Optimization of Process Parameters in Boring Operation: A Review

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Abstract **--In order to produce any product with desired quality by boring , proper selection of process parameters are essential. Surface roughness is a measure to determine the quality of bored product. Critical parameters like speed, feed and depth of cut etc. are affect the surface finish. optimization of boring process parameters is highly complex and time consuming. Taguchi robust design is important tool, which offers simple and systematic approach to optimize a design for performance, quality and cost.**

Keywords-Boring process parameters, surface roughness, optimization, taguchi method

I. INTRODUCTION

Boring is a precision machining process for generating internal cylindrical forms by removing metal with singlepoint tools or tools with multiple cutting edges. This process is most commonly performed with the workpiece held stationary and the cutting tool both rotating and advancing into the work. Common applications for boring include the enlarging or finishing of cored, pierced, or drilled holes and contoured internal surfaces. Related operations sometimes performed simultaneously with boring include turning, facing, chamfering, grooving, and threading. Precision boring can be performed on machines specifically designed for this purpose. Boring operations involving rotating tools are applied to machine holes that have been made through methods such as pre-machining, casting, forging, extrusion, flame-cutting, etc. Roughing operations are performed to open up the exisiting hole to within large tolerances and usually to prepare for finishing, which makes the hole to within tolerance and surface finish limits. Typically, boring operations are performed in machining centres and vertical boring machines. The rotating tool is fed axially through the hole. Most holes are through-holes, often in prismatic or round components. External boring operations can be accomplished using specially adapted boring tools.boring operation can be performed on both conventional lathe machine and CNC lathe machines.

Taguchi technique has been used widely for product or process on determining parameters and their performance measure with minimum variation. It is an efficient problem solving tool which can improve the performance of the product, process, design and system with a significant slash in experimental time and cost.

II. BORING PROCESS

Boring is a process of producing circular internal profiles on a hole made by drilling or another process. It uses single point cutting tool called a *boring bar*. In boring, the boring bar can be rotated, or the workpart can be rotated. Machine tools which rotate the boring bar against a stationary workpiece are called *boring machines* (also *boring mills*). Boring can be

accomplished on a turning machine with a stationary boring bar positioned in the tool post and rotating workpiece held in the lathe chuck as shown in figure.

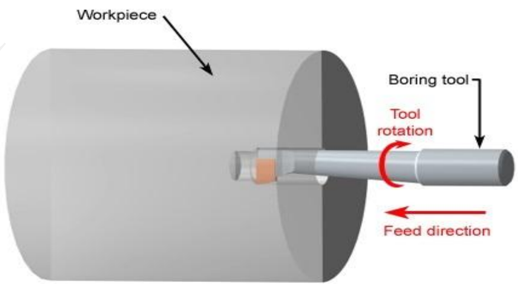

Fig. Boring process

III. BORING PROCESS PARAMETERS

The quality of the boring process depends on the folloing parameters

Speed:

Speed always refers to the spindle and the work piece. When it is stated in revolutions per minute (rpm) it tells their rotating speed. But the important feature for a particular boring
operation is the surface speed, or the speed at which the work piece material is moving
past the cutting tool. It is simply the product of the rotating speed times the circumference
of the work piece before the cut is started. It is expressed in meter per minute (m/min), and it refers only to the work piece. Every different diameter on a work piece will have a different cutting speed, even though the rotating speed remains the same.

$$v = \frac{\pi DN}{1000}\ m/min$$

Here, v is the cutting speed in turning, $D$is the initial diameter of the work piece in mm, and N is the spindle speed in RPM.

Feed:

Feed always refers to the cutting tool, and it is the rate at which the tool advances along its cutting path. On most power-fed lathes, the feed rate is directly related to the spindle speed and is expressed in mm (of tool advance) per revolution (of the spindle), or mm/rev.

.min 1 $m\ F = f\ N\ mm -$ Here, $m\ F$ is the feed in mm per minute, f is the feed in mm/rev and N is the spindle speed in RPM.

Depth of Cut:

Depth of cut is practically self explanatory. It is the thickness of the layer being removed (in a single pass) from the work piece or the distance from the uncut surface of the work to the cut surface, expressed in mm. It is important to note, though, that the diameter of the work piece is reduced by two times the depth of cut because this layer is being removed from both sides of the work.

$$d cut = \frac{D-d}{2} \text{ mm}$$

IV. OPTIMIZATION MODELS OF BORING BY TAGUCHI

Show-Shyan Lin, *et al* investigated the optimization of CNC boring operation parameters for aluminum alloy 6061T6 using the grey relational analysis (GRA) method. The feed rate is identified to be the most influence on the roughness average and roughness maximum, and the cutting speed is the most influential factor to the roundness. Additionally, the analysis of variance (ANOVA) was also applied to identify the most significant factor; the feed rate is the most significant controlled factor for the CNC boring operations according to the weighted sum grade of the roughness average, roughness maximum and roundness.

Balamuruga Mohan Raj. G, *et al* investigated three cutting speeds, three feed rates and three depth of cuts were used in boring operation. Finally the Gaussian Process regression model has been developed to predict the surface roughness based on tool post vibration and cutting conditions. The developed Gaussian model was used in predicting surface roughness for various cutting conditions with tool post vibration signal. The developed prediction system was found to be capable of accurate surface roughness prediction.

K Ramesh, *et al* was concluded that the addition of brass as a damping material reduces the displacement of the tool (amplitude of vibration) and cutting temperature. However, it does not have any major effect on the tool wear during cutting operations. experiments have been conducted using full factorial design on an all-geared head lathes with the experimental setup. The adequacy of the developed model is verified by using the neural network model, which has been developed using the feed-forward back propagation algorithm using training data and tested using test data.

T.Alwarsamy,*et al* investigates the cutting forces are theoretically resolved in the tangential force (*Ft*), feed force (*Ff*), radial force (Fr) directions. When the cutting force decreases with increasing in cutting speed. In all machining concept depth of cut increases obviously increasing Cutting force hastily, hence theoretically proved. A predictive theoretical cutting force model has been developed and influence of cutting parameters on force components has been predicted as graphs using mathematical tool MathCAD 8 professional software.

M. Senthil kumar, *et al investigates* The experimental investigations on the effectiveness of particle damping in vibration control of boring bar are carried out and reported. The particle damping is found to be remarkably effective. Although it is nonlinear, a strong rate of energy dissipation is achieved within a broadband range. It was found that considerable reduction in vibration was achieved with the particle damping. Results from testing different types of particles indicated that the frequency at which maximum damping occurs and the amount of damping obtained depend on properties of the particles. This suggests that the particles can be designed to target vibration reduction in a specific frequency range.

G.M.Shmedayeed, *et al* investigates in turning operation the effects of the changes in tool overhang on the surface quality of the work piece, its microstructure and deflection of the tool experimentally.1. From the experiments performed on the machining parameters, we observed that the surface roughness of work piece increases as the tool overhang increases. 2. Using the same tool overhang, the surface roughness of the work piece increases as the DOC increases. These results are compatible with the literature. 3. In the measurements performed after the experiments were complete, we observed that the cutting tool deflection values increased as the tool overhang increased. 4. Depth of cut parameter adversely affects surface finish.

G.-L. Chern *et al* investigates vibration cutting (VC) has been applied to boring and drilling processes using a vibration device we developed. We analyzed the effect of vibration in boring by investigating the surface roughness of workpiece with the help of Taguchi method and analysis of variance (ANOVA). It has been shown that the utilization of VC in boring improves the surface roughness prominently

L. Rubio , *et al* conclude that the chatter stability of a boring bar with an attached passive dynamic vibration absorber. The stability problem has been properly solved and the stability lobe diagram constructed .The Method could be easily implemented in the design procedure of passive absorbers in boring operation ,an denote that it is fully applicable when the damping ratio of the boring bar is non-null a sit occurs in practical operations.

F. Atabey , *et al* investigates that the chip geometry removed by curved boring inserts is modeled as a function of tool geometry, feed rate and radial depth of cut. As a result, the cutting forces in boring have a linear dependency with the chip area, but non-linear dependency with the feed rate and radial depth of cut. The cutting coefficients are evaluated mechanistically by conducting cutting tests at different feeds, speeds and depth of cuts with inserts having irregular rake face geometry.

Harsimran Singh Sodhi, *et al* investigates Taguchi parameter optimization methodology is applied to optimize cutting parameters in boring. The boring parameters evaluated are, cutting Speed, feed rate, and depth of cut, of the material each at three levels. The results of analysis show that feed rate and cutting speeds have present significant contribution on the surface roughness and depth of cut have less significant contribution on the surface roughness.

Yahya Isik ,*et al* investigates in turning process 1. The coolant helps breaking up chips and removing them from the cutting area more efficiently, which means the cutting tool spent less time for breaking metal chips. 2. The cutting fluid has significantly reduced the amount of heat and friction at the point where a tool cuts into a metal work piece. 3. For most tests, cutting speed did not show a significant effect on surface roughness for both dry and wet machining conditions. The effect of the cutting speed is negligible.

B. Moetakef-Imani ,***et al*** investigates In this research a model is presented to simulate the dynamics of boring process .The proposed approach relies on the novel algorithms of geometrical modeling .In contrast to the previous models that were only able to predict the stability region ,this model computes the dynamic cutting force components and frequencies instable boring operation .The performed cutting experiments have shown that the cutting force components and the vibration frequencies in chatter-free dynamic boring operation could be predicted within 715%errormargin.Themodelisvalid for both finishing(DOC or) and roughing(DOC 4r) boring processes. The model is also able to predict the chatter on set in boring operation.

V. Conclusion

- From the above review it is conclude that speed, feed and depth of cut are most significant parameters. Optimizing these parameters gives better surface finish.
- The use of the Taguchi parameter design technique was considered successful as an efficient method to optimize machining parameters in a boring operation which will tends to reduce the machining time and enhance the productivity.

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