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Research Article

Modification of Honing tool to optimize Honing process

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Abstract

Honing is generally used as finishing technology in manufacturing valves. It consist of multi-stone tool which rotates and reciprocates in motion in axial direction. Honing stones are expanded to the machined surface by special rigid mechanism that provides cutting of work-piece cylindrical surface. The tool vibrates in transverse and axial direction. In this research, we aim to improvise and solve the problems faced while machining i.e production of scratches and chatter marks on internal surface of cylinder, ovality and tapper produced while operation. Formerly, we took a brief analysis of the manufacturing defects including chatter marks, scratches, tapper marks and then studied the parameters affecting it. After a vast research on the machining process and components, we finally discovered the main causes of these problems and found out the solution and implemented the solution. The next step we took was implementation of results and analysis of our calculations and research done. Modifications done will improve and will result in smooth continuous machining operation. A series of honing equipments were carried out to calibrate the parameters and coefficients of model. The modified model thus show good accuracy and smooth surface finishing of products with a long run time and less distortion.

Keywords: *Honing, Scratches, Chatter marks, Machining, Surface finishing*

1. Introduction

The honing process is a slow operation. Honing is a low velocity abrasive process in which stock is removed from metallic or non-metallic surfaces by metal bonded diamond abrasive sticks. It is a finishing operation employed not only to produce high finish but also to correct out-of-roundness, taper and axial distortion in work piece. In honing, since a simultaneous rotating and reciprocating motion is given to the stick, the surface produced will have a characteristic cross-hatch lay pattern.(Permanan, *et al*, 2017) The surface finish has a vital influence on most important functional properties such as fatigue strength, wear resistance, power losses due to friction and corrosion resistance.

The process of honing can be done on many general purpose machines also, such as lathes and drilling machines. In production work where the honing is to be done on a large scale, such machines will fail to give satisfactory and economical results. In such cases, the use of regular honing machines will give the desired results. These honing machines are made in various types and sizes. The most common classification of these are 'Horizontal honing machine and Vertical honing machine' (A.Yadav, *et al,* 2014).

Honing stones also called honing sticks which consists of particles of aluminum oxide, silicon carbide or diamond bonded together with vitrified clay, cork, carbon, metal or resinoid. The abrasive particles which provide the cutting action must be able to withstand the cutting pressure required for the metal removal. The bond must be strong enough to hold the grit, but it must not be so hard as to rub the workpiece and retard cutting. The porosity of the structure of the stick is depending on the mixture of grit and bond. The method and pressure used in forming the sticks, facilitates chip clearance, thereby minimizing the generation of heat.(Rohit Lokhande, *et al*, 2017)

While observing vertical type of honing machine, problem observed commonly was the formation of scratches and chatter marks on internal surface of the workpiece leading to improper surface finish. Due to these problems, reworking was needed which simultaneously leads to an increase in the total cycle time. Mainly the cause of problem is the deviation of tool from its center line due to misalignment shaft and tool axis.

The interaction forces of honing sticks and machined surface are non-conservative and straight configuration of tool shaft is unstable for sonic values of tool stiffness. The increasing of tool stiffness and initial expansion pressure lead to unstable vibrations of shaft. (A. Gouskovet, *et al*, 2003).

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In this work, we intend to report a suitable method of improvising honing process, which will help eliminate the problem of scratches and chatter marks produced in the machining of cylindrical parts and ultimately lead to the production of work-pieces with better surface finish.

2. Methodology

The problems faced during honing process results into various defects and leads to the reworking of parts produced which ultimately leads to the increase in time of production and cost of production. So from various analysis and observations, the tool which is a heavy machine component connected to a shaft which is long enough in length, will cause small misalignment which will result in excess force applied to the cylindrical workpiece .This is because of small gap between outer diameter of tool and inner diameter of workpiece and moreover the tool will deviate from its path.

To eliminate this problem we need to reduce the gap between tool's outer diameter (O.D) and workpiece's inner diameter (I.D) so that even after rotating at a very high speed, it will not deviate from its position.

Our proposed optimum solution is that we need to fill the gap between O.D and I.D which can be done by providing guiding sticks of thickness equivalent to the gap and thus avoiding the deviation of tool. This can be done by creating slots on the tool body to vertically mount the sticks which will rotate with the tool as a single body even when the honing sticks expand.

Fig.1 Tool before and after providing guiding sticks

Selection of guiding stick material plays a vital role because improper selection may lead to excess friction between tool and workpiece and results in the increase in heating problem. The material selected should be such that it should have properties viz. high flexibility, high heat resistance, high corrosion resistance, high wear resistance, light weight and should be cost effective. Considering the following properties and taking into account different materials, we have selected Teflon material as a suitable one. So the guiding sticks made of Teflon material will be placed vertically around the tool circumference in between the honing stones

3. Results and Discussion

In this work we have been able to achieve our prime objectives with lucid understanding of the honing process and its parameters

The following objectives are achieved in this project:

1) Minimize and eliminate the scratches from the surface of the components. This was our prime objective and we achieved this by modifying and improvising the tool of honing machine. As a result the parts produced later after the modifications were scratch free or with very minimum scratches.

2) The parts produced with improved surface finish led to less rejection of parts with the increase in productivity.

3) The objective of reducing the ovality of cylindrical workpiece within suitable limits was achieved successfully by providing Teflon material sticks in the guide ways such that uniform pressure is applied to the entire component being machined without any uneven pressure applied on the component irrespective of the holes and other features of the component thus also reducing tapper.

4) Thus this also led to another achievement of reducing the cost due to the rejection of component faced. The rejection of component before led to an increase in total cost of manufacturing which was insignificant and thus any how was to be reduced. Thus this objective was also successfully achieved.

5) With uniform pressure applied to the component the speed of operation increased simultaneously, as we achieved our objectives. This led to a reduction in the cycle time required per component. Finally a proper manufacturing with reduced cycle time, reduced stresses on the tool and component, proper uniform feed rate and uniform pressure is being carried out on the honing machine.

Total reduction in time: Initial - After = 120 - 90 = 30 min
Total Reduction in cost/hr machining in Indian rupees: Initial-After = 400 - 300 = 100 rupees

Factors like feed pressure, stroke pressure and spindle speed found to play of significant role on parameters like MRR and surface roughness. The effects of the pressure parameters such as feed pressure, stroke pressure and spindle speed and responses characteristics v/s MRR and Ra were studied on gray cast iron in vertical honing machine (Pimpalgaokar M.H, *et al*, 2013)

Table 1 Cycle time for machining i.e machining time in minutes

S. No	Process	Initial Time (mins)	Initial cost (per hr of machining in Indian rupees)	Time After modifications (mins)	Cost after modifications(per hr of machining in Indian rupees)
1	Honing	90	300	90	300
2	Reworking	30	100	0	0
	Total	120	400	90	300

Conclusions

While concluding this report, we feel quite fulfilled in having completed the research work. We conclude that the surface roughness of cylindrical workpieces has been reduced upto permissible limit. Ovality of the cylindrical workpiece has been reduced. Deep line marks are eliminated and surface texture has been improved. Ultimately the rejection of the components has been avoided. Thus we have been able to achieve the prime objective of our research work of improving machining of the components manufactured by honing. Our deep study and extensive research has only made this possible and our hard-work has proved to be a path to success of this research work. Thus we have successfully achieved our project goals and thus gained a fruitful and knowledgeable industrial experience which will not only help us in our future but also will make easy for us to understand any new future invention and modifications in this machine if made so leading to a development of strong pillars of industrial knowledge and engineering.

Finally concluding this report we learnt complete overall honing machine process, parameters and components.

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