EVALUATION OF FIBER REINFORCEMENT COMPOSITE MATERIAL AS PER GRADE TYPE BY USING MOOSRA TECHNIQUE

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Abstract
An FRP composite is defined as a polymer that is reinforced with a fiber. The chief function of fiber reinforcement composite is to carry load along the length of the fiber and to give strength and stiffness in individual direction. FRP represents a class of materials that falls into a category referred to as composite materials. Fiber Reinforced Polymer (FRP) are used in almost every type of advanced engineering structures, with their usage ranging from aircraft, helicopters and spacecraft through to boats, ships and offshore platforms and to automobiles, sports goods, chemical processing equipment and civil infrastructure such as bridges and buildings. The utility of FRP composites continues to grow at an impressive rate as these materials are used more in their existing markets and become established in relatively new markets. In the presented research work, different grade type of fiber reinforcement composite is given and the author applied MOOSRA technique in order to evaluate the best as per given their properties.
Keywords: Fiber Reinforcement Composite, MOOSRA, Technique, Different Grade, Properties

I. INTRODUCTION:

Composite materials are engineered or naturally occurring materials made from two or more constituent materials with significantly different physical or chemical properties which remain separate and distinct within the finished structure. Most composites have strong, stiff fibers in a matrix which is weaker and less stiff. The objective is usually to make a component which is strong and stiff, often with a low density. Commercial material commonly has glass or carbon fibers in matrices based on thermosetting polymers, such as epoxy or polyester resins. Sometimes, thermoplastic polymers may be preferred, since they are moldable after initial production. There are further classes of composite in which the matrix is a metal or a ceramic. Fiber-reinforced plastic (FRP) (also called fiber-reinforced polymer, or fiber-reinforced plastic) is a composite material, which is made of a polymer matrix reinforced with fibres. The fibers are usually glass (in fiber glass), carbon, aramid, or basalt. Rarely, other fibers such as paper, wood, or asbestos have been used. The polymer is usually an epoxy, vinylester, or polyester thermosetting plastic, though phenol formaldehyde resins are still in use **[1-9].**

Fiber-reinforced polymer (FRP), also Fiber-reinforced plastic, is a composite material made of a polymer matrix reinforced with fibers. The fibers are usually glass, carbon, or aramid, although other fibers such as paper or wood or asbestos have been sometimes used. The polymer is usually an epoxy, vinylester or polyester thermosetting plastic, and phenol formaldehyde resins are still in use. FRPs are commonly used in the aerospace, automotive, marine, and construction industries. The authors conducted few literature survey to find the data and relevant method in order to evaluate the best fiber reinforcement composite between several as per given their properties. The fibers (or, in some cases, particles) are often rather complex; for example, improvements may be sought in creep, wear, fracture toughness, thermal stability, etc [1]. Composite materials consist of two or more materials that retain their respective chemical and physical characteristics when combined together. FRP composites are different from traditional construction materials like steel or aluminium. FRP composites are anisotropic (properties apparent in the direction of applied load) whereas steel or aluminium is isotropic (uniform properties in all directions, independent of applied load). Therefore FRP composites properties are directional, meaning that the best mechanical properties are in the direction of the fiber placement [2-9].

II. TYPES OF FIBRE REINFORCED COMPOSITE

There are different types of fiber reinforced polymer are: glass fiber, carbon, aramid, ultra high molecular weight polyethylene, polypropylene, polyester and nylon. The change in properties of these fibers is due to the raw materials and the temperature at which the fiber is formed

1. Glass fiber reinforced polymer:

Glass fibers are basically made by mixing silica sand, limestone, folic acid and other minor ingredients. The mix is heated until it melts at about 1260°C. The molten glass is then allowed to flow through fine holes in a platinum plate. The glass strands are cooled, gathered and wound. The fibers are drawn to increase the directional strength. The fibers are then woven into various forms for use in composites.

Based on an aluminium lime borosilicate composition glass produced fibers are considered the predominant reinforcement for polymer matrix composites due to their high electrical insulating properties, low susceptibility to moisture and high mechanical properties. Glass is generally a good impact resistant fiber but weighs more than carbon or aramid. Glass fibers have excellent characteristics equal to or better than steel in certain forms.

2. Carbon fiber reinforced polymer:

Carbon fibers have a high modulus of elasticity, 200-800 GPa. The ultimate elongation is 0.3-2.5 % where the lower elongation corresponds to the higher stiffness and vice versa. Carbon fibers do not absorb water and are resistant to many chemical solutions. They with stand fatigue excellently, do not stress corrode and do not show any creep or relaxation, having less relaxation compared to low relaxation high tensile pre-stressing steel strands. Carbon fiber is electrically conductive and, therefore might give galvanic corrosion in direct contact with steel.

3. Aramid fiber reinforced polymer:

Aramid is the short form for aromatic polyamide. A well known trademark of aramid fibers is Kevlar but there exists other brands too, e.g Twaron, Technora and SVM. The modulli of the fibres are 70-200 GPa with ultimate elongation of 1.5-5% depending on the quality. Aramid has a high fracture energy and is therefore used for helmets and bullet-proof garments. Aramid fibers are sensitive to elevated temperatures, moisture and ultraviolet radiation and therefore not widely used in civil engineering applications. Further aramid fibers do have problems with relaxation and stress corrosion.

III. MOOSRA TECHNIQUE

$A = \{A_1, A_2, ..., A_m\}$ be the set of alternatives, and $C = \{C_1, C_2, ..., C_n\}$ be the set of criteria-attributes. Let $\tilde{\tilde{w}}_{kj} = (w_{j1}, w_{j2}, w_{j3})$ be the attribute weight given by the decision maker e_k, where $\tilde{\tilde{w}}_{kj}$ is also a triangular fuzzy number.

Construction of Weighted Decision-Making Matrix:

Let $\tilde{\tilde{V}} = \left[\tilde{\tilde{v}}_{ij}\right]_{m\times n}$ be the weighted matrix, then:

$$\tilde{\tilde{v}}_{ij} = \tilde{\tilde{x}}_{ij} \otimes \overset{\approx}{w}_j \quad (1)$$

Above equation presented the submission of all considered beneficial J[th] criterion g=1,2…n. under the A_i. Therefore this equation is valid merely for beneficial criterions associated by their alternative $A_{i_1}, A_{i_{21}}, A_{i_{31}}, A_{i_{41}} ....A_{i_n}$

$$y_j^* = \sum_{i \in \Omega_G^+} s_i\, x_{ij}^* / \sum_{i \in \Omega_G^-} \otimes s_i\, x_{ij}^*, \quad (2)$$

IV. PROCEDURAL STEPS

Step 1: Fiber-reinforced polymer (FRP), data against Young's modulus, strength, density, coefficient of thermal expansion, and thermal conductivity and density, respective is given in Table 1. Attitude at Table 2.

Step 2: Constructed a normalized decision matrix by normalization formula [1] and then used using [Equa. 1]; to construct weighted normalized matrix, shown in Table 3.

Step 3: Rank the different grade type of fiber reinforcement composite by applying [Equa. 2], MOOSRA technique as per given their properties, result is shown in Table 4.

V. CONCLUSION

Composite materials are engineered or naturally occurring materials made from two or more constituent materials with significantly different physical or chemical properties which remain separate and distinct within the finished structure. Most composites have strong, stiff fibers in a matrix which is weaker and less stiff. The objective is usually to make a component which is strong and stiff, often with a low density. Commercial material commonly has glass or carbon fibers in matrices based on thermosetting polymers, such as epoxy or polyester resins. Sometimes, thermoplastic polymers may be preferred, since they are moldable after initial production. There are further classes of composite in which the matrix is a metal or a ceramic. In the presented research work, different grade type of fiber reinforcement composite is given and the author applied MOOSRA technique in order to evaluate the best as per given their properties. M55J is the best than other as scoring is high 1.379.

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TABLE: 1 [3]
Fiber reinforcement composite material grade type

Trade Name/Type	Young's Modulus (Msi)	Tensile Strength (Ksi)	CTE (PPM/^{0}F)	Thermal Conduct. (Btu/hr-ft-^{0}F)	Density (Lb/in^3)
T300	33.5	530	-0.3	5	0.064
AS4	33.5	530	-0.3	5	0.065
IM7	41.1	710	-.5	9	0.065
T50	56.4	350	-0.55	40	0.0654
UHMS	64	550	-0.55	40	0.067
P75S	75	300	-0.72	107	0.072
P100S	105	325	-0.8	300	0.078
Kevlar®49	18	525	-2.2	5.3	0.052
E-glass	10.5	500	2.8	0.56	0.094
S2-glass	12.6	665	3.1	0.56	0.090
Quartz	10	500	0.3	0.56	0.0795
K1100	145	550	-0.9	676	.0813
M46J	63.3	611	-0.5	676	0.0665
M50J	69	569	-0.55	57	0.0672
M55J	78.2	583	-0.61	90	0.690
M60J	85.3	569	-0.61	88	0.0694
XN-50	75	530	-0.8	100	0.0773
XN-70	105	530	-0.9	180	0.0780
XN-80	114	530	-0.9	235	0.0780

TABLE: 2
Attitude of Fiber reinforcement composite properties

Trade Name/Type	Young's Modulus (Msi)	Tensile Strength (Ksi)	CTE (PPM/^{0}F)	Thermal Conduct. (Btu/hr-ft-^{0}F)	Density (Lb/in^3)
T300	+	+	+	+	+
AS4	+	+	+	+	+
IM7	+	+	+	+	+
T50	+	+	+	+	+
UHMS	+	+	+	+	+
P75S	+	+	+	+	+
P100S	+	+	+	+	+
Kevlar®49	+	+	+	+	+
E-glass	+	+	+	+	+
S2-glass	+	+	+	+	+
Quartz	+	+	+	+	+
K1100	+	+	+	+	+
M46J	+	+	+	+	+
M50J	+	+	+	+	+
M55J	+	+	+	+	+
M60J	+	+	+	+	+
XN-50	+	+	+	+	+
XN-70	+	+	+	+	+
XN-80	+	+	+	+	+

TABLE: 3
Normalized matrix of Fiber reinforcement composite material grade type

Trade Name/Type	Young's Modulus (Msi)	Tensile Strength (Ksi)	CTE (PPM/^{0}F)	Thermal Conduct. (Btu/hr-ft-^{0}F)	Density (Lb/in^3)
T300	0.105	0.228	-0.056	0.005	0.085
AS4	0.105	0.228	-0.056	0.005	0.086
IM7	0.129	0.305	-0.093	0.008	0.086
T50	0.177	0.150	-0.102	0.038	0.086
UHMS	0.201	0.236	-0.102	0.038	0.088
P75S	0.236	0.129	-0.134	0.100	0.095
P100S	0.330	0.140	-0.149	0.282	0.103
Kevlar®49	0.057	0.226	-0.409	0.005	0.069
E-glass	0.033	0.215	0.520	0.001	0.124
S2-glass	0.040	0.286	0.576	0.001	0.119
Quartz	0.031	0.215	0.056	0.001	0.105
K1100	0.455	0.236	-0.167	0.634	0.107
M46J	0.199	0.263	-0.093	0.634	0.088
M50J	0.217	0.245	-0.102	0.053	0.089
M55J	0.246	0.251	-0.113	0.084	0.911
M60J	0.268	0.245	-0.113	0.083	0.092
XN-50	0.236	0.228	-0.149	0.094	0.102
XN-70	0.330	0.228	-0.167	0.169	0.103
XN-80	0.358	0.228	-0.167	0.221	0.103

TABLE 4: Ranking orders

Trade Name/Type	Young's Modulus (Msi)
T300	0.366
AS4	0.368
IM7	0.436
T50	0.349
UHMS	0.461
P75S	0.426
P100S	0.705
Kevlar®49	-0.053
E-glass	0.893
S2-glass	1.021
Quartz	0.408
K1100	1.266
M46J	1.091
M50J	0.501
M55J	1.379
M60J	0.573
XN-50	0.511
XN-70	0.662
XN-80	0.742

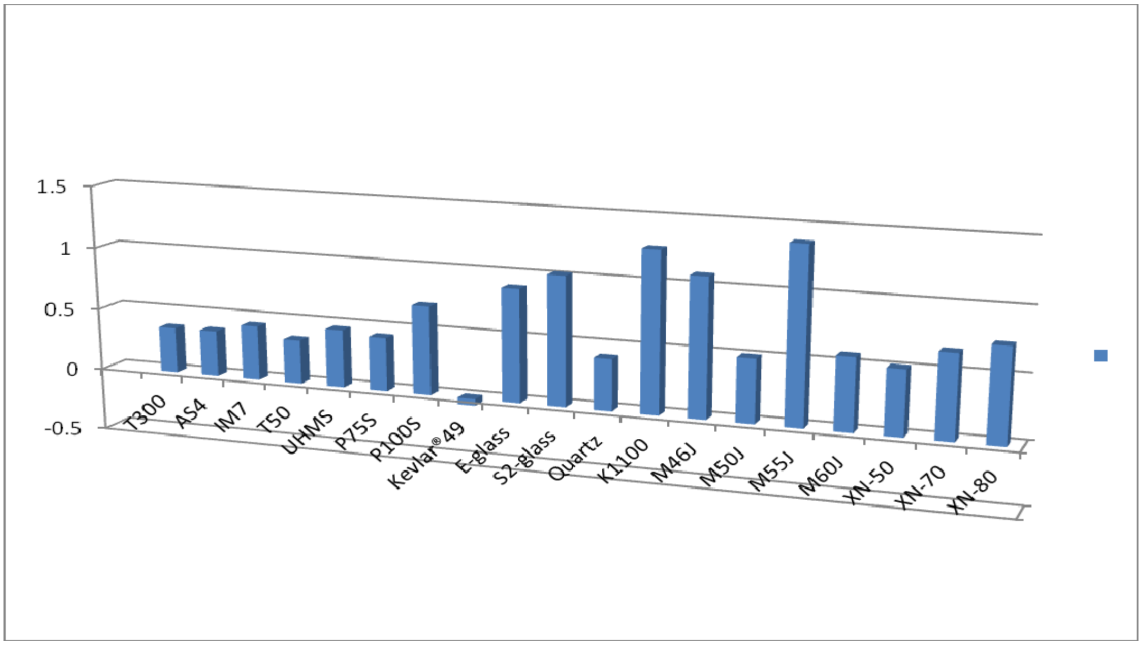

Fig: 1: Ranking orders of Fiber reinforcement composite material grade type