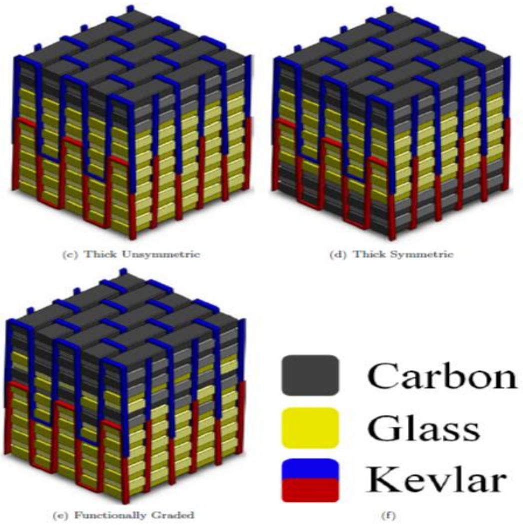
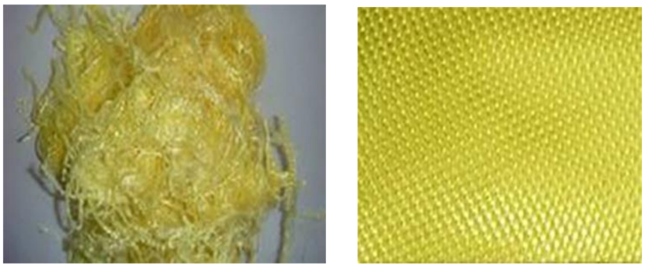


Figure. 4.2 : Orientation of Z-fiber

The Z-fiber for these samples is glass just shown as Kevlar to differentiate it from the rest of the glass fiber tow bundles , thin unsymmetrical [4].

The figure 5 (a) shows the fiber in unprocessed manner and figure 5 (b) shows the fiber in woven roving mat chopped in either direction.



(a) (b)

Figure. 5: (a) Unprocessed Kevlar fiber, (b) Woven Kevlar fiber, Epoxy LY 556 and Resin HY951 are used

There are different types of Kevlar with its own unique set of properties and performance characteristics such as Kevlar 29, 49, 100, 119, 129, 149 etc.Table.2 depicts the properties of different types of Kevlar fibers.

Yarn properties	Kevlar 29	Kevlar 49	Kevlar 100	Kevlar 119	Kevlar 129	Kevlar 149	Twaron
Tensile strength (GPa)	3.6	3.6-4.1	3.0	3.1	3.45	3.4	3
Elastic modulus (GPa)	83	131	60	55	97	143	178
Elongation (%)	3.0	2.8	2.9	3.1	3.4	2.3	3.3
Density (g/cc)	1.44	1.45	1.44	1.44	1.45	1.47	1.44

Table 2: Properties of different types of Kevlar.

Kevlar is a polymer; this means that it is made up of a large number of the same basic unit, called a monomer, which are attached to each other to form a long chain. Kevlar fiber showing in below diagram.

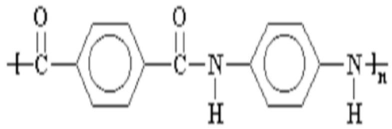


Figure. 6 : Structure of Kevlar polymer

The aramid fabric used in this study is Kevlar 29. The density and the thickness of Kevlar 29 fabric are 1.44 g/cm3 and 0.33 mm, respectively . A thermoset liquid epoxy resin (D.E.R.331) with joint amine type (905-3S) curing agent was used as the matrix.

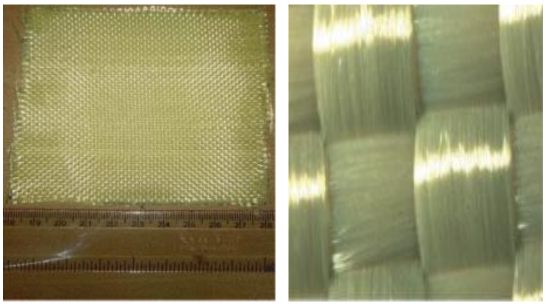


Figure.7: Plain two-dimensional Kevlar fabric.

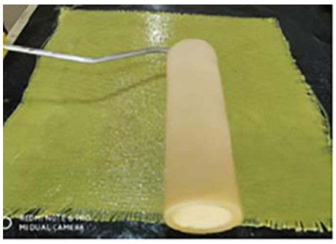
Kevlar has a unique combination of high strength, high modulus, toughness and thermal stability. It was developed to meet the demands of industrial and modern technology applications. Many types of annular caviar are currently manufactured to meet widespread end-use. Kevlar is a chemical fiber, an organic fiber from a family of fragrant polyamides. Molecular formula: $C_{14}H_{14}N_2O_4$. Density 1.44, breaking power -328, braking-2920 MPa. Tensile Modules 70500 MPa Interval length 3.6% .

(a) (b)

Figure.8: (a) Kevlar fiber 29 (woven), (b) Kevlar fiber 29 (Foam)

Egg shells are bio-waste and readily available from the food industry as waste, which have high compressive strength and good binding properties that we use. So we chose this material to make the patterns. Here are two samples in which eggs are not treated and treated.

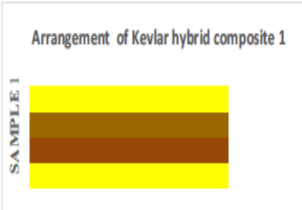
(a) (b)



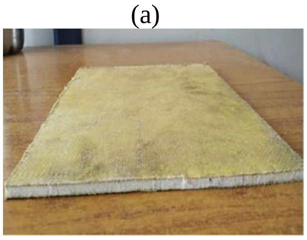
(c)

Figure.9: (a) Before Chemical process Egg shell, (b) After Chemical process Egg Shell, (c) Fabrication of Kevlar fiber

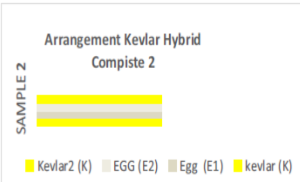
(a)



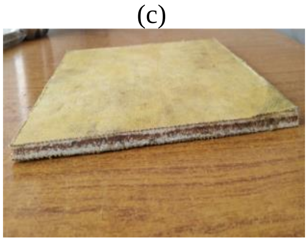
(b)



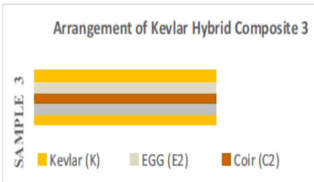
(c)



(d)



(e)



(f)

Figure.10: (a) Sample 1, (b) Layer arrangement Sample 1, (c) Sample 2, (d) Layer arrangement Sample 2, (e) Sample 3, (b) Layer arrangement Sample 3

Epoxy resins are the most commonly used resins. Epoxy LY 556 resin, chemically belonging to the “epoxide” family is used as the matrix material. The low temperature curing epoxy resin (Araldite LY 556) and the corresponding hardener (HY 951) are mixed in a ratio of 3:1 by weight as recommended.

Figure.11: Reinforced fibers chopped carbon and short Kevlar fiber used for epoxy composite system

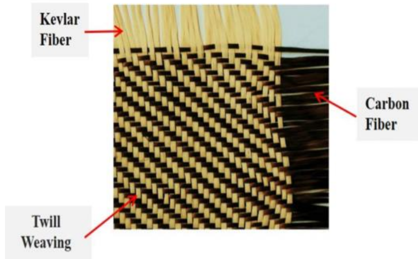


Figure.12: CKS-220 Carbon/Kevlar Hybrid Fabric

The specimens identifications, associated with this hybrid composite laminate, are described below and used to better understand the comparative analyses between their mechanical properties:

- CLCO - CL specimens with carbon fibers in the direction of the applied load and in the original condition (without hole);
- CLKO - CL specimens with Kevlar fibers in the direction of the applied load and in the original condition (without hole);
- CLCH - CL specimens with carbon fibers in the direction of the applied load and with a circular hole;
- CLKH - CL specimens with Kevlar fibers in the direction of the applied load and with a circular hole.

III. EXPERIMENTAL TENSILE TESTING

The Author taking at three different fiber directions, They are 0˚, 45˚and 90˚below Figure [1].

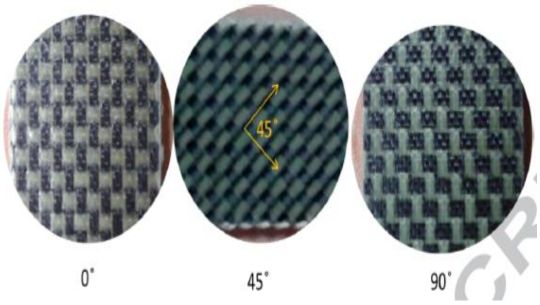
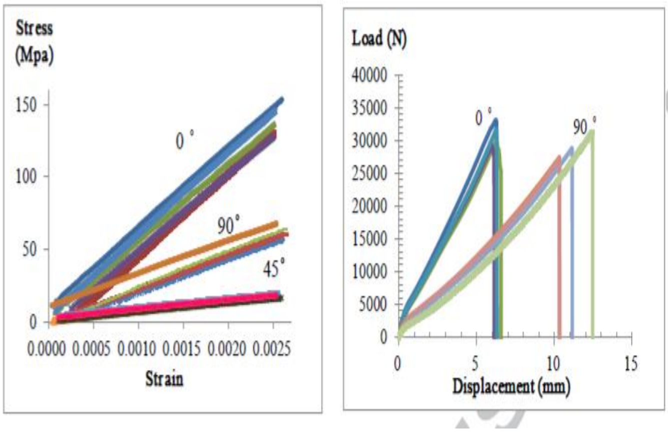


Figure 13: Carbon-Kevlar hybrid composite cut at three different fiber directions

Fiber directions[°]	Tensile strength[MPa]	Tensile Modulus[GPa]	Elongation at break (mm)	Poisson’s Ratio
0	554 ± 26.9	54.95 ± 1.67	6.31 ± 0.1	0.1
45	110.5 ± 3.81	6.35 ± 0.13	61.42 ± 1.4	-
90	467.5±41.8	23.67 ± 1.2	11.05 ± 0.9	0.05

Table. 3: Result of Tensile test



(a) (b)

Figure 14: (a) Stress-strain curves of the hybrid Composite at different fiber directions (b) Load Displacement curve of hybrid composite cut at 0°and 90°fiber

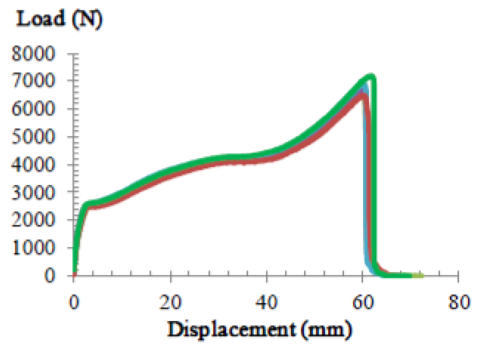


Figure 15: Load–displacement curves of Hybrid composite cut 45 ° grain direction

The effective modules of different architectures can be seen in Table 3. It should be noted here that the proportions of proportional samples are due to different levels of strain insulation (carbon side vs. glass side) hybridization and error inequality, which leads to bending.

The average curves obtained in the unconnected tensile tests, which are the original condition for the test samples, are the disciplinary tests. (0/90) and GLO (± 45) of Fig.16. The stresses are shown in the diagram. For the GLO (0/90) test samples, the behavior between the tension and the length of the pieces was linear, but for the GLO (±. 45).

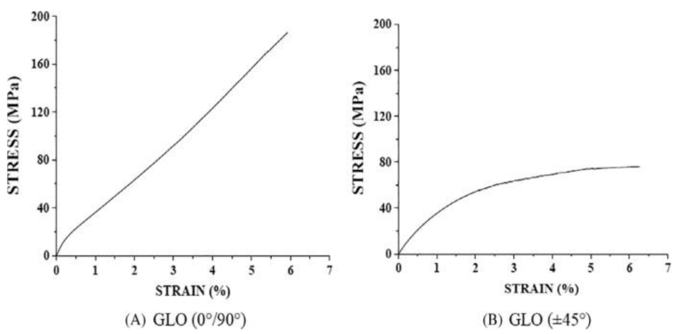


Figure. 16: Stress-strain diagram (average curves) GL laminate (original condition)

With respect to the average curve profiles obtained in the uniaxial tensile tests for test specimens with a central hole, GLH (0/90) and GLH (±45) exhibited similar behavior to that of test specimens in the original condition.

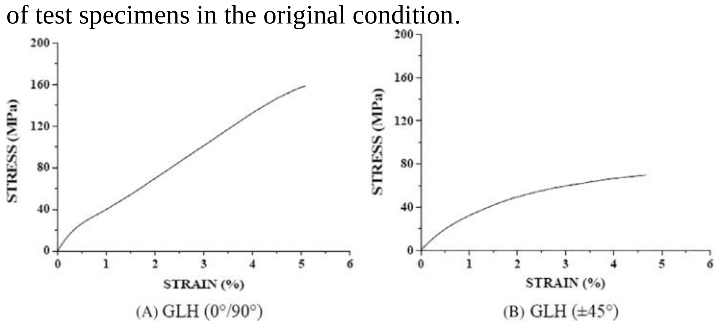
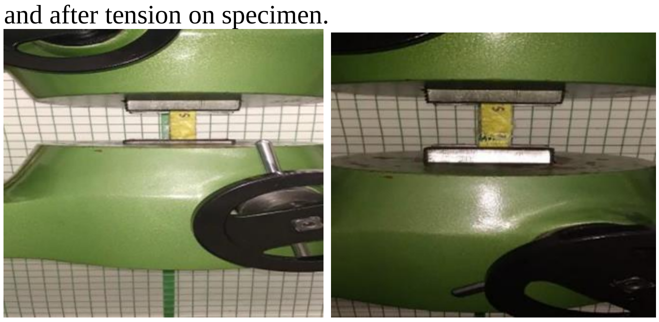


Figure. 17: Stress-strain diagram (average curves) GL laminate (central hole condition)

The tensile test of composites was conducted by universal testing machine at specified load and cross head speed, range. Image showing tensile test conducted Kevlar hybrid composite specimen on Universal Testing Machine Before and after tension on specimen.

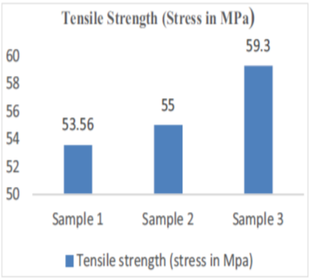


(a) (b)

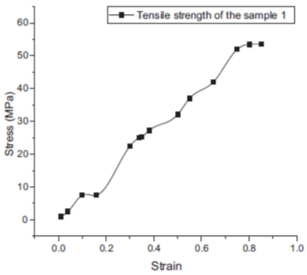
Figure. 18: (a) Tensile test setup specimen on UTM before testing (b) Tensile test setup specimen on UTM after testing

Sr. No	Specimen Name	Sequences of Layer Arrangement	Tensile modulus (GPa)	Tensile strength (GPa)	Force (KN)	Thickness (mm)
1	T1(SKC)	(K + C1 + C2 + K)	50.58	53.6	6.2	5
2	T2 (SKE)	(K + E1 + E2 + K)	47.21	55	6	5
3	T3(SKEC)	(K + E1 + C2 + E2 + k)	52.72	59.3	6.4	5

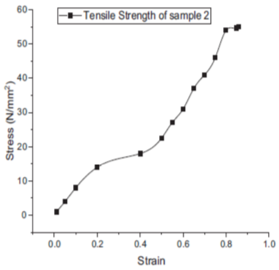
Table. 4: Tensile behaviors of Kevlar hybrid composite



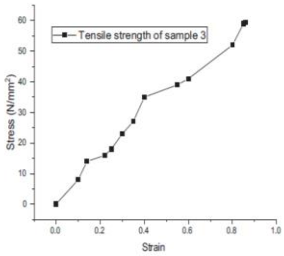
(a)



(b)



(c)



(d)

Figure. 19: (a) Tensile strength of Kevlar hybrid composite (b) Tensile strength of Sample 1 (c) Tensile strength of Sample 2
(d) Tensile strength of Sample 3

CONCLUSION

A detailed review on orientation pattern, mechanical properties, experimental behavior, have been carried out by the different researcher is reported in this paper. Kevlar has a good strength, toughness and better thermal behavior compared with other fiber. The different orientation of the Kevlar fiber leads to give the considerable changes in the behavior. Tensile testing of Kevlar for different orientation gives the significant change in the tensile strength.

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