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Taguchi method used in turning operation with different parameters

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A B S T R A C T

Turning is one among the metal cutting process in which quality of the finished product depends mainly upon the machining parameters such as speed, depth of cut, feed rate, type of coolant used, types of inserts used etc. Similarly the work piece material plays a vital role in metal cutting process. In this thesis an attempt to make use of Taguchi optimization technique to optimize cutting parameters during high speed turning of EN 31 tool And H13 tool steel using cemented carbide cutting tool. The cutting parameters are cutting speed, feed rates for turning of work piece EN 31 tool steel And H13 steel. In this work, the optimal parameters of cutting speed are 1200pm, 2000rpm and 2500 rpm, feed rate are 120mm/min, 250mm/min, and 380 mm/min. Experimental work is conducted by considering the above parameters. Cutting forces, surface roughness values are validated experimentally. The experiment will be conducted above parameters and different cutting parameters and different materials such as EN31 steel and H13 steel. This paper investigates the parameters affecting the roughness of surfaces produced in the turning process for the various materials studied by researchers. Design of experiments were conducted for the analysis of the influence of the turning parameters such as cutting speed, feed rate and depth of cut on the surface roughness. The results of the machining experiments were used to characterize the main factors affecting surface roughness by the Analysis of Variance (ANOVA) method Taguchi's parametric design is the effective tool for robust design it offers a simple and systematic qualitative optimal design to a relatively low cost.

Key words: Turning process, Taguchi method, Minitab software

1. TURNING

Turning is the removal of metal from the outer diameter of a rotating cylindrical work piece. Turning is used to reduce the diameter of the work piece, usually to a specified dimension, and to produce a smooth finish on the metal. Often the work piece will be turned so that adjacent sections have different diameters.

ADJUSTING THE TOOL BIT

Choose a tool bit with a slightly rounded tip, like the one described above in the tool grinding section. This type of tool should produce a nice smooth finish. For more aggressive cutting, if you need to remove a lot of metal, you might choose a tool with a sharper tip. Make sure that the tool is tightly clamped in the tool holder. Adjust the angle of the tool holder so the tool is approximately perpendicular to the side of the work piece. Because the front edge of the tool is ground at an angle, the left side of the tip should engage the work, but not the entire front edge of the tool. The angle of the compound is not critical; I usually keep mine at 90 degrees so that the compound dial advances the work .001" per division towards the chuck.First point.

Cutting Speeds

If you read many books on machining you will find a lot of information about the correct cutting speed for the movement of the cutting tool in relation to the work piece you must consider the

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rotational speed of the work piece and the movement of the tool relative to the work piece. Basically, the softer the metal the faster the cutting Don't worry too much about determining the correct cutting speed: working with the 7x10 for hobby purposes, you will quickly develop a feel for how fast you should go.

Turning with Power Feed

One of the great features of the 7x10 is that it has a power lead screw driven by an adjustable gear train. The lead screw can be engaged to move the carriage under power for turning and threading operations. Turning with power feed will produce a much smoother and more even finish than is generally achievable by hand feeding. Power feed is also a lot more convenient than hand cranking when you are making multiple passes along a relatively long work piece.

Measuring the Diameter

Most of time, a turning operation is used to reduce the work piece to a specified diameter. It is important to recognize that, in a turning operation, each cutting pass removes twice the amount of metal indicated by the cross slide feed divisions. This is because you are reducing the radius of the work piece by the indicated amount, which reduces the diameter by twice that amount. Therefore, when advancing the cross slide by .010", the diameter is reduced by .020".

Turning a Shoulder

A shoulder is a point at which the diameter of the work piece changes with no taper from one diameter to the other. In other words, there is a 90 degree face moving from one diameter to the other as you can see in the next photograph.

Introduction to en 8 steel

Tool steel refers to a variety of carbon and alloy steels that are particularly well-suited to be made into tools. Their suitability comes from their distinctive hardness, resistance to abrasion, their ability to hold a cutting edge, and/or their resistance to deformation at elevated temperatures (red-hardness). Tool steel is generally used in a heat-treated state.

LITERATURE REVIEW

Application of vegetable oil-based metalworking fluids in machining ferrous metals—A review

The increasing attention to the environmental and health impacts of industrial activities by governmental regulations and by the growing awareness level in the society is forcing industrialists to reduce the use of mineral oil-based metalworking fluids as cutting fluid. Cutting fluids have been used extensively in metal cutting operations for the last 200 years. In the beginning, cutting fluids consisted of simple oils applied with brushes to lubricate and cool the machine tool. As cutting operations became more severe, cutting fluid formulations became more complex. There are now several types of cutting fluids in the market and the most common types can be broadly categorized as cutting oils or water-miscible fluids. In this review, the applicability of vegetable oil-based metalworking fluids in machining of ferrous metals has been undertaken. The advantages of metalworking fluids and its performances with respect to the cutting force, surface finish of work piece, tool wear and temperature at the cutting zone have been investigated. It has been reported in various literature that metalworking fluids, which are vegetable oil-based, could be an environmentally friendly mode of machining with similar performance obtained using mineral oil-based metalworking fluids

INTRODUCTION TO CUTTING FORCES AND SURFACE FINISH

Knowing the magnitude of the cutting forces in the turning process as function of the parameters and conditions of treatment is necessary for determining of cutting tool strength, cutting edge wearing, limit of the maximum load of the cutting machine and forecasting the expected results of the processing. In particular, during machining with high cutting speed, using modern materials and modern cutting machines imposes the necessity of studying physical phenomena in the cutting process and their mathematical modeling.

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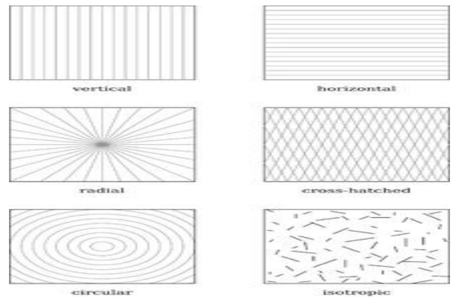

Manufacturing

Many factors contribute to the surface finish in manufacturing. In forming processes, such as molding or metal forming, surface finish of the die determines the surface finish of the work piece. In machining the interaction of the cutting edges and the microstructure of the material being cut both contribute to the final surface finish.

Manufacturing

Many factors contribute to the surface finish in manufacturing. In forming processes, such as molding or metal forming, surface finish of the die determines the surface finish of the work piece. In machining the interaction of the cutting edges and the microstructure of the material being cut both contribute to the final surface finish.

EXPERIMENTAL INVESTIGATION

The experiments are done on the CNC turning machine with the following parameters:

CUTTING TOOL MATERIAL –cemented Carbide Tool

WORK PIECE MATERIAL – EN 31 Steel and H13 steel

FEED – 120mm/min, 250mm/min, 380mm/min

CUTTING SPEED – 1200rpm, 2000rpm, 2500rpm,

DEPTH OF CUT – 0.5mm, 1mm, 1.5mm

EXPERIMENTAL PHOTOS

CNC turning machine

Programming

Machining Process

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FACTORS	PROCESS PARAMETERS	LE VEL1	LEVEL2	LEVEL3
A	CUTTING SPEED(rpm)	1200	2000	2500
B	FEED RATE (MM/REV)	120	250	380
C	DEPTH OF CUT	0.5	1	1.5

केन्द्रीय उपकरण अभिकल्प संस्थान
CENTRAL INSTITUTE OF TOOL DESIGN
(A Govt. of India Society - Ministry of Micro, Small & Medium Enterprises)

Ref.: CITD.W.O.No. ISO 5544
Date: 5/01/2023

INSPECTION REPORT

Name of the Party: M/s. DUN TECHNOLOGIES,HYDERBAD.

Surface finish Tester, Model Surtronic 3+, Rank Taylor Hobson Ltd., Made in England. Which is Periodically Calibrated using Reference Specimen Type 112/1534.
Lab Temperature 20 ± 2°c.

EN-31 Steel	
S.No.	Surface finish (R_a) µm
1	0.62
2	0.78
3	0.91
4	1.21
5	1.46
6	1.94
7	2.41
8	2.84
9	3.12

Inspector Q.C
Inspection & Metrology
Central Institute of Tool Design

BALANAGAR, HYDERABAD - 500 037, A.P. INDIA
(An ISO 9001:2008, ISO 14001:2004, ISO 29990:2010 Certified Institution)

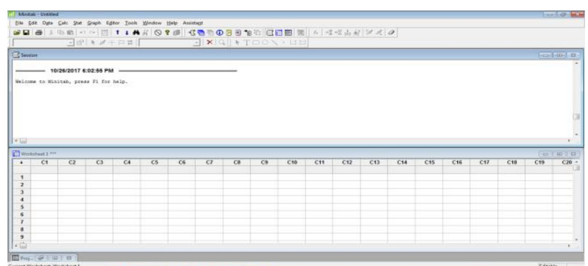
INTRODUCTION TO TAGUCHI TECHNIQUE

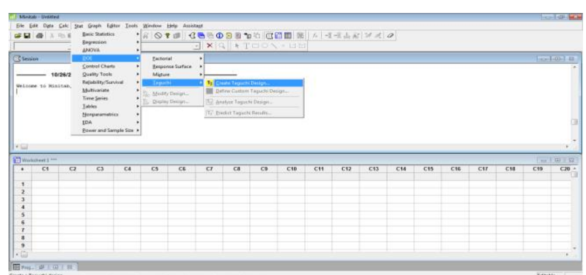
- Taguchi defines Quality Level of a product as the Total Loss incurred by society due to failure of a product to perform as desired when it deviates from the delivered target performance levels.
- This includes costs associated with poor performance, operating costs (which changes as a product ages) and any added expenses due to harm ful side effects of the product in use.

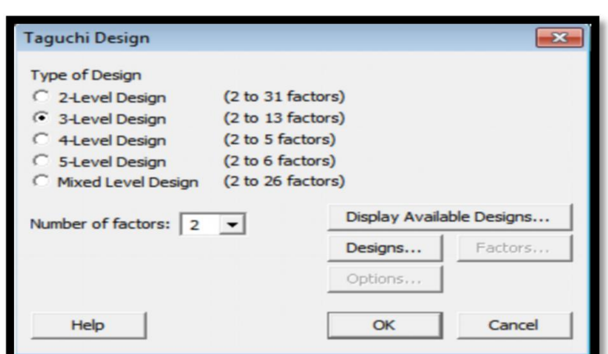
Taguchi Methods

- Help companies to perform the Quality Fix!
- Quality problems are due to Noises in the product or process system
- Noise is any undesirable effect that increases variability
- Conduct extensive Problem Analyses
- Employ Inter-disciplinary Teams
- Perform Designed Experimental Analyses
- Evaluate Experiments using ANOVA and Signal-to noise techniques

OPTIMIZATION OF SURFACE ROUGHNESS USING MINITAB SOFTWARE MATERIAL-EN 31 STEELINTERFACE







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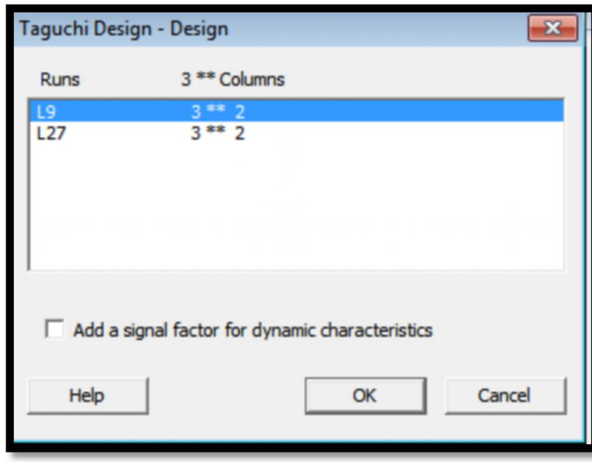
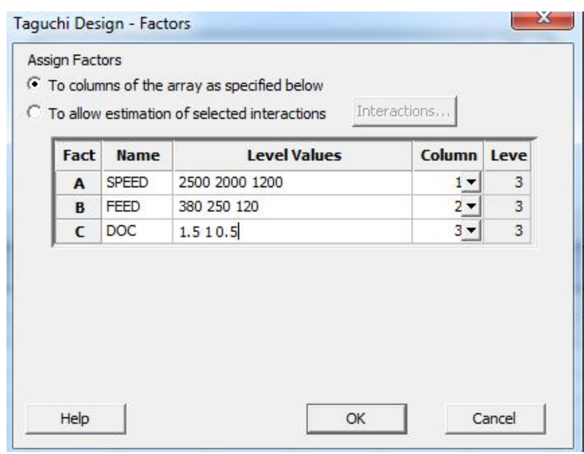
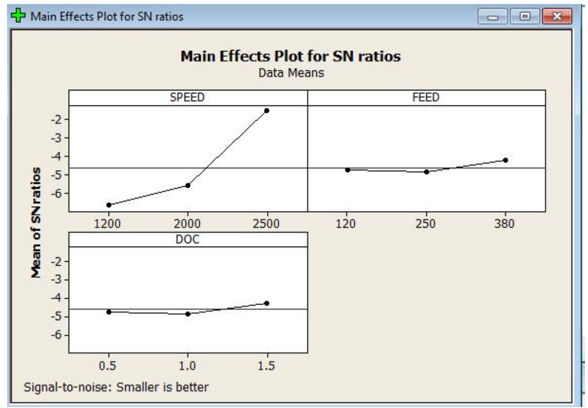
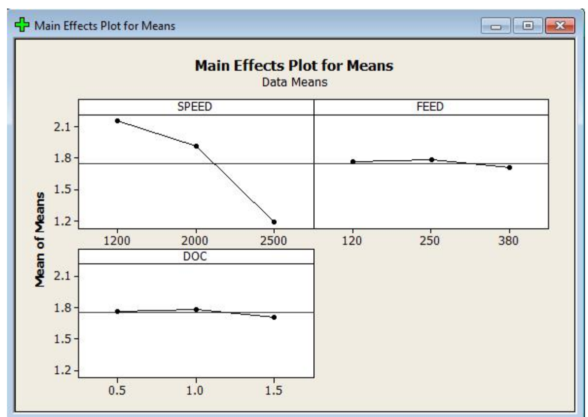




Worksheet 1 ***

↓	C1	C2	C3	C4	C5
	SPEED	FEED	DOC	SURFACE ROUGHNESS	SURFACE ROUGHNESS 1
1	2500	380	1.5	1.053	1.055
2	2500	250	1.0	1.051	1.500
3	2500	120	0.5	1.049	1.420
4	2000	380	1.0	1.915	1.912
5	2000	250	0.5	1.913	1.910
6	2000	120	1.5	1.912	1.911
7	1200	380	0.5	2.149	2.150
8	1200	250	1.5	2.168	2.167
9	1200	120	1.0	2.152	2.151





↓	C1	C2	C3	C4	C5	C6	C7
	SPEED	FEED	DOC	SURFACE ROUGHNESS	SURFACE ROUGHNESS 1	SNRA1	MEAN1
1	2500	380	1.5	1.053	1.055	-0.45682	1.0540
2	2500	250	1.0	1.051	1.500	-2.24611	1.2755
3	2500	120	0.5	1.049	1.420	-1.92679	1.2345
4	2000	380	1.0	1.915	1.912	-5.63657	1.9135
5	2000	250	0.5	1.913	1.910	-5.62749	1.9115
6	2000	120	1.5	1.912	1.911	-5.62749	1.9115
7	1200	380	0.5	2.149	2.150	-6.64675	2.1495
8	1200	250	1.5	2.168	2.167	-6.71918	2.1675
9	1200	120	1.0	2.152	2.151	-6.65483	2.1515

CONCLUSION

In this thesis an attempt to make use of Taguchi optimization technique to optimize cutting parameters during high speed turning of EN 31 tool And H13 tool steel using cemented carbide cutting tool. The cutting parameters are cutting speed, feed rates for turning of work piece EN 31 tool steel And H13 steel. In this work, the optimal parameters of cutting speed are 1200pm, 2000rpm and 2500 rpm, feed rate are 120mm/min, 250mm/min, 380 mm/min. Experimental work is conducted by considering the above parameters. Cutting forces, surface roughness values are validated experimentally. This paper investigates the parameters affecting the roughness of surfaces produced in the turning process for the various materials studied by researchers. Design of experiments were conducted for the analysis of the influence of the turning parameters such as cutting speed, feed rate and depth of cut on the surface

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roughness. The results of the machining experiments were used to characterize the main factors affecting surface roughness by the Analysis of Variance (ANOVA) method Taguchi's parametric design is the effective tool for robust design it offers a simple and systematic qualitative optimal design to a relatively low cost. The experiment will be conducted above parameters and different cutting parameters and different materials such as EN31 steel and H13 steel. By observing the experimental results and by taguchi, the following conclusions can be made: To get better surface finish, the optimal parameters are spindle speed – 2500rpm, feed rate – 120mm/min and EN 31 tool steel.

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