RESEARCH PAPER | Engineering | Volume : 2 | Issue : 3 | December 2012 | ISSN - 2249-555X

Enhancement of Surface Finish of Boring Operation Using Passive Damper

KEYWORDS: Boring Bar, Passive(Impact) Damper, Surface Roughness.

Kanase Sandip S
Research Scholar, BharatiVidyapeeth Deemed University College of Engineering, Pune, Maharashtra, India

Jadhav Vishvas S
Asst. Professor, BharatiVidyapeeth Deemed University College of Engineering, Pune, Maharashtra, India

ABSTRACT *In this paper a creative approach of passive vibration damping is presented to absorb the vibrations created in boring operation. Due to larger overhang, requires because of deep hole drilling vibrations generated which will affect the surface finish of the machined surface. An impact damper concept is used to minimize the effect of vibrations and subsequently results into good surface finish.*

1.0 INTRODUCTION

A major concern in the manufacturing industry, today, is the vibrations induced by metal cutting, e.g.turning, milling and boring operations. The vibration problem associated with metal cutting has considerable influence on important factors such as productivity, production costs, etc. In particular, vibrations in internal turning operations are usually a cumbersome part of the manufacturing process. Excessive vibrations accelerate tool wear, because poor surface finish and may damage spindle bearings.

In internal boring, the metal-cutting processes are critical finishing operations carried out in pre-drilled holes or holes in cast, etc. The dimensions of the workpiece hole generally determine the length and limit of the diameter or cross sectional size of the boring bar. In this paper, a stationary boring bar is taken for study. In boring, the long, cantilevered boring bars have inherently low stiffness and become the weakest link in the boring bar-clamping system of the lathe. If the static/dynamic rigidity of these cantilever elements is inadequate, they directly limit the attainable accuracy, due to the easy deflection of the boring bar, even under low magnitude cutting forces, indirectly limit accuracy, the high-frequency micro-vibrations produce noticeable wear in the cutting inserts during each cutting cycle which results in tapered surfaces instead of the required cylindrical ones and limit machining regimes through the generation of self-excited vibrations even at relatively low cutting regimes when the length-to-diameter (L/D) ratio of the boring bar exceeds 4:1[2,6].

The passive(impact) damper has the following features: (i) small and simple in construction; (ii) easy to mount on the main vibratory systems; and (iii) no need to adjust parameters of an impact damper to the vibratory characteristics of the main vibratory systems[1]. Furthermore, it was clarified that by applying this impact damper to a drill, chatter vibration could be suppressed effectively.

Thus, in the present study, the improvement of the damping capability of boring tools and suppression of chatter vibration using the impact damper were tested. In addition, the impact damper used in this study allows a free mass to be equipped on the outside of the main vibratory system. In the vibratory system presented in Fig. 1, the free mass exists inside the main mass [1].

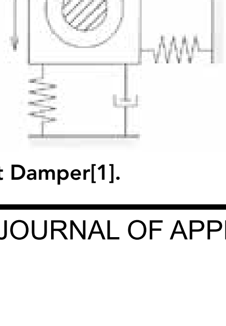

Figure 1.1: Impact Damper[1].

2.0 PROBLEMS WITH BORING OPERATIONS:

In machining, boring is the process of enlarging a hole that has already been drilled (or cast), by means of a single-point cutting tool (or of a boring head containing several such tools), for example as in boring a cannon barrel. Boring is used to achieve greater accuracy of the diameter of a hole, and can be used to cut a tapered hole. Boring can be viewed as the internal-diameter counterpart to turning, which cuts external diameters

After choosing the boring bar material selects the most suitable clamping method for the machine in question. Stability is the keyword to turn bores to the appropriate criteria such as dimension tolerances and surface finish. It is essential, for retaining satisfactory results, to clamp the cylindrical boring bar in a split sleeve, as this will have maximum contact area. With Easy Fix sleeves the best possible clamping is achieved together with exact centre height positioning. Achieving correct centre height is one of the most important factors towards gaining maximum benefit from the tool system used, as the centre height affects the rake angle and cutting force on the tool. Using screws directly in contact with the cylindrical boring bar will not give satisfactory results and maximum performance of the boring bar will not be achieved.

The determination of optimal cutting condition for specified surface roughness and accuracy of product are the key factors in the selection of machining process. In Turning operations, and especially boring operations, are associated with serious vibration-related problems. To reduce the problem of vibration and ensure that the desired shape and tolerance are achieved, extra care must be taken with production planning and in the preparations for the machining of a work-piece. A thorough investigation of the vibrations involved is therefore an important step toward solving the problem.

Researchers have been done to improve cutting tool material, tool geometry and cutting parameter to optimize the machining process. The diameter and length of boring bar are the most important factor has to be considering in boring operation, following the other cutting parameter such as cutting speed, feed rate and depth of cut. The wrong selection of combination cutting parameter will occurs the bad cutting condition e.g. vibration that effect the poor surface finish. Different workpiece material with different property and microstructure give different effect to the cutting tool performance. In lathe boring operation, we found no adequate empirical model for prediction of surface roughness.

In boring operation, the performances of cutting tools are depending on a few cutting conditions and parameters. The proper selection of feed rate has direct effect to the product surface roughness. Turning process by maximizing cutting speed and depth of cut will optimize the cutting process

Volume : 2 | Issue : 3 | December 2012 | ISSN - 2249-555X

and minimize the production cost. The tool life, machined surface integrity and cutting forces are directly dependent on cutting parameters and will determine the cutting tool performances. The study of surface roughness form will resolve the characteristic and phenomena happening during the machining process. The questions to be answered at the end of the study are how does the boring bar tool length and diameter influence the surface roughness during internal turning operation?

3.0 VIBRATION AND SURFACE FINISH RELATION:

In the boring operation, vibration is a frequent problem, which affects the result of the machining, and, in particular, the surface finish. Tool life is also influenced by vibration. Severe acoustic noise in the working environment frequently occurs as a result of dynamic motion between the cutting tool and the work piece. In all cutting operations like turning, boring and milling, vibrations are induced due to the deformation of the work-piece. This implies several disadvantages, economical as well as environmental.

Today the standard procedure toavoid vibration during machining is bycareful planning of the cuttingparameters. The methods are usuallybased on experience and trial and errorto obtain suitable cutting data for eachcutting operation involved in machininga product. Machining vibration existsthroughout the cutting process. Whileinfluenced by many sources, such asmachine structure, tool type, workmaterial, etc., the composition of themachining vibration is complicated.However, at least two types ofvibrations, forced vibration and self excited vibration, were identified as machining vibrations. Forced vibrationis a result of certain periodical forcesthat exist within the machine. Thesource of these forces can be bad geardrives, unbalanced machine-toolcomponents, misalignment, or motorsand pumps, etc. Self-excited vibration,which is also known as chatter, iscaused by the interaction of the chipremoval process and the structure of themachine tool, which results indisturbances in the cutting zone. Chatteralways indicates defects on themachined surface; vibration especially self-excited vibration is associated with the machined surface roughness [9,10].

A large number of theoretical and experimental studies on surface roughness of machined products have been reviewed where cutting conditions (such as cutting speed, feed rate, depth of cut, tool geometry, and the material properties of both the tool and work piece) significantly influence surface finish of the machined parts. The surface roughness can be affected by built up edge formation. The analysis of tool vibration on surface roughness is also investigated by some authors.

4.0 EXPERIMENTAL SETUP

Number of experiments was conducted to analyze the effect of vibration on surface finish. Boring bar of 20 mm × 20 mm cross-section and 200 mm long of WIDAX make is used. The workpiece material used for study is EN9. The boring operations were carried out on CNC turning centre of ACE make.

4.1. The Boring Bar

Two identical boring bars with steel mandrels of length 200mm and diameter 20mm having removable carbide inserts were selected as shown in figure 4.1.

(a) (b)

Figure 4.1: (a) Boring Bar (b) Impact damper mass

Figure 4.2: Boring bar installation Figure 4.3: Sample workpiece

4.2. Experimental Procedure

The work piece was mounted using a pneumatic chuck in CNC turning centre and the clamping pressure was set as10 bar. The machining parameters like feed, depth of cut, clamping pressure, etc. were selected based on the manufacturers recommendations and were kept constant for all the samples used. Only the cutting speed,passive damper position on boring bar and overhang length was changed. The recommended cutting speed, feed, depth of cut, etc. is shown in table 4.1. Boring was carried out for 105mm internal diameter as shown in figure 4.4.

Figure 4.4: CNC turning centre

Table 4.1: Parameters

Boring tool	BT_A	BT_B	
Overhang length L (mm)	40	80	120
Impact Damper position	Vertical	Horizontal	
Clearance CL (mm)	0.4		
Spindle rotation N (rpm)	80	160	240
Feed rate S (mm/min)	0.9		
Depth of cut t (mm)	0.6		

5.0 RESULTS

The figure 5.1 shows the experimental arrangement used to measure the surface roughness of bored parts. A Mitutoyo SJ-201P apparatus was used. The profilometer technique used in this study is common in most machine shops. For each specimen three readings were taken at approximately 600 angles and the average value was found out.

Figure5.1. Surface Roughness Tester

Volume : 2 | Issue : 3 | December 2012 | ISSN - 2249-555X

Table 5.2Surface Roughness or Ra value (μm): Overhang Length= 40mm.

Speed	Job No.	Vertical			Job No.	Horizontal		
		μ1	μ2	μ3		μ1	μ2	μ3
240	6	2.37	2.39	2.51	23	2.76	2.79	2.73
160	4	2.70	2.61	2.65	15	2.96	2.78	2.94
80	7	3.16	3.30	3.28	14	3.29	3.46	3.31

6.0 CONCLUSION

An innovative method is proposed to reduce tool chatter is and enhance surface finish in boring operation. The results prove the particle damping technique has vast potential in the reduction of tool chatter. Also the suppression in tool chatter by using impact damper boring bars is very significant. Boring bars with impact damping are also relatively cheaper than other damped boring bars. It is therefore concluded that impact damping has a good effect in improving surface finish in boring operation.

REFERENCE 1. Satoshi Ema, Etsuo Marui, Suppression of chatter vibration of boring tools using impact dampers, International Journal of Machine Tools & Manufacture 40 (2000) 1141–1156. | 2. M. Senthilkumar, K. M. Mohanasundaram and B. Sathishkumar, A case study on vibration control in a boring bar using particle damping, International Journal of Engineering, Science and Technology Vol. 3, No. 8, 2011, pp. 177-184. | 3. M.R. Duncan, C.R. Wassgren, C.M. Krousgrill, The damping performance of a single particle impact damper, Journal of Sound and Vibration 286 (2005) 123–144. | 4. Steven E. Olson, An analytical particle damping model, Journal of Sound and Vibration 264 (2003) 1155–1166. | 5. B. Moetakef-Imani, N.Z.Yussefian, Dynamic simulation of boring process, International Journal of Machine Tools & Manufacture 49 (2009) 1096–1103. | 6. B. Sathishkumar, K. M. MohanaSundaram, and M. Senthil Kumar, Experimental Studies on Impact of Particle Damping on Surface Roughness of Machined Components in Boring Operation, European Journal of Scientific Research ISSN 1450-216X Vol.71 No.3 (2012), pp. 327-337. | 7. S. Chatterjee, On the principle of impulse damper: A concept derived from impact damper, Journal of Sound and Vibration 312 (2008) 584–605. | 8. R. D. Friend and V. K. Kinra, Particle Impact Damping, Journal of Sound and Vibration(2000) 233(1), 93}118. | 9. K. Ramesh, T. Alwarsamy, Investigation of Modal Analysis in the Stability of Boring Tool using Double Impact Dampers Model Development, ISSN 1450-216X Vol.80 No.2 (2012), pp.182-190. | 10. Safeen Y. Kassab and Younis K. Khoshnaw, The Effect of Cutting Tool Vibration on Surface Roughness of Workpiece in Dry Turning Operation, Eng. & Technology, Vol.25, No.7, 2007.