OPTIMIZATION OF MACHINING PARAMETERS IN THE CUTTING ACTION OF TEXTURED CARBIDE TOOL USING GREY RELATION ANALYSIS IN TAGUCHI METHOD

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CERTIFICATE

It is certified that the work contained in this thesis entitled“**Optimization of Machining Parameters In The Cutting Action Of Textured Carbide Tool Using Grey Relation Analysis In Taguchi Method**”, by **Sreelakshmi V** (1180456005), for the award of **Master of Technology** from BabuBanarasi Das University has been carried out under our supervision and that this work has not been submitted elsewhere for a degree.

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Optimization of Machining Parameters in the Cutting Action of Textured Carbide Tool Using Grey Relation Analysis In Taguchi Method

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ABSTRACT

In this paper presents a novel approach for optimization of machining parameters on hard turning of AISI 1055 (EN9) steel by using textured TNMG16 triangular tungsten carbide tool inserts with multiple responses based on techniques of grey relation analysis in Taguchi method and entropy weight. Experiments are conducted under dry machining condition. In the present work turning parameters such as Cutting speed (Vc) federate (f) depth of cut (t) are optimized considering multiple responses such as cutting force (CF) cutting temperature (CT) surface roughness (Ra).Gray relation analysis used to determine grey relation grade (GRG) and identified the optimum levels of parameters .the significant contribution of parameters on responses are determined by ANOVA. Validation of the test results are confirmed by conducting confirmation test. The optimal outcome shows improvement of 53%, 16.27%, and 66.88% on responses CF, CT, Ra respectively and 0.2970 improved GRG. Experimental upshots have proved that the responses in turning process can be enhanced efficiently through this approach

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LIST OF ABBREVIATION

Abbreviation	
ANOVA	Analysis Of Variance
CF	Cutting Force
CT	Cutting Temperature
EDM	Electric DischargeMachine
F	Feed Rate
GRA	Grey Relation Analysis
GRC	Grey Relation Coefficient
GRG	Grey Relation Grade
HSS	High speed steel
OA	Orthogonal Array
PVD	Physical Vapor Deposition
Ra	Surface Roughness
t	Depth Of Cut
WC	Tungsten Carbide

CHAPTER 1

INTRODUCTION

The manufacturing industries are continuously challenged for attaining superior productivity and high quality production so as to remain competitive. Turning is a salient and widespread process in engineering industries. When machining stainless steels, it is important to use the suiTable tools that are designed for Medium carbon steel. Commonly cutting tools used for machining stainless steels is either high speed steel (HSS) (wrought or sintered) or cemented carbide tools [7] Tungsten carbide has been well known cutting tool for its best performance, high hardness, strength and wears resistance. Tungsten carbide (WC) typically consists of tungsten-carbide particles bonded together in a cobalt matrix. [21] The combined effect of higher machining forces and higher tool wear deteriorates surface finish of the work piece [4]. The surface roughness plays major role for product quality and its function in manufacturing industries .[23] In hard turning the absence of cutting fluid results in increased friction, heat generation, and adhesion of work piece material on the tool surface. This result in reduced tool life and thermal damage to the work piece[10] Texturing of the cutting tools has recently emerged as a promising and green machining method for effective heat removal from the machining zone[18] have reported that texturing of the cutting tools can improve performance in machining of various materials by reducing the machining zone temperature, decreasing machining forces, and improving wear resistance of the cutting tool .[22] There are no rules and guidelines for designing effective textures and these parameters are currently optimized using trial and error method only.[15]The effect of texturing of the cutting tools to improve machining of EN 9 steel by tungsten carbide tool has not been studied. Therefore, this paper attempts to study the optimal combination for best textured design from dot parallel and vertical line texturing.

CHAPTER 2

LITERATURE REVIEW

In order to enhance the cutting performance in manufacturing industry, a collection of research journals has been analyzed. This study indicates findings that helps the industry to improve the cutting performance.to maintain such quality of work the tribological studies are fundamental. Which interprets the study of interactive surfaces in relative motion .therefore all the research work implies that texturing as one method that improves the performance at the insert and work piece interface. Few of these research papers were investigated and the details are mentioned as follows.

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Authors	Title	Description	Conclusion
Mayur S. Sawant et.al[21]	Influence of spot and dimple texturing of HSS cutting tool on machining of Ti-64l-4v.	Study of spot and dimple texture by micro plasma transferred arc powder deposition (µ-PTAPD) process on rake face of the HSS cutting tools and this HSS tools were used in turning of Ti-6Al-4 V alloy and their performance was compared in terms of machining forces, flank wear, tool temperature, chip shapes, and surface roughness of workpiece	Spot textured cutting tool resulted least value cutting ans thrust force ,chip tool contact length, tool temperature flank wear and segmented chips. HSS tool with spot texture rake face economical effective and environmental friendly.
Youqiang Xing et.al[29]	Cutting performance and wear mechanism of nanoscale and microscale textured Al2O3/TiC ceramic tools in dry cutting of hardened stee	The effect of the textures on the cutting performance was investigated using the textured self-lubricated tools and conventional tools in dry cutting tests. The tool wear, cutting force, cutting temperature, friction coefficient, surface roughness and chip topography were measured.	Resulted reduced cutting force, cutting temperature, friction coefficient and tool wear in Nano scale and micro scale textured self-lubricated tools The developed tool with wavy micro scale textures on the rake face is the effective in improving the cutting performance

Noritaka Kawasegia et.al[10]	Development of cutting tools with microscale and nanoscale textures to improve frictional behavior	Texturing micro scale or Nano scale features on a solid surface fabricated using a femtosecond laser. The effect of the texture shape on the machinability of an aluminum alloy	lower cutting forces were achieved when the texture was perpendicular to the chip flow direction rather than parallel
Kedong Zhang et.al[11]	Effect of microscale texture on cutting performance of WC/Co-based TiAlN coated tools under different lubrication conditions	The effect of the textures on the cutting performance was investigated using the textured coated tools and conventional coated tools in cutting AISI 1045 hardened steel tests.	The presence of microscale grooves created by laser technique on rake face resulted in decrease in the cutting forces, coefficient of friction, surface roughness and tool wear comparing to the un textured tools The cutting performance of textured tools was enhanced, especially under the full lubrication condition.
Mozammel Mia et.al[14]	Effects of duplex jets high-pressure coolant on machining temperature and machinability of Ti-6Al-4V superalloy	effects of duplex coolant jets on chip-tool interface temperature studied and machinability investigation the surface roughness, cutting force, tool wear and chip formation have been analyzed at varying cutting speed and feed rate combinations	The duplex-jets of pressurized coolant are capable of creating effective cooling and lubrication The main cutting force is reduced and tool performance enhanced by prolonged tool life by HPC.
Roshan et.al[19]	Performance of laser surface textured high speed steel cutting tool in machining of Al7075-T6 aerospace alloy	The effect of the laser parameters like wavelength and fluence on the dimensions and form of individual dimples were studied	Use of textured cutting tools resulted in reduction of both cutting and thrust forces. The tool-chip contact length is also less in the case of textured tool.

			The results show that textured high speed steel tools can significantly improve the metal cutting process while dry machining ductile workpieces
Amlana Panda et.al[1]	Multi-attribute decision making parametric optimization and modeling in hard turning using ceramic insert through grey relational analysis: A case study	parametric optimization of multi-responses such as flank wear and surface roughness during machining hardened AISI 52100 steel (55±1) steel using mixed ceramic insert under dry environment through grey relational analysis combined with Taguchi approach	grey-based Taguchi methodology has been proved to be efficient for solving multi-attribute decision making problem as a case of hard machining environment
Damir graguras et.al[5]	Influence of rake face texturing on machining performance of carbide tools	8 carbide tools with different rake face texturing have been tested and evaluated over following factors: (i) cutting force, (ii) chip shape and (iii) surface roughness	Rake face texturing does affect machining performance of carbide tools Best performance provides parallel textured tools shape and orientation of the texturing does have an influence on cutting force,chip length,cutting force and surface roughness

Carlos A A leal et.al[13]	Chamfer texturing of tungsten carbide inserts applied to turning of grey cast iron	laser texturing the cutting edge chamfer of uncoated tungsten carbide inserts aiming at weakening the stability of the seizure region .Two parallel columns of dimples with variable distance were produced and the turning experiments were carried out dry with the application of minimal quantity lubrication	Longer tool lives were promoted when turning using textured tools in the presence of MQL. The average value of the turning force components was lower when textured tools were employed and tools with dimples 100 μm apart promoted the lowest average forces.
A M Zaharudin et.al[30]	Influence of cutting speed on coated TiCN cutting tool during turning of AISI 316L stainless steel in dry turning process	The surface finish of AISI 316L stainless steel work piece, wear rate and tool life of uncoated and coated TiCN insert in turning of stainless steel was investigated	The higher the cutting speed applied produced a smoother surface finish for the work piece. Cutting speed have affected the wear rate, the flank wear length and tool life of the cutting tool insert The surface quality of the work material become smooth even though the wear rate increase and tool life decrease
P. Jayaramanet.al[8]	Multi-response Optimization of Machining Parameters of Turning AA6063 T6 Aluminum Alloy using Grey Relational Analysis in Taguchi Method	Experiments are conducted on AA 6063 T6 Aluminum alloy. Turning tests are carried out using uncoated carbide insert under dry cutting condition. turning parameters such as cutting speed, feed rate and depth of cut are optimized considering the multiple responses such as surface roughness roundness and MRR .	feed rate, depth of cut are prominent factors which affect the turning of aluminum alloy There is an improvement in the S/N ratio from the initial cutting parameters to the optimal cutting parameters of GRG

Kishor Kumar Gajrani et.al[4]	Environmental friendly hard machining performance of uncoated and MoS_2 coated mechanical micro-textured tungsten carbide cutting tools	performances of six different mechanical micro-textured (MμT) cutting tools are compared., three different types of MμTs are fabricated on the cutting tool rake face Using Vickers hardness and micro-scratch testers. Furthermore, a set of MμT tools are coated with molybdenum disulphide dry machining	MoS_2 coated perpendicular MμT tool performs better among all

CHAPTER 3

EXPERIMENTATION AND TEST RESULTS

3.1 Work piece material, Cutting tool, Operator tool and Measurement

In this experiment work AISI 1055 (EN9) steel was used as the work piece. The work piece is medium carbon steel grade commonly available as rolled condition. It can flame or induction hardened to produce high surface hardness steel for shafts, axes, knives, crankshafts, screws ,sickles wood working drills and hammers ,etc. .Dimension of the work piece is φ30mm-100mm.the chemical composition of EN9 steel is in Table 1and physical and mechanical properties in Table 2. The cutting tool inserts for the hard turning operations is used commercially available negative mixed AlTiN thin PVD coated TNMG16 triangular tungsten carbide (WC) which produced by a processing called sintering. Properties of tungsten carbide cutting tool in Table 3. Surface texturing on tool inserts are conducted on built in Scarmax electrical discharge machine (EDM) ZNC S430S with capacity of 380L.The spark EDM machine used copper electrode φ0.7 mm for making vertical and parallel textures on specimen with inputs of 40v-80v and 4amps.A brass tool used in drilling EDM ZNC φ0.8 mm for making dotted textured surface on specimen with input of 40v-80v and 2amps

Fig. 1.MTJN2020K16 WIDAX used as a tool holder for the WC inserts. The turning operations were carried out by Qetcos HMT LMT20 center lathe machine. The response parameters cutting force(CF)is measured by Unitech scaleslathe tool dynamometer model UIL 15.the cutting temperature (CT)is recorded using fluke 59max+ IR thermometer (-30ºC-500ºC).the surface roughness (Ra) is measured by the Surfcom 130a Zeiss profilometer.

Table 1. EN 9 alloy steel round bar chemical composition

material	carbon	phosphorus	manganese	Sulphur	silicon
EN9 steel	0.50-0.56%	0.06%	0.50-0.80%	0.06% max	0.05-0.35%

Table 2. EN9 alloy steel round bar physical and mechanical properties

Density(g/cm^2)	8.08
Melting point(^{o}C)	1425
Tensile strength(MPa)	551
Yield strength(MPa)	241
Rockwell hardness scale	B
Elongation (%)	30

Table 3.properties of tungsten carbide cutting tool

Property	range
Poisson's ratio	0.2-0.22
Shear modulus	243-283
Tensile strength	370-530
Young's modulus	600-686

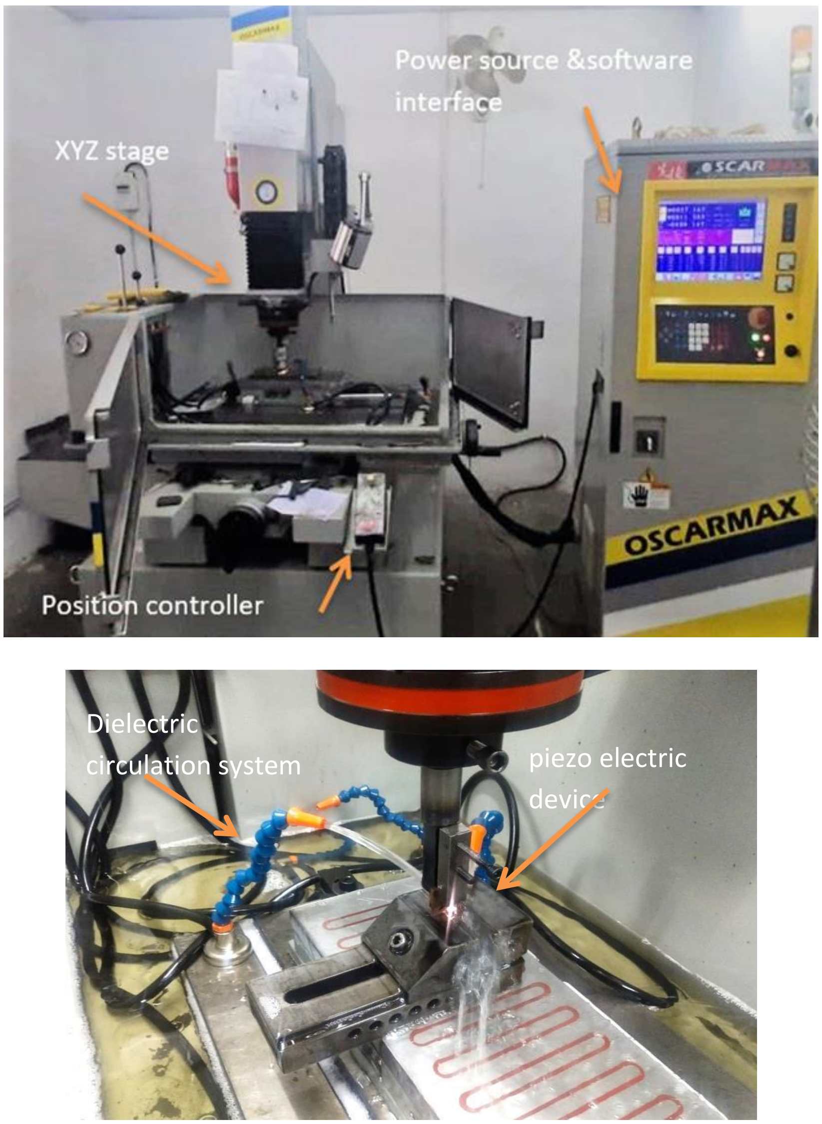

Fig. .1 EDM experimental setup

3.2 Turning Conditions And Method

Cutting speed (Vc) federate (f) depth of cut (t) were considered as machining parameters. The values of cutting parameters were selected from the manufacturing and machinery handbook recommended for the tested material and the operator machine conditions. Cutting parameters and their levels are given in Table 4.The all four WC tool inserts are for conducting dry machining shown in Fig. .2 .The dimensions are for dot texture diameter of 0.8mm dots and for other two textures width of line is 0.7mm with a gap of 0.1 mm.

Taguchi L9 orthogonal array was used for the design the test runs with three factors (CF, CT, and Ra) and three levels. Each tool inserts are considered same L9 orthogonal array experimental conditions as it is powerful tool used in design of experiments [12].The assignments of the levels to the factors and the different input conditions used are given Table 4.

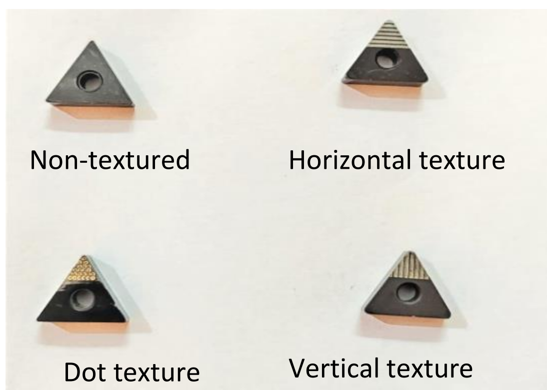

Fig. 2.WC tool inserts

Table 4. Assingments of the levels of factors

Factors	symbols	Level 1	Level2	Level3
Cutting speed (m/min)	Vc	75	120	165
Feed rate (mm/rev)	f	0.026	0.021	0.016
Depth of cut (mm)	t	1.00	0.75	0.50

According to the input conditions the test runs were conducted in a central lathe machine and tabulated for each textured and non-textured tool inserts given in Table 5,6and Table 7

Table 5. Experimental results for L9 orthogonal array on dot texture

Trial no	Input conditions			Dot textured insert		
	Vc(m/min)	f(mm/rev)	t(mm)	CF(N)	CT(^oC)	Ra(μm)
1	1	1	1	366	64.5	2.452
2	1	2	2	257	65.2	2.312
3	1	3	3	195	52.6	1.533
4	2	1	2	271	105	1.671
5	2	2	3	229	90.7	0.927
6	2	3	1	231	96.1	1.321
7	3	1	3	167	107.2	0.887
8	3	2	1	130	109.6	1.5053
9	3	3	2	163	106.1	0.814

Table 6. Experiment Results Of Non-textured

Experiment No.	Cutting force (N)	Cutting temperature (°C)	Surfaceroughness(microns)
1	389	77.5	2.462
2	267	66	2.377
3	218	50.5	1.834
4	261	119.7	1.915
5	252	108.7	1.739
6	264	112.3	1.441
7	194	117.4	1.041
8	191	133.6	1.26
9	169	128.6	1.128

Table 7 . Experiment Results Of Parallel &Vertical line Texture

	Vertical line textured			Horizontal line textured		
Expt No.	Cutting force (N)	Cutting temperature (°C)	Surface roughness(microns)	Cutting force (N)	Cutting temperature (°C)	Surface roughness(microns)
1	377	68.5	2.762	371	71.6	2.854
2	263	61.2	2.177	264	65.2	2.261
3	214	58.1	1.734	207	59.6	1.786
4	260	110.6	1.515	274	115.4	1.662
5	244	95.1	1.439	236	98.4	1.524
6	258	105.2	1.241	255	93.3	1.374
7	188	109.3	1.041	173	110.5	1.022
8	176	111.6	0.96	153	125.7	1.112
9	164	110.6	0.991	160	118.1	1.034

Comparison of experiments results carried out in order to find the best performed design. For that each response were considered. Comparison study of cutting forces on textured and non-textured WC tool inserts are statistically shown in Fig. 3. From that arrived a conclusion that The cutting force of textured machining is reduced 8.8%(dot textured machining),6.78%(vertical line textured machining),5%(parallel line textured machining) than that of plain machining

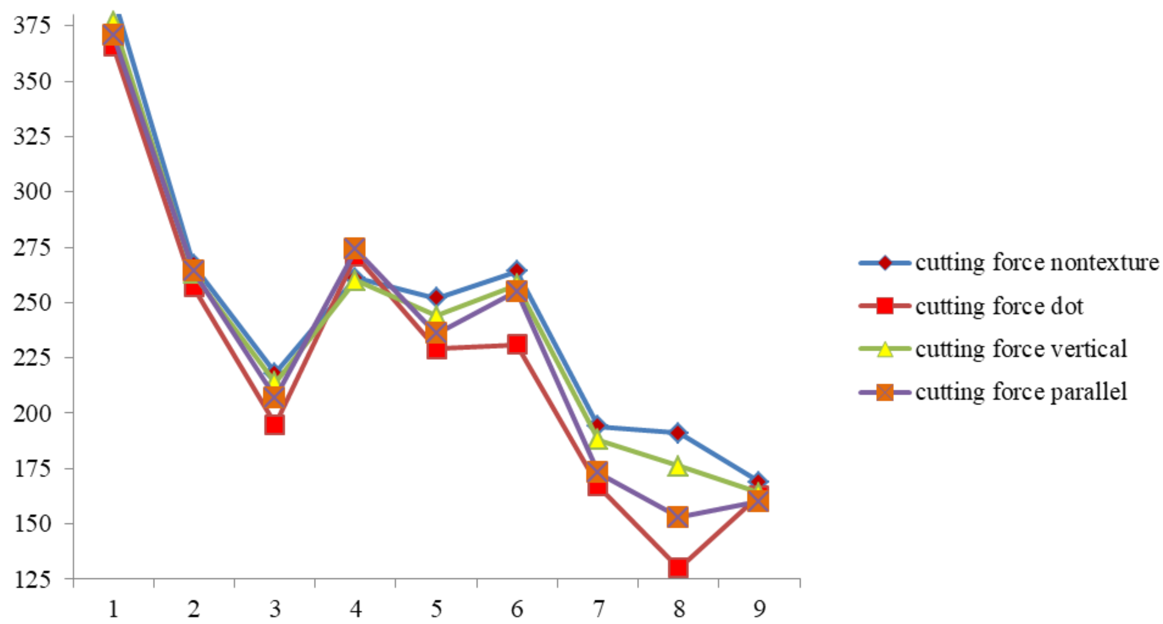

Fig. 3 Comparison of cutting force

Second response parameter cutting temperature also taken for the comparison study shown in Fig. 4 and found out that. The cutting temperature of textured machining is reduced 12.8%(dot textured machining),9.1%(vertical line textured machining),6.1%(parallel line textured machining) than that of plain machining.

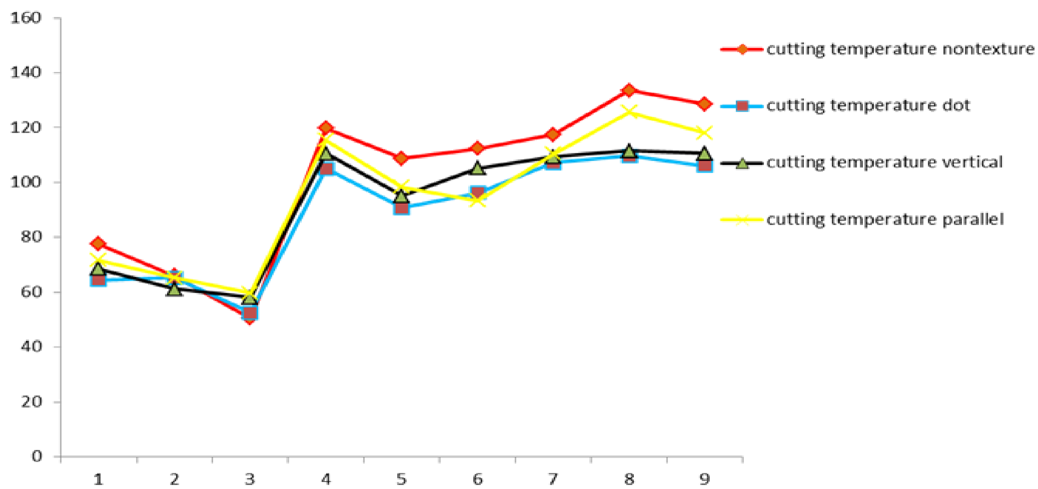

Fig. 4 Comparison of cutting force

Last response parameter surface roughness compared and shown in Fig. 5.which indicates that The surface roughness of textured machining is reduced 11.3%(dot textured machining),8.3%(vertical line textured machining),3.5%(parallel line textured machining) than that of plain machining.

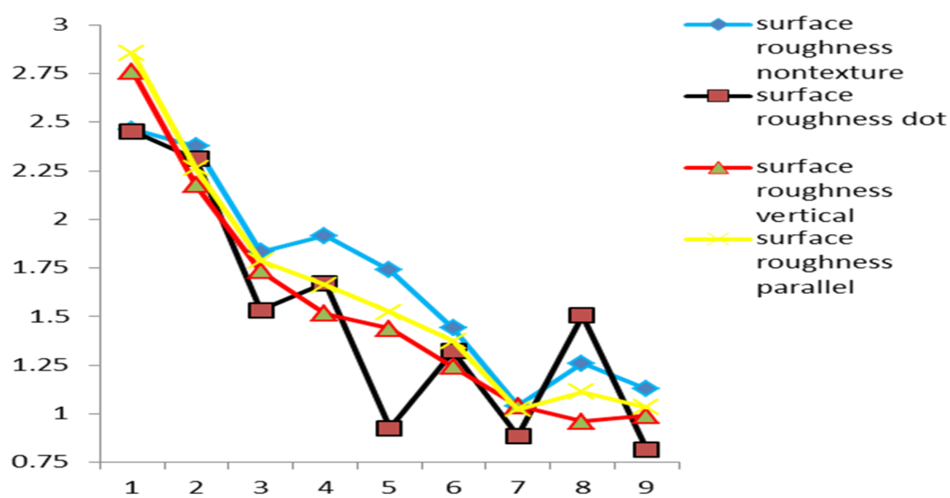

Fig. 5.comparison on surface roughness

All these individual responses combined and comparison between texture designs is done and shown statistically in Fig. 6.which clearly shows that the dot textured design is best with enhanced performance

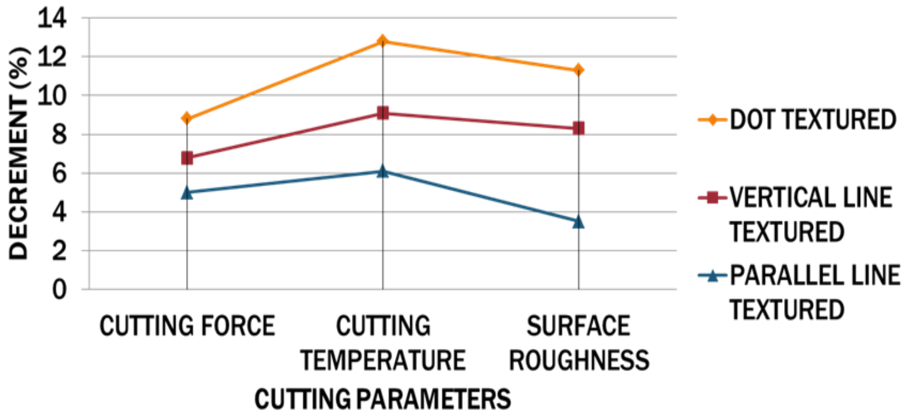

Fig. 6. Comparison of decrement percentage of textured tools

4. Optimization results & discussions

From detailed comparison study it's found that the best performance are displayed when using dot textured WC tool insert than vertical and parallel line textured designs. Such that optimization done on dot textured designs using the following steps.

Step1: Taguchi method analysis

Taguchi method technique for optimization of process parameters depends on S/N ratio and calculated by equation (1) [9] given by Table 6.

$$\text{S/N ratio} = -10 \log \left[\frac{1}{n} \sum_{i=1}^{n} yi^2 \right] \qquad (3.1)$$

Here, y_i =observed response, n= trials number

Step2: GRA analysis

In the multi response problem the impact and correlation between different parameters is complex not clear. This is termed as grey which signifies poor and undetermined data's [5] .grey relation grade take on to convert multi objective problems into a single objective. The data is first to be normalized avoid different units and to reduce the variability. A suiTable value is derived from the original value to make the array between 0 to 1[5] in order to convert original data into comparable data .from this normalized value grey relation coefficient (GRC) and final

GRG is calculated. The maximum GRG value represented by optimal condition for control parameters [11, 3].following steps are used for resolving multi response problem by GRA.

Step: 1

If the response is to be minimized ten smaller the better technique is intended for normalization of S/N ratios to scale it into an acceptable range using equation(2)[1]given in Table 6

$$Xi^{*} = \frac{Max\ Xi(P) - Xi(P)}{MaxXi(P) - MinXi(P)} \qquad (3.2)$$

Here Xi(P)= normalization value ,Max Xi(P) and Min Xi(P)= maximum and minimum value of Xi(P),i=number of experiments and p= number of response parameters.[16]

Table 8 .S/N ratios and its normalized values

Trial no	S/N ratio			Normalized values		
	CF	CT	Ra	CF	CT	Ra
1	-59.2696	-36.1911	-7.7904	0	0.7221	0
2	-48.1986	-36.2849	-7.2797	0.3415	0.7074	0.0716
3	-45.8006	-34.4197	-3.7108	0.6082	1	0.5720
4	-48.6593	-40.4237	-4.4595	0.2903	0.0584	0.4670
5	-47.1967	-39.1521	0.6584	0.4530	0.2578	1
6	-47.2722	-39.6544	-2.4180	0.4446	0.1790	0.7532
7	-44.4543	-40.6038	1.0415	0.7580	0.0301	0.9462
8	-42.788	-40.7962	-3.5507	1	0	0.5944
9	-44.2437	-40.5143	1.7875	0.7814	0.0442	0.8146

Step:2

In this step to calculate GRC, ξi(P)from the normalized values by using equation(3) and given in Table 8

$$\xi io(P) = \frac{\Delta min + \xi \Delta max}{\Delta oi(P) + \xi \Delta max} \qquad (3.3)$$

Here, ξio(P) and Δoi(P) is the relative and absolute difference of comparative and reference sequence resp. The Δoi(P) is the deviation sequence of the reference sequence $X_0(P)$ and the comparability sequence $X_i(P)$e and $\Delta oi(P)=\|X_0(P)-X_i(P)\|$,ξ=distinguished coefficient and usually taken as 0.50 in many metal cutting problems.[2,3,17,20]

Table 9. Grey relational coefficient(GRC)

Exp.no	GRC Values			GRG	RANK
	CF	CT	Ra		
1	0.3333	0.6428	0.3333	0.4342	8
2	0.4316	0.6309	0.3500	0.4700	7
3	0.5607	1	0.5388	o.6968	1
4	0.4133	0.3468	0.4840	0.4137	9
5	0.4775	0.4025	1	0.6210	4
6	0.4737	0.3785	0.6695	0.5051	6
7	0.6738	0.3401	0.9029	0.6438	2
8	1	0.3333	0.5521	0.6394	3
9	0.6958	0.3434	0.7595	0.5999	5

Step:3

In this step, the individual weights of all response are calculated by using the entropy weight method. The entropy is mapped by following function fi(0)=0,fi(x)=fi(1-x) here, fi(x) is monotonically increasing from X€(0,0.50). The function of entropy is defined by equation (4).[14]

$$W \equiv \frac{1}{(e^{0.50}-1)n} \sum_{i=1}^{n} We(Xi) \tag{3.4}$$

Here We(Xi) is the mapping function

The normalized weight is calculated by equation (5)

$$Wj = \frac{\frac{1}{K-E}(1-Ej)}{\sum_{j=1}^{p} \frac{1}{K-E}(1-Ej)} \tag{3.5}$$

The weights for three responses have been calculated by equation (5) and found as 0.3481, 0.3277 and 0.3229 respectively. The larger value of entropy means more significant the response parameter.

Step:4

The GRC values in Table 9 are converted in to single GRG by multiplying the designated weight of GRC by equation (6) and introduced in Table 9

$$\Upsilon oi = \sum_{i=1}^{n} Wj\xi\ o, i(P) \qquad i=1,\ldots n \qquad (3.6)$$

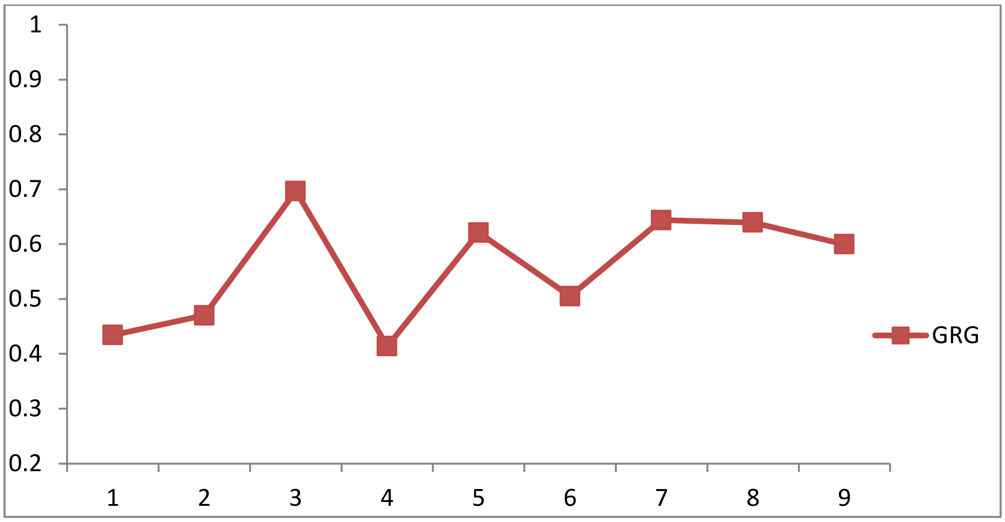

Fig. 7.deviation of GRG for 9 experiments

An optimum level of process parameters is determined using maximum grey relation grade. That indicates better product quality which is the desired value for the response. From Table 10 and Fig. 7.the experiment number 3 has higher GRG value. Thus the overall best performance for all three responses (CF, CT, Ra) from nine experiment is experiment 3.

Table 10. Response for weighted GRG

Turning parameters	GRG at different level				rank
	1	2	3	Max-min	
Vc	0.5337	0.5132	0.6277	0.144	2
F	0.4972	0.5768	0.6006	0.103	3
t	0.5262	0.4945	0.6539	0.159	1
delta	0.1144	0.1034	0.1593		

The response Table for the means of grey relational grade is shown in Table [8].the higher the GRG of individual parameters is optimum value and turned out V3-f3-t3 i.e., V_C=165m/min, f=0.016 mm/rev, t=0.50 mm. The difference between maximum –minimum GRG (Table 8) is follows cutting velocity=0.144, feed rate =0.103, depth of cut=0.159.the maximum variation for GRG is as 0.159.which signifies that depth of cut has more effects on the responses than the other parameters.

Step3: ANOVA analysis and effect of the parameters

ANOVA output of the multiple performance characteristics shows in Table 11.From the analysis of Table 10,it could be concluded that depth of cut followed by cutting speed and feed rate are significantly affecting the GRG. The percentage contribution of each parameters are cutting speed=27.06%,feed rate=21.23%,depth of cut=51.69% and the effect of all factors responses represented in Fig. .4

Table 11. ANOVA analysis for weighed GRG

parameters	ss	df	ms	F ratio	Pc%
Vc	0.2235	2	0.011	137.5	27.06
f	0.1758	2	0.008	1	21.23
t	0.0426	2	0.0213	266	51.69
Pooled error	0.0175		0.008		
total	0.0824	6			

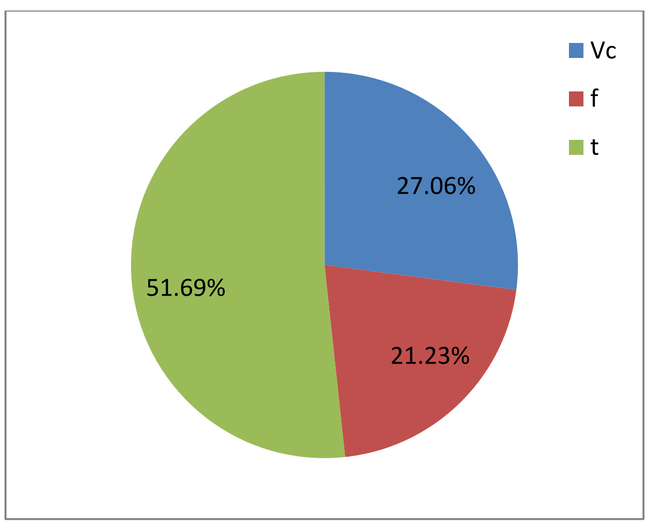

Fig. .8 Percentage contribution of each factor step4: confirmation experiment

Confirmation runs are conducted to identify the improvement of GRG from initial parameter setting to the optimal parameters obtained from GRA. After the optimal level has been selected, can predict the optimum response using the following equation (7):

$$\Upsilon predicted = \Upsilon m + \sum_{i=1}^{n} (\Upsilon i - \Upsilon m) \qquad (3.7)$$

where ϒm is the total mean grey relation grade, ϒi is the mean grey relation grade at optimum level of each parameter, n is the number of the significant process parameter[14]. Based on the Eq.(7) the GRG is predicted for the optimum combination of parameters (V3-f3-t3)and its value is 0.766.finaly confirmation test was performed using the optimum combination of parameters (v3-f3-t3) given in Table 12 shows comparison of predicted multiple performance characteristics with the actual one. The GRG at optimal setting becomes 0.729 which is close to predicted value 0.766.from the analysis it is revealed that GRG of each responses are significantly improved (0.2970) through setting of optimal parametric combination. Also it is observed from Table that the percentage improvement in response is CF=53%,CT=16.27%and Ra=66.88% which indicates the optimal condition gives better surface finish with lower cutting force and cutting temperature than the initial arrangements.

Table 12.confirmation experiment

Initial factor setting		Optimal cutting parameter		%improvement
		predication	experiment	
level	$V_1F_1C_1$	$V_3F_3C_3$	$V_3F_3C_3$	
CF	366		172	53%
CT	64.5		75	16.27%
Ra	2.452		0.812	66.88%
GRG	0.432	0.766	0.729	
IMPROVED GRG=0.2970				

CHAPTER 4

CONCLUSION

This paper presents the findings of the combined approach of Taguchi method-grey relational analysis techniques based on entropy weight is used to optimize the parameters of the cutting action of textured carbide tool turning process. Following conclusions are reached after analysis**.**

- From all experiments it showed that compare to other two(vertical& parallel) textured carbide tool inserts dot textured tool inserted are best textured design for better efficiency
- The best multiple performance characteristics was obtained when turning in cutting speed of 165m/min, feed rate of 0.016 mm/rev and depth of cut of 0.5 mm.
- The value of multiple performance characteristics obtained from confirmation experiment is with in the 95% confidence interval of the predicted optimum condition
- The grey relation grade is significantly improved (0.2970) through setting of optimal parametric combination, thus the machining efficiency also enhances.
- the optimal setting obtained from the GRA approach gives minimum responses (CF,CT,Ra) than to initial set parameters
- The improvement in responses at optimal condition for the responses CF=53%,CT=16.27%and Ra=66.88%.

CHAPTER 05

FUTURE SCOPE

Although the use of textured tool has resulted in better machining outcome but the research in the direction is in its infancy. The research in the near future can be followed in the many directions:

This study confined to only three designs of texturing and exclude the study of tool wear ,and in future it is possible to expand new designs, which will make dry machining more flexible .Also this thesis work excludes cost estimation related to implementation of textured cutting tool and in future it is necessary to carry out such cost estimation for successful implementation .The effectiveness of these surface textured cutting inserts over a long period of metal cutting has not been studied. It can be argued that the effectiveness of self-lubricating cutting inserts will decrease with time as the embedded lubricant will be taken away by moving chip in due course of time and also the textures may wear.

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