper material is given in Table 1.

Table 1. Chemical composition of the copper material (weight %)

Sn	Pb	Zn	Si	Mn	Fe
0.0348	0.00692	0.0152	0.001	0.0021	0.001
Ni	Sb	Al	Bi	S	Cu
0.00824	0.0188	0.0022	0.0005	0.001	99.91

This material was selected because it has low density and it is widely used in aeronautics and automotive industries. The test specimens that sized outer diameter of 50 mm, inner diameter of 20 mm and thickness of 20 mm were prepared. The surface characteristics of hole before and after the roller burnishing process are shown in Fig. 2.

2.2. Hole Drilling Processes

Primarily taking into account the burnishing depth, the test specimens was drilled in the inner diameter size by a HSS drill using a CNC machine of Taksan TTC-630. Initial machining conditions were kept the same for all the specimens and the cutting parameters were selected as cutting speed 50 m/min and feed rate 0.2 mm/rev.

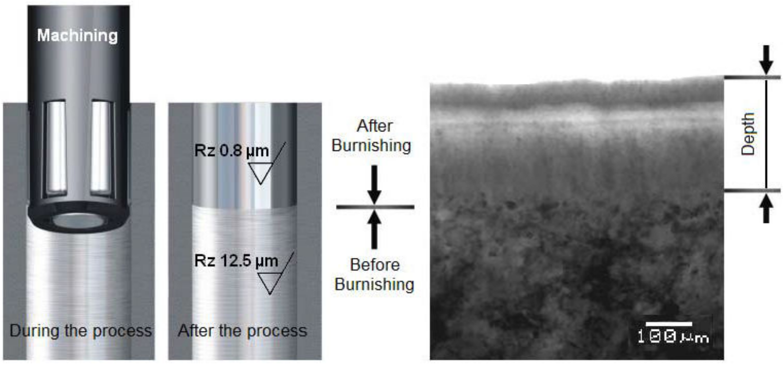


Figure 2. Before and after the roller burnishing process [14].

2.3. Surface Processes Applied After Drilling

Considering the parameters recommended according to the copper material for each of surface finish processes; the turning, the grinding, the reaming, the honing and the roller burnishing were applied to the pre-drilled test specimens to take into account the depths of finishing surface process pass. The size of ∅20 mm roller burnishing process was applied on a group of specimens, on an vertical drilling machine using a roller burnishing tool which is capable of burnishing range ∅15-21 mm (as with adjustable reamer). In order to prevent the entry of chips between tool and workpiece, balls were cleaned continuously during roller burnishing. This was carried out using Superoll coolant which has anticorrosion and cooling effects.

The roller burnishing process conditions defined in Table 2 were kept the same for all the specimens. As the circularity of the surface obtained is negatively affected by increase in burnishing duration (in case of appropriate feed rate is not selected), the burnishing speed was selected as 1.5 m/s taking into account the material properties and the tool availability. Another parameter among the burnishing parameters which has significant effect on the circularity is the burnishing depth, in other words; the penetration depth. It is known that the circularity of hole becomes better with the increase of the burnishing depth up to a certain value according to the structural properties of materials. But, when the share of burnishing and the burnishing depth are selected extremely for all materials; Loh and Tam [2], El-Khabeery and El-Axir [12], El-Tayeb et al. [13] and Abd Al-Wahhab [15] have recently shown that this situation causes surface to burn and causes particles to break from the surface in the form of flake.

Table 2. The roller burnishing machining parameters

Burnishing speed	1.50 m/s
Burnishing depth	0.5 mm
Burnishing diameter	20 mm
Burnishing duration	60 s
Burnishing coolant	Wet-Superoll
Hardness of the material machined	55 HV

2.4. Metallographic Studies

After applying the hole surface finishing processes, the sample with the dimensions of 12×12×10 mm were cut from each test specimens and then the samples were processed for microstructure examinations by applying standard metallographic processes (grinding and polishing). The samples were prepared using Keller's etch. Leica optical microscope was used for viewing microstructures.

3. TEST RESULTS AND DISCUSSION

3.1. Effect of Hole Finishing Processes on Microstructure

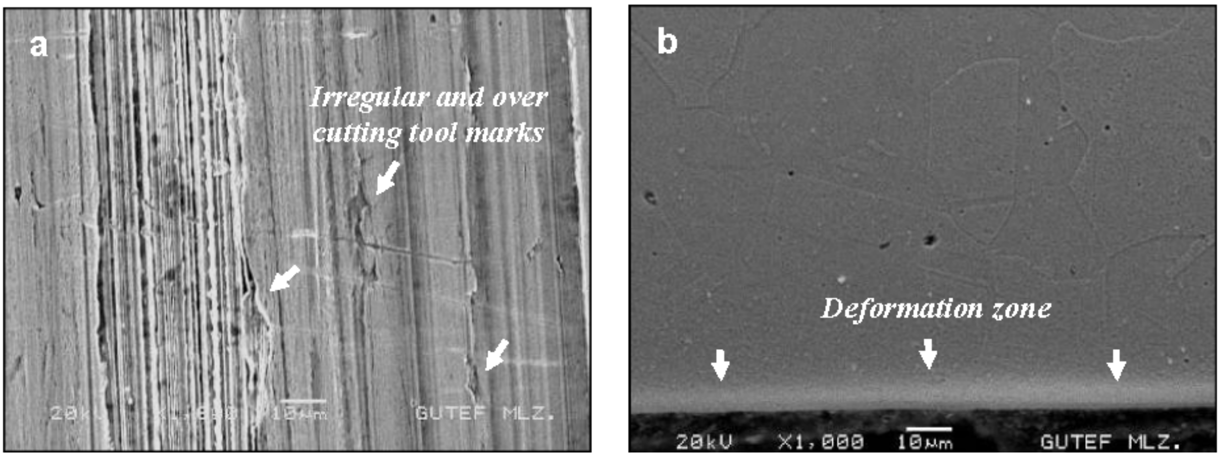
When detailed metallographic examination is carried out for each of the sample surface to which hole finishing process is applied, it is observed that structural changes stemmed from characteristic of each method take place. When these surface morphologies are examined to compare with the original structure, it is observed that the microstructures obtained by honing and roller burnishing methods are similar and the surface roughness of these surfaces is low. A coarse microstructure is obviously seen on hole surface as a result of the amount of deformation intensity on hole surface in drilling method (Fig. 3). A smoother surface was obtained by turning method compared with drilling. It is possible to talk about a hole surface in the medium-quality roughness in reaming and grinding.

Compared to other methods, the more homogeneous grains and the surface less affected by deformation were obtained in roller burnishing process. Despite the cutting fluid grinding and honing processes, the spotted structural change is observed caused by burn on the surfaces obtained and the depths very close to it.

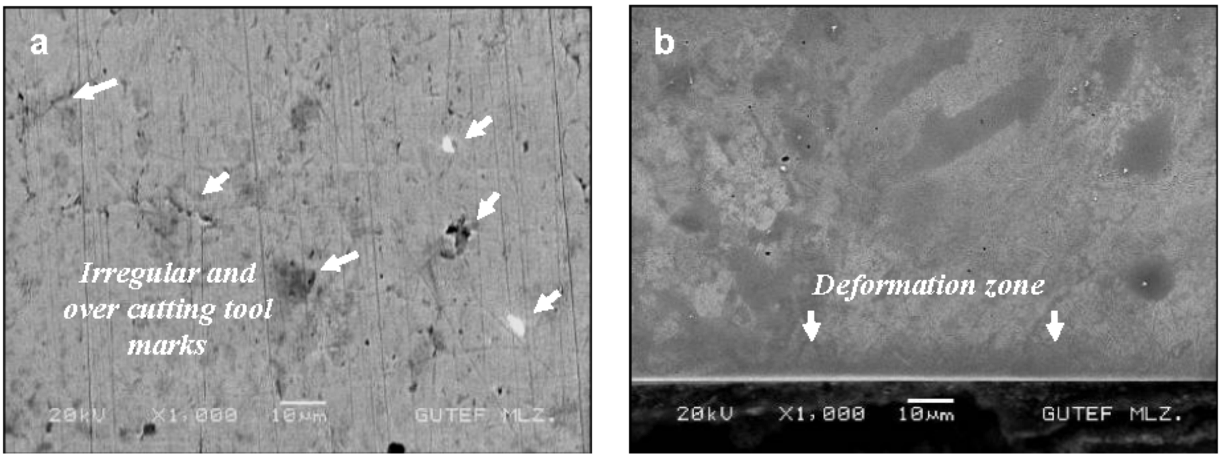
3.2. SEM Images of the Surface After Hole Finishing Processes

After each one of the hole surface finishing processes was applied to the pre-drilled holes of specimens, the SEM images of the surfaces obtained were taken with 1000 magnification. The SEM images given in Fig. 3 demonstrate the surface views of the top and the cross-sectional side, which show surfaces of the region affected by the process, the images on the left and right, respectively.

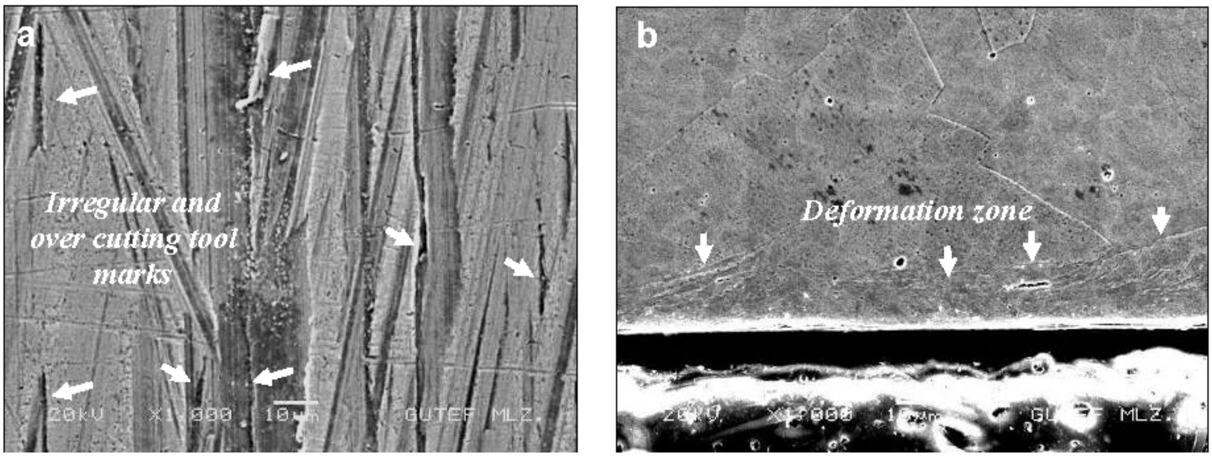
When the surface obtained by the roller burnishing method is examined from the cross-sectional side (picture b in Fig. 3a), the region affected by the process was clearly displayed. As result of comparison of the burnished surface with the surfaces obtained other processes, it was concluded that this surface is the smoothest. Looking at the surface obtained by honing process (Fig. 3b), the region affected by the process is in negligible size, and the honed surface is the second smoothest surface after the roller burnishing process. Looking at the surface obtained by finishing turning process (Fig. 3c), the presence of the region affected by the process was clearly displayed, and the surface obtained is rougher than the surfaces obtained by roller burnishing and honing processes. The effect of deformation occurring during the drilling process is clearly seen from cutting edge to the inner regions (Fig. 3d) and it can be concluded that drilling is the worst method among hole surface finishing processes because of the poor surface properties. When the images of the surface obtained by reaming process are examined (Fig. 3e), the effect of deformation up to a certain depth is clearly displayed and the medium-quality surface is obtained. Looking at the surface obtained by grinding process (Fig. 3f), there are rather small amounts of deformation on the grinding layer and the region close to it, and the medium-quality surface is obtained by grinding process like reaming.



a)



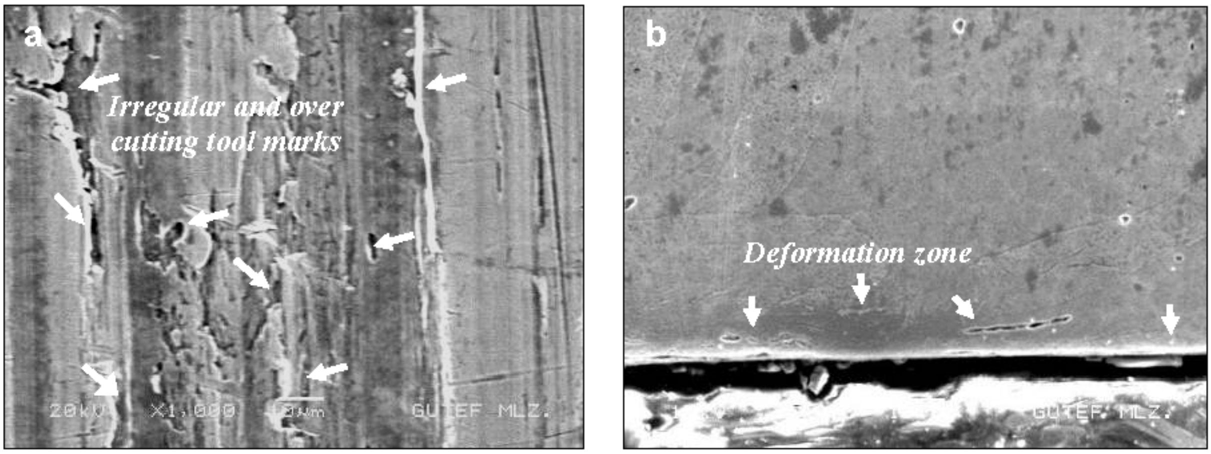
b)



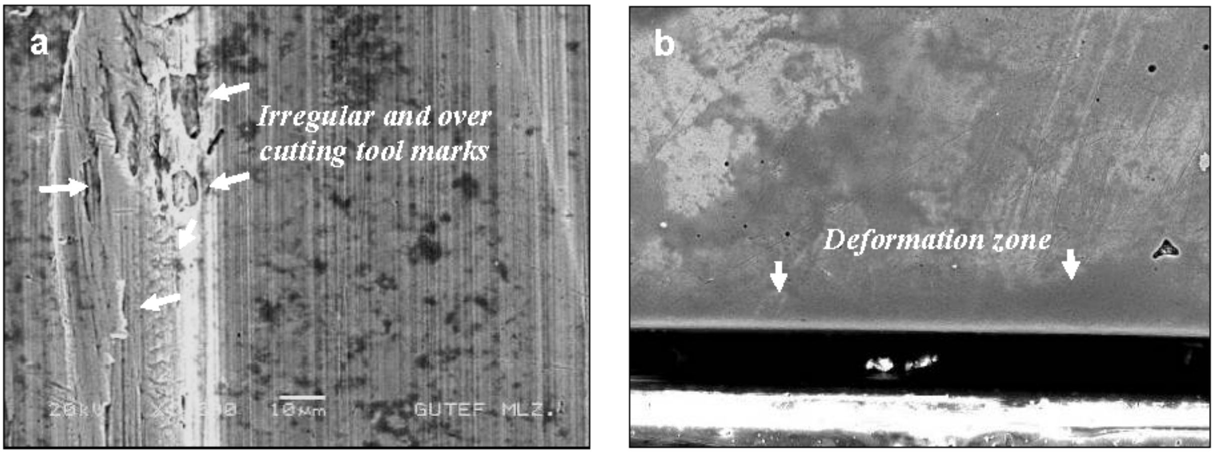
c)

Figure 3. Images of microstructures obtained by surface machining methods applied to hole surfaces

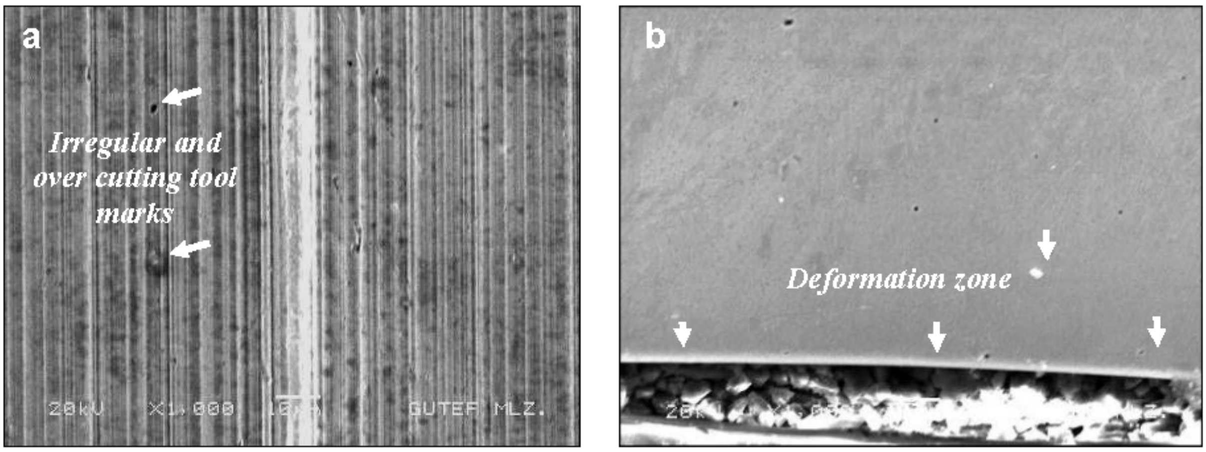
a) Roller burnishing b) Honing c) Turning.



d)



e)



f)

Figure 3. Images of microstructures obtained by surface machining methods applied to hole surfaces (continued) d) Drilling e) Reaming f) Grinding.

3.2.1. Effect of burnishing parameters on surface properties

The performance of burnishing process depends on the many complex factors and their results. Loh et al. [16] have recently shown that the optimum burnishing conditions based on the parameters affecting the surface properties such as the feed rate of burnishing tool, the burnishing force, the penetration depth, the number of burnishing tool passes, the roller burnishing tool material, the workpiece material, the roller burnishing tool size and the coolant type. Because the compressive strength, the deformation resistance and the wear resistance of copper materials are high, it makes the selection of optimal parameters much more important in choice of the burnishing parameters. As a result of inappropriate parameters, the negative conditions such as the breaking of the particles in the form of surface scaling on hole surface, the cracks and the fractures also the breaks on the surface and the region close to it will be inevitable. Especially considering the application areas (cutting tool and mould making), if the selection of roller burnishing process parameter and the burnishing pass number of copper materials is not appropriate, the cutting tool breakage and the fragmentation will occur in production stage. Therefore, the selection of each parameter should be made carefully.

3.3. Effect of Hole Finishing Processes on Micro Hardness

The decreases in hardness are higher than the base material in hole finishing processes with grinding, honing, drilling, turning and reaming, respectively, because of the nature of each method (Fig. 4). It is observed that the lowest hardness occurs with grinding and honing processes due to the instant heat occurring during the high speed material removal.

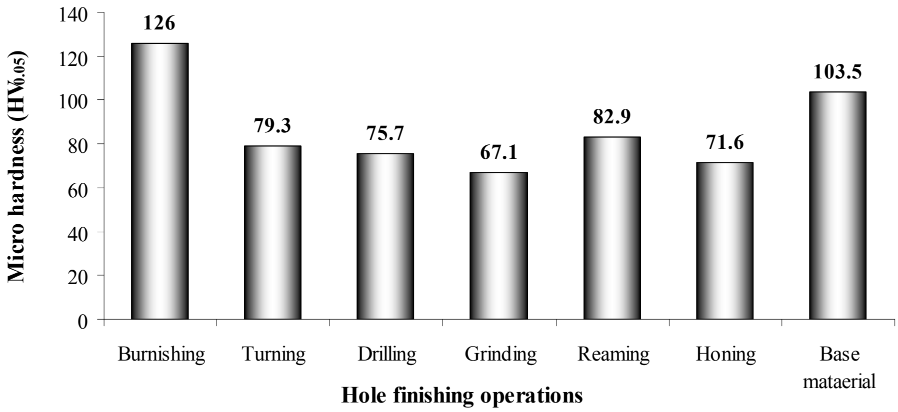


Figure 4. Micro hardness variation due to different surface machining methods.

Strain hardening occurs in a certain depth from the surface due to excessive plastic deformation occurring during roller burnishing process and an increase occurs in the surface hardness significantly. The literature survey show that the roller burnishing process leads to an increase in the surface hardness for all types of material as demonstrated by Akkurt [3], El-Khabeery and El-Axir [12], Abd Al-Wahhab [15], El-Axir [17], El-Axir and El-Khabeery [18], Al-Qawabah [19]. When the all of hole processing methods are evaluated, the best hardness values and the hardness variation from hole start to toward inside the workpiece were obtained with the roller burnishing method (Fig. 5). The results obtained in this study are agreed with the literature.

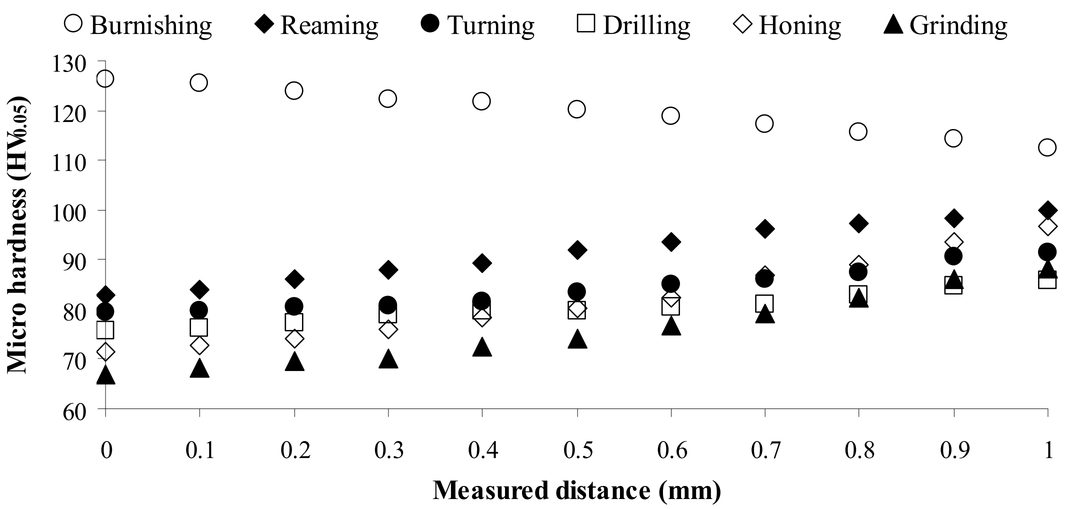


Figure 5. The variation of micro hardness from surface to centre due to different surface machining methods.

3.4. Effect of Hole Processes After the Pre-drilled Process on Circularity

As a result of experimental studies carried out, it is concluded that the roller burnishing process leads to a significant change in the hardness and the circularity of test specimens. For example, it can be seen that the irregular topological errors such as recesses and protrusions occur on the surface with very high magnification when the shaft is examined in Fig. 6, although the diameter of the shaft measured by different measuring instruments is the same. According to statement by El-Axir and Ibrahim [20], Dixit and Dixit [21] and Al-Bsharat [22], these topological errors (recesses and protrusions) carry most amount of the load when a force is applied on the shaft and causes stress concentrations.

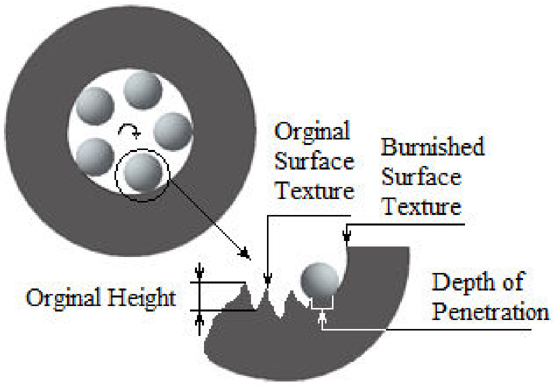


Figure 6. The roller burnishing process in the internal hole surface.

The circularity tests in this study were carried out by Hommel-Etamic laser circularity measurement device. The circularity has a significant effect on the mechanical properties of the rotating parts during process. The causes of distortion of the circularity are the tool wear, the incorrect positioning of the tool or the irregular forces applied during cutting. The circularity range is affected by many parameters such as cutting speed, feed rate, depth of passes, number of passes, etc. as demonstrated by Pettersson and Jacobson [23, 24]. The number of passes affecting the circularity and the surface characteristics in the roller burnishing process is one of the most important parameter and it can be observed that the large deviations in circularity occur with increasing the number of passes. This deviation in circularity is attributed to the excessive strain hardening as a result of plastic deformation. Therefore, the number of passes in this study was kept as minimum and the single pass was preferred for the roller burnishing process. The burnishing force is another important parameter in the circularity in the roller burnishing process. The previous studies indicated that the highly significant improvement in the circularity is due to the certain percentage increase in the burnishing force increasing the homogeneity of the deformed burnishing surface. The stress distribution on the surface obtained by roller burnishing process with the regular burnishing force is shown in Fig. 7.

When the burnishing force exceeds a certain limit, the surface discontinuities arising from the cutting losses on the surface may occur. Considering all these effects of the burnishing force, it was applied as 770 N in the tests by the aim of getting the most relevant results. The experimental results have shown that a much better range of circularity would be obtained by the roller burnishing compared to other traditional machining methods. The variations in the properties of circularity and cylindricality of the test specimens machined using traditional machining methods and the roller burnishing method were investigated.

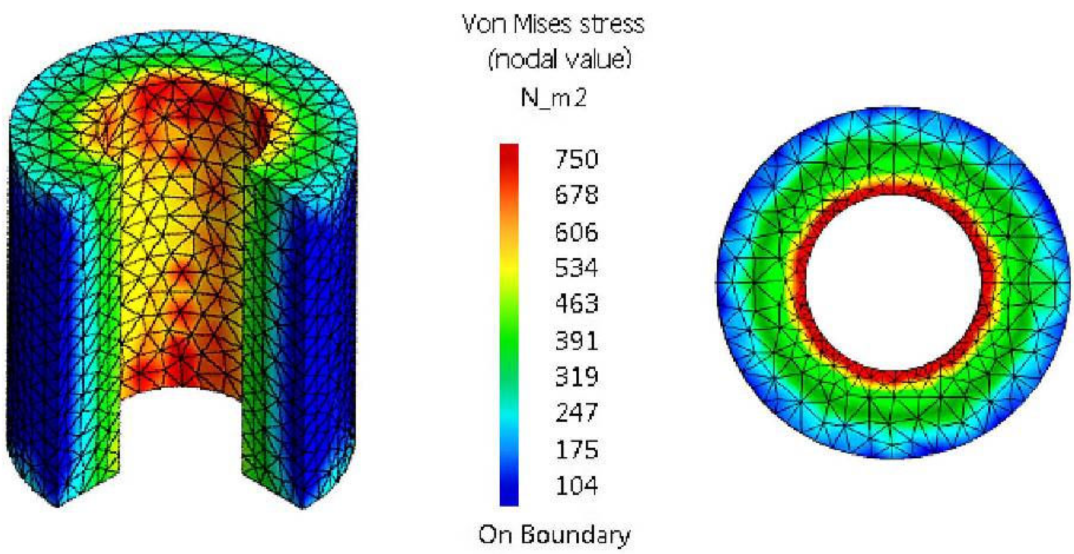
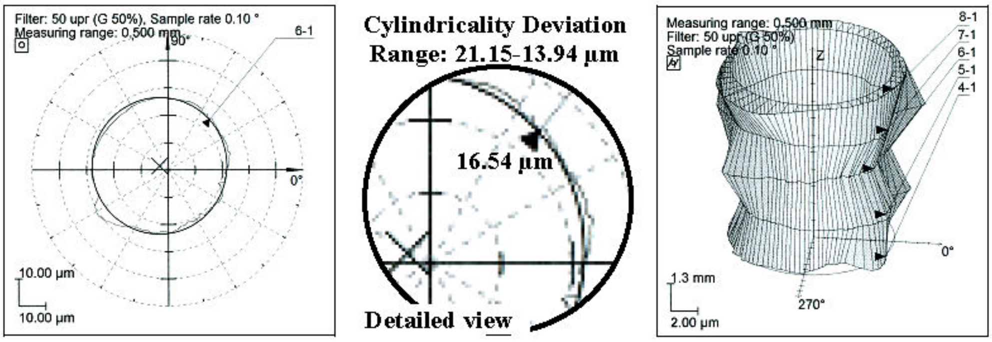


Figure 7. The stress distribution on the surface with the regular burnishing force.

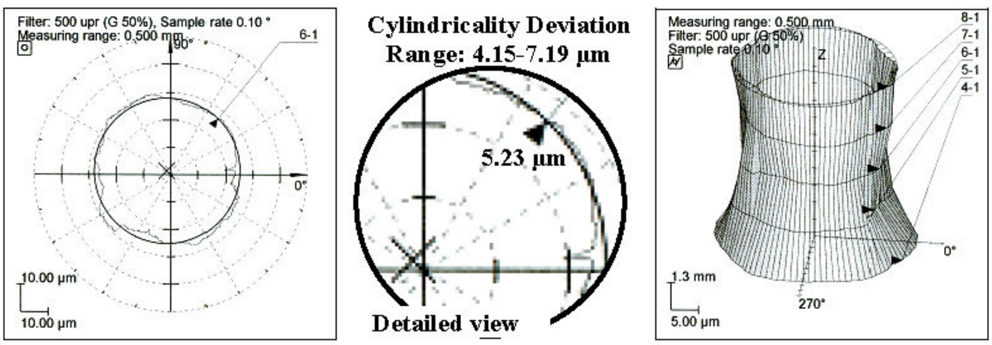
Due to the fact that the poorest and the best results in terms of surface properties are generally achieved by the drilling and the roller burnishing method respectively, the variations in the circularity and the cylindricality of the test specimens are shown in Fig. 8 for the drilling and the roller burnishing method. The measurements were made in 5 different locations (the numbers from 4 to 8) throughout the thickness of the test specimen.

When the test specimens are compared in terms of the variations in the properties of circularity and cylindricality, it is concluded that the best circularity and cylindricality are achieved by the roller burnishing method (Fig. 9).



Profile of Location	Result (mm)
4	21.15!
5	21.15!
6	16.54!
7	13.31!
8	13.94!

a)



Profile of Location	Result (mm)
4	4.15!
5	4.53!
6	5.23!
7	4.32!
8	7.19!

b)

Figure 8. Cylindricality properties of the test specimens machined using different surface machining methods.

a) Drilling operation b) The roller burnishing operation.

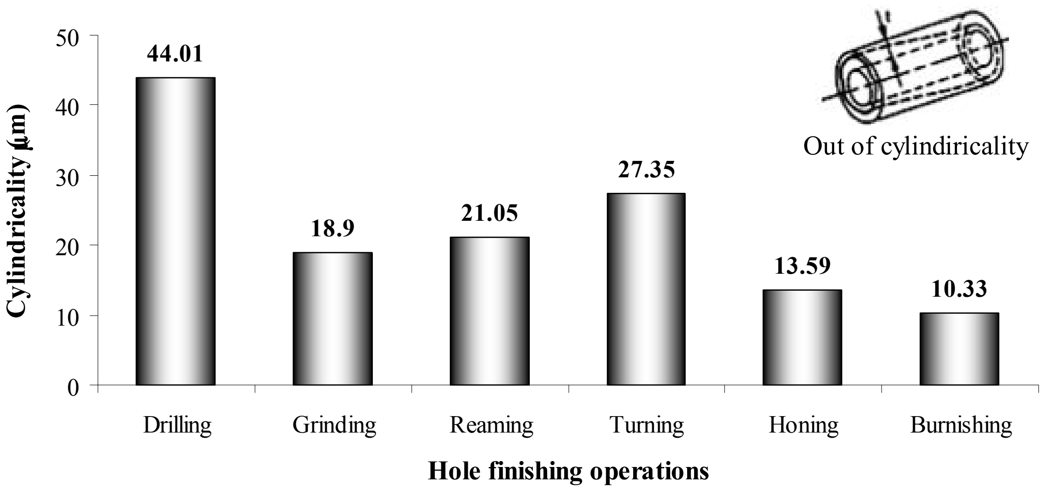


Figure 9. Comparison of cylindricality values after surface finishing operations.

3.5. Effect of Burnishing Parameters on the Surface Roughness

The graphs in Fig. 10 show the variations in the surface roughness obtained by the roller burnishing process according to the important parameters such as burnishing force, number of passes and feed rate. It should be noted that the graphs are created by reference to the value of roughness obtained by the reaming which is one of the hole surface finishing processes. The reaming process is selected due to the fact that it has an average surface roughness value in the surface roughness charts generated by metal removal (the reaming process, compared to other surface finishing methods, it is intensively preferred in machining as surface finishing).

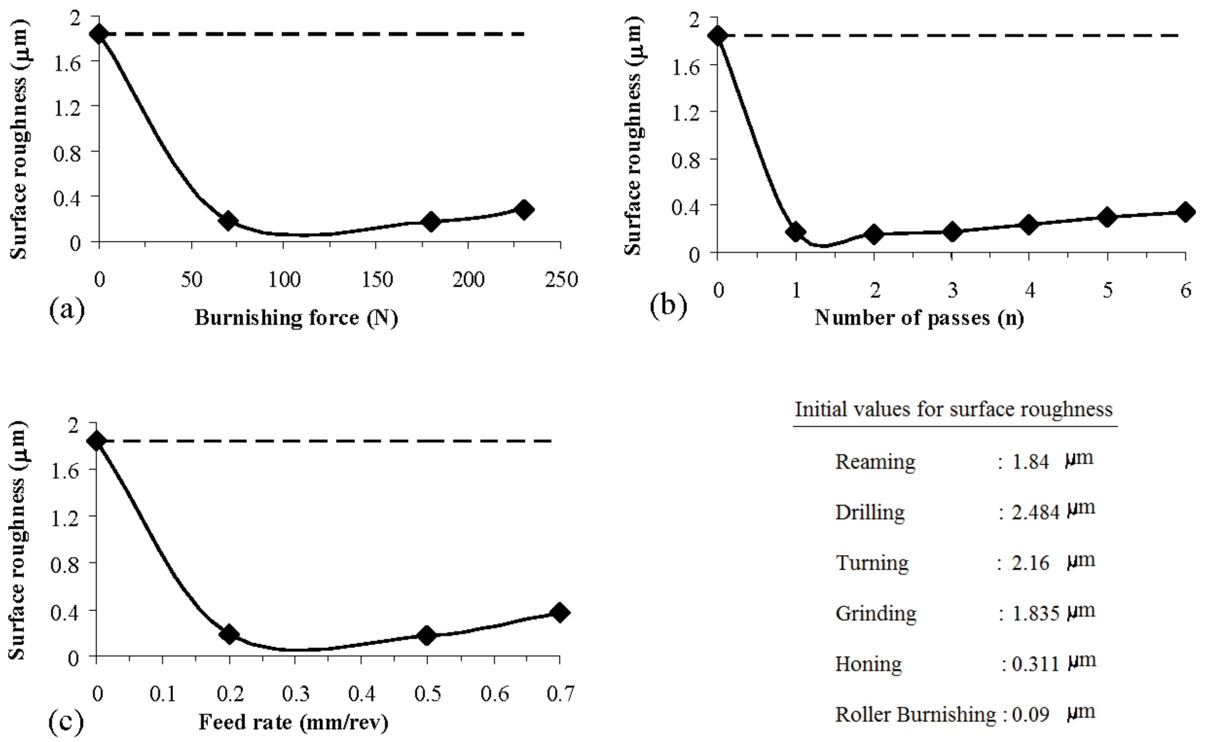


Figure 10. The effect of burnishing parameters on the surface roughness.

a) Burnishing force b) Number of passes c) Feed rate

The burnishing parameters have a significant effect on the surface roughness as shown in Fig. 10. The amount of plastic deformation occurring during the roller burnishing process increases with increase of the burnishing forces and consequently the surface hardness will increase with increase of the strain hardening. The surface roughness value will increase as a result of the irregular forces occurring during the machining with increase in the hardness (Fig. 10a). Although the increase in the number of passes, another important parameter in the roller burnishing process, does not cause a significant change in the surface roughness in the second and third pass, a significant increase in the surface roughness after the fourth pass is observed (Fig. 10b). This situation is due to the deterioration of homogeneous zone hardened with the increase in number of passes and the formation of inhomogeneous cutting forces during machining. Fig. 10c clearly shows that the increase in the surface roughness result from the increase in the amount of feed rate. The best surface roughness has been achieved with the feed rate 0.2 mm/rev. Increase in the feed rate leads to increase of the deformation and consequently the surface roughness values increase. Inappropriate machining parameters (burnishing force, number of passes and feed rate) give negative results in the material structure such as cracking, fracturing, flaking, etc [25].

3.6. Effect of Burnishing Parameters on the Cylindricality

The graphs in Fig. 11 show the variations in cylindricality obtained by the roller burnishing process according to the important machining parameters such as burnishing force, number of passes and feed rate. It should be noted that the graphs are created by reference to the value of cylindricality obtained by the reaming which is one of the hole surface finishing processes. The reaming process is selected due to the fact that it has an average surface cylindricality value in the evaluation charts generated by metal removal (the reaming process, compared to other surface finishing methods, it is intensively preferred in machining as surface finishing).

Although the increase in the number of passes initially increases the circularity property, it starts to affect adversely from the fourth pass and the cylindricality value rises up to 14.1 µm in the sixth pass. Whereas the cylindricality initially improves as a result of increase in hardness; due to increases in the amount of deformation, the cylindricality is adversely affected by the formation of strain hardening with the increase in number of passes. While the cylindricality is positively affected by the increase in burnishing force, the negative effects are seen when the threshold value is exceeded (Fig. 11). It was seen that surface in a wavy form occurs instead of a hard surface layer after the burnishing force exceeds the threshold value. As shown in burnishing forces graph in Fig 11b, the burnishing forces in certain ranges were selected in a systematic way and each force value was applied to different test specimens. Therefore, the results obtained with applications of 60 N intervals are very close to each other. The circularity is adversely affected by the increase in feed rate as well as burnishing forces. It is determined that the surface begins to deteriorate rapidly after a specific value of the feed rate (0.4 mm/rev).

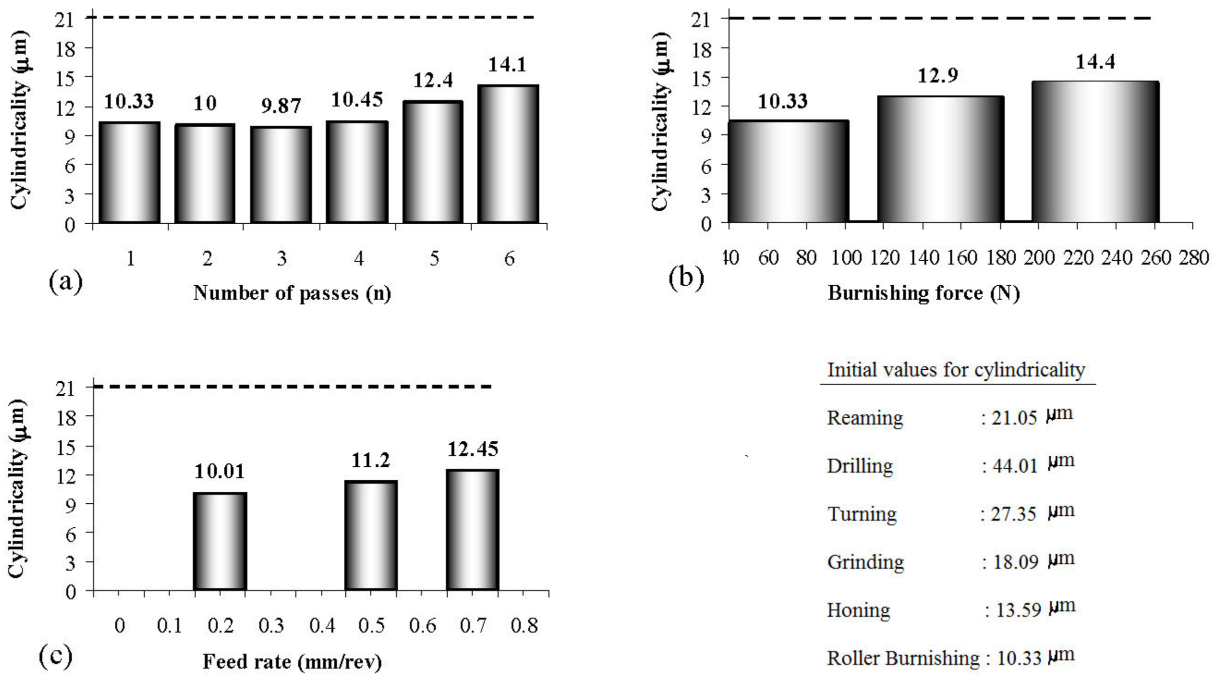


Figure 11. The effect of burnishing parameters on the cylindricality.

a) Number of passes b) Burnishing force c) Feed rate.

3.7. Effect of Hole Processes on the Surface Roughness

The poorest and the best surface roughness are generally achieved by the drilling and the roller burnishing method respectively, the variations in surface profile of the test specimens are shown in Fig. 12 for the drilling and the roller burnishing method. One of the most important parameters affecting the surface profile in roller burnishing method is the feed rate. Previous studies showed that surface roughness increases with increase in the feed rate. However, this reduction in surface roughness obtained by the roller burnishing process is attributed to the excessive vibration at high speeds of the burnishing tool on the machined surface. It is stated in the literature by Zum-Gahr [26], Shiou and Hsu [27] that the feed rate should not exceed 2 m/s and the ideal feed rate should be within the range of 1-1.9 m/s. In this study, the feed rate was selected as 1.50 m/s by taking into account the effects of the feed rate on the surface roughness, and the surface quality values in honing and roller burnishing methods were close to each other. Although the graphics in Fig. 12 are seem to be close to each other, it should be noted that the scales are different. For example, the maximum surface roughnesses on the surface obtained by the roller burnishing and the drilling processes are R_a=0.6 µm and R_a=40 µm, respectively. The reason of such a high surface roughness in drilling is attributed to the irregular cutting forces applied to the surface during the drilling process.

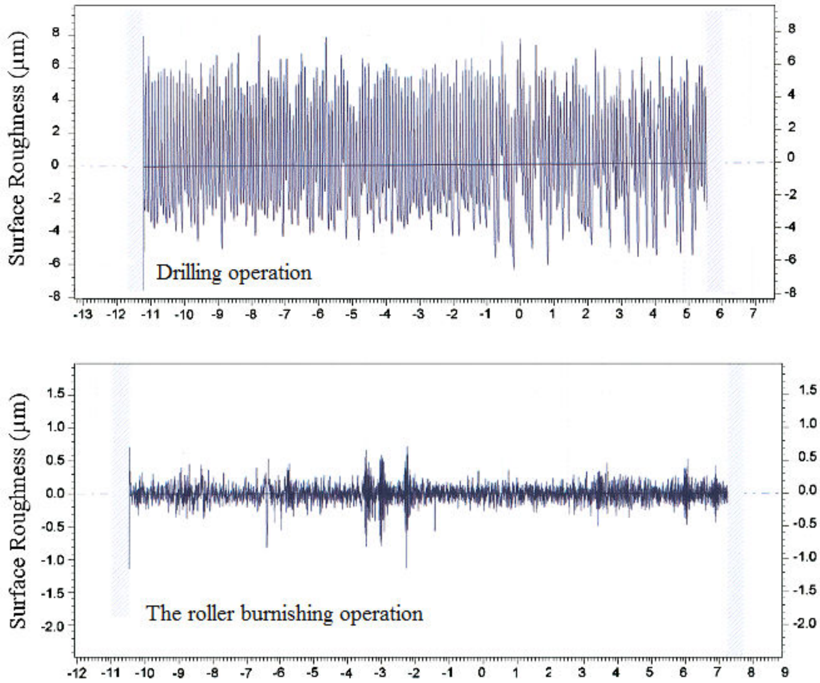


Figure 12. The change in surface profiles, R_a, due to surface machining methods.

The surface roughness values measured by the laser beam for all hole surface finishing processes are given in Table 3. When each parameter was examined according to the process type, it is unquestionable that the roller burnishing process gives the best results, and the quality expectations of surface are met by the roller burnishing method. When the surface roughness parameters were examined in terms of the results of measurement carried out; it is observed that the surface roughness values obtained by the roller burnishing method are approximately four times as much more efficient than the honing, even the honing process is usually considered as the most efficient method in terms of the roughness by machinery manufacturers.

Table 3. The surface roughness parameters in hole finishing operations.

Hole finishing processes	Surface Roughness Parameters (μm)									
	R_a	R_p	R_s	R_q	R_v	R_t	R_z	R_c	R_{3z}	R_{3y}
Roller burnishing	0.09	0.3	13.87	0.122	0.134	1.82	0.613	0.432	0.376	0.975
Honing	0.311	0.94	26.60	0.455	1.796	6.75	2.74	1.77	1.365	2.74
Turning	2.16	5.8	104	2.57	3.45	12.44	9.253	7.921	8.3	8.87
Drilling	2.484	6.639	89.89	2.94	4.707	14.206	11.347	8.18	9.4	10.496
Reaming	0.84	2.89	31.14	1.235	4.3	17.21	7.19	4.09	4.24	7.64
Grinding	1.835	3.721	75.78	2.185	4.273	10.99	7.995	5.91	5.458	7.21

4. RESULTS

In this study, different hole surface finishing processes such as drilling, turning, reaming, grinding, honing and roller burnishing were applied to the test specimens made of copper material separately. As result of all the measurements and assessments in terms of the mechanical, metallurgical properties and the surface quality, the important findings from this experimental study are summarized as follows:

- When the roller burnishing process applied to hole surfaces is compared with the other hole surface finishing processes, it is seen that the best surface finish characteristics are obtained with the roller burnishing process. The roller burnishing process gives excellent results in terms of the surface roughness and the surface hardness.

- The second-best surface roughness after the roller burnishing is obtained with the honing. The more accurate and uniform surface can be obtained by applying the roller burnishing process. The roller burnishing method gives the opportunity of decrease in the friction force between the surfaces of elements working together and the possibility of the desired size calibration. In particular taking into consideration the surface roughness, surface hardness, etc., the necessary use of the roller burnishing process in the automotive and aerospace industries instead of the honing is an inevitable result.

- In the copper materials, which are necessary to be forged while hardening and to attain desired results obtained by joining hardness-saving elements into, the formation of a hard layer on the surface is formed with strain hardening as a result of intense plastic deformation on the surface of material occurring during the roller burnishing process, as well as in many other materials group. As a result of this, a harder surface than all other methods is obtained. The abrasion resistance of the part, which is hardened by the roller burnishing and the surface resistance of which is increased, will be increased. In addition, the elimination of micro-cracks making the notch effects on hole surface with the roller burnishing process leads to a significant increase in hole life.

- The measurements and the images of micro-structure give that the characteristics of the surface quality are determined by the selection of appropriate roller burnishing parameters whereas the inappropriate parameters rather negatively affect the process.

- Particularly in drilling method compared to other finishing processes, the deformation of surface is the highest level and consequently it is observed that the extreme deterioration on the surface occurs (roughness, cylindricality, circularity, etc.).

- It is shown that the combination of the appropriate surface characterization and the mechanical properties were obtained by roller burnishing process.

- The roller burnishing process is an environment friendly process due to lack of chip, dust, etc.

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