

Machining Characteristics of Natural Fiber Particle Reinforced Polymer Composite Material using Artificial Neural Network

T. Naresh Kumar, B. Murali and J. Arulmani

Abstract: *The point of research is improvement of biocomposite materials dependent on biopolymers and characteristic filaments has been made through creation of Natural fiber powdered material (Abaca, Mudar and Hemp strengthened polymer composite material by utilizing bio epoxy tar. The present work centers around the forecast of push power and torque of the normal fiber fortified polymer composite materials and the qualities, contrasted and the Artificial Neural Network.*

Key words: *Abaca, Mudar, Hemp, Bio Resin, ANN, Machining Parameters*

I. INTRODUCTION

As of late, the characteristic filaments have pulled in generous significance as potential basic material. The appealing in addition to purpose of normal fiber is regarding modern use which has made its accessibility all the more requesting [1]. Keeping this in view the present work has been embraced to build up a polymer network composite (epoxy tar) utilizing regular strands as fortification and to ponder its mechanical properties and execution [2]. India is a nation which to a great extent relies upon farming. Homestead items comprise the different joints and bones of the foundation of the nation's economy out of which regular fiber has been a waste item which remains to a great extent undiscovered [3]. As of late the regular fiber epoxy composites has pulled in generous significance as a potential basic material [4]. The alluring highlights of regular strands like jute, sisal, coir and banana have been their minimal effort, light loads, high explicit modulus, recharge capacity and biodegradability [5]. Fiber fortified composites are being utilized broadly today, owing their utilization to better mechanical properties like high quality than weight proportion, high solidness to weight proportion and plan adaptability [6-7]. Expanded utilization of composites has implied there is interest for joining of a portion of the parts together [8]. Cement holding is the strategy utilized frequently for joining most composites, yet it has its

detriments. Glue holding requires surface readiness of the materials before they can be joined [9]. Warmth and weight might be required for relieving purposes during cement holding. Glues are synthetic compounds used to consolidate composites [10-11]. Contingent upon the glue picked, the fix time of composites may be low or high [12]. Because of the synthetics utilized, security and wellbeing may be in danger. Reinforced joints are hard to assess for deficiencies or as a rule [13-14].

II. MATERIALS AND METHODS

The example utilized in this examination is a round and hollow bar of 60×40 mm made of regular fiber fortified composite material. The composite is made of common filaments.

The materials utilized in this undertaking are:

- Abaca and Hemp (half and half) molecule fiber strengthened composite
- Mudar and Abaca (half and half) molecule fiber strengthened composite
- Mudar and Hemp (half and half) molecule fiber strengthened composite.

A. Preparation of Composite Cylindrical Rod

A form of sixty metric straight unit length and forty metric direct unit distance across was made misuse GI sheet shape. partner OHP Sheet was taken and a purifying operator was connected over it and fitted with the inward part of the form and permitted to dry [15]. A glass measuring utensil and a glass pole or a stirrer were taken and clean well with running water and a short time later with warmth water. At that point, determined measure of bio manufactured pitch and hardner was superimposed and in this way the blend was mixed for almost 10-15 min. Mixing was done to shape an unvaried blend of natural compound and quickening agent particles. a while later, determined measure of filaments was superimposed and in this way the blending strategy was proceeding [16]. At that point, the blend was filled the shape and smashed tenderly for uniform settlement. The form was permitted to cement for almost 24 h [17].

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B. Machining of Composite Specimens

In the wake of acquiring the composite tube shaped pole with required measurements, the machining (boring procedure) of composite examples is appropriated abuse MAXMILL CNC machining focus misuse High Speed Steel (HSS) bit bits. The boring technique was circulated misuse HSS bend drills with consistent unadulterated arithmetic. The level of the machining parameters used in this examination zone unit given as Table 1. Drill device estimating instrument was wont to live pushed power and torsion severally all through the penetrating procedures [18]. the consequences of machining parameters on push power, torsion and delamination of composite materials were comprehended by sizable sum (27) of machining tests [19].

Table 1. Assignment of the levels to the factors

Drill Level	size, d (mm)	Velocity, N (m/min)	Feed rate, f (mm/rev)
1	3	600	0.1
2	4	900	0.2
3	5	1200	0.3

C. Factorial Design

A 3³ full factorial structure with an aggregate of 27 exploratory runs were done. The push power and torque were the reaction factors recorded for each run. The impact of the machining parameters is another significant angle to be considered. It very well may be seen that the slicing speeds from 20 to 60 m/min are typically utilized, while feed rate esteems lower than 0.3 mm/rev are visit. Cutting rate is definitely not a restricting component when boring polymeric composites, especially with hard metals and in this way, the utilization of cutting velocities underneath 60 m/min might be clarified by the most extreme rotational speed of customary machining devices, since drill distances across over 10 mm are infrequently detailed [20]. Another

explanation behind continuing cutting rates underneath 60 m/min may live in the way that higher slicing rate esteems lead to higher cutting temperature, which thusly may cause the conditioning of the framework [21-22]. The utilization of feed rates beneath 0.3 mm/rev might be related with the delamination harm caused when this parameter is expanded.

D. Experimental Setup

Various boring examinations were completed on a CNC machining focus (Maxmill) utilizing HSS contort drills for the machining of NFRP composites. A two-part drill apparatus dynamometer was utilized to record the push power and torque. Traditional fast steel bend drills were utilized as much as established tungsten carbide drills. Device geometry is a significant angle to be considered in penetrating of fiber-fortified plastics, especially when the nature of the machined gap is basic.

III. DISCUSSION

In this examination work ANN has been utilized as a device to anticipate the test results. In ANN, feed forward back propogation was utilized to anticipate the qualities. The information parameters are speed, feed and instrument distance across. By methods for utilizing these parameters the yield parameters, for example, push power and torque has been anticipated. The system has been prepared by differing the neurons and the layers. Two-third of the exploratory qualities are utilized for 33% of the qualities are anticipated dependent on the preparation and both the outcomes from trial and Artificial Neural Network are great in understanding as appeared Table. 2-7. Factual qualities and of mixture of Abaca and Hemp, half and half of Abaca and Mudar and cross breed of Hemp and Mudar are appeared Table 8-10 and Scatter Index of above said crossover materials appeared from this correlation of exploratory and ANN results cross breed of Abaca and Mudar machining properties is superior to other two mixture materials.

Table 2. Trained values of hybrid of Abaca and Hemp thrust force and torque using ANN

Sl. No.	Drill diameter (mm)	Speed (rpm)	Feed (mm/rev)	Thrust (EXP) (N)	Torque (EXP) (N-m)	(ANN) Thrust (N)	(ANN) Torque (N-m)
1	3	300	0.1	3	0.93	3.008	0.932
3	3	900	0.1	4.48	0.98	4.488	0.980
5	3	600	0.2	6.27	1.77	6.270	1.776
7	3	300	0.3	6.45	2.45	6.450	2.452
8	3	600	0.3	8.31	2.54	8.310	2.545
10	4	300	0.1	5.04	1.2	5.040	1.199
11	4	600	0.1	6.5	1.24	6.488	1.240
13	4	300	0.2	8.18	2.21	8.170	2.190
14	4	600	0.2	10.55	2.28	10.542	2.277
15	4	900	0.2	12.23	2.32	12.230	2.322
17	4	600	0.3	13.99	3.26	13.980	3.260
18	4	900	0.3	16.23	3.32	16.230	3.322
20	5	600	0.1	9.74	1.5	9.722	1.522
21	5	900	0.1	11.3	1.53	11.322	1.520
22	5	300	0.2	12.25	2.68	12.442	2.677
24	5	900	0.2	18.32	2.82	18.322	2.810
25	5	300	0.3	16.25	3.83	16.252	3.832
27	5	900	0.3	24.31	4.04	24.322	4.041

Table 3. Predicted values of hybrid of Abaca and Hemp thrust force and torque using ANN

Sl. No.	Drill diameter (mm)	Speed (rpm)	Feed (mm/rev)	Thrust (EXP) (N)	Torque (EXP) (N-m)	(ANN) Thrust (N)	(ANN) Torque (N-m)	% of Error in Thrust	% of Error in Torque
2	3	600	0.1	3.86	0.96	3.82	0.96	1.04	0.00
4	3	300	0.2	4.86	1.72	4.86	1.72	0.00	0.00
6	3	900	0.2	7.27	1.81	7.27	1.81	0.00	0.00
9	3	900	0.3	9.65	2.59	9.65	2.59	0.00	0.00
12	4	900	0.1	7.54	1.26	7.54	1.27	0.00	0.79
16	4	300	0.3	10.85	3.15	10.84	3.14	0.09	0.32
19	5	300	0.1	7.55	1.46	7.54	1.46	0.13	0.00
23	5	600	0.2	15.79	2.77	15.78	2.77	0.06	0.00
26	5	600	0.3	20.95	3.96	20.95	3.96	0.00	0.00

Table 4. Trained values of hybrid of Abaca and Mudar thrust force and torque using ANN

Sl. No.	Drill diameter (mm)	Speed (rpm)	Feed (mm/rev)	Thrust (EXP) (N)	Torque (EXP) (N-m)	(ANN) Thrust (N)	(ANN) Torque (N-m)
1	3	300	0.1	6.93	0.85	6.868	0.844
3	3	900	0.1	10.98	0.8	10.990	0.799
5	3	600	0.2	24.05	1.5	24.052	1.522
7	3	300	0.3	31.43	2.22	31.442	2.220
8	3	600	0.3	42.02	2.14	42.001	2.140
10	4	300	0.1	8.38	1.1	8.421	1.100
11	4	600	0.1	11.2	1.06	11.214	1.062
13	4	300	0.2	21.75	2.02	21.744	2.022
14	4	600	0.2	29.07	1.95	29.061	1.966
15	4	900	0.2	34.45	1.91	34.442	1.910
17	4	600	0.3	50.8	2.77	50.773	2.770
18	4	900	0.3	60.2	2.72	60.114	2.720
20	5	600	0.1	12.98	1.3	12.972	1.292
21	5	900	0.1	15.38	1.28	15.377	1.277
22	5	300	0.2	25.2	2.47	25.220	2.460
24	5	900	0.2	39.92	2.33	39.912	2.332
25	5	300	0.3	44.02	3.52	44.022	3.511
27	5	900	0.3	69.74	3.32	69.722	3.322

Table 5. Predicted values of hybrid of Abaca and Mudar thrust force and torque using ANN

Sl. No.	Drill diameter (mm)	Speed (rpm)	Feed (mm/rev)	Thrust (EXP) (N)	Torque (EXP) (N-m)	(ANN) Thrust (N)	(ANN) Torque (N-m)	% of Error in Thrust	% of Error in Torque
2	3	600	0.1	9.27	0.82	9.34	0.82	0.76	0.00
4	3	300	0.2	17.99	1.56	17.88	1.55	0.61	0.64
6	3	900	0.2	28.5	1.47	28.42	1.47	0.28	0.00
9	3	900	0.3	49.79	2.09	49.7	2.08	0.18	0.48
12	4	900	0.1	13.27	1.04	13.27	1.044	0.00	0.38
16	4	300	0.3	38	2.87	38	2.87	0.00	0.00
19	5	300	0.1	9.71	1.35	9.72	1.35	0.10	0.00
23	5	600	0.2	33.68	2.38	33.67	2.37	0.03	0.42
26	5	600	0.3	58.85	3.39	58.85	3.39	0.00	0.00

Table 6. Trained values of hybrid of Hemp and Mudar thrust force and torque using ANN

Sl. No.	Drill diameter (mm)	Speed (rpm)	Feed (mm/rev)	Thrust (EXP) (N)	Torque (EXP) (N-m)	(ANN) Thrust (N)	(ANN) Torque (N-m)
1	3	300	0.1	6.93	0.85	6.922	0.851
3	3	900	0.1	10.98	0.8	10.966	0.810
5	3	600	0.2	24.05	1.5	24.011	1.499
7	3	300	0.3	31.43	2.22	31.432	2.220
8	3	600	0.3	42.02	2.14	42.021	2.140
10	4	300	0.1	8.38	1.1	8.382	1.122
11	4	600	0.1	11.2	1.06	11.200	1.066
13	4	300	0.2	21.75	2.02	21.744	2.022
14	4	600	0.2	29.07	1.95	29.070	1.954
15	4	900	0.2	34.45	1.91	34.442	1.910
17	4	600	0.3	50.8	2.77	50.778	2.770
18	4	900	0.3	60.2	2.72	60.110	2.722



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20	5	600	0.1	12.98	1.3	12.99	1.322
21	5	900	0.1	15.38	1.28	15.380	1.288
22	5	300	0.2	25.2	2.47	25.200	2.470
24	5	900	0.2	39.92	2.33	39.900	2.332
25	5	300	0.3	44.02	3.52	44.011	3.522
27	5	900	0.3	69.74	3.32	69.744	3.322

Table 7. Predicted values of hybrid of Hemp and Mudar thrust force and torque using ANN

Sl. No.	Drill diameter (mm)	Speed (rpm)	Feed (mm/rev)	Thrust (EXP) (N)	Torque (EXP) (N-m)	(ANN) Thrust (N)	(ANN) Torque (N-m)	% of Error in Thrust	% of Error in Torque
2	3	600	0.1	9.27	0.82	9.26	0.82	0.11	0.00
4	3	300	0.2	17.99	1.56	17.82	1.57	0.94	0.64
6	3	900	0.2	28.5	1.47	27.37	1.46	3.96	0.68
9	3	900	0.3	49.79	2.09	49.79	2.09	0.00	0.00
12	4	900	0.1	13.27	1.04	13.27	1.04	0.00	0.00
16	4	300	0.3	38	2.87	38	2.87	0.00	0.00
19	5	300	0.1	9.71	1.35	9.69	1.35	0.21	0.00
23	5	600	0.2	33.68	2.38	33.67	2.38	0.03	0.00
26	5	600	0.3	58.85	3.39	58.85	3.39	0.00	0.00

Conclusion

When all is said and done, the push and torque parameters will for the most part rely upon the assembling conditions utilized, for example, feed, cutting pace, apparatus geometry, machine instrument and cutting device unbending nature. A bigger push power happens for bigger width drills and higher feed rates. As it were, feed rate and drill distance across are perceived as the most noteworthy elements influencing the push power. Destroyed drill might be one of the significant explanations behind the intense increment in the push power just as for the presence of bigger push powers when utilizing multifacet drill than those when utilizing turn drill at high cutting velocity. In any case, we found that the expansion in torque was a lot littler than that in push power, with the expanding cutting rate. The normal torque showing up when utilizing a multifacet drill was bigger than that utilizing the wind drill at low penetrating velocity and the normal torque when utilizing a multifacet drill was littler than that when utilizing turn drill at high boring pace.

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