MULTI OBJECTIVE OPTIMIZATION OF MACHINING PARAMETERS BY TAGUCHI METHOD

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Abstract- This paper consist of optimization of surface roughness and material removal rate having machining parameters like cutting speed, feed and depth of cut and many more. Here surface roughness and material removal rate are the best way to describe weather the material is highly machining possibilities or not. The paper mainly have parameter consideration which have a great influence to optimized parameter, also have many other result optimizing techniques further. If we will talking about the specialty of the paper so the paper which have all about taguchi and machining have different-different work piece as well as tool.

I. INTRODUCTION

If we have a look around our productive environment we will find that each and every thing passes through a particular machining process. The main thing of this paper is to make the machining optimizing in a very quick time and have high productivity. Optimizing is one of the best factor to obtaining a desired result. Obtaining may be either required or to be obtained directly. In this review paper we will talk about the works have been done on the taguchi optimizing techniques the papers have the following names(tittles). Shyam kumar karna, ran vijay singh rajeshwar sahai are one who wrote this paper named as Application of taguchi method in process optimization. This paper works as a reference paper for me to understand that what is taguchi optimization technique and how it applies and selection of orthogonal array too.[1] As the accordance to joão Ribeiro,luis queijo and others, This paper consist of milling process parameter optimization material steel 1.2738(tungsten carbide coated tool) is used. The final result is minimizing the surface roughness to 1.662µm having radial depth of cut with 64% of contribution for the surface finish. Three level of parameters are used. And the parameter is also 3 and L9 array is used so the number of experiments are 27. Parameter in study are speed, feed radial depth of cut. Now if we are talking about the result obtain in this paper so this is all relates with the surface roughness. Now if we are considering the speed feed, DOC then the surface roughness results to 1.662µm.[2] The author Surendra kumar saini, sharad kumar pradhan says about optimization of multi-objective response during turning using taguchi-fuzzy application that L27 array is used, aluminum with carbide insert having light weight and high strength. as we know that surface roughness and material removal rate plays a vital role in deciding about the productivity in global manufacturing. Designing parameters are speed, feed and depth of cut. in this paper surface roughness and material removal rate both optimized and the taguchi-fuzzy approach for multi responses used. Taguchi-fuzzy is a approach in which we are studying or optimized two opposite things like- man and woman, girl and boy. So as MRR and SR both are opposite in nature means SR required minimum s\n ratio and MRR required maximum s\n ratio. This approach also called as comprehensive output measure. Conclusion among all the selected independent parameters feed is found to be the most effective parameter followed by depth of cut and spindle speed for SR while depth of cut is most significant parameter for MRR.[3] Having accordance to P. Jayaraman and L. Mahesh kumar description of Multiple response optimization of machining parameter of turning AA6063 T6 aluminum alloy using grey relational analysis in taguchi method described. In this paper study taguchi is applying with gray relational analysis and this multi response will results optimized surface roughness, roundness and material removal rate with inputs speed feed and depth of cut. So the question is arises that what is gray relational analysis, answer is when we need to find a known thing from a number of unknown things then this apply and as the name signifies gray, so gray is a combination of white and black so in this same manner we are moving from white(known) to Black (unknown) and we obtain a middle result which is mean(gray). The value of multiple performance characteristics obtained from confirmation experiment is within the 95%confidence interval of predicted optimum condition.[4]

Trial No.	Actual value			R_a (µm)	Roundness (O)	MRR (cm^3/min)
	v (m/min)	f (mm/rev)	d (mm)			
1	119.22	0.05	0.1	0.380	3.63	0.2123
2	119.22	0.075	0.15	0.360	3.9	0.4302
3	119.22	0.1	0.2	0.535	6.4	0.6872
4	158.96	0.05	0.15	0.388	3.85	0.3865
5	158.96	0.075	0.2	0.509	5.36	0.6872
6	158.96	0.1	0.1	0.533	7.37	0.5208
7	198.71	0.05	0.2	0.459	4.12	0.5821
8	198.71	0.075	0.1	0.469	3.73	0.4899
9	198.71	0.1	0.15	0.556	7.1	0.8531

B.Singarve, T. Selvaraj and R.Jaypaul having the 12th global congress on manufacturing and management give our thoughts as in this paper titled as multi objective optimization in turning of EN25 using taguchi based utility concept with principal component analysis. The main thing, this method has been employed for simultaneous minimizing of surface roughness cutting force and maximizing of

material removal rate. The multi SN ratio is obtained by multiplication of SN ratio and weight factor. In this experimental analysis the optimum machining parameter are estimated using taguchi based utility concept coupled with principal component analysis on turning with CVD(chemical vapor deposition) and PVD(physical vapor coated deposition) carbide tools. In this paper input parameters are coated tools, cutting speed feed having output are depth of cut, surface roughness, cutting force, material removal rate. To improve the quality of product a composite index is achieved by combination of various evaluated attributes for improving the rational decision making.

Sl.No	Coated tools	Cutting speed (m/min)	Feed rate (mm/rev)	Depth of Cut (mm)	Surface roughness (µm)	Cutting force (N)	M re (µ
1	CVD	113	0.10	0.5	0.43	110	9
2	CVD	113	0.18	1.0	1.21	302	3
3	CVD	113	0.26	1.5	1.62	561	7
4	CVD	179	0.10	0.5	0.82	129	1
5	CVD	179	0.18	1.0	1.12	243	5
6	CVD	179	0.26	1.5	1.43	469	1
7	CVD	244	0.10	1.0	0.93	154	4
8	CVD	244	0.18	1.5	1.07	395	1
9	CVD	244	0.26	0.5	1.28	165	5
10	PVD	113	0.10	1.5	0.98	359	2
11	PVD	113	0.18	0.5	2.12	138	1
12	PVD	113	0.26	1.0	2.69	258	4
13	PVD	179	0.10	1.0	1.45	131	2
14	PVD	179	0.18	1.5	2.37	419	8
15	PVD	179	0.26	0.5	2.83	221	3
16	PVD	244	0.10	1.5	1.74	309	6
17	PVD	244	0.18	0.5	2.38	159	3
18	PVD	244	0.26	1.0	2.92	252	1

The taguchi utility concept coupled with PCA is found to be very simple method used for simultaneous minimization of surface roughness, cutting force and maximization of metal removal rate.[5] Analysis of surface roughness by turning process using Taguchi methodby S. Thamizhmanii, S. Saparudin, S.Hasan concludes that purpose of this paper is mainly analysis of optimum cutting condition to get lowest surface roughness in turning SCM 440 alloy steel by taguchi. In this paper cutting parameters are used as speed feed and depth of cut and the surface roughness will optimized. The the surface roughness decreases with increasing nose radius, larger the nose radius tools have produced better surface roughness.

This research gives how to use taguchi parameter design to obtain optimum condition with lowest cost, minimum number of experiments and industrial engineering can use this method. The research can be extended by using tool nose radius, lubricant, material hardness, etc as parameter.[6] Narendra kumar verma and Ajeet singh sikarwar author of Optimizing turning process by taguchi method under various machining parameters write this paper AISI 1045 steel with coated cemented carbide tool under dry cutting condition.Array L9 is used, and both material removal and surface roughness are optimized. The optimal value of surface roughness is 2.35 µm and surface roughness is 44.15 mm2/min.

Experiment no.	Spindle speed (rpm), N	Feed rate (mm/rev), f	Depth of cut (mm), d	Surface roughness, Ra (µm)	S/N ratio of surfaces roughness
1	160	0.3	0.7	2.24	-7
2	160	0.4	0.8	5.67	-15.07
3	160	0.5	0.9	5.93	-15.46
4	320	0.3	0.8	5.34	-14.55
5	320	0.4	0.9	4.87	-13.75
6	320	0.5	0.7	6.07	-15.66
7	620	0.3	0.9	2.91	-9.27
8	620	0.4	0.7	3.78	-11.54
9	620	0.5	0.8	5.05	-14.06

The researcher also mention that as further scope of paper and taguchi other factors like nose radius, type of inserts, cutting condition like wet and dry may also further study.[7] Mahadev Naik, Ashish gorule and others as a author of this paper on optimization of turning process parameters for AISI 410 Steel using taguchi method give a optimized result as surface roughness. As we know that now a day's surface finish is most important requirement for many machining process and requirement of high productivity increases.[8] According to Dalip kumar and Kulbhushan Sharma,this paper consist the taguchi method of optimization and here optimizing is opted on CNC turning process. The turning will held on the EN24 (Capable of retaining good impact values at low temperature). In this paper surface roughness is optimized. Surface roughness measured has been done using a portable stylus-type talysurf instrument.

S.no.	Speed (rpm)	Feed (mm/rev.)	D.OC (mm)	Nose rad.	Ra
1	1600	0.08	0.5	0.4	1.144
2	1600	0.08	0.5	0.4	0.688
3	1600	0.08	0.5	0.4	0.66
4	1600	0.1	0.75	0.8	0.936
5	1600	0.1	0.75	0.8	0.888
6	1600	0.1	0.75	0.8	0.998
7	1600	0.12	1	1.2	0.786
8	1600	0.12	1	1.2	0.856
9	1600	0.12	1	1.2	0.82
10	1700	0.08	0.75	1.2	0.576
11	1700	0.08	0.75	1.2	0.464
12	1700	0.08	0.75	1.2	0.668
13	1700	0.1	1	0.4	1.082
14	1700	0.1	1	0.4	0.9
15	1700	0.1	1	0.4	1.264
16	1700	0.12	0.5	0.8	0.502
17	1700	0.12	0.5	0.8	1.014
18	1700	0.12	0.5	0.8	0.904
19	1800	0.08	1	0.8	0.59
20	1800	0.08	1	0.8	0.764
21	1800	0.08	1	0.8	0.93
22	1800	0.1	0.5	1.2	0.51
23	1800	0.1	0.5	1.2	0.534
24	1800	0.1	0.5	1.2	0.494
25	1800	0.12	0.75	0.4	1.09
26	1800	0.12	0.75	0.4	1.474
27	1800	0.12	0.75	0.4	1.178

This have the following orthogonal array. surface finish in turning found to be influenced by a number of factors like cutting speed, feed rate and depth of cut. The various simple surface roughness parameters used in the industries such as average roughness (Ra), where f= feed rate (mm/rev) and R= tool nose radius (mm). It means that surface roughness increases with increasing feed rate and a large tool nose radius reduce surface roughness of the work piece. The analysis reviews that feed rate and cutting speed are the main factors affecting the surface roughness and vibration. Principal cutting edge angle and depth of cut are the least affecting factors. Feed is the most influencing controlling factor on surface finish. The depth of cut was found to be less Insignificant on surface roughness but with decreasing depth of cut surface roughness will decrease. Direct effect of cutting speed, depth of cut & cutting speed has influence on the measurement of surface roughness. This roughness increases with the increase of speed up to middle level and then decreases.[9] Krishnkant , jatin taneja, mohit bector and rajesh kumar have been given their views in this paper, application of taguchi method method for optimizing turning process by the effects of machining parameter. Dimensions are 60mm diameter and the material is EN24 steel. L9 array is used. In this research all the process of minitab (software) is represented which make it easy to understand.[10] Fatima nagarwala, pranav mankikar and V.S.Kanthale author of Design of experiments for optimization of cutting parameter for turning of AA7075 aluminum alloy. L27 array is used here and this document gives a brief introduction on design of experiments and the various types of methods use same. For this study, turning parameter for AA7075 aluminum are taken into consideration. In this study comparison between taguchi and regression method is used. Regression process is the process of determining the relationship between two variables is called as regression. From regression analysis the coefficients of each parameter are obtained the regression equation makes it clear that 1unit increase in speed will cause surface roughness increase by 0000266724 and I unit increase in feed causeses very significant increment in surface roughness by 44.2358097.[11] Accordance with Sayed Baba N, Akbar basha S about parameter optimization of surface roughness and material removal rate on HPMMC(hybrid particulate aluminum metal matrix composite) Taguchi method. The presence of the graphite in ceramic (SiCP) reinforced aluminum metal matrix composites gives the better machining performance on machining process. It was observed that the increase in graphite reinforcement with addition of SiC will improve the MRR with good surface finish. The surface roughness is dependent on speed and feed rates of cutting process majorly. The MRR is majorly dependent on the speed and DOC of cutting process.[12] Akhil soman, Anbarasan N and others take some different point of view to optimize the machining as in this experiment, experimental study on the effect of electric current applied at the interface of cutting tool and workpiece for turning operation. The wear of a cutting determines its life lesser the wear, more is the life of cutting tool and consequently the tool has to be replaced less frequently . Optimization of the process use of cutting fluids for lubrication and hard coatings on the tool are widely Used methods to reduce tool wear. The wear rate of the anodic surface was reduced and that of cathodic surface was increased. This paper attempts to study the effect of application of DC electric current on wear turning insert during the turning operation of stainless steel 304 material. As the conclusion the wear rate of the tool is made a cathode and the work piece as node a cathode and the work piece as anode. The tool wear rate was much higher when compared to normal turning operation in the absence of external electric current. When the tool was made as anode the tool wear rate was reduced and the wear was lower compared to normal turning operation in the absence of external electric current. Improvement in machining of steel was also observed.[13] João Eduardo Ribeiro, manuel Braz cèsar Hernãni Lopse on 2nd international conference on structural integrity, portugal take this research as Optimization of machining parameters to improve the surface quality so the surface roughness will influence the quality and effectiveness of the subsequent coating for protection against corrosion, wear resistance and finishes quality of decorative layers. It is noted that the minimum roughness measured was 105µm. the result shows that the radial cutting depth and the interaction between the radial and axial depth of cut are the radial cutting depth of cut are the most relevant parameters, being their contribution for the minimization surface roughness about 30% and 24% respectively. The taguchi method proved to be quit robust and allowed in this study to determine the contribution of each of machining parameter and their interaction. Through the analysis of the values it is shown that the most important factors are radial cutting depth and the interaction between radial cutting depth and axial cutting depth, leading to the minimization of surface roughness, being their contribution of about 30% and 24% respectively.[14] Roopsandeep Bammidi and others author of optimization of single point turning tool. Metal cutting process from the basis of the engineering industry and is involved either directly or indirectly in the manufacture of nearly every product of our modern civilization, basically this paper includes designing of single point cutting tool with commercial angles and then the analysis of it. After knowing the results of analysis we modified the geometrical design and designed various tools then analyzed them individually. Different tools are used like 18-4-1- HSS, 8-4-1 HSS, cobalt based HSS, Carbides, Abrasives, diamond, cubic boron nitride, ceramics, cast alloy, by using these tools we will optimized the result by taguchi method. The optimal tool geometry Is expected to have many more tool life than the basic tool. To achieve the greatest machining efficiency we must use the maximum depth of cut consist with the available power and rigidity of work piece and machined and obtain the cutting speed to give the desired tool life.[15] Nagaanjeneyulu Avinash.M describe about optimization of cutting tool life parameters by application of taguchi method on a CNC milling machining , milling operation is performed on it by using poly crystalline cubic boron nitrite as the cutting tool material and En 8 steel as work piece material to predict the tool life. Data is collected from CNC milling machine. The input of model

consist of feed rate cutting speed and depth of cut while the output from the modal is the tool life which is calculated by taylor's tool life equation.this research is to test the collection data by taguchi method. The optimization of the tool life is studied in the comparison of relationship of the parameters involved. The result of analysis shows that depth of cut was the only parameter found to be significant. The analysis also shows that the predicted value and calculated value are very close, that clearly indicates that the developed model can be used to reduce the cost of machining.[16]

Dhrindom Sonwal, Parimal Bakul Thuleshwar nath and Dhrupat Sharma have opinion on taguchi optimization of cutting parameters in turning AISI 1020 MS with HSS tool. In this paper the effect of three cutting parameters spindle speed, feed and depth of cut on surface roughness of AISI 1020 mild steel bar in turning was investigated and optimization to obtain minimum surface roughness. A confirmatory experiment the average value of surface roughness is found to be 2.408 µm which is well within the range (0.418 µm to 4.299 µm) predicted for confirmatory experiment. A confirmatory experiment is done considering the predicted optimal setting of the factors to verify the result. [17] Accordance with Lakhan singh, Rajeev choudhary, Deepak kumar juneja on optimization of cutting parameters based on taguchi method of AISI 1316 using CNC lathe machine. The main thing of research is have focus on the analysis of optimum cutting conditions to get lowest surface roughness in CNC turning. Each and every input parameters works on quality improving of surface roughness and the result shows that the maximum effect on surface roughness produce by depth of cut. The surface roughness of workpiece is least affected by turning cutting speed.[18]

II. CONCLUSION

Now studying these all papers we can summarize our study on these paper as the taguchi is very vast and it can also proceed with the some other kind of process with this for optimizing more than one result and it is also observed it is a robust process that it can apply each and every places, things and process.

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