DIFFERENTIAL DEFORMATION STUDY WITH WORN TOOL MACHINING IN CLIMB AND CONVENTIONAL MILLING OF HARD METALS-TOOL FEASIBILITY

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ABSTRACT:

There are two unmistakable approaches to cut materials when processing, traditional (up) processing and move (down) processing forms. The distinction between these two methods is the relationship of the pivot of the cutter to the bearing of bolster. 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 2 flute and 4 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 Tool, Optimization Techniques, and Deformation.*

1.0 INTRODUCTION:

Surface unpleasantness is one of the significant attributes in metal cutting that is being followed in machining forms. Harshness of the surface is regularly characterized by having the normal of the least and most noteworthy focuses inside the estimation space. In metal cutting, where a wide range of sorts of machines are being utilized, there are parameters that are available and specifically influence the surface harshness. 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 unpleasantness and furthermore research whether the uncontrolled cutting parameters significantly affect surface harshness. Since the start of 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 procedure were resolved, and after that examinations centered toward that path. When all is said in done there are three noteworthy unmistakable parts of the cutting procedure: the machine, the cutting device, and the work-piece material. Among these three sections, the cutting device has its own particular significance as far as cost and effectiveness. Frederick Winslow Taylor, 1800's, performed thinks about on cutting devices because of his investigations on cutting devices; Taylor figured the connection between cutting rate and 2 apparatus life for various instruments. The changes he oversaw in instrument effectiveness and yield by utilizing his details were striking. Because of cost contemplations, more accentuation was set on apparatus life.

An instrument that never again plays out the coveted capacity is said to have fizzled and along these lines achieved the finish of its valuable life. By then of time, the apparatus is not any more equipped for playing out a cutting. The instrument must be either honed or supplanted. There are approaches to determine the apparatus life amongst honing and substitution;

- Actual slicing time to disappointment
- Total time to disappointment as on account of an intruded on cutting procedure (e.g. processing)
- Length of work slice to disappointment
- Volume of metal expelled

- Number of parts delivered to disappointment
- Cutting speed for an offered time to disappointment.

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 backlash.

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.

2.0 LITERATURE REVIEW:

[1] Tomadi et al. (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.

[2]Kapil Banker, UjjvalPrajapati, JaiminPrajapati, Paras Mod (2014) In this procedure, the material expulsion is happened electro thermally by a progression of progressive 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 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 investigation had been done alongside copper instrument 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. Execution of water based dielectric is yet to be explored for machining materials like composites and carbides.

[3] UgurKoklu and GültekinBasmaci (2017) Compared to processing on a full scale, the small scale processing process has a few unwieldy indicates that need be tended to. Quick instrument 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 performed effectively utilizing a consistent cutting velocity, bolster rate, and profundity of cut with two distinctive cutter way procedures. Inside the confinement of momentum investigate, it was presumed that the apparatus way technique and coolant factor assumed an imperative part as far as cutting power and surface quality for the miniaturized scale processing

[4]U Ashok Kumar, P. Laxminarayana(2017) In present day commitment the apparatus cost assume 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 ideal instrument 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.

3.0 METHODOLOGY:

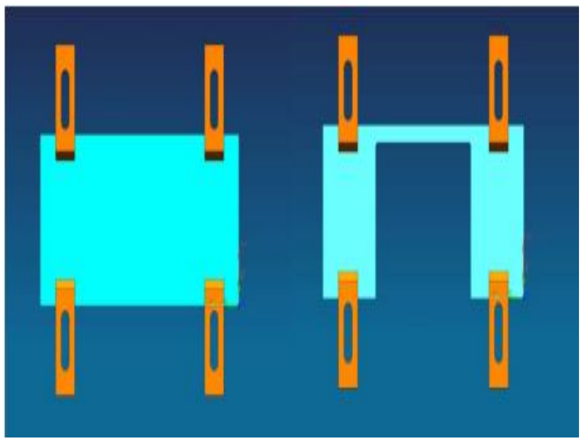
The workpiece material used in the experiment is a unidirectional continuous carbon fiber reinforced composite, with 3.5 millimeter thickness and each layer has 0.127 millimeter thickness. The material code is ABS5377A0000-01 used in the experiments and it is also epoxy prepreg material which contains 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 the Figure. The workpiece was cut into blanks of 400x188 millimeter in an automated cutting machine for the experiment.

The Structure of the Unidirectional (UD) Continuous CFRP Composite Material

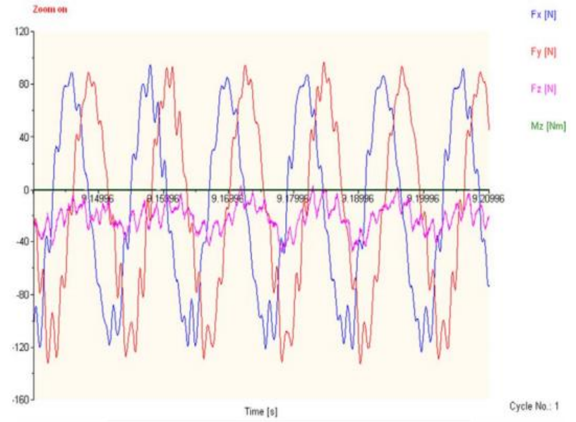
Machining parameters:

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 are shown below.

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



Work piece before and After Machining

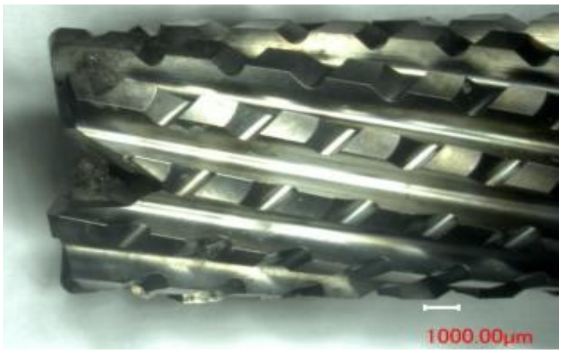


n= 5000 rpm fz= 0,01 mm/tooth Vf= 600 mm/min

Figure shows Cutting Force Data

Tool Wear Measurement:

The tool 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

Figure shows Cutting Tool Image under the Microscope for 5000 rpm Spindle Speed

4.0 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

Machining Configuration:

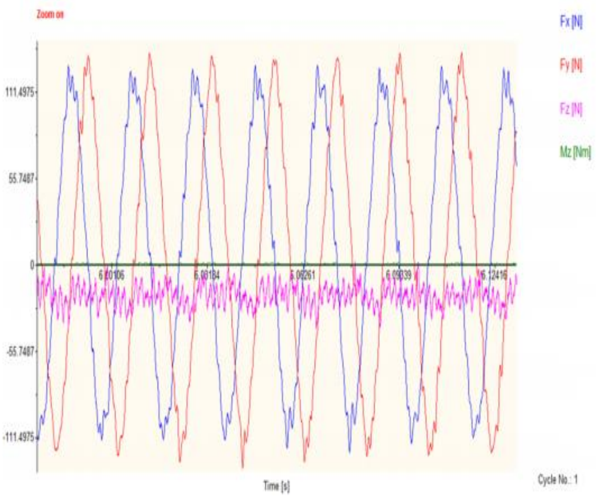
Climb milling (down milling) was applied in all experiments to specify the appropriate machining condition for lesser tool wear and to prevent delamination. Nowadays, climb milling is considered to be the optimal way to machine parts. This is because it decreases the load from the cutting edge, leaving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

Table shows The Results of the Experiments at 5000 rpm

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	125 187
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

The Experiment Matrix Table

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



n= 3000 rpm fz= 0.02 mm/tooth Vf= 720 mm/min

Figure shows The Cutting Forces for 3000 rpm

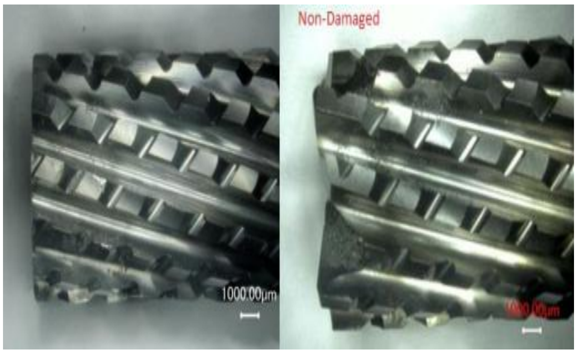
n=3000 rpm fz=0.02 mm/tooth Vf=720 mm/min

n=3000 rpm fz=0.03 mm/tooth Vf=1080 mm/min

n=5000 rpm fz=0.02 mm/tooth Vf=1200 mm/min

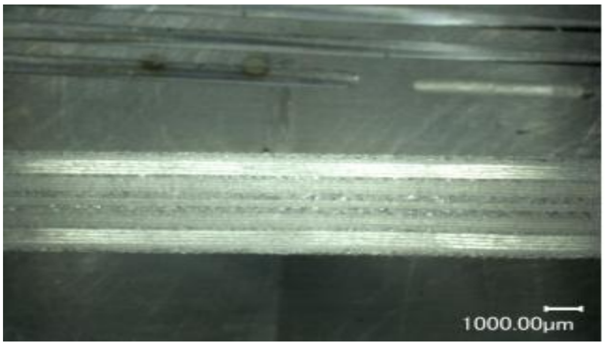
n=5000 rpm fz=0.03 mm/tooth Vf=1800 mm/min

n=7000 rpm fz=0.02 mm/tooth Vf=1680 mm/min

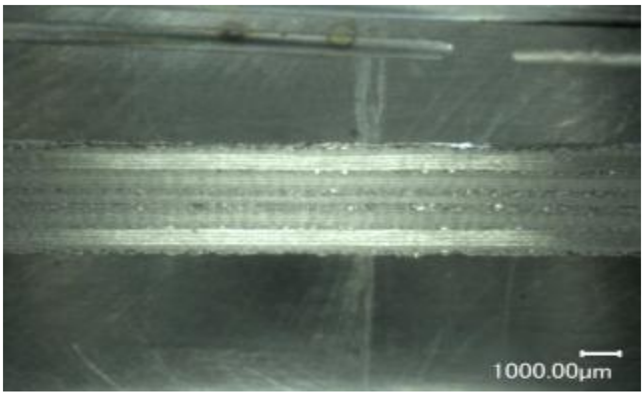


n=7000 rpm fz=0.03 mm/tooth Vf=2520 mm/min

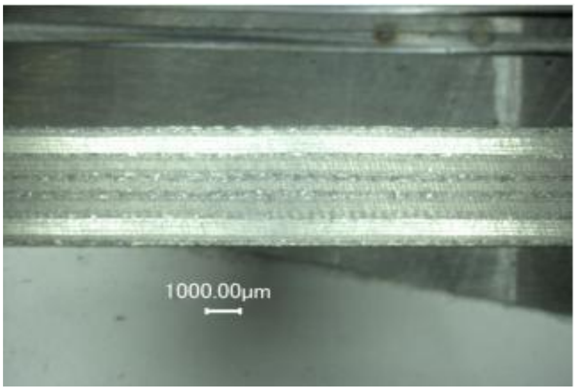
Delamination Measurement:



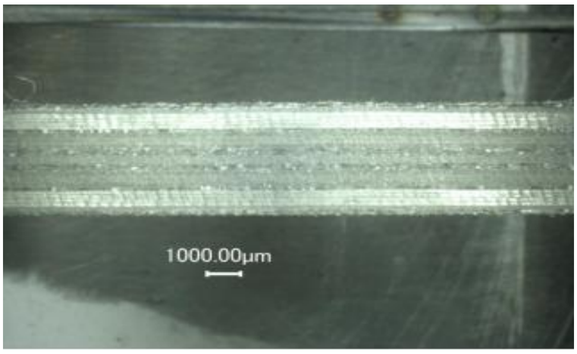
n=3000 rpm fz=0.02 mm/tooth Vf=720 mm/min



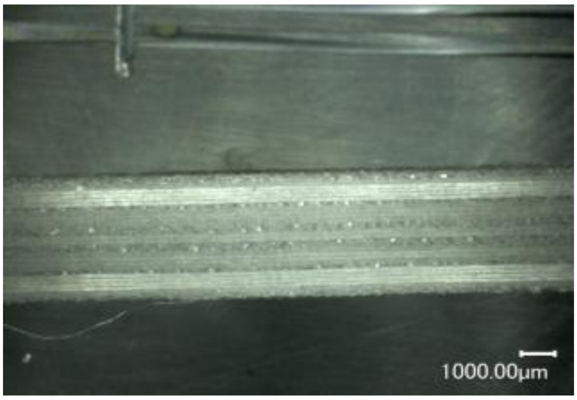
n=3000 rpm fz=0.03 mm/tooth Vf=1080 mm/min



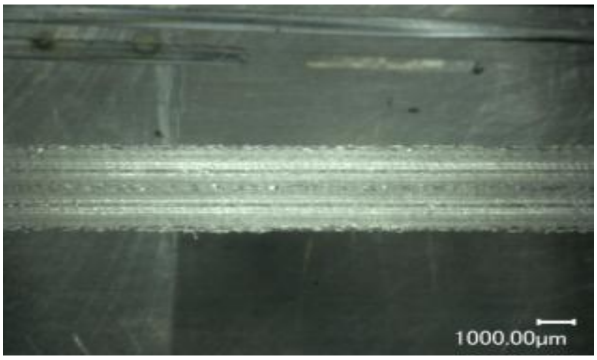
n=5000 rpm fz=0,02 mm/tooth Vf=1200 mm/min



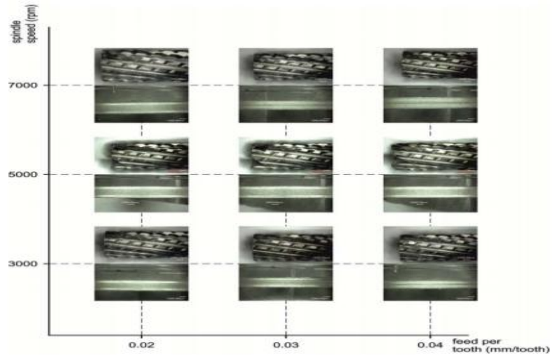
n=5000 rpm fz=0,03 mm/tooth Vf=1800 mm/min



n=7000 rpm fz=0,02 mm/tooth Vf=1680 mm/min



n=7000 rpm fz=0,03 mm/tooth Vf=2520 mm/min



The Results of Experiments According to Spindle Speed and Feed per Tooth

Delamination does not occur any feed per tooth and spindle speed values, there are edge 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.

CONCLUSIONS:

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 millimeter. 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.

FUTURE WORKS:

• This thesis involved varying the spindle speed and feed speed, 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).

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