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Parametric Optimization of the Boring Process by Alternate Tooling Head to Improve the Productivity of GG25 Cylinder Liner: A Review

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Abstract

Manufacturing in today's era is a critical and essential part of society, which always gets better day by day. The optimization of manufacturing process helps in increasing the productivity and economy for both company and customer, which leads to efficient manufacturing. The boring process is used for enlarging the bore of the cylinder liner. It is an essential process which considered for dimensional accuracy. The optimization of the boring process can lead to increase in productivity. The study investigates the optimization of the boring process by optimizing its process parameters for improving the productivity of GG25 cylinder liner using alternate tooling head.

Keywords: *Boring machine, boring head, design of experiment*

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INTRODUCTION

The manufacturing processes are getting better day by day and resulting in effective production and economy. The machines are the heart of any mechanically based firm which is to be upgraded and maintained with time. When the production is at a high rate the machines or processes play important role in production to be kept efficient enough for a required result.

The boring process is simple internal turning process in the manufacturing process and used to enlarge the holes. The boring process is used after drilling process to maintain close dimensional accuracy which cannot achieve in drilling itself. In simple turn boring process, the workpiece is held in the spindle chuck and the cutting tool insert with a linear motion which advances the workpiece while rotates on its axis which is generally done in CNC having machining center and different operation can be carried out.

The cylinder liner and cylinder sleeves are mainly manufactured using casting process. Thus after casting, to provide close dimensional accuracy the boring process comes in picture. The boring process is done using carbide insert having single point geometry. In the boring process, there are many heads of the boring bar are available in which sandvik provides two different heads for special purpose boring which satisfies for cylinder liner. The head namely 570-STFCR has shown in Figure 1. After study and research, the head is replaced with 570-DSKNR which is shown in Figure 2, for the high rate of production.

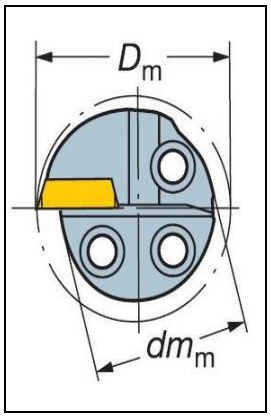

Fig. 1: 570-STFCR

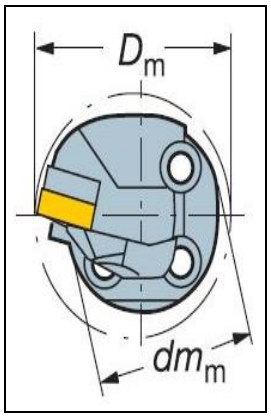

Fig. 2: 570-DSKNR

Where, dm_m in figure is coupling size with bar and D_m is cartridge size of machining process.

The two different heads are shown in Figure 1 and Figure 2 which have positive and neutral rake insert for head used for the boring process.

The research is to be carried out by for new installation of head which give the same number of component in manufacturing than the previous head. Also, the optimization process is to be carried out using design of experiments and validation of experimental results with a mathematical model.

PRIOR TO ART

The boring process used in cylinder liner increases the bore of the cylinder after centrifugal casting process. The various researches are carried out on boring process describing different types of mathematical and experimental techniques for its optimization.

Li *et al*. researches on CNC machine considering its process planning, cutting parameter optimization and using the mathematical algorithm of multiple objective integration models which gives optimized result by experimental optimization of process parameter. It shows the energy efficient manufacturing which is useful for minimizing total energy consumption and also to balance the workloads in production [1]. Koleva *et al*. researches about cutting forces acting on a component which lead to deformation of the component when in contact. With the increase in the free length of the cutting tool, deformation is decreased which is in favor of machining the low stability workpiece and further states that it is necessary for experimental study for defining the value of cutting forces and bore size on machining and its deformation [2]. Kadu *et al*. concludes on basis of a mathematical model that mathematical model can be successfully used for getting an optimized result for process parameter which results in required surface roughness and validated by comparing with experimental ANN results [3]. Kaymakci *et al*. using mathematical modeling for different conventional material removal process allows a general and unique solution for developing a unique model which can be used for analyzing the cutting forces on components and tools [4]. Jain *et al*. describes non-conventional machining and their optimization using genetic algorithms and optimizing process parameter of advanced machining process like WJM in which the obtained optimum solution was used to optimize most influential parameter [5]. Atabey *et al*. studies about single point cutting tool and orthogonal cutting tool and modeling them for operational study which are dependent on feed and DOC for which the **c**utting coefficient were mechanistically evaluated for different feeds, speed and depth of cut, laying the foundation to study forced and chatters vibration in boring operations [6].

R.B. Obara researches on internal combustion defects that occur in development and running of engine like metal folds and reducing up to certain limit but when engine is run then on longer period the metal folds are not removed thus mechanism for metal folds based on plastic deformation is observed and a mechanism for folded metal formation based on plastic deformation of matrix formation were seen near graphite tip surface cracks are suggested [7]. Kai Egashira researches on conventional or new era machining like WJM, EDM *etc*. and also concludes about EDM machining the material removal rate optimization for increasing the bore circularity. Thus providing the feed for EDM for prevention of tool was failure [8]. YEO *et al*. researches using boring process and optimizing using different raw material shows the cost tolerance model and to reduce the cost up to an extent by an approach to optimize production sequence and machining intolerance based on lowest production cost criteria. The paper also shows an AND/ OR tree structure for showing the relation between process [9]. Patel *et al*. describes the optimization of boring operation using taguchi method and obtaining required optimized surface finish under given parameter which concludes that with an increase in feed rate and decrease in speed, the surface roughness increases. Also, the affecting parameter was speed and feed rated for surface roughness [10]. Vaishnav *et al*. researches using taguchi method for optimization of a process parameter of cutting validates the lowest surface roughness on experimenting and implies on the optimized result. The affecting parameter for surface roughness was speed and

feed, also the least affecting parameter was coolant flow rate [11]. Vohra *et al*. describes computational analogy and also by using taguchi method for optimization giving an optimum result on a boring operation which had a most affecting parameter like cutting speed and depth of cut. The results showed were mathematically analyzed using analysis of variance and were validated with experimental results [12]. Lin *et al*. using taguchi method of optimization, an optimized parameter for 6061T6 CNC boring process and confirmed with grey rational analysis on the orthogonal array for an optimum result which concluded that the optimum results were obtained by affecting parameter like cutting speed, feed, and depth of cut which maximized the average roughness. Also using ANOVA the percentage of contribution was found out [13]. Yeo *et al*. shows the EDM process for machining and its used and improvement in silicon boring through electrode and considering the electrode wear taking to optimum. Also, the removal rate of monocrystalline silicon was higher than steel while less wear in electrode was observed. Thus using monocrystalline silicon the high aspect ratio of boring can be attained [14]. Badadhe *et al*. studies of the optimization of a cutting parameter of boring operation using taguchi methods show the optimized result in the process. The most effective parameter was spindle speed, depth of cut and feed rate. Also for different L/D ratio, the optimization was carried out successfully. The mathematical model of Analysis of variance was carried out to validate the experimental results which reduced the machining time and enhance the productivity of boring process [15].

The research on alternate tooling head is to be carried out for the optimization of the boring process used in cylinder liner which will show a variety of result in optimization procedure and the result may obtain and implementable.

METHODOLOGY

The work is to be carried out is comparing the number of components machined from the previous head and the number of components machined from the new head with their required dimensional results**.**

The work further will be for optimizing the boring process for a new head. There are many methods of optimizing which include modeling, predictive and experimental methods. The experimental work will be carried out using Design of Experiment.

There are many design of experimental techniques available to be applied for experimental optimization. From these methods, any one can be carried out according to level and machine boundary and will be validated using a statistical model.

CONCLUSION

The research may conclude the optimization of boring process parameter for manufacturing cylinder liner. By performing experiments using the design of experiments and validating with the mathematical model may get optimized parameter which will be in the interest of economic and effective production of the boring process. The optimization process shall lead to exploring of the effective parameter and validating with mathematical results shall be responsible for signifying the experimental result error which will be led to an economic production and for further purposes.

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