

RESEARCH ARTICLE

EVALUATION OF CARBON FIBRE REINFORCED POLYMERS USING FUZZY TOPSIS MCDM METHOD

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Manuscript Info

Abstract

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*Key words:-*Fuzzy Topsis, CFRP, GFRP, FRP Carbon Fiber Reinforced Polymer (CFRP) is Repair of reinforced concrete structures and both are used for reinforcement One of the composite materials. Polymer reinforced with carbon fibres an advanced non-metal made of resin compound, which is of high strength, Weight loss, itching and excessive fatigue It has many excellent performances like resistance. Carbon fiber reinforced polymer (CFRP) is the best specific machine has properties, so these products High such as automobile and aerospace sectors widely used in technical industries. Dimensional or assembly related requirements CFRP composites to complement Machining is often necessary. The approach is based on the Fuzzy TOPSIS technique (Fuzzy Technique for Order Preference by Similarity to Ideal Solution) this analysis using the Alternative Value Conventional twist drill, Double point angle twist drill, Brad & spur drill, Dagger drill, Core drill and Cutting force, Cutting torque, Tool wear, Cutting temperature is Evaluation parameters value Core drill is got the first rank whereas is the Dagger drill is having the lowest rank.

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Introduction:-

Composite is used in composite materials is one each repair and strengthening of strengthened concrete systems. Carbon fiber strengthened polymer (CFRP) is a sophisticated non-steel composite fabric fabricated from polymer resin strengthened with carbon fibers, which has many incredible performances which includes high electricity, light weight, corrosion and excessive fatigue resistance. Carbon fiber is a polymer and is on occasion referred to As graphite fiber. It is very easy Very sturdy fabric. Carbon fiber Five times stronger And twice as hard as metallic. The key distinction between CFRP and GFRP is that CFRP contains carbon as fiber factor whereas GFRP consists of glass as fiber aspect. The time period FRP stands for Fiber Reinforced Plastic. These are polymers, known as composite substances, which can be made from a polymer matrix strengthened with fiber. Carbon-fiber strengthened polymer (CFRP) is used for dependable and excessive-performance structural strengthening systems. However, CFRPs are considered low mark inability materials because the abrasive nature of carbon fibers causes' strong device put on, which changes the geometry of the drill bit and influences the final floor first-rate of the work piece. Instead of end-of-life carbon fiber ending up in landfills, there is now an entire supply chain that can recover it and a market that wants to use it. And the energy requirements are much lower than using virgin carbon fiber. TOPSIS Originally by Wang and Lee Created, this method basic concept is selective alternatives are positive and A negative ideal from solution A short distance from the solution Must have long range too. The TOPSIS technique is to solve

Corresponding Author:- Nayeemuddin Address:- Department of Mechanical Engineering, KBN University Kalaburagi, Karnataka India. general decision-making problems is used This Technique for all alternatives in the problem A comparison between alternatives is based.

Carbon Fibre Reinforced Polymers

The definition of NPLs varies by region. In one nation, a loan could be regarded as NPL, and in the other, it may not be. However, views in some cases do coincide. As such, the "International Monetary Fund's (IMF) Compilation Guide on financial soundness indicators" (2015) states that:

Carbon fiber reinforced polymer (CFRP) is two major An excellent structural composite of components The material is Manufacture However, high-tech Erectile dysfunction is an important requirement. This is specifically for such as Stiffness is relatively low in CFRP composites density, high damping capacity, good dimensionality Stability and good corrosion protesting [4]. Hydrodynamic effects Sliding positions are selected to minimize. All Liquids and carbon/polymer debris on the opposite face prevent the formation of transfer films and dry the rate of wear is generally greater than that obtained in condition will be more. Terrain in the Depreciation Process and the type of opposite face plays an important role and corrosion by liquid is also important [2]. Carbon fibers, their processing dictates their very last houses. They are produced by using the equal method steps as fiber Rayon, polyacrylonitrile (PAN) and including pitch isotropic or mesophase Formation of carbon-rich natural precursor's stabilization and carbonation. Carbonaceous the precursor is changed first fiber shape after which go-linked to resist very excessive temperatures [3]. The mechanical conduct of carbon fiber bolstered polymer (CFRP) isn't always a completely appreciably investigated subject matter. Regarding this fabric, it ought to Its homogeneous and anisotropic Traditional metal due to features Finding its analogies in works That the miles are hard should be noted. With modern-day technology, it is viable to gadget correct nice holes the usage of high priced and specialized cutting tools, however greater research and investigation is needed to develop less expensive opportunity technologies (which includes helical grinding with a strong carbide tool). [5]. to evaluate such capability technology. Generation, especially inside the aerospace industry wherein CFRPs are widely diagnosed as particularly fatigue resistant because of their high specific stiffness and electricity, but, this gain is regularly no longer absolutely exploited. In layout, therefore, information the existence of these substances is of exceptional hobby. Fatigue layout strategies composite laminates are their due to decay not well established more than one interactive harm modes along with fiber/. However, for predicting fatigue life, dependable predictions primarily layout [11]. Carbon fibers had been recovered from strong At two unusual temperatures of 500 and seven hundred oC Silica having a weighted form of stable residue Pyrolysis residue by placing in crucibles samples have been eliminated periodically As long as the weight of the sample is constant, the charcoal is completely burnt Confirmed to have changed. Recovered carbon Effect of oxidation temperature on fiber housing these temperatures have been used for the study. The fibers were then slowly separated from the ash [12]. = 0.11 mm thick carbon FRP fabrics Compatible with ply (SikaWrap-200C) exterior were used as reinforcement. Fiber path beam is efu = 1.5% mm/mm, respectively [15]. Carbon fibers with different fiber period distributions with average flexural electricity of fiber concrete are investigated within the following. This rCF changed into evolved a commercial heat recycling system from pyrolysis, it rCF approx corresponds to the situation of use within the creation profession. This fact from previous studies different, it is manual or manual the fiber reinforcements produced are concentrated laboratory-scale equipment, without warmness treatment to get rid of adhesive or fixed fiber lengths. Mechanical residences are acquired from 4-factor bending tests on fiber strengthened concrete [16]. Joints fail by way of cracking at the periphery of the grafting quarter and this between the residue and the aluminum or alloy propagates across the interface floor. If of the crack transition zone reaches the beginning trade to compounds from their pathway interface can and plastic diffuses into the deformed zone the block near the metal microbubble, is region Associated with failure is a high dose of this [17]. The carbon fiber strengthened Polymer with the aid Sycom have been accompanied, not like steel substrates, which might be regularly blasted prior to bloodless spraying; CFRP substrates are corroded at some point of grid blasting [14]. Carbon fiber bolstered polymers. Many studies of moisture reinforced polymers in the open literature checks that affect houses, but such Research examines only a few basic engine houses does. In discusses the effect of humidity in more detail there are no guides. In this investigation constructed realities for shaping can be used as manual additives from these materials below the have an effect on of humidity [7]. The use of carbon fiber strengthened polymers calls for appropriate disposal results in degradation of the polymer matrix however can also depart stable carbon residues within the fiber. These residues block the fiber size and are thereby reused in new merchandise. In cutting-edge situations, those residues are removed by means of thermal remedy with oxygen inside the atmosphere. However, it can damage the tensile energy of the fiber [9].

The most common twist drill bit (common sold in hardware stores) 118 degrees The point contains the angle, tree, Metal, plastic and others work best to use the optimal angle for each Meaning. or general purpose twist drills the helix angle is about 32°, of the tapering point the angle formed by the two sides is constant 118° for drills, while hard metals For drilling, one with an angle of 135° a flat point is recommended. Broad point drill bits are specially designed for drilling and drilling clean holes without wandering through hard and soft woods. These drill bits are designed with a center pin as seen in the pictures below and to the right. A broad point drill provides a clean, straight and precisely sized hole in wood. Designed to create non-ablation holes in graphite materials and/or graphite/aluminum material layers. These exercises can put the point on the ground repeatedly without thinning. The best practices for composite materials are solid carbide or diamond phase depending on the materials in the laminate. Although more expensive, solid carbide can be sharpened and diamond recoated, the performance of these drill bits is best when fitted with high-speed drills. Core drilling involves using a hollow punch or drill bit to remove a clean core for testing. It is commonly used in mining, concrete work and other applications to determine the quality, density, strength and various properties of a material. Cutting force is the opposite of the penetration Performed on production machines Various such as turning, grinding and drilling Force directions and amplitudes in shear processes vary-mostly CNC for turning Predicted cutting torque, milling process planning Cutting forces and chattering for purposes Tangential shear force to accurately predict sections Also used to identify coefficients. Possible adverse effects of lowering temperature in machining: Heat during and after machining Due to deflection and expansion-contraction Dimensional inaccuracy of work. oxidation, Surface damage due to accelerated corrosion, burning etc.

Fuzzy Topsis

TOPSIS is widely used Fuzzy TOPSIS is a decision-making method or reliable of group dimming TOPSIS In-depth studies, comparisons and We still believe that more is needed. standardization technique to reap this purpose [15]. Fuzzy TOPSIS technique Manufactured by KAU Projects are divided 4 classes specifically instructional homes, personnel quarters. KAU campus streets and roads and all infrastructure projects. Scope of Control It is the completion of all production tasks with minimum value and high penalty correct time. Alternatively, KAU will create Projects are more uncertain and with budgetary constraints are started dynamically. [16]. Fuzzy TOPSIS techniques with MCDM. To determine the preferred weighting of the assessment is used and then, to the real ones Alternate between to improve the intervals Research follows Fuzzy TOPSIS performance values and the preferred tiers in every measurement and criterion and to locate the great options to obtain the preferred/suitable tiers based totally at the 4 proposed entities. This research hopes to offer some strategic tips for Taiwan industries and authorities [17].Fuzzy TOPSIS Techniques for facility location are proposed choice, critiques of numerous opportunity places below numerous subjective criteria and of all standards Weights are also fuzzy numbers represented [18]. Fuzzy TOPSIS outcomes are furnished with the aid of unique distance metrics. A comparative analysis of c programming language-valued fuzzy TOPSIS scores from every distance scale is illustrated with discussions of consistency ratios [19]. Fuzzy TOPSIS technique, target Change of criteria through the application is accomplished of Hsu and Chen approach, which guarantees Compatibility between concepts Every chance and every Each scale is weighted Membership aspect of moderator generated the usage of fuzzy numbers Interval Arithmetic, to do keep away from the Complexity of Random Fuzzy Numbers Aggregation, this is weighted Ratings are simple values are destroyed rank approach of the common of eliminations [20]. Fuzzy TOPSIS strategies aren't efficient sufficient, due to the fact "fuzzy high quality-satisfactory solution" and "vaguely negative-at best Answer", fuzzy ranking Techniques are used However no person can supply a fuzzy ranking. Numbers satisfactorily in all instances and conditions. Additionally, calculating the space from the pleasant answer and the poor-first-rate answer is difficult. To remedy those issues in making an ambiguous choice A new ambiguity Topsis approach proposed [21]. The proposed method is by decision maker's marks and Weight age to be allotted to be averaged and comparable are normalized every normal A club activity with weights estimate of each opportunity region for every criterion is certainly constructed. In order net values They are changed, every chance they get for large and negativepositive responses of proximity Helps to calculate distance [22]. Many fuzzy TOPSIS methods and programs were advanced in latest years. First used fuzzy numbers to establish fuzzy topsis. Created a fuzzy Topsis approach of every opportunity in this relative intimacy is absolute Predicted based on ambiguity mathematics features. Proposed Primarily a fuzzy MCDM Idealism and Resistance based onideality standards. Technique for unclear GDM conditions A similarly stepped forward set of rules became proposed extending Alpha degrees with spacing based on units Fuzzy TOPSIS approach mathematics [23]. Among many popular MCDM techniques, Subjective and objective Fuzzy with weights Technique for performance, ranking and to select a pair A realistic and A powerful approach. potential options by means of measuring Euclidean distances. TOPSIS become in the beginning developed [24]. Fuzzy TOPSIS implementations Application areas are categorized to differentiate areas of not unusual interest along with supply chain control, environmentally pleasant solutions, power profession or business However, ambiguous topsis has been implemented in a completely huge range of regions, applied in a restrained industry, along with in health care such as weapon selection or surest remedy selection [25]. Fuzzy TOPSIS is multivariate in order to select properties has been introduced troubles. Fuzzy TOPSIS became used for plant place selection and TOPSIS for dealer choice. Used fuzzy TOPSIS for business robotic machine choice [26].

Analysis and Discussion:-

 Table 1:- Carbon Fibre Reinforced Polymers.

	Cutting force	Cutting torque	Tool wear	Cutting temperature
Conventional twist drill	34.56	155.6	32.63	22.05
Double point angle twist drill	33.48	175.2	45.63	27.30
Brad & spur drill	25.63	185.6	32.16	23.10
Dagger drill	38.46	125.3	55.54	25.15
Core drill	40.63	186.35	30.16	20.89

Table 1 show the Carbon Fibre Reinforced Polymers for Analysis using the TOPSIS Method. Cutting force, Cutting torque, Tool wear, Cutting temperature in Evaluation parameters. This is the Alternative Conventional twist drill, Double point angle twist drill, Brad & spur drill, Dagger drill, Core drill.

Figure 1:- Carbon Fibre Reinforced Polymers

Figure 1 shows the Carbon Fibre Reinforced Polymers for Analysis using the TOPSIS Method. Cutting force, Cutting torque, Tool wear, Cutting temperature in Evaluation parameters. This is the Alternative Conventional twist drill, double point angle twist drill, Brad & spur drill, Dagger drill, Core drill it is seen that Core drill is showing the Highest Value for Cutting force and Brad & spur drill, is showing the Lower value. Core drill is showing the Highest Value for Cutting torque and Dagger drill is showing the lowest value. Dagger drill is showing the Highest Value for Tool wear and Core drill is showing the lowest value. Double point angle twist drill is showing the Highest Value for Cutting temperature and Core drill is showing the lowest value.

Table 2:- Square and Root of Value.

1			
1194.3936	24220.6969	1064.7169	486.2025
1120.9104	30677.5225	2082.0969	745.2900
656.8969	34454.7844	1034.2656	533.6100
1479.1716	15697.5841	3084.6916	632.5225
1650.7969	34726.3225	909.6256	436.3921

Table 2 shows the Square and Root of Value Carbon Fibre Reinforced Polymers for Analysis using the TOPSIS Method. Cutting force, Cutting torque, Tool wear, Cutting temperature. Conventional twist drill, Double point angle twist drill, Brad & spur drill, Dagger drill, Core drill SQRT Value.

Table 3:- Normalized Data.

Cutting force	Cutting torque	Tool wear	Cutting temperature
0.4424	1.9923	0.3609	0.4142
0.4286	2.2422	0.5047	0.5128
0.3281	2.3762	0.3557	0.4339
0.4923	1.6039	0.6143	0.4724
0.5201	2.3855	0.3336	0.3924

Table 3shows the Normalized Data Carbon Fibre Reinforced Polymers for Analysis using the TOPSIS Method. Cutting force, Cutting torque, Tool wear, Cutting temperature. Conventional twist drill, Double point angle twist drill, Brad & spur drill, Dagger drill, Core drill. is the Normalized Value.

Figure 2. Normalized Data

Figure 2 shows the Normalized Data Carbon Fibre Reinforced Polymers for Analysis using the TOPSIS Method. Cutting force, Cutting torque, Tool wear, Cutting temperature. Conventional twist drill, Double point angle twist drill, Brad & spur drill, Dagger drill, Core drill is the Normalized Value.

Table 4:- Calculate the fuzzy linguitic scale & Significance Value.

		1	m	u
Extremely low	EL	0.1	0.3	0.5
very low	VL	0.3	0.5	0.7
low	L	0.1	0.3	0.5
medium	М	0.5	0.7	0.9
high	Н	0.3	0.5	0.7
very high	VH	0.7	0.9	1
Extremely high	EH	0.9	1	1

Table 4 shows the Calculate the fuzzy linguistic scale & Significance Value Cutting force, Cutting torque, Tool wear, Cutting temperature. Conventional twist drill, Double point angle twist drill, Brad & spur drill, Dagger drill, Core drill.

	DM1	DM2	DM3
	Onwer	Capten	Coach
Cutting force c	EH	VL	М
Cutting torque	L	EH	VH
Tool wear ear	L	М	VH
Cutting temperature	L	М	VL

Table 5 shows the Criteria linguitic scale using common value of Carbon Fibre Reinforced Polymers and Cutting force, Cutting torque, Tool wear, Cutting temperature.

Table 6:- Convert the linguistic rating of decision makers into quantative value.

	DM1			DM2			DM3		
Cutting force c	0.9	1	1	0.3	0.5	0.7	0.5	0.7	0.9
Cutting torque	0.1	0.3	0.5	0.9	1	1	0.7	0.9	1
Tool wear ear	0.1	0.3	0.5	0.5	0.7	0.9	0.7	0.9	1
Cutting temperature	0.1	0.3	0.5	0.5	0.7	0.9	0.3	0.5	0.7

Table 6 shows the Convert the linguistic rating of decision makers into quantative value of Carbon Fibre Reinforced Polymers and Cutting force, Cutting torque, Tool wear, Cutting temperature

Table 7:- Calculate Aggregated Fuzzy Weight Value.

	L-FW	M-FW	U-FW
Cutting force c	0.57	0.73	0.87
Cutting torque	0.57	0.73	0.83
Tool wear ear	0.43	0.63	0.80
Cutting temperature	0.30	0.50	0.70

Table 7 shows the Calculate Aggregated Fuzzy Weight Value of Carbon Fibre Reinforced Polymers and Cutting force, Cutting torque, Tool wear, Cutting temperature.

Cutting	force		Cutting torque			Tool wear			Cutting temperature		
0.2507	0.3244	0.3834	1.1289	1.4610	1.6602	0.1563	0.2285	0.2887	0.1242	0.2070	0.2899
03	39	28	61	08	36	81	57	04	59	99	38
0.2428	0.3143	0.3714	1.2705	1.6442	1.8684	0.2186	0.3196	0.4037	0.1538	0.2564	0.3589
68		46	61	56	73	85	16	25	45	08	71
0.1859	0.2406	0.2843	1.3465	1.7425	1.9801	0.1541	0.2252	0.2845	0.1301	0.2169	0.3037
23	07	53	12	45	65	29	65	45	76	61	45
0.2789	0.3610	0.4266	0.9088	1.1761	1.3365	0.2661	0.3890	0.4914	0.1417	0.2362	0.3307
94	51	97	7	85	74	79	31	07	29	15	
0.2947	0.3814	0.4507	1.3518	1.7493	1.9879	0.1445	0.2112	0.2668	0.1177	0.1962	0.2746
35	22	72	08	98	53	44	56	5	22	04	85

Table 8:- Weighted Normalized Decision Matrix.

Table 8 shows the weighted normalized decision matrix Cutting force, Cutting torque, Tool wear, Cutting temperature. Conventional twist drill, Double point angle twist drill, Brad & spur drill, Dagger drill, Core drill is the weighted normalized decision matrix of Value.

Α	0.294	0.381	0.450	1.351	1.749	1.987	0.144	0.211	0.266	0.117	0.196	0.274
+	735	422	772	808	398	953	544	256	85	722	204	685
Α	0.185	0.240	0.284	0.908	1.176	1.336	0.266	0.389	0.491	0.153	0.256	0.358
-	923	607	353	87	185	574	179	031	407	845	408	971

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Table 9 shows the A+, A- Maximum and Minimum Value Cutting force, Cutting torque, Tool wear, Cutting temperature. Conventional twist drill, Double point angle twist drill, Brad & spur drill, Dagger drill, Core drill.

Table 10:- Fuzzy positive ideal solution.

Conventional twist drill	0.056924	0.282977	0.017484	0.011461
Double point angle twist drill	0.067053	0.103169	0.109504	0.063334
Brad & spur drill	0.14067	0.006724	0.014157	0.021836
Dagger drill	0.02035	0.562453	0.179652	0.042091
Core drill	0	0	0	0

Table 10 shows the Fuzzy positive ideal solution Cutting force, Cutting torque, Tool wear, Cutting temperature. Conventional twist drill, Double point angle twist drill, Brad & spur drill, Dagger drill, Core drill.



Figure 3:- Fuzzy positive ideal solution.

Figure 3 shows the Fuzzy positive ideal solution Cutting force, Cutting torque, Tool wear, Cutting temperature. Conventional twist drill, Double point angle twist drill, Brad & spur drill, Dagger drill, Core drill.

Tuble 11 Tubby Tregative Ideal Solution.							
Conventional twist drill	0.083746	0.279476	0.162168	0.051872			
Double point angle twist drill	0.073617	0.459285	0.070148	0			
Brad & spur drill	0	0.555729	0.165495	0.041498			
Dagger drill	0.12032	0	0	0.021243			
Core drill	0.14067	0.562453	0.179652	0.063334			

Table 11:- Fuzzy Negative Ideal solution.

Table 11 shows the Fuzzy Negative ideal solution Cutting force, Cutting torque, Tool wear, Cutting temperature. Conventional twist drill, Double point angle twist drill, Brad & spur drill, Dagger drill, Core drill.

Figure 4:- Fuzzy Negative ideal solution

Figure 4 shows the Fuzzy Negative ideal solution Cutting force, Cutting torque, Tool wear, Cutting temperature. Conventional twist drill, Double point angle twist drill, Brad & spur drill, Dagger drill, Core drill.

	Si+	Si-	Cci	Rank
Conventional twist drill	0.368846	0.5772628	0.610144	4
Double point angle twist drill	0.343059	0.6030498	0.6374	3
Brad & spur drill	0.183387	0.7627221	0.806167	2
Dagger drill	0.804547	0.1415627	0.149626	5
Core drill	0	0.9461093	1	1

Table 12:- Si	positive. Si neg	ative. CCi Closen	ess coefficient &	Final Result.
	positive, or neg		cos councient a	I mai nosun

Figure 5:- Si positive, Si negative, CCi Closeness coefficient & Final Result

Figure 5 shows the Si positive, Si negative, CCi Closeness coefficient & Final Result Si positive, Dagger drill is having is Higher Value and Core drill is having Lower value. In Si Negative, Core drill is having is Higher Value Dagger drill is having Lower value. Ci is calculated using the Ci, Core drill is having is Higher Value and Dagger drill is having Lower value.

Figure 6:- Shown the Rank

Figure 6 Shows the Ranking of Carbon Fibre Reinforced Polymers of Final Result in Core drill is got the first rank whereas is the Dagger drill is having the lowest rank.

Conclusion:-

Carbon fiber reinforced polymer (CFRP) are two major An excellent structural composite of components The material is Manufacture of carbon fibers and CFRP composites Costs are very high; However, high-tech Erectile dysfunction is an important requirement. This is specifically for the following areas and products. TOPSIS is widely used Fuzzy TOPSIS is reliable for decision-making method or group fuzzy we believe that TOPSIS needs in-depth studies, comparisons and more. Standardization technique to harvest this objective [15]. Fuzzy TOPSIS technique prepared by KAU projects is divided into 4 classes, specifically instructional housing, staff quarters, KAU campus streets and roads and all infrastructure projects. The objective of control is to complete all production tasks on time with minimum cost and maximum penalty. The approach is based on the Fuzzy TOPSIS technique (Fuzzy Technique for Order Preference by Similarity to Ideal Solution) and the fuzzy set theory this analysis using the Alternative Value Conventional twist drill, Double point angle twist drill, Brad & spur drill, Dagger drill, Core drill and Cutting force, Cutting torque, Tool wear, Cutting temperature is Evaluation parameters value Core drill is got the first rank whereas is the Dagger drill is having the lowest rank.

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