OPTIMIZATION OF OVALITY OF KTM BIKE SMC PART

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ABSTRACT

The purpose of this research is optimizing the ovality by varying the cutting parameter, it is deals with the effect of controllable factors mainly Cutting Speed, Feed Rate, Depth of Cut in optimization of ovality of KTM bike SMC part. the aim of this work is reduce the error called ovality turned work piece the ovality is a output response and machining parameter is input parameter .the Minitab 17is used for the optimization of process parameter of SMC part as well as Response surface Methodology (RSM), Analysis of variance (ANOVA) and Taguchi method for Finding more Controllable Factors for KTM bike SMC part. The ovality has been found by most significant process parameter the effect is caused by cutting parameter in a CNC operation i.e. FR, DOC, CS, Clamping forces. In this paper the Reduction of ovality is shown in Graphs with the help of Different Cutting Parameter at Different Level.

Keyword: - *SMC , Taguchi method, ANOVA, Minitab 17, RSM, Optimization, KTM bike*

1. INTRODUCTION

At present manufacturing industries facing competitions due to the globalization of business. It is required to produce the quality product with precision and to be supplied to the customer at the right time. Moreover the quality of the job produced on the machines depends on the quality and performance of the machine. The industries like RBD engineers manufacture precision components. The KTM Bike SMC (starter motor cover) are used in the Automobiles, which has to be very precise and accurate in Dimensions. In addition these SMC are manufactured in lots. Therefore the production of these components has to be done at faster rate with higher precision. The accuracy of the components is in microns therefore the manufacturing processes have to be done very precisely [1].

The material removal rate depends on two factors which are feed rate and depth of cut. By maintaining and control the position between the cutting tool and work piece is a way to get very good surface quality and positioning accuracy in the machine tool parameter and measurement. Control the factors that influence in the performance of this case study is a contributor to make some project achieved. By control and examine the characteristic during the operation from disturbance like the position of material(radial and feed), clamping force of machine tool, the cutting speed, also the parameters of machine like the cutting speed, feed rate during the cutting operation, depth of cut and others small factors that influence the performance of project. By highlight and alert all of this characteristic will make the proposed of this case study succeeded in reducing the ovality and its performance. Force on the tool involve in the important aspect in machining to provide a good result of some project of case study. It means the right selection and correct measurement example like the clamping force, the tenacity of material and others can make project succeeded. For any manufacturer or who want to involve in machine tool producing, the knowledge and value added for the estimation of force specially in design of machine tool, the performance of machine the tool holder and fixtures and the strength of material is important to learned about the force. The cutting force is a priority in optimizing the tool with right angle and accurate measurement [18].

Nowadays, the features during the turning operation are an important part to be mention clearly because it was a factor that can succeeded some case study or project. A good understanding of the behavior of machine, the relationship between the work piece metal and cutting tool material is a way to do in making a very good condition during the operation. For the case study which is had cutting process, the requirement about the cutting condition and process parameter is most highly important. To determine the cutting parameter, the understanding of ferrous metal behavior must be known first before we decide in material selection. The depth of cut, cutting speed, feed rate and effect of rake angle is a feature that we have to know in effective machining process. The selection of cutting tool materials for particular application is among the most important factors in machining operations. Characteristic of cutting tool is thermal shock resistance, wear resistance, chemical stability and inertness and lastly is toughness. The familiar cutting tool that have been used in industry nowadays is high speed steel (HSS), coated carbide, ceramics, diamond and many others. The characteristic, the application, and limitations of these tool materials in machining operation, including the required characteristic we outlined and including cost. High speed machining has been currently used in this high technology era. Since 1990"s, the estimation of high speed machining has been extensive. By applying the high speed machining to the ferrous metal using turning process to determine the effect of tool material, coating, and cutting operating parameter on cutting force, tool life, and workpiece surface. The majority of turning operations involve the use of simple single point cutting tools [18].

Fig- 1: Geometrical View of SMC Part

2. OBJECTIVE OF PROJECT

The main purpose of this project is:

(a) To study the preferred size of thin wall hollow cylinder used in industrial component making.

(b) To determine the factors affecting accuracy of thin wall cylinder.

(c) To determine the how to maintain an ovality of SMC part.

(d) To determine the thin wall cylinder accuracy with difference cutting parameters using CNC turning machines.

(e) To determine the how to control cutting parameter of SMC part.

(f) To study about different types of tool materials.

(g) To determine others factors, affects the ovality.

The SMC part are manufactured in industry, it is required good accuracy and ovality. which is depends on different cutting parameter. Now the ovality of this part is 100 micron. The main goal of this project maintains the ovality up to 30 micron.it is possible to varying the cutting parameter and changing the other factors.

3. PROBLEM STATEMENT

Nowadays in this high technology era, anything can be providing with any ways especially in engineering field. The demand from customer must be followed by the manufacture to make customer satisfaction. The KTM Bike SMC part are manufactured in industry, Sometimes the requirements of customer maintain the ovality of SMC part up to 30 micron, but industry can able to maintain the ovality of SMC part up to 100 micron. So, to create to make the project can achieve the target, by the variation of cutting parameter and changing the other factors Ovality of SMC part can be decreased.

4. EXPERIMENTAL METHODOLOGY

4.1 Introduction

The SMC part is used in Bajaj KTM Bike. The material used of SMC part is Mild steel, we know that in industrial area required good quality product for customer satisfaction.so, aim of my project is to maintain the ovality of SMC part on CNC turning machine. On CNC turning machine the critical factors which is effect on the product that is cutting parameter this is more essential factors which is affect on the ovality of product so maintain the ovality of SMC part. I am studied about the cutting parameters, cutting tools, and external forces.

4.2 Experimental setup

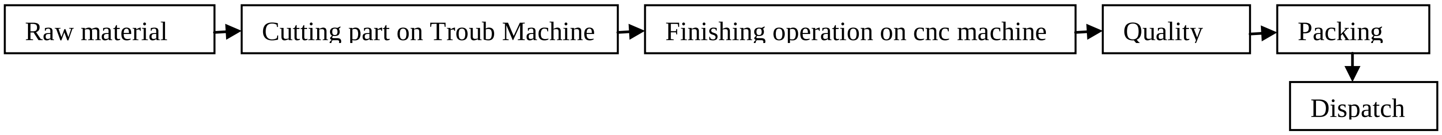
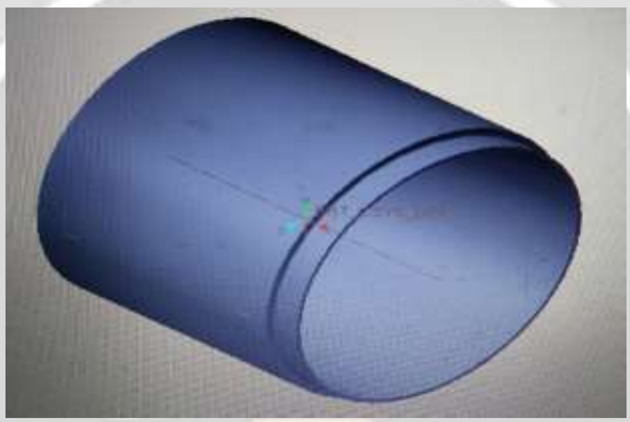


Fig -2: Flow chart of SMC part

4.3 Design of SMC Part



4.4 Experimental setup Description

A) Raw material: as per the customer requirement industry select the mild steel as a raw material for SMC part. The industrial size of this raw material is Ø64.5 x 60 x 3.3, the shape of raw material is cylindrical hollow section thin wall pipe.

B) part cutting on traub machine: Automatic Lathes: TRAUB: The name that has grown synonymous with Single Spindle Automatic Lathes across the world. PMT Machines, a rechristened version of Traub India, manufactures the same machines in India with the complete original design and manufacturing techniques to the highest.

C)Finishing operation on cnc turning machine : Computerized numerical control machine is the advancement over NC machines, CNC is the short form for Computer Numerical control. We have seen that the NC machine works as per the program of instructions fed into the controller unit of the machine. The CNC machine comprises of the mini computer or the microcomputer that acts as the controller unit of the machine. In CNC machine the program is stored in the memory of the computer.

D) Quality of SMC part: Quality is the major factor of industry. Quality means customer satisfaction. If industry maintains the quality or produce good quality of product automatically increase profit and demand of product in market. Since for check the quality of SMC part uses different types of Gauges that is,
1) Go and No Go Gauge,
2) Spinn Gauge
3) Verniear Height Gauge.

4.5 Experimental Design

Number of Experiments to is decided with the help of Taguchi Method using Minitab-17 Software. Three Factors (Feed rate, Depth of cut, Cutting speed) at 3 levels each are as follows:

Table -1: Level of Experimental Parameters

SR. NO.	PARAMETERS	UNIT	LEVELS		
			[-1]	[0]	[+1]
1	FEED RATE [FR]	mm/rev	0.075	0.085	0.090
2	DEPTH OF CUT [DOC]	mm	0.3	0.35	0.4
3	CUTTING SPEED [CS]	mm/min	420	470	520

According to above input to the Design of Experiment using taguchi approach in Minitab-17 Software for optimum no. of experiment it gives 20 Runs For three levels of the three factors.

Table -2: Design Matrix

EXP NO.	FEED RATE [FR] [mm/rev]	DEPTH OF CUT [DOC] [mm]	CUTTING SPEED [CS] [mm/min]
1	[-1]	[-1]	[0]
2	[+1]	[-1]	[-1]
3	[-1]	[0]	[-1]
4	[+1]	[+1]	[-1]
5	[-1]	[-1]	[+1]
6	[0]	[-1]	[-1]
7	[-1]	[0]	[+1]
8	[+1]	[-1]	[+1]
9	[-1]	[0]	[0]
10	[+1]	[+1]	[-1]
11	[0]	[-1]	[0]
12	[-1]	[+1]	[0]
13	[-1]	[0]	[-1]
14	[+1]	[+1]	[+1]
15	[-1]	[-1]	[0]
16	[0]	[+1]	[0]
17	[-1]	[0]	[-1]
18	[-1]	[-1]	[0]
19	[+1]	[+1]	[+1]
20	[0]	[0]	[0]

5. EXPERIMENTAL PROCEDURE

The Experiment Were performed on CNC Machine.

5.1 Parametric Analysis

Ovality model has been obtained by analyzing the data and is given by,

Ovality =[-1089 + 25783 FR + 445 DOC - 0.085 CS- 164135 FR*FR + 95DOC*DOC + 0.000013 CS*CS-806 FR*DOC+ 4.43 FR*CS- 0.79 DOC*CS]

Where,
FR= Feed Rate
CS= Cutting Speed
DOC= Depth of Cut

Table -3: Output Response

EXP NO.	FEED RATE [mm/rev]	DEPTH OF CUT [mm]	CUTTING SPEED [mm/min]	OVALITY [micron]
1	0.075	0.3	470	40
2	0.09	0.3	420	54
3	0.08	0.35	420	70
4	0.09	0.4	420	65
5	0.075	0.3	520	53
6	0.085	0.3	420	42
7	0.08	0.35	520	75
8	0.09	0.3	520	63
9	0.076	0.35	470	64
10	0.093	0.4	420	62
11	0.085	0.26	470	65
12	0.075	0.43	470	60
13	0.08	0.35	385	61
14	0.09	0.4	554	66
15	0.08	0.3	470	63
16	0.085	0.4	470	67
17	0.075	0.35	420	67
18	0.080	0.3	470	68
19	0.090	0.4	520	70
20	0.085	0.35	470	69

5.2 ANOVA Analysis

Analysis of variance (ANOVA) of the overall set is done to show the important parameters. If the P value for a factor becomes less than 0.05 then that factor is considered as significant factor at 95% confidence level. Statistical software with an analytical tool of ANOVA is used to decide which parameter importantly affects the performance characteristics

Learning Objectives:

1. Be able to identify the factors and levels of each factor from a description of an experiment
2. Determine whether a factor is a between-subjects or a within-subjects factor
3. Define factorial design

Table -4: Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	9	1018.06	113.118	2.32	0.0103
Linear	3	172.26	57.420	1.18	0.0366
Feed Rate	1	33.00	33.000	0.68	0.0430
Depth of Cut	1	149.45	149.449	3.07	0.0110
CS	1	21.55	21.553	0.44	0.05
Square	3	332.73	110.908	2.28	0.0142
FR*FR	1	316.1 1	316.106	6.49	0.029
DOC*DOC	1	9.09	9.089	0.19	00.342
CS*CS	1	0.01	0.009	0.00	0.0112
2-Way Interaction	3	31.71	10.568	0.22	0.0432
FR*DOC	1	0.88	0.883	0.02	0.0456
FR*CS	1	16.10	16.101	0.33	0.0389
DOC*CS	1	23.10	23.098	0.47	0.0289
Error	10	487.14	48.714		
Lack-of-Fit	9	474.64	52.738	4.22	0.362
Pure Error	1	12.50	12.500		
Total	19	1505.20			

The ANOVA of reduced model indicates that the model is significant as R-sqr statistics is 81.31

6. RESULT & DISCUSSION

A. Effect of Cutting speed and Depth of cut on Ovality:-

The figures 3 shows the effect of depth of cut and cutting speed on ovality while keeping feed rate constant. contour plot shows that due to the increase in cutting force the depth of cut is increased, ovality is also increased.With increase in cutting speed, ovality is increases gradually but increase is less than depth of cut.

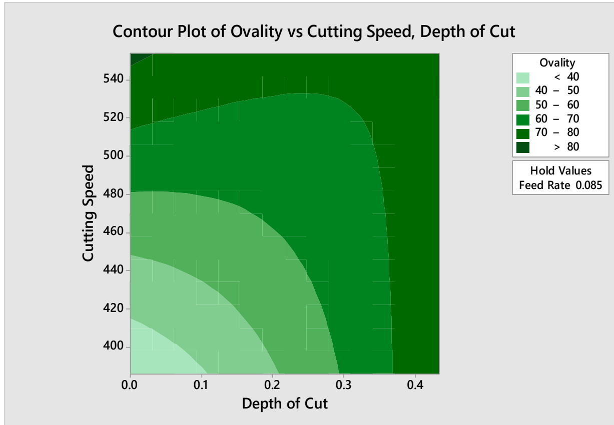


Fig- 3: Contour Plot of Ovality VS Cutting speed, Depth of cut

B.Effect of Cutting speed and Feed rate on Ovality :

The figure 4 shows the effect of feed rate and cutting speed on ovality while keeping depth of cut constant. contour plot shows that changing the cutting speed and feed rate , there is change in the ovality.

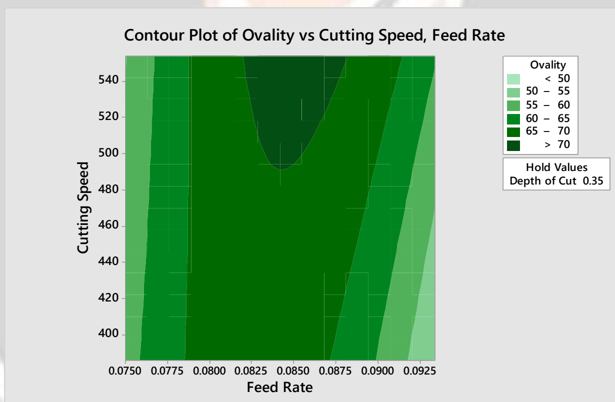


Fig- 4: Contour Plot of Ovality VS Cutting speed, Feed Rate

C. Effect of Depth of cut and Feed rate on Ovality:-

The figure 5 shows the effect of depth of cut and feed rate on ovality while keeping cutting speed constant. contour plot shows that as the depth of cut is increased the ovality is also increased. Contour plot shows that if the depth of cut is increase and feed rate kept in constant the ovality will be inside 5 microns.

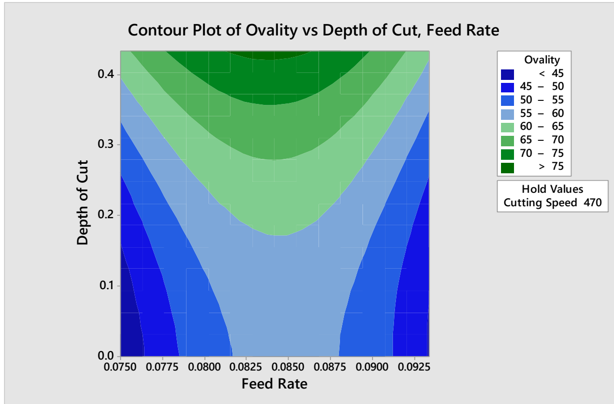


Fig- 4: Contour Plot of Ovality VS Depth of Cut, Feed Rate

7. CONCLUSIONS

1. Experimental results shows that ovality is highly depend on the depth of cut as compared to feed rate and cutting speed. With increase in depth of cut more force is exerted on the workpiece which increase an ovality. At higher feed rate less heat is generated and hence plastic deformation will take place at higher stress which reduces the ovality. Cutting speed and feed rate are less sensitive to ovality competed to depth of cut.

2. The results shows that the in the process of manufacturing the main task to achieve the final ovality up to 30 micron with other Geometrical and Dimensional aspects. The task is complicated due to the hollow cylinder, the process went through several trial before achieving the final ovality up to 30 micron. By optimizing variation of cutting parameter.
3. Taguchi's design of experimental technique was used to find the optimum levels of process parameters in Project. The optimum levels of the cutting parameter is feed rate, depth of cut , cutting speed.

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