STUDY OF WORN TOOL MACHINING PROCESS IN CLIMB AND CONVENTIONAL MILLING

DR.G SRIKANTH REDDY
Associate Professor,
Department of Mechanical Engineering,
Mahaveer Institute of Science & Technology
Hyderabad, Telangana-500005
Email Id: gsreddy320@gmail.com

DR. ASHISH NARAYAN
Associate Professor,
HOD, Department of Mechanical Engineering,
Chaibasa Engineering College,Chaibasa,
West Singhbhum, Jharkhand-833215
Email Id: ashishnarayan2007@gmail.com

Abstract –*There are two distinct ways to cut materials when milling, conventional (up) milling and climb (down) milling processes. The variation between these two techniques is the relationship of the rotation of the cutter to the direction of feed. The objective of this study has to find out the optimal differences in tool materials by considering both cutting types and number of flutes. The practical study has been considered on EN24 material with both HSS and carbide tool with two flute and four flute milling cutters by using CNC BMV40 machining center. The work has been optimized by using Taguchi techniques of orthogonal arrays. The deformation result has been tabulated to check the variation in deformation of the component at different tools.*

Keywords:* *Machining types; Worn Too; Optimization Techniques and Deformation.

I. INTRODUCTION

Surface roughness is one of the significant attributes in metal cutting that is being followed in machining forms. The roughness of the surface is characterized by having the normal of the least and highest within the estimation space. In metal cutting, where a wide range of sorts of machines are being utilized. Some parameters are available and specifically influence the surface roughness. These cutting parameters can be gathered as in two gatherings: controlled and uncontrolled. In this examination, we will probably discover the viability of the controlled cutting parameters on surface roughness and furthermore research whether the uncontrolled cutting parameters significantly affect surface roughness. Since the start of the twentieth century, a surprising measure of consideration was put into cutting procedures. By nonstop examination of the cutting procedure, factors that influence the result of the process were resolved, and after that examinations centred toward that path. When all is said in done there are three different parts of the cutting procedure: the machine, the cutting device, and the work-piece material. Among these three sections, the cutting tool has its particular significance as far as cost and effectiveness. Frederick Winslow Taylor, 1800's, performed studies about on cutting devices because of his investigations on cutting devices; Taylor figured the connection between cutting rate and tool life for various tools. The changes he oversaw in tool effectiveness and yield by utilizing his details were striking. Because of cost contemplations, more accentuation was set on tool life.

A tool that never again plays out the coveted function is said to have fizzled and along these lines achieved the finish of its valuable life. By then of time, the tool is not any more capable of doing out cutting. The tool must be either honed or supplanted. There are approaches to determine the tool life amongst honing and substitution;

1. Actual cutting time to failure

2. Total time to failure as on account of an intruded on cutting procedure (e.g. processing)

3. Length of work cut to failure

4. Volume of metal expelled

5. Number of parts delivered to failure

6. Cutting speed for an offered time to failure.

Climb milling can be used in most milling applications, It is especially important when machining Titanium, Cobalt and Nickel-Based Alloys. However, it is important to note that the machine must not have backlash, or must, at least have a backlash eliminator attachment.

Conventional milling is recommended for milling castings or forgings with very rough surfaces due to sand or scale and should be used in all applications where the machine has a backlash.

II. PROBLEM STATEMENT

Configuration engineers incorporate dimensional, positional resistances and surface necessities into the outline of the parts relying upon their usefulness and the mating parts that they will work with. Regarding machining parts that will cooperate, the surface unpleasantness necessity is a standout amongst the most critical criteria. In processing forms there are sure parameters, cutting parameters, which can be resolved preceding machining and kept the same all through the machining. These parameters are cutting rate, nourish speed, profundity of cut, and coolant utilization. Then again, there are different factors amid the cutting operation which we don't have a control over.

III. LITERATURE REVIEW

Armargosa, Brown (2014) the wear land on the clearance face is around parallel to the surface being machined. Additionally, wear tends to change its slant. This change shows that the wear rate is higher close to the cutting edge than furthermore down the clearance face. The wear land is frequently taken as a solitary measure of aggregate wear in basic leadership on the measure of the wear. Notwithstanding that, the measure of the flank wear straightforwardly impacts plan geometry of a tool. This may influence the measurements of components delivered in a machine with set cutting positions, or it might impact the shape of segments created in operation using a frame tool. The change in slant occurs due to the wear and this may tend to increase wear rate closer to cutting edge.

Choudhury, Bartarya (2013) in completing operations the surface roughness and dimensional exactness are of real significance; and the tool will fail when the predetermined conditions can never again be accomplished. In a roughing operation, over the top ascent in cutting forces and power necessities might be taken as the failure model. Failure (failure of the tool crater) is normally caused by high cutting forces or sudden loads which create a fracture reaching out from the rake face to the clearance face. This condition is incited by intruded on cutting conditions, crater and wear land development.

Kapil Banker, Ujjval Prajapati, Jaimin Prajapati, Paras Mod (2014) In this procedure, the material expulsion is happened electro thermally by a progression of following discrete releases amongst anode and the work piece. The improvement of the parameters of the EDM machining has been done by utilizing the Taguchi's strategy for the plan of examinations (DOE). As of late numerous ways has been found for enhancing the MRR of the work piece. Taguchi strategy has been utilized for outline of tests with three information parameters and their three levels utilizing L9 cluster. In the examination, nine investigations had been done alongside copper tool material and in addition AISI 304L material had been utilized as a work piece Future extension which would express this exploration is some non-electrical parameters like anode pivot and work piece revolution while machining enhance the flushing conditions and consequently may enhance MRR.

Tomadi S.H., Hassan M.A., Hamedon Z. (2009) contributed the machining of tungsten carbide with copper tungsten as anode. The full factorial plan of tests was utilized for breaking down the parameters. The essential impacting parameters for Surface Roughness (Ra) were voltage and heartbeat off time while current and heartbeat on time were the optional parameters. For Material Removal Rate (MRR) the most persuasive was beat on time took after by voltage, current and heartbeat off time. At long last if there should arise an occurrence of Tool Wear Rate (TWR) the essential factor was beat off time took after by crest current. For breaking down the parameters, a number of tests were utilized.

Ugur Koklu and Gültekin Basmaci (2017) Compared to processing on a full scale, the small scale processing process has a few unwieldy indicates that need is tended to. Quick tool wear and crack, serious burr arrangement, and poor surface quality are the real issues experienced in the small scale processing process. This investigation intended to uncover the impact of cutting way procedures on the cutting power and surface quality in the small scale processing of a pocket. Miniaturized scale processing of an AA 5083 H116 combination under dry, air blow, and surge coolant conditions was efficiently performed utilizing a consistent cutting velocity, bolster rate, and profundity of cut with two distinctive cutter way procedures.

U Ashok Kumar, P. Laxminarayana (2017). In present-day commitment the apparatus cost assumes a crucial part in the aggregate assembling cost is roughly half. In EDM, device wear is a noteworthy issue, due to it the geometrical exactness and type of the apparatus are not replicated on the work piece precisely while machining. Because of these reasons the device wear must be precisely taken care of while arranging electrical release machining operations of miniaturized scale openings. The mix of parameters and their levels for tool wear for 300 µm anode is A3B1C3 (i.e. Current 0.8Amps, T-on 6µs, T-off 8 µs) which is concurring with the exploratory examination. The mix of parameters and their levels for ideal device wear for 500 µm& 900 µm terminal is A2B1C3 (i.e. Current 0.4Amps, T-on 6µs, T-off 8 µs) from the affirmation test got.

IV. METHODOLOGY

The work piece material used in the experiment is a unidirectional continuous carbon fiber reinforced composite, with 3.5 millimeter thickness and each layer has 0.127 millimeter thickness. The material code is ABS5377A0000-01 used in the experiments and it is also epoxy prepreg material which contains 194 g/m2 fiber in it. The tensile strength of material is 2980 MPa and its tensile modulus is 170 GPa. The structure of the unidirectional carbon fiber reinforced composite material is shown in Fig.1. The work piece (carbon fiber reinforced composite) was cut into blanks of 400x188 millimeter in an automated cutting machine for the experiment.

Fig.1: Structure of the Unidirectional (UD) Continuous CFRP Composite Material.

V. MACHINING PARAMETERS

For finding the quantity of the tool wear the machining parameters are used these are also used to specify the cutting conditions during the time of CRPF routed panels. He used parameters as shown in table.1.

Table.1 Shows the Machining Parameters

Table.1

Spindle Speed(rpm)=5000	
Feed per tooth (mm/tooth)	Feed Speed (mm/min)
$f_z1=0.01$	$V_f1=600$
$f_z2=0.015$	$V_f2=900$
$f_z3=0.02$	$V_f3=1200$
$f_z4=0.025$	$V_f4=1500$
$f_z5=0.03$	$V_f5=1800$
$f_z6=0.035$	$V_f6=2100$
$f_z7=0.04$	$V_f7=2400$
$f_z8=0.05$	$V_f8=3000$

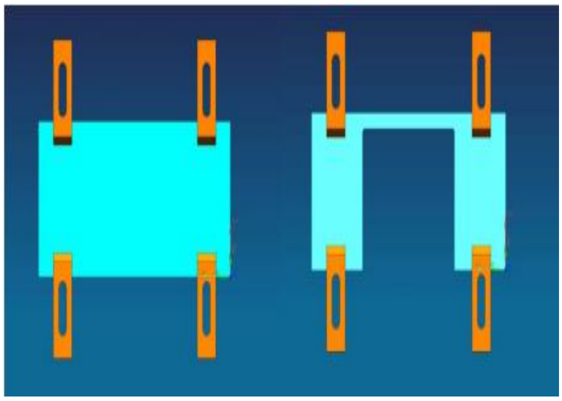
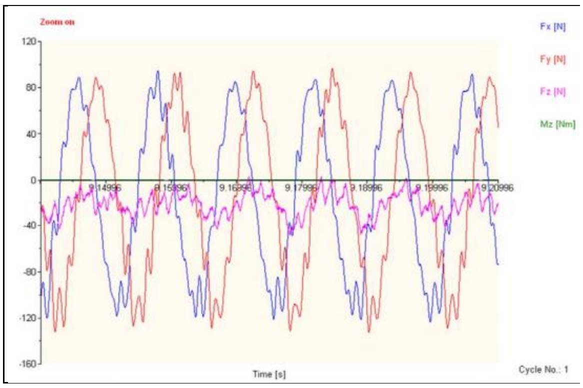


Fig.2: Work piece before and After Machining



n= 5000 rpm, fz= 0.01 mm/tooth, Vf= 600 mm/min

Fig.3: Shows Cutting Force Data

VI. TOOL WEAR MEASUREMENT

The tool shown in Fig.4 was cleaned with dry air to allow for a clear description of wear land on the router knurled tool before the measurement. It has 0.1X-5000X magnification range and 360-degree observation. Moreover, it has 2D and 3D imaging and measurement capacity in its optical microscope. The tool wear measurements were carried out with a 20X zoom lens and a 2D measuring system.

n=5000 rpm, fz=0.025 mm/tooth, Vf =1000 mm/min

Fig.4: Shows Cutting Tool Image under the Microscope for 5000 rpm Spindle Speed

VII. RESULTS AND DISCUSSIONS

Composites require some secondary machining processes to put them into their final dimensional requirement for assembly purposes even though they are largely produced as a near net shape.

A. Machining Configuration

Climb milling (down milling) was applied in all experiments to specify the appropriate machining condition for minor tool wear and to prevent delamination. Nowadays, climb milling is considered to be the optimal way to machine parts. This is because it decreases the load from the cutting edge, leaving a much better surface finish and improved tool life.

Table.2 Shows the Results of the Experiments at 5000 rpm

Table.2

Tool number	Feed per tooth (mm/tooth)	Cutting distance (mm)	Tool wear (µm)	Cutting distance (mm)	Tool wear (µm)
1	0.01	3060	NO	6120	125187
2	0.015	3060	NO	6120	NO
3	0.02	3060	NO	6120	NO
4	0.03	3060	NO	6120	NO
5	0.035	3060	NO	6120	NO
6	0.04	3060	NO	6120	NO
7	0.05	3060	NO	6120	NO

Table.3 Shows the Experiment Matrix

Table.3

Feed per tooth	Spindle speed (rpm)		
0.02	3000	5000	7000
0.03	3000	5000	7000
0.04	3000	5000	7000

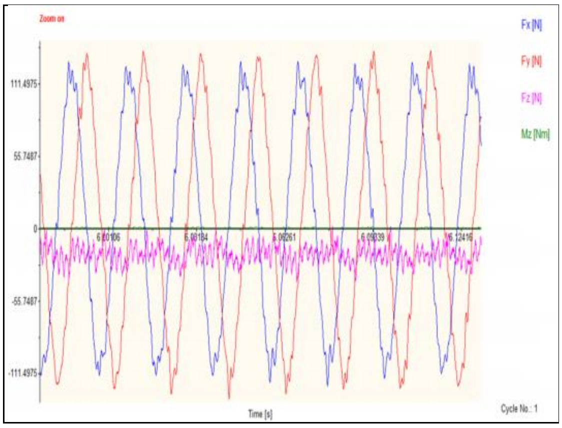


Fig.5: Shows the Cutting Forces for 3000 rpm

Fig.6: n=3000rpm, fz=0.02mm/tooth, Vf=720 mm/min

Fig.7: n=3000rpm, fz=0.03mm/tooth, Vf=1080 mm/min

Fig.8: n=5000rpm, fz=0.02mm/tooth, Vf=1200 mm/min

Fig.9: n=5000rpm, fz=0.03mm/tooth, Vf=1800 mm/min

Fig.10: n=7000rpm, fz=0.02mm/tooth, Vf=1680 mm/min

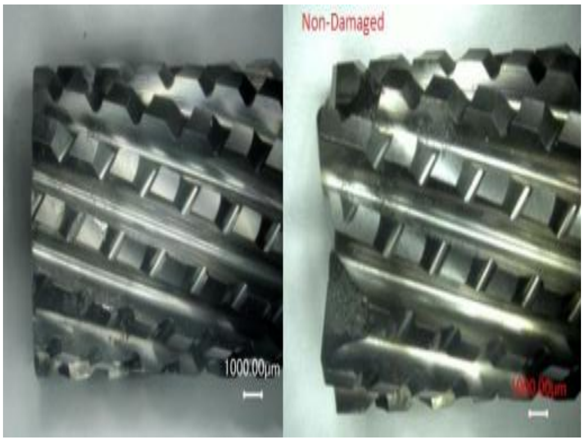


Fig.11: n=7000rpm, fz=0.03mm/tooth, Vf=2520 mm/min

B. Delamination Measurement

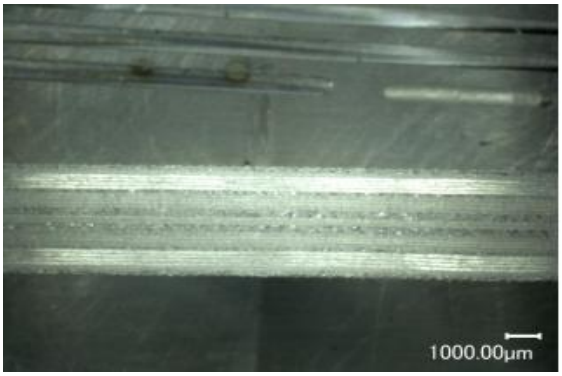


Fig.12: n=3000rpm, fz=0.02mm/tooth, Vf=720 mm/min

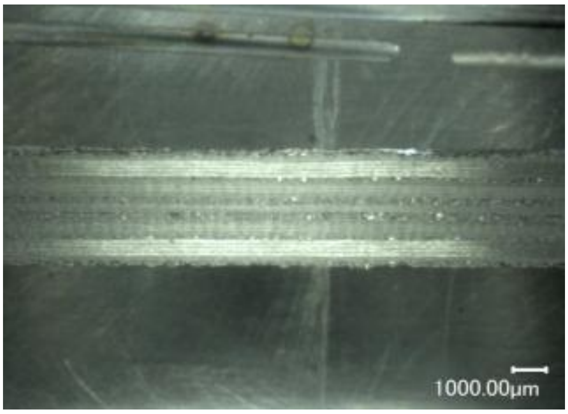


Fig.13: n=3000rpm, fz=0.03mm/tooth, Vf=1080 mm/min

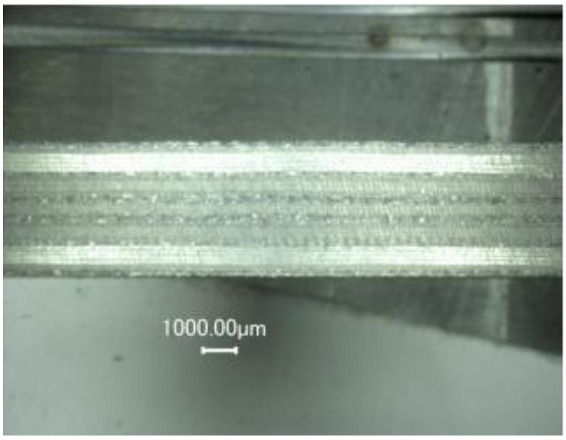


Fig.14: n=5000rpm, fz=0.02mm/tooth, Vf=1200 mm/min

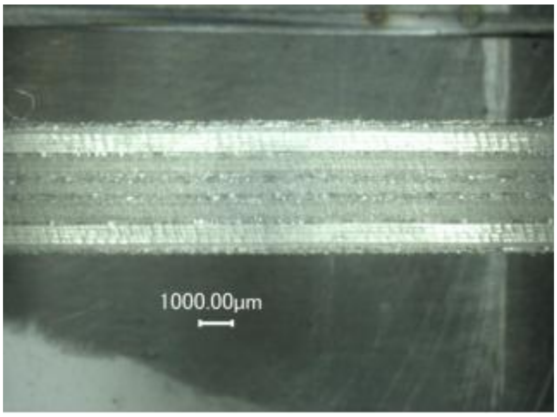


Fig.15: n=5000rpm, fz=0.03mm/tooth, Vf=1800 mm/min

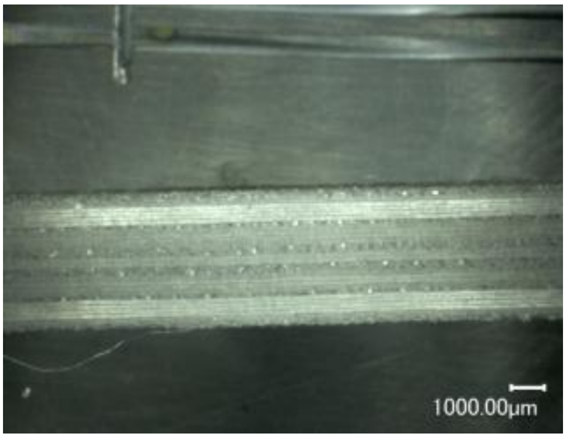


Fig.16: n=7000rpm, fz=0.02mm/tooth, Vf=1680 mm/min

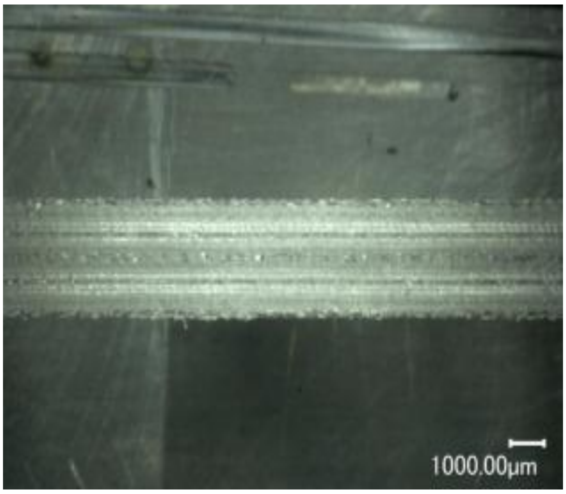


Fig.17: n=7000rpm fz=0.03mm/tooth, Vf=2520 mm/min

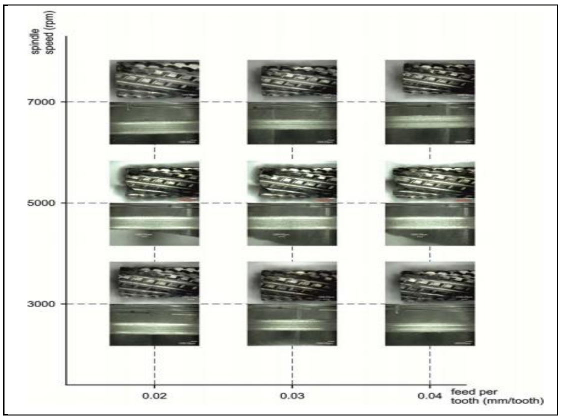


Fig.18: Experimental results according to Spindle Speed and Feed per Tooth

Delamination does not occur for feed per tooth and spindle speed values; there are edges chippings are seen on the cutting tool edges in 0.02, 0.03 and 0.04 feed per tooth values. Due to the machining time, the values at 3000 rpm are eliminated. In conclusion, the most appropriate cutting conditions are obtained at 5000 rpm.

VIII. CONCLUSION

This research concentrated on the issue of developing a method for quantifying tool wear in material coated interlocked knurled tool, and of developing a method that would suggest the time for tool replacement during the edge trimming of CFRP composite material. The work piece used was a 28-ply unidirectional CFRP panel with an overall thickness of 3.5 millimeters.

Considering, delamination damage as a controlling factor, the routing operation on CFRP panels was carried out on a 3-axis CNC machine router. An optical microscope was used to measure tool wear during the trimming operation of CFRP composite material for different combinations of machining parameters as spindle speed and feed speeds. In addition, cutting tool forces cutting tool wear and Delamination were monitored and recorded at regular intervals of time.

IX. FUTURE WORKS

• This work involved varying the spindle speed and feed rate, while the depth of cut was kept constant. The effect of varying the depth of cut could be investigated.
• The effect of cutting forces on surface finish might be studied in detail.
• Different tools with varying tool geometry can be used to study the effects of process parameters on tool life and surface quality.
• The wear characteristics of the knurled tool were determined only by examining it under an optical microscope. Better knowledge and measurement of wear propagation phenomenon could be acquired by analyzing it under a scanning electron microscope (SEM).

References

[1] Armargosa, Brown (2014) The wear arrive is frequently taken as a solitary measure of aggregate wear in basic leadership on the measure of the wear" Journal of Materials Processing Technology, ISSN 0882-4894, Volume 68, Issue 3, PP: 365–371.

[2]Choudhury, Bartarya (2013) the apparatus will come up short when the predetermined conditions can never again be accomplished."Journal of Materials Processing Technology, ISSN: 2347-1697. Volume 3, Issue 10, pp: 126-159.

[3]Kapil Banker1, Ujjval Prajapati2, Jaimin Prajapati3, Paras Mod. (2014). Parameter advancement of Electro Discharge Machine of AISI 304 Steel by utilizing Taguchi Method" International Journal of Application or Innovation in Engineering and Management ISSN 2319 – 4847, Volume 3, Issue 8.

[4] Tomadi S.H., Hassan M.A., Hamedon Z.(2009), "Analysis of the Influence of EDM Parameters on Surface Quality, Material Removal Rate and Electrode Wear of Tungsten Carbide," Proceedings of the International Multi Conference of Engineers and Computer Scientists, ISBN: 978-988-17012-7-5 Volume 2.

[5] U Ashok Kumar1, P. Laxminarayana (2017) Study of Tool Wear Optimization in Micro Holes Machining of SS316 by Die Sinker Electrical Discharge Machining. International Journal of Scientific Research in Research Paper. Multidisciplinary Studies ISSN: 2454-9312 Volume.3, Issue.7, pp.1-4.

[6] Ugur Koklu and Gültekin Basmaci (2017) Evaluation of Tool Path Strategy and Cooling Condition Effects on the Cutting force and Surface Quality in Micro Milling Operations. Molecular Diversity Preservation International. Metals 2017, 7, 426; doi: 10.3390/met7100426