

Design and Development of Ball Burnishing Tool

Mr. Pavan Kumar¹ and Purohit G K²

¹*Department of Mechanical Engineering, SMVITM, Udupi-574115, INDIA.*

²*Department of Mechanical Engineering, PDA College of Engineering,
Gulbarga- 585 102, INDIA.*

Abstract

Today's metal processing industries is often interested to induce compressive residual stress in the several components which they will come across the fabrication processes. The conventional methods of finishing process viz. grinding, broaching used to improve the surface finish of the metallic components, but the burnishing process which is having same role to play in finishing process has many advantages associated with it fulfilling above said requirement successfully. This paper presents study about the design and developmental issues of Ball burnishing tool. The tools are used to perform burnishing process successfully by controlling different parameters.

Keywords: compressive stress, surface finish, ball burnishing tool.

1. Introduction

Burnishing, which is a post finishing operation, in which highly polished ball or roller burnishing tools are pressed against pre-machined surfaces to plastically deform peaks in valleys. today it is very popular among the finishing operation in metal process industries because of its many advantages because by inducing the compressive stresses in metal surfaces increases properties associated with metal like surface finish, surface hardness, wear resistance, fatigue resistance, yield and tensile strength and corrosion resistance (1).

It is observed that the conventional machining methods such as turning and milling leave inherent irregularities on surface and it becomes necessary to very often resort to a series of finish operations with high costs (3). however, conventional finishing process like grinding, honing and lapping are traditionally used finishing methods but these methods essentially depend on chip removal to attain the desired surface finish,

these machining chips may cause further surface abrasion and geometrical tolerance problems. Accordingly, burnishing process offers an attractive post-machining alternative due to its chip less and relatively simple operations (NSM).

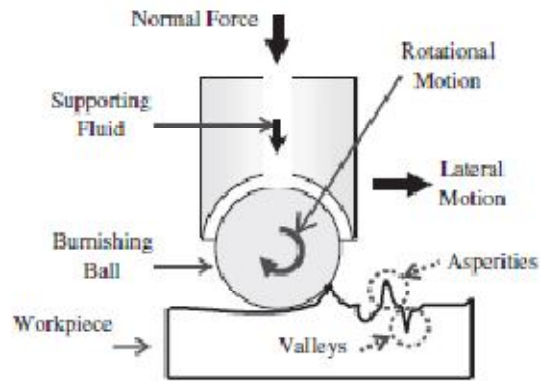


Fig. 1. Schematic illustration of burnishing mechanism.

Many researchers have done their experiments by developing different types of burnishing tools i.e. ball burnishing and roller burnishing and making them ready to use with conventional machine tools. A.M. Hassan et.al (1) developed ball burnishing tool with different ball diameters and examined the effects of other parameters. Mieczyslaw Korzynski et.al (2) has developed the centreless burnishing device to conduct experiments on long length workpieces. H. Hamadache et.al (8) Characterized Rb40 steel superficial layer properties under ball and roller burnishing. Equal or even more work has been done by roller burnishing tool by researchers (4). Researchers used these tools lathe and milling machines. This paper deals with design of ball burnishing tool to carry out experimental works.

2. Design of burnishing tool

As it was decided to carry out the ball burnishing process in present work among two process of burnishing, the first thing is to design and develop the ball burnishing tool by selecting suitable materials, dimensions and proper design such that the process and the tool is simple, cheaper and requires minimum time consumption with minimum cost. The tool developed here can be used on convectional machine tools like lathe.



Figure 1: Ball burnishing adapter with roller burnishing interchanging adapter type tool.

The burnishing tool designed in above said manner consists of parts namely ball holder, square casing, and spring, lock pins and threaded lock support. The design is made in consideration with the parameters in the work. The experimental work is planned to conduct mainly considering four different parameters and burnishing force is one among the parameters. So, the force is measured by means of spring deflections in the tool. The work piece material will be 60/40 Cu-Zn and the maximum force applied on the work piece during experiment is 30kgf.

Design of spring:

Maximum of Burnishing force, $F = 294 \text{ N}$

Maximum Measurable deflection (d) = 21.38 mm

Stiffness of the spring (K) = $(F/D) = (294/21.38 \times 10^{-3}) = 11760 \text{ N/m}$

Available spring of stiffness ($K1$) = 13740 N/m was selected

As ($K < K1$); the selected spring is Safe in design.

Specification of spring: $D = 25 \text{ mm}$ $d = 3 \text{ mm}$

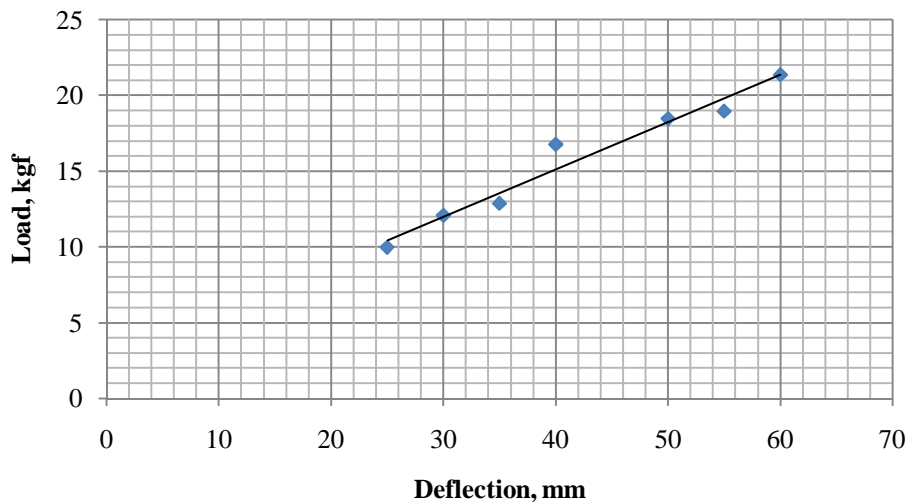


Figure 2: Load, kgf vs. Deflection, mm

Design of ball adapter:

The ball adapter has made up of EN 8 material and it has sufficient strength to take the loads arises in machining of brass. This adapter will be inserted into the square casing and locked by means of the locking pin and simultaneously it is hold threaded nut at the end.

Design of square casing: this is made of mild steel and has dimensions of 150 mm*25mm*25mm. This part holds the tool in the chuck of the lathe.



Figure 3: Ball burnishing operation.

3. Conclusions

The developed ball burnishing tool can be used successfully to study the effect of different burnishing parameters on the work piece. It is believed that the ball burnishing process will become interesting in case of hardness than roller burnishing.

The parameters like speed, feed, force and number of passes has been selected as parameters and the effects of these parameters will be studied on surface roughness and hardness.

The following advantages may result from the burnishing process

1. Mirror like surface finish
2. Dimensional Consistency / Repeatability
3. Single Pass Operation
4. Increase in Surface Hardness
5. Reduces the Reworks and Rejections.

4. Application of Burnishing Tools

Burnishing tools are being used in sectors like Automobile, Aircraft, Defense, Spacecraft, Railways, Textile, Machine Tool, Motors and Pump Industry, Hydraulic

and Pneumatic Farm Equipment, Home Appliances etc., and areas where close tolerance and superior surface finish is required.

Reference

- [1] Adel Mahmood Hassan*, Ayman Mohammad Maqableh, The effects of initial burnishing parameters on non-ferrous components, *Journal of Materials Processing Technology* 102 (2000) 115±121
- [2] Mieczyslaw Korzynska,*, Andrzej Pacanab, Centreless burnishing and influence of its parameters on machining effects, *Journal of Materials Processing Technology* 210 (2010) 1217–1223
- [3] G. Schneider Jr., *Cutting Tool Application*, Prentice-Hall Publication, 2002, pp. 2–65 (Chapter 1).
- [4] N.S.M. El-Tayeb , K.O. Low, P.V. Brevern, Influence of roller burnishing contact width and burnishing orientation on surface quality and tribological behaviour of Aluminium 6061, *Journal of Materials Processing Technology* 186 (2007) 272–278
- [5] N.S.M. El-Tayeb, K.O.Low,P.V.Brevern, On the surface and tribological characteristics of burnished cylindrical Al-6061, *Tribology International* 42 (2009) 320–326
- [6] Fang-Jung Shiou, Chuing-Hsiung Chuang, Precision surface finish of the mold steel PDS5 using an innovative ball burnishing tool embedded with a load cell, *Precision Engineering* 34 (2010) 76–84
- [7] L.N. Lo´pez de Lacalle*, A. Lamikiz, J. Mun˜oa, J.A. Sa´nchez, Quality improvement of ball-end milled sculptured surfaces by ball burnishing, *International Journal of Machine Tools & Manufacture* 45 (2005) 1659–1668
- [8] H. Hamadache*, L. Laouar, N.E. Zeghib, K. Chaoui, Characteristics of Rb40 steel superficial layer underball and roller burnishing, *Journal of Materials Processing Technology* 180 (2006) 130–136.

