REVIEW ON OPTIMIZATION OF PARAMETERS AFFECTING THE PERFORMANCE OF CNC MACHINE

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ABSTRACT

CNC machine tool is broadly utilized by manufacturing engineers and production personnel to rapidly and successfully set up manufacturing forms for new products. This study talks about an investigation concerning the utilization of Taguchi Parameter Design approach for Parametric Study of CNC processing activity for Surface Roughness and Material Removal Rate as a response variable. The Taguchi parameter plan strategy is a efficient experimental technique in which a response variable can be examine, utilizing less experimental run than factorial design strategy. The control parameters for this operation included: spindle speed, feed rate and depth of cut.

Keyword: *-Optimization, Taguchi method, Feed rate, Cutting parameters.*

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1. INTRODUCTION

The advance of current innovation and another age of manufacturing equipment, especially Computer numerical control (CNC) machine, have conveyed tremendous changes to the assembling segment. For the most part, the handbook or human experience is utilized to choose convenient machine parameters in manufacturing industry. In process planning of traditional milling, choosing sensible processing parameters is important to fulfill requirement including machining economical quality and safety. The machining parameters in milling operation comprises of cutting speed, depth of cut, feed rate and number of passes. These machining parameters essentially affect on the cost, productivity and quality of machining parts. The viable improvements of these parameters influence significantly the cost and production time of machined parts and additionally the quality of final items. The turning and milling operation is an essential metal machining operation that is utilized generally in ventures managing metal cutting. The choice of machining parameters for a turning and milling operation is a important task with a specific end goal to achieve elite. By high performance, we mean great machinability, better surface finish, lesser rate of tool wear, higher material evacuation rate, speedier rate of production and so on.

The surface finish of a product is typically estimated as far as a parameter known as surface roughness. It is considered as a list of product quality. Better surface finish can achieve enhanced quality properties, for example, protection from corrosion, protection from temperature, and higher fatigue life of the machined surface. Notwithstanding strength properties, surface finish can influence the functional behavior of machined parts as well, as in friction, light reflective properties, warm transmission, capacity of distrubuting and holding a lubricant and so on. Surface finish likewise influences production costs. For the aforesaid reasons, the minimization of the surface roughness is fundamental which thus can be accomplished by optimizing some of the cutting parameters.

2. LITERATURE REVIEW:

N.V.MAHESH BABU TALUPULA [1]: .It says that Computer Numerical Control (CNC) machines are broadly utilized as a part of manufacturing industry. Conventional machines, for example, vertical millers, centre lathes, shaping machines, routers etc... Worked by a prepared engineer have, much of the time, been replaced by control machines. Since the beginning of the CNC (Computer Numerical Control) machines presentation in the machining part, they have been praised for being precise, quick, steady and adaptable. Despite the fact that CNC machines are not absolutely free, a great deal of real industries rely upon these wonder machines. Basic CNC-subordinate enterprises incorporate the metal business and the carpentry business. Profitability and in addition quality the two similarly affects last product. In this exploration work, milling tests are completed on Mild Steel.

N.S. POHOKAR [2] : In this paper to appraise the tool life choice of ideal parameters. It is important to decide them at first for the given machining circumstance. There are a few strategies accessible to decide the ideal estimations of these parameters, in this paper machining parameters, cutting speed, feed, depth of cut, and one geometric parameter rake angle are considered for optimization. The Genetic calculation was produced for foreseeing the outcomes. To approve the outcomes tentatively trials are then done a CNC milling utilizing HSS tool by ceaseless running condition under dry keep running on the AISI 1040 MS plate of 140 X 120 X 10 mm work piece. The anticipated outcomes coordinate 95 % including the mistakes. In this manner demonstrates the hereditary genetic is utilized for optimization of geometric and machining parameters for the estimation of tool life.

NAGAANJENEYULU. K [3] : Our work centers around the optimization of cutting tool life of a CNC milling machine and end milling operation is performed on it by utilizing Poly Crystalline cubic Boron Nitride (PCBN) as the cutting device material and En8 steel (HRC 46) as work piece material to predict the tool life. Information is gathered from CNC milling machine which is controlled by various examples of tests utilizing programming. The contribution of the model comprises of feed rate, cutting speed and depth of the cut while the yield from the model is the Tool life which is ascertained by Taylor's device life condition. This exploration is to test the gathering information by Taguchi strategy. The improvement of the tool life is concentrated to analyze the relationship of the parameters included. The aftereffect of the examination demonstrates that depth of cut was the main parameter observed to be noteworthy. The investigation likewise demonstrates that the anticipated qualities and ascertained qualities are close that obviously shows that the created model can be utilized to decrease the cost of machining.

NEERAJ KUMAR [4] : This paper talk about of the writing audit of advancement of processing machining process parameters for composite materials. Machining process has attributes that portray their execution with respect to productive utilization of machine instruments by setting ideal cutting parameters. The conventional optimization methods are not appropriate on the grounds that processing machining activity is exceedingly compelled in nature. Consequently we propose an adjusted optimization approach in view of up to this point inquire about examination for processing machining parameters.

MR.DHRUV H. PATEL [5] : In this paper we have study on CNC Router, impact of different machining parameters like, instrument speed (rpm),tool feed(mm/min), and depth of cut (mm). In the present examination, tests are led on Composite material of Acrylic gum and Aluminium TriHydrate with three levels and three variables to improve process parameter and surface unpleasantness. A L9 (3*3) Taguchi standard orthogonal exhibit (OA) is decided for outline of trials and the primary impacting factor are resolved for each given machining criteria by utilizing Analysis of difference (ANOVA). The surface finish have been distinguished as quality attributes and are thought to be straightforwardly identified with productivity. In this test we were discovered that request of critical of fundamental parameter decreasing order Tool feed, Tool speed and Depth of cut.

V S THANGARASU [6] : This study highlights optimization of CNC fast milling process parameters to give better surface finish and also high material expulsion rate. The surface finish and material expulsion rate have been distinguished as quality credits and are thought to be straightforwardly identified with profitability. Keeping in mind the end goal to develop an extension amongst quality and profitability, and attempt made to upgrade previously mentioned quality attributes in little and medium size organizations required with heterogeneous product request. This welcomes a muti-target enhancement issue which has been solved by DOE based genetic algorithm optimization strategy. The response surface technique for Box-Benkhen method has been adjusted to get multi target optimization issue. The technique observed to be helpful in simultaneous optimization of more number of reactions.

3. MILLING MACHINE:

Milling Processing is the way toward machining flat, curved, or irregular surfaces by sustaining the work piece against a turning cutter containing various cutting edges. The regular mill comprises essentially of an motor driven spindle, which mounts and spins the Milling cutter, and a responding reciprocating adjustable, which mounts and feed the work piece. Milling machines are fundamentally named vertical or horizontal. These machines are likewise named knee-type, ram type, manufacturing or bed type, and planer - type. Most milling machines have independent electric drive motor, coolant system, variable spindle speeds, and power-worked table feeds. A milling machine is a machine device that cuts metal with a numerous tooth cutting tool called a milling cutter. The work piece is secured to the milling machine table and is sustained against the rotating milling cutter. The milling cutters can have cutting teeth on the periphery or sides or both.

Machines can be classified under three fundamental headings:

1. General Purpose machines - these are essentially the column and knee type (horizontal and vertical machines).

2. High Production types with fixed beds-(horizontal types).

3. Special Purpose machines, for ex, copying, profiling, rise and fall, turning table, planetary and double end types.

Milling attachments can likewise be fitted to other machine tools including lathe arranging machines and drill bench presses can be utilized with milling cutters. Milling machine is a standout amongst the most flexible traditional machine tool with an extensive variety of metal cutting ability. Numerous confounded activities, for example, indexing, gang milling, and straddle milling can be completed on a milling machine. Work material and its properties and tool geometry. Fewer changes in the previously mentioned factors may realize significant changes in the product quality and tool life.

4. MACHINING PARAMETERS

The turning operation is represented by geometry factors and machining factors. This examination comprises of the three essential movable machining parameters in a basic turning task viz. speed, feed and depth of cut. Material evacuation is acquired by the mix of these three parameters. Other information factors impacting the output parameters, for example, surface roughness and tool wear exist, yet the last are the ones that can be effortlessly changed by the operator over the span of the operation.

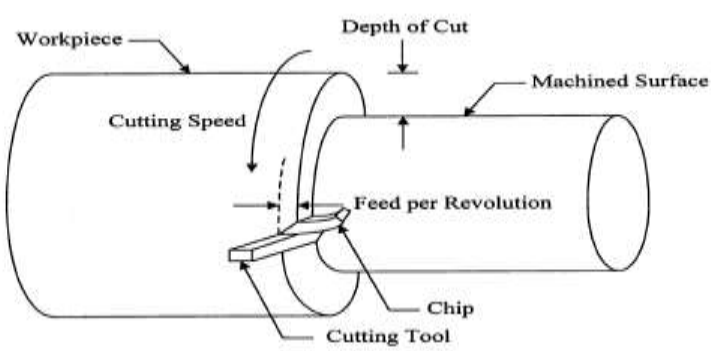

Fig-1 The adjustable machining parameters

4.1 Cutting Speed:

Cutting rate might be characterized as the rate at which the uncut surface of the work piece passes the cutting tool. It is frequently referred to as surface speed and is usually expressed in m/min, however ft./min is additionally utilized as a satisfactory unit. Cutting speed can be obtained from the spindle speed. The spindle speed is the speed at which the spindle, and henceforth, the work piece, turns. It is given as far as number of revolutions of the work piece every moment i.e. rpm. In the spindle speed is N rpm, the cutting speed Vc (in m/min) is given as

$$V_c = \frac{\prod DN}{1000}$$

Where, Vc = Cutting Speed

D = Diameter of the work piece in mm

N= Spindle Speed in rpm

4.2 Feed:

Feed is the distance moved by the tool tip along its way of movement for each unrest of the work piece. It is indicated as f and is expressed in mm/rev. Once in a while, it is additionally expressed as far as the shaft speed in mm/min as

Fm = f N

Where, f = Feed in mm/rev,

N = Spindle speed in rpm

4.3 Depth of cut:

Depth of cut (d) is characterized as the separation from the recently machined surface to the uncut surface. In other words, it is the thickness of material being expelled from the work piece. It can likewise be characterized as the depth of penetration of the tool into the work piece estimated from the work piece surface before turn of the work piece. The diameter across in the wake of machining is decreased by twice of the depth of cut as this thickness is removed from the two sides owing to the turn of the work.

$$d = \frac{D_1 - D_2}{2}$$

Where, D1 = Initial dia of job

D2= Final width of job

4.4 Cutting Tool :

A cutting tool can be characterized as a part of a machine tool that is in charge of expelling material from the work piece by direct mechanical abrasion and shear deformation. Efficient cutting tool should to have the accompanying attributes .

1. **Hardness:** The tool material ought to be harder than the work material.

2. **Hot hardness**: The tool must keep up its hardness at elevated temperatures experienced during the machining process.

3. **Wear Resistance:** The tool should to have served to its adequate level of life before it wear and should be replaced.

4. **Toughness:** The material should to be sufficiently strong in order to withstand shock and vibrations. During interrupted with cutting, the tool should not chip or break.

5. MACHINE SELECTION

With a regularly increasing demand for a greater hole count per panel, the new high power straight motor offer a huge decrease in the drilling process duration.

Fig -2: Jyoti Huron CNC machine

It consists of
1. Robust, interlocked base unit
2. High accuracy mechanical linear guides in all 3 axes
3. High dynamic Linear motors for the X- and Y-axes, (Z-axes as option)
4. CNC control systems
5. Variable clamping systems
6. Micro drilling pressure foot
7. Constant dill breakage monitor
8. Laser drill check system

Specifications:

1. Granite bed with length 1600mmX 800mm.
2. Magazine capacity is 16 tools.
3. Vacuum cleaner for dust remove.

6. WORK MATERIAL :

6.1 Work Material:

The work piece utilized for the finished up try was AISI 202 review Austenitic stainless steel. There are two arrangement of Austenitic stainless steels – 300-arrangement and 200-arrangement. 300 arrangement steels find most wide use the world over yet 200 arrangement have turned out to be exceptionally well known in the Asian subcontinent as an other option to the 300 arrangement to counter the expansion in costs of Nickel . Review 202 steel can be made into plates, sheets and curls and finds broad use in eatery hardware, cooking utensils, sinks, car trims, engineering applications, for example, entryways and windows, railroads autos, trailers, railway and so forth.

Element	Wt %
Iron, Fe	68
Chromium, Cr	17-19
Nickel, Ni	4-6
Manganese, Mn	7.5-10
Silicon, Si	1
Nitrogen, N	0.25
Carbon	0.15
Phosphorous, P	0.06
Sulphur, S	0.03

Table no 1: Chemical composition (wt %) of AISI 202 Steel

Property	Value
Tensile Strength	515 MPa
Yield Strength	275 Mpa
Elastic Modulus	207 Gpa
Poisson's Ratio	0.27-0.30
Elongation at break	40%

Table no 2: Chemical composition (wt %) of AISI 202 Steel

6.2 Insert material:

The tool insert selected was a covered carbide tool (Kennametal make) whose function is demonstrated as follows. Covered carbide devices are found to perform superior to uncoated ones .

ISO Catalog Number	ANSI Catalog Number	Grade	Dimensions									
			D		L10		S		R_ε		D1	
			mm	in	mm	in	mm	in	mm	in	mm	in
SNMG 120408	SNMG 432MS	KCU25	12.70	0.5	12.70		0.5	4.76	0.1875		5.16	0.203

Table no 3: Specification of Cutting Tool

The tool insert was rotatable and reversible so an aggregate number of 8 cutting edges can be created. KCU25 takes 22 advantage of PVD covering innovation including unique surface treatment that enhances machining performance in high-temperature materials. The coating on the insert is TiAlN (Titanium Aluminum Nitride).

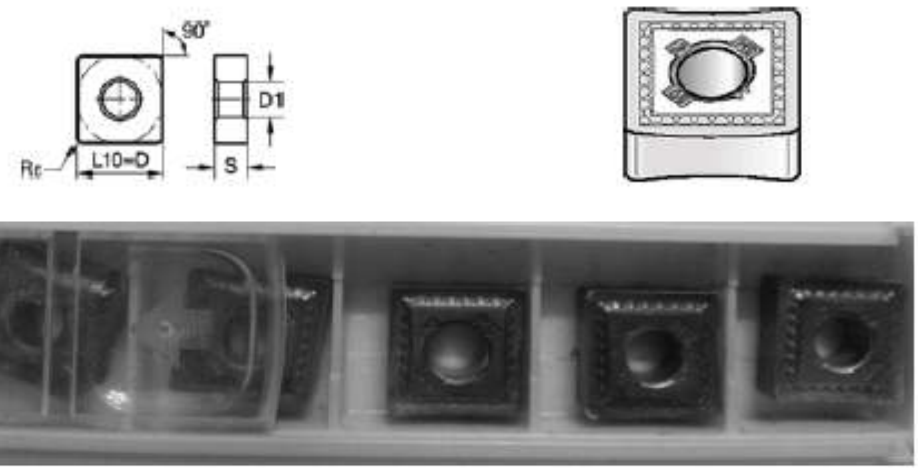

Fig -3: Coating on the insert

7. MACHINE PARTS

Automatic Tool Changer (ATC):

Simple CNC machines work with a single tool. Turrets can work with an extensive number of tools. But if we require significantly more number of tools, at that point ATC is given. The tool is kept on a magazine. It enables the machine to work with an number of tool without an operator. The fundamental parts of a automatic tool changer are base, gripper arm, tool holder, support arm and tool magazines. However, the ATC expands the reliability, speed and accuracy, yet it has likewise more difficulties as contrast with manual tool change like the tooling utilized must be anything but difficult to focus, be simple for changer to grab and there should to be some mean for giving the tool self withdrawal easy. tool utilized as a part of ATC are secured in instrument holders uniquely designed.

Fig -4 Automatic Tool Changer

7.1.1 Function:

The automatic changers changers expand the productive time and decrease the useless time to a huge extend. It gives the capacity of the tool which are returned automatically to the machine tool after completing the required tasks, builds the flexibility of the machine tool makes it easier to change heavy and large tools, and allows the automatic renewal of cutting edges.

7.2 Bed:

It is heavy duty enormous construction to give stiffness to maintain extensive cutting dynamic force, load of different components and so forth. It is made of good quality granite and it goes about as establishment for every single other parts of the machine.

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Fig -5 Bed of Jyoti CNC machine

7.3 Tool Magazine:

A two-stage approach is created to solve the tool magazine course of action and tasks sequencing issues. The general point is to limit the aggregate manufacturing cost by using the advantages of tool sharing idea and loading copy tools because of a conceivable decline in tooling and tool working costs while keeping up the possibility as far as priority, tool magazine limit, tool life covering and tool accessibility limitations because of tool dispute among the tasks for a predetermined number of tool types, because the absence of such essential requirements may prompt in-feasible outcomes. Moreover, the proposed approach can give a successful basic decision making tool for the short operational choices of FMS.

Fig -6 Tool Magazine

7.4 Single Spindle:

Hole diameters are getting littler and littler, requiring the requirement for a dedicated drill spindle - however rotating can likewise be required inside a similar job. All item makers perceive this issue. JYOTI has the arrangement. - the DLG 615-1+1. This machine has separate drill and rout spindles, which are chosen consequently. This machine is outfitted with 2 distinct spindles. The two spindles deal with the PCB; they are changed over consequently from tool necessities in the program. The drill spindle is a rapid air bearing type for drilling small scale and medium gap hole sizes. The other spindle is a ball roller drill and rout spindle (10.000 to 60.000 rpm) for drilling huge holes and routing. Different drilling spindles are accessible with up to 300,000 rpm. This machine idea is superbly suited for the optional JYOTI multilayer identification system.

Fig -7 Single spindle

7.5 Controller:

The CNC (numerical control) system of a machine tool contains the control unit itself, and in addition less noticeable parts of the motion control system, for example, the servomotors, drives and axis positioning devices. These segments are a piece of any CNC machine tool, however they may be purchased independently and retrofitted later on more established machines that are redesigned or repaired. Likewise part of the control system is sensors that may enable the control to settle on certain constant choices during unattended or lightly attended machining processes. These can include tests for estimating the situation of the part or machined features, and additionally monitoring systems for identifying the nearness of the tool or the force that is being applied in the cut.

Fig -8 Controller

8. CONCLUSIONS

From the discussion so far it has been concluded that R&D parameter is better material cutting than other parameter. Al will help in lessening in material removal rate burr, plain surface finishing and preferred cutting quality over other parameter like machine supplier, tool supplier and so forth material Removal rate minimization procedures can be effortlessly executed in material. The general conclusions from the examinations are:

1. Burr decrease with optimize parameter speed.
2. Better surface finish with optimize parameter.
3. Significant reduction of exit burr with properly constructed system.

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