EVALUATION AND SELECTION OF DIAMOND WHEEL GRIT SIZE FOR SOLID CARBIDE GRINDING OPERATION IN ROLLOMATIC CELL BY TAGUCHI METHOD

Sharath Kumar R[1], Puneeth K H[2], Teli Kalappa[3], Anil K C[4]

[1] *Post graduate student, Department of Industrial Engineering and Management, Siddaganga Institute of Technology, Karnataka, India*
[2] *Assistant Professor, Department of Industrial Engineering and Management, Siddaganga Institute of Technology, Karnataka, India*

[3] *Executive Manufacturing, Manufacturing, Kennametal india ltd, Karnataka, India*
[4] *Assistant Professor, Department of Industrial Engineering and Management, Siddaganga Institute of Technology, Karnataka, India*

Abstract - *Carbide end mills are widely utilized in the aluminum, magnesium and steel cutting industries. The main objective of the project is to optimum use of diamond wheel grit size in end mill manufacturing. The scope of the project is limited to end mill manufacturing. The project is undertaken to optimum use of diamond wheel grit size in an grinding operation. Diamond wheels with different grit size are used for milling operation. The parameters (Cycle time, Surface finish) are measured or noted down and optimized grit size for different parameters is determined by using Design Of Experiment Technique. The one with the least cycle time, better surface finish and maximum productivity can be selected and implemented in grinding operation.*

Key Words: Taguchi method, Grit size, Surface roughness, Cycle time.

1. INTRODUCTION

Many types of tool materials, ranging from high-carbon steels to ceramics and diamonds, are used as cutting tool materials in today's metalworking industry.
Carbide is a compound composed of carbon and a less electronegative element. Carbides can be generally classified by chemical bonding type as follows: (i) salt-like, (ii) covalent compounds, (iii) interstitial compounds, and (iv) "intermediate" transition metal carbides.
Diamond possesses all the desirable characteristics but has very high cost. Diamond is made by graphitization technique. It's hot hardness temperature is about 2000°C. Its hardness is higher than any other material.
Grinding Operations:

1) Fluting: Fluting refers to removal of material from a cylindrical surface usually creating grooves.
2) Gashing: Gashing is a machining process used to make a deep cut &rough out coarse pitched gears and sprockets.
3) OD Finish: It is finishing operation of an cylindrical surface of the tool.
4) End Face: It is finishing operation carried out at end face of the tool.

Grain and Grit Size: It refers to the actual size of the abrasive particles. The grain size is denoted by the number.

2. LITERATURE REVIEW

K.Wegener et al [1] presents preparation of grinding tool influences metal removal rate, grinding forces, surface quality and material properties of sub surface zone. For optimization of dressing process, prediction of grinding wheel topography and ground surface should be done.

Y.Wand et al [2] Experiment has been carried out to determine the influence of depths of cut of diamond grinding wheels on the wear of diamond abrasives and the material removal rate of silicon nitride during single pass grinding. The results suggest that there is an optimum depth of cut, which yields the greatest material removal rate.

J.Xie et al [3] Introduces a new In-process evaluation method for grit protrusion feature on wheel surface by monitoring discharge current trace during ECD

dressing of metal bonded fine diamond grinding wheel.

3. PROBLEM DEFINATON

The major problem is associated with the End mill manufacturing production unit in Rollomatic cell is, during the grinding operation the grinding cycle time of end mill product is observed greater than 20% compared to standardized cycle time. Poor surface finish is obtained because of using different grit size diamond wheels for grinding operations.

4. METHODOLOGY

4.1 Process floe diagram for end mill manufacturing

5. ANALYSIS

In our present work, diamond wheels with different grit size are used for grinding operation. The parameters (Cycle time, Surface finish) are measured or noted down and optimized grit size and cutting feed for different parameters are determined by using Design of Experiment Technique. List of Variables: Concentration, Dia of Wheel, Wheel shape, Wheel bond, Bond Type, Cutting Speed, Cutting Feed, Grit Size.

Team Decided to do DOE on Grit size and Cutting Feed

Table 5.1 Input Variables

Factors	Total no of Operations	L1	L2	L3
Grit Size	Flute Polish	46	64	35
	Gashing	64	46	35
	OD Finish	46	35	30
	End Face	46	54	76
Cutting Feed	Flute Polish	40	30	60
	Gashing	45	55	35
	OD Finish	10	30	35
	End Face	10	15	35

The following DOE Combinations are obtained by L9 orthogonal array Taguchi method.

Flute			Gash		
DOE Combination	FP Grit Size	FP Cutting Feed	DOE Combination	G Grit Size	G Cutting Feed
1	46	40	1	64	45
2	46	30	2	64	55
3	46	60	3	64	35
4	64	40	4	46	45
5	64	30	5	46	55
6	64	60	6	46	35
7	35	40	7	35	45
8	35	30	8	35	55
9	35	60	9	35	35

Table 5.2 DOE Combination of Flute and Gashing operation

Table 5.3 DOE Combination of OD and End Face operation

OD			End Face		
DOE Combination	OD Grit Size	OD Cutting Feed	DOE Combination	EF Grit Size	EF Cutting Feed
1	46	10	1	46	10
2	46	30	2	46	15
3	46	35	3	46	35
4	35	10	4	54	10
5	35	30	5	54	15
6	35	35	6	54	35
7	30	10	7	76	10
8	30	30	8	76	15
9	30	35	9	76	35

5.1 Component Specification

Cutting diameter: 6mm
Cutting length: 16mm
Overall length: 57mm
Wheel speed: 22m/sec
No of flutes: 4
Actual cycle time and surface roughness has been observed from CNC Machine

Table 5.4 Fluting CT and Ra

DOE Combination	FP Grit Size	FP Cutting Feed	Act Cycle Time	Surface Finish
1	46	40	2.19	0.049
2	46	30	2.7	0.098
3	46	60	1.68	0.142
4	64	40	2.19	0.083
5	64	30	2.7	0.169
6	64	60	1.68	0.203
7	35	40	2.19	0.105
8	35	30	2.7	0.182
9	35	60	1.68	0.244

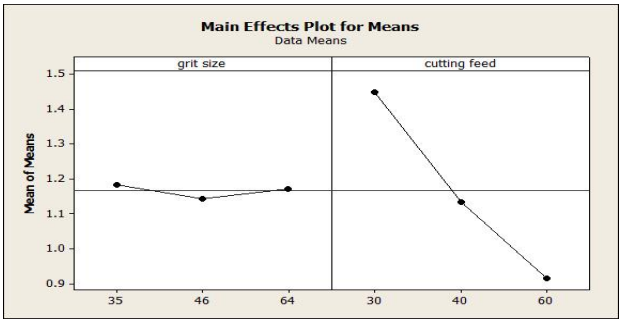

Fig 5.1 Main Effects of Fluting

By observing the main effects plot for means the best DOE Combination is Grit size D46 and Cutting feed 60mm/min.

Table 5.5 Gashing CT and Ra

DOE Combination	G Grit Size	G Cutting Feed	Act Cycle Time	Surface Finish
1	64	45	1.6	0.143
2	64	55	1.2	0.208
3	64	35	1.45	0.182
4	46	45	1.6	0.108
5	46	55	1.2	0.192
6	46	35	1.45	0.177
7	35	45	1.6	0.124
8	35	55	1.2	0.259
9	35	35	1.45	0.206

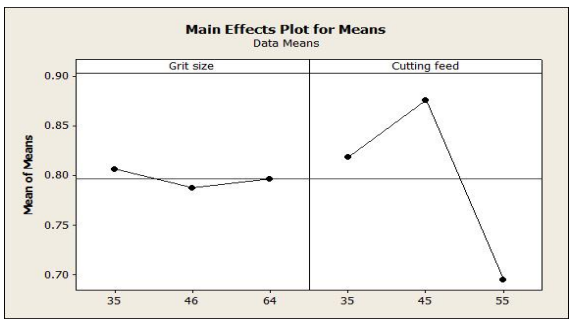

Fig 5.2 Main Effects of Gashing

By observing the main effects plot for means the best DOE Combination is Grit size D46 and Cutting feed 55mm/min.

Table 5.6 OD Finish CT and Ra

DOE Combination	OD Grit Size	OD Cutting Feed	Act Cycle Time	Surface Finish
1	46	10	3.33	0.082
2	46	30	1.78	0.109
3	46	35	1.35	0.13
4	35	10	3.33	0.043
5	35	30	1.78	0.098
6	35	35	1.35	0.121
7	30	10	3.33	0.147
8	30	30	1.78	0.19
9	30	35	1.35	0.214

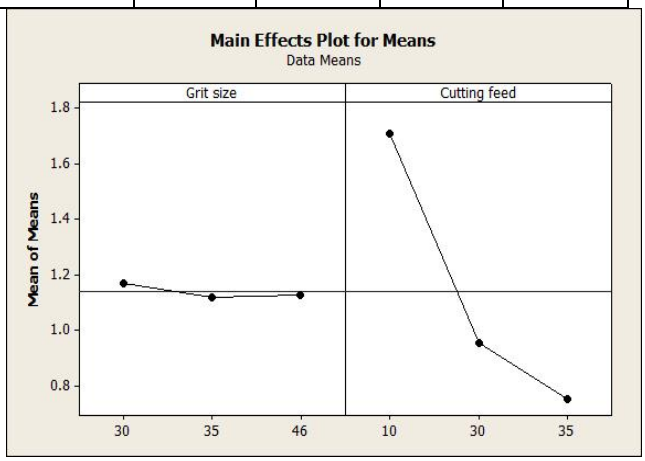

Fig 5.3 Main Effects of OD Finish

By observing the main effects plot for means the best DOE Combination is Grit size D35 and Cutting feed 35mm/min.

Table 5.7 End Face CT and Ra

DOE Combination	EF Grit Size	EF Cutting Feed	Act Cycle Time	Surface Finish
1	46	10	3.33	0.048
2	46	15	3	0.073
3	46	35	1.97	0.112
4	54	10	3.33	0.09
5	54	15	3	0.147
6	54	35	1.97	0.183
7	76	10	3.33	0.132
8	76	15	3	0.157
9	76	35	1.97	0.219

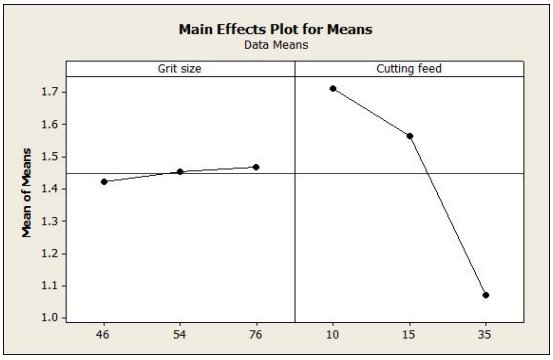

Fig 5.4 Main Effects of End Face

By observing the main effects plot for means the best DOE Combination is Grit size D46 and Cutting feed 35mm/min.

6. CONCLUSION

After implementing the best optimal grit size and feed rate for grinding operations, Cycle time has been reduced from 7.6minutes to 6.20minutes and surface finish has been improved i.e<0.4.

For fluting Grit size 46 and Feed rate 60 has improved surface finish and reduced cycle time.

For Gashing Grit size 46 and Feed rate 55 has improved surface finish and reduced cycle time.

For OD Finish Grit sze 35 and Feed rate 35 has been improved surface finish and reduced cycle time. For End face Grit size 46 and Feed rate 35 has been improved surface finish and reduced cycle time.

Table 6.1 After Implementation results

	ACT				
	Min	Sec	Min	Total Min	Ra value
Fluting	1	41	0.68	1.68	
Gashing	1	12	0.20	1.20	0.4 max
OD	1	21	0.35	1.35	0.4 max
End Face	1	58	0.97	1.97	0.4 max
	4		2.20	6.20	Dec Min

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