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A Review on Mechanical Characteristics of Various Fibers Reinforcement with MWCNT/Hybrid Nano Composite

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ABSTRACT: Kevlar is a heat resistance and strong synthetic fiber, related to other aramids such as Nomex and Technora. These fibers are extremely stiff, strong, and light, and used in many processes to create excellence building materials. Specimens have been prepared using vacuum moulding process with ASTM standards. Tensile strength test has been carried out in a computerized Universal Testing Machine (UTM). Flexural strength test have been carried with the help of relevant test setups. The various strength values of the specimens have been compared for choosing better composition of Kevlar fiber composite structure. All mechanical strength test result reveal that Kevlar fiber composite with more glass fiber layer that reinforced with multi-walled carbonnanotube (MWCNT) and epoxy exhibits higher strength values.

I. INTRODUCTION

A composite is combination of two or more materials in which one of the materials, called the reinforcing phase, is in the form of fibers, sheets, or particles, and is embedded in the other materials called the matrix phase. The reinforcing material and the matrix material can be metal, ceramic, or polymer. Composites typically have a fiber or particle phase that is stiffer stronger than the continuous matrix phase and serve as the principal load carrying members. The matrix acts as a load transfer medium between fibers, and in less ideal cases where the loads are complex, the matrix may even have to bear loads transverse to the fiber axis. The matrix is more ductile than the fibers and these acts as a source of composite toughness. The matrix also serves to protect the fibers from environmental damage before, during and after composite processing.

The physical properties of composite material of generally not isotropic (independent of direction applied force) in nature, but rather are typically anisotropic (different depending on the direction of applied force or load). A recently developed concept of composites is that the composite should not only be a combination of two materials, but the combination should have its own distinctive properties. In term of strength, heat resistance, or some other desired characteristic, the composite must be better than either component alone. Most desirable properties of general composite structure are High creep resistance, High tensile strength at elevated temperature, High tensile modulus and High toughness. Composite are number of advantages over traditional engineering material. These beneficial characteristics have enabled the rapid acceptance of composites in many products with High specific strength, Ability to Form Shapes, Inherent durability and Low Relative investment.

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II. LITERATURE SURVEY

Warsaw et al (2016) have clarified the multi-walled carbon nanotubes (MWCNTs) utilized as support in an epoxy tar with weight rates (0, 0.2, 0.4, 0.6, 0.8, 1) wt%, separately, by utilizing both direct (nonhomogeneous) and homogeneous scattering blending procedures to plan (epoxy/MWCNTs) nanocomposites. Elastic and drop weight sway tests are utilized to assess the mechanical properties of the composites. Results show that homogeneous scattering greatly affects improving mechanical properties of multi-divider carbon nanotube strengthened composites. The option of 0.2 wt% MWCNTs builds the ductile properties and including 0.6 wt% of MWCNTs upgrades sway properties. **Mei-Chen Lin et al** (2019) have explored the mechanical properties and harm conduct of adaptable covered composites. Needle punching is performed to consolidate woven Kevlar texture and two nonwoven low-liquefying point polyester (LMPET) textures into a texture interlayer. A sheet-expulsion machine is utilized to bond two thermoplastic polyurethane (TPU) sheets on each side of a texture interlayer. The rigidity, strip burden, and static cut opposition of the adaptable overlaid composites are assessed, and the impacts of needle-punching rates and profundities are inspected. Test outcomes show that a high needle-punching rate or profundity decidedly influences elasticity by advancing fiber snare. The elasticity of the 300-15 gathering arrives at 24.70Mpa. In addition, when the needle-punching profundity doesn't surpass 11 mm, dissolved LMPET filaments help security two-stage materials and consequently increment the strip heaps of the last composites. The 200-11 gathering has an ideal cut opposition of 5.86 N. The blend of TPU sheets and woven Kevlar textures yields adaptable covered composites with great static cut obstruction. The consequences of this examination can be applied to improve the exhibition of adaptable overlaid composites. **Van-Tho Hoang et al** (2017) has examined that Multi-walled carbon nanotubes (MWCNTs) are blended in with Unsaturated polyester tar (UPR) utilizing the mixed strategy at high temperatures. The blending temperature and hardener proportion were improved dependent on pressure properties and the exothermic temperature. In the investigation, 60 °C and 1wt% of Methyl ethyl ketone peroxide (MEKP) were picked for the blending condition and impetus focus, individually. MWCNTs with various weight portions (0.05, 0.1, 0.2 and 0.3 wt.%) were scattered to research the impact of MWCNTs on pliable properties of the UPR, and it was discovered that 0.1 wt.% of MWCNTs indicated the best execution right now fiber weight part because of higher quality (42.14 %), modulus (14.33 %) and break strain (37.17 %) than unadulterated UPR. The condition of scattering and course of action of filaments were analysed by a Field discharge Scanning electron magnifying lens (FE-SEM) as indicated by brake surfaces. Likewise, the FE-SEM additionally demonstrated better outcomes with 0.1 wt% of MWCNTs blended in the UPR. **Hany Fouda Lin Guo et al** (2017) has referenced that two techniques were utilized for expansion multiwall carbon nanotubes (MWCNTS) into carbon fiber (CF)/epoxy sap composite framework. The mechanical properties of the readied tests were contrasted with show the best technique for the expansion of MWCNTS from the perspective of mechanical properties. The presentation of carbon nanotubes (CNTs) into fiber strengthened polymer composites has been accomplished principally by means of two courses: blending CNTs totally all through the network (lattice adjustment) or joining CNTs onto fortifying filaments (interface alteration). In every single past reference, the expansion of CNTs happens through one course from the two courses however right now, it brought MWCNTS into CF/epoxy tar composite through the two courses simultaneously. Three CF composite examples were arranged CF/epoxy gum composite (C1), CF/1wt% MWCNTS/epoxy tar composite (C2) in which MWCNTS included by means of one course (epoxy sap framework) and the third example was CF/1wt% MWCNTS/epoxy pitch composite (C3) in which MWCNTS included by means of two courses (epoxy gum and CF texture). The outcome shows that the mechanical properties of C3>C2>C1, for instance, the flexural quality of C3 higher than C2 by 19% and C2 higher than C1 by 51% individually. This is on the grounds that expansion MWCNTS through two courses increment the capacity of the good blending of CNTs with epoxy pitch and great scattering of CNTs into the CF texture surface and these prompts to improve the interface holding between the CF and epoxy so improve the mechanical properties. **Iman Taraghi et al** (2014) has researched the low-speed sway reaction of woven Kevlar/epoxy overlaid composites upgraded with various weight rates (61%) of multi-walled carbon nanotubes (MWCNTs), was examined under surrounding (27⁰C) and low temperature (40⁰C) conditions. Vitality profile outlines (EPDs) were utilized to decide the infiltration limit of Kevlar/epoxy covered composites. What's more, the impact of MWCNTs on cover composites was assessed by exposing all examples to a similar degree of vitality, 45J. The time history of consumed vitality, redirection and speed

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are estimated and a few parameters, for example, solidness bowing, entrance cutoff, and greatest diversion, for the two composites and nanocomposites at surrounding and low temperatures are accounted for. Results demonstrated a noteworthy reliance on harm arrangement on temperature and substance of MWCNTs. It was inferred that the MWCNTs was improved the effect reaction and was confined the harm size in the woven Kevlar fiber composites at surrounding and low temperature. The expansion of 0.5% MWCNTs came about in about 35% increment in vitality assimilation at encompassing temperature, and the expansion of 0.3% MWCNTs expanded the retained vitality capacity about 34% at low temperature. **Karim Aly et al** (2016) has referenced the troubles related to performing pressure tests and the unpredictable idea of pressure disappointment, the quantity of studies that have inspected the piezoresistive reaction of carbon nanotube (CNT) detecting systems in composites under pressure stacking has been constrained. This paper presents a novel strategy for implanting adjusted sheets of two millimeters since quite a while ago, interconnected CNTs into the entomb laminar area of overlaid composite structures to evaluate the capability of the CNT sheets to work as strain detecting materials for composite structures exposed to pivotal pressure stacking. Semi-static and cyclic pressure mechanical stacking tests were joined by continuous electrical opposition change information procurement and the outcomes proposed that the CNT sheet detecting material made out of six CNT sheets layers displayed improved affectability, dependability, and repeatability which are fundamental properties for any fruitful wellbeing observing procedure. The coupons with six CNT sheets layers implanted displayed piezoresistivity that gave some linearity in strain and was nonlinear in pressure. This piezoresistive reaction was described as against symmetric around zero strain right until crack. **Sunil Manohar Maharana et al** (2019) has clarified their work manages the creation of Epoxy polymer grid half breed composites by fortifying jute and Kevlar fiber utilizing hand lay-up process. The half breed composites contain a fixed weight level of 20% of Kevlar though the measure of jute was changed with epoxy. The impact of fiber stacking and direction on the tractable and flexural quality was assessed. Diverse direction for example 0, 30, 45, and 60 were joined for the creation of the polymer composite. The rigidity apparently was most extreme for 40% fiber stacking with 30 directly through the flexural quality was seen to be greatest for 40% fiber stacking with 45 fiber direction for the polymer composites. The fiber stacking for half composites displayed a higher void substance. Fiber breaking and pull out were portrayed by the elastic crack morphology of the composites. **FarhadAhmadijokani et al** (2019) has explored the impact of short carbon fiber on the tribological conduct of phenolic gum-based grating materials, a reference contact composite holding different fixings without short carbon fiber, and three grinding composites holding 1,2 and 4 vol% carbon fiber was planned. The dynamic-mechanical and thermogravimetric examinations demonstrated the expansion of capacity modulus and decrease of warm steadiness individually, with the fuse of carbon fiber into the brake composites. The tribological portrayals uncovered that the coefficient of rubbing (COF) and explicit wear pace of the contact composites dropped with the expansion of carbon fiber into the composites. Carbon fiber additionally exasperated the blur conduct, decrease of COF with temperature increment. The SEM imaging of the composites uncovered the development of essential and optional levels in the erosion composites after the expansion of carbon fiber. The outcomes got from the dynamic-mechanical examination, thermogravimetric investigation and SEM imaging were utilized to explore the well-used surface of the examples and legitimize the tribological conduct. **K.L.Kepple et al** (2008) have examined the Woven carbon fiber (CF) overlay are functionalized in situ with carbon nanotubes (CNTs) to test the speculation that developing CNTs on CF (i.e., carbon fiber packages or tow) would improve the properties of polymeric carbon composites, explicitly epoxy-carbon composites that are utilized in aviation applications. The CNT as-developed on the woven CF were appeared to significantly improve the break strength of the restored composite on the request for half. This was joined by no misfortune in the basic firmness of the last composite structure. Truth be told, the flexural modulus expanded around 5%. The noteworthy increment in the break strength as tried under the ASTM D 5528 standard shows that the harm resistance of a composite structure would profit by the CNT material applied right now. Their methodology has taken into account altogether bigger examples to be consistently functionalized with CNTs than is accounted for somewhere else in the open writing. Furthermore, this work showed CNT functionalization on adaptable substrates that remaining parts adaptable after functionalization, while most CNT development substrates are inflexible so as to withstand the high (>800°C) development temperatures regularly experienced in CNT blend.

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III. VARIOUS FIBERS

The material with embedded fibers such as fiber glass, quartz, Kevlar and carbon are used in the automobile industries to improve the mechanical and thermal properties.

a. Glass fibers

Fibers of various varieties of glass such as, E-glass, C-glass, E-CR-glass and AR-glass are popular. The most common reinforcement for the polymer matrix composites is a glass fiber: Most of the fibers are based on silica (SiO_2), with addition of oxides of Ca, b, Na, Fe, and Al. The glass fibers are divided into three classes E-glass, S-glass and C glass. The E-glass is designated for electrical use and S-glass for high strength.

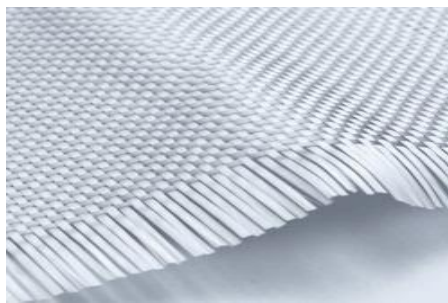


Fig.1 Glass Fiber

b. Kevlar fiber

Kevlar is a warmth safe and solid engineered fiber, identified with different aramids, for example, nomex and technora. This high quality material was utilized first economically in the mid 1970's as a swap for steel in hustling tires. Normally it is spun into ropes or texture sheets that can be utilized accordingly or as a fixing in composite material parts. Several grades of Kevlar are available: Kevlar K29, K49, K100, K119, K129.



Fig.2 Kevlar Fiber

c. Carbon Fiber

Carbon Fiber is a polymer and is now and then known as graphite fiber. It is a solid material that is additionally lightweight. Carbon fiber is five-times more grounded than steel and twice as hardened. In spite of the fact that carbon fiber is more grounded and stiffer than steel, it is lighter than steel; making it the perfect assembling material for some parts. These are only a couple of reasons why carbon fiber is supported by architects and fashioners for assembling. Carbon fiber is made of slim, solid crystalline fibers of carbon that is utilized to fortify material. Carbon fiber can be more slender than a strand of human hair and gets its quality when wound together like yarn. At that point, it very well may be woven together to frame material and if necessary to take a lasting shape, carbon fiber can be laid over a form and covered in pitch or plastic. It has high firmness, high rigidity, low weight to quality proportion, high in synthetic opposition, temperature lenient to over the top warmth and low warm extension. Along

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these lines, carbon fiber is exceptionally famous in numerous enterprises, for example, aviation, car, military, and recreational applications.



Fig.3Carbon Fiber

IV. CARBON NANOTUBES

Carbon nanotubes (CNTs) are barrel-shaped particles that comprise of moved up sheets of single-layer carbon molecules (graphene). CNTs can go about as receiving wires for radios and other electromagnetic gadgets. Conductive CNTs are utilized in brushes for business electric engines. They supplant customary carbon dark. The nanotubes improve the electrical and warm conductivity since they stretch through the plastic network of the brush. They additionally have extraordinary rigidity and warm conductivity, on account of their nanostructure and its quality of the bond between carbon particles.

a. Single walled Carbon nanotubes

Single-walled carbon nanotubes (SWNTs) are an exceptional class of carbon materials known as one-dimensional materials. They comprise of sheets of graphene, moved up to frame empty cylinders with dividers one particle thick. It has a size of 0.5 to 1.5nm.

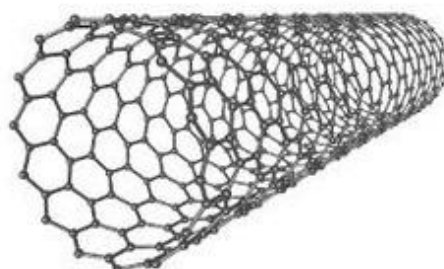


Fig.4Single walled Carbon nanotubes

b. Double walled Carbon nanotubes

Double-walled carbon nanotubes (DWCNTs) belong to the family of one-dimensional materials, similar to single-walled carbon nanotubes. This particular class of carbon nanotube consists of two nanotubes, with one nested within the other.

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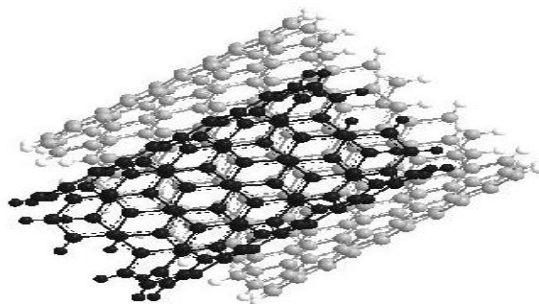


Fig.5 Double walled Carbon nanotubes

c. Multi walled Carbon nanotubes

Multi Walled Carbon Nanotubes (MWCNTs) are hollow, cylindrically shaped allotropes of carbon that have a high aspect ratio (length to diameter ratio). Their name is derived from their structure and the walls are formed by multiple one-atom-thick sheets of carbon.

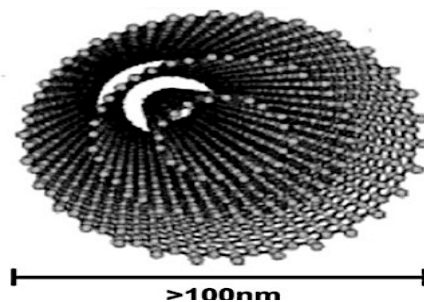


Fig.6 Multi walled Carbon nanotubes

V. METHODOLOGY

Fibers/MWCNT and epoxy are to be selected for the specimen as per their properties. By comparing other materials Kevlar fiber is a heat resistance and strong synthetic fiber, these fibers are extremely stiff, strong, and light, and used in many processes to create excellence building materials. Specimens have been prepared using vacuum moulding process with ASTM standards. That specimen is cut into pieces with ASTM standard dimension. Tensile strength test has been carried out in a computerized Universal Testing Machine (UTM). Flexural strength test have been carried with the help of relevant test setups. The various strength values of the specimens have been compared for choosing better composition of Kevlar fiber composite structure. Kevlar fiber composite with more glass fiber layer that reinforced with multi-walled carbon nanotube (MWCNT) and epoxy exhibits higher strength values.

a. Epoxy resins

It is a polymeric or semi-polymeric material, and as such infrequently exists as unadulterated substance, since variable chain length results from the polymerization response used to deliver them. High virtue evaluations can be delivered for specific applications, for example utilizing a refining decontamination process. One drawback of high virtue fluid evaluations is their propensity to frame crystalline solids because of their high standard structure, which expect to soften to empower handling. Epoxy pitches might be responded either with themselves through synergist homopolymerization, or with a wide scope of co-reactants including polyfunctional amines, acids (and corrosive anhydrides), phenols, alcohols, thiols.

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b. Hardener

Hardener is a high thick fluid material, blended in with gum in reasonable extent during the procedure of readiness of composites which helps in the cementing of the wet, smooth composite. It is utilized to solidify the smooth composite subsequently it is called as hardener. Right now reasonable evaluation of hardener is utilized to blend in with epoxy tar in 10:1 extent during the time spent assembling of composite.

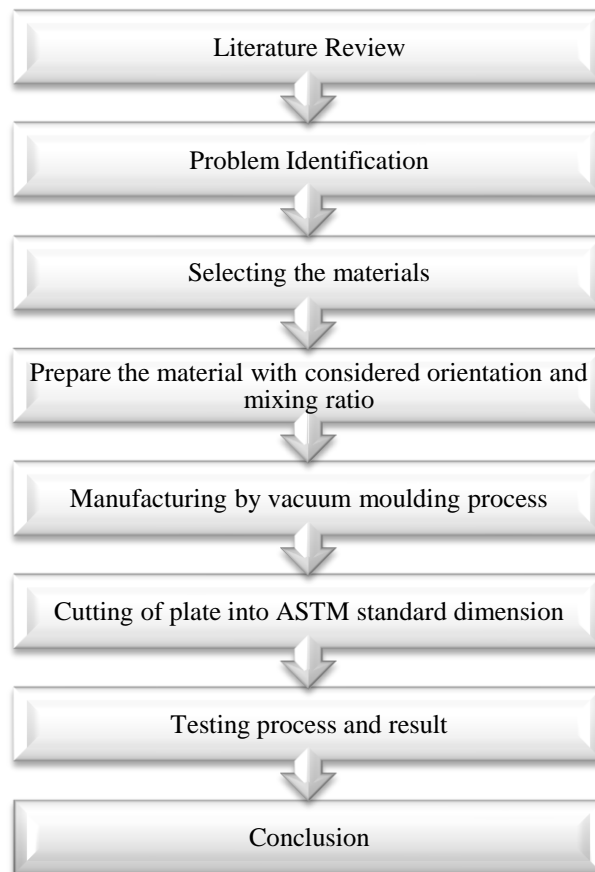


Fig.7 Methodology chart

VI.PROCEDURE

Vacuum pack shaping uses an adaptable film to encase the part and seal it from the outside air. Vacuum sack material is accessible in a cylinder shape or a sheet of material. A vacuum is then drawn on the vacuum sack and environmental weight packs the part during the fix. At the point when a cylinder molded sack is utilized, the whole part can be encased inside the pack. When utilizing sheet sacking materials, the edges of the vacuum pack are fixed against the edges of the forming surface to encase the part against a hermetically sealed shape. When packed away right now, the lower shape is an unbending structure and the upper surface of the part is framed by the adaptable layer vacuum sack. The adaptable layer can be a reusable silicone material or an expelled polymer film. In the wake of fixing the part inside the vacuum pack, a vacuum is drawn on the part (and held) during the fix. This procedure can be performed at

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either surrounding or raised temperature with encompassing climatic weight following up on the vacuum pack. A vacuum siphon is commonly used to draw a vacuum. A prudent strategy for drawing a vacuum is with an endeavor vacuum and air blower.

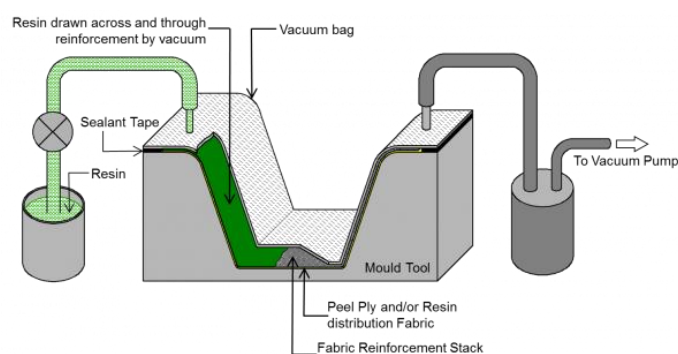


Fig.8 Vacuum bag moulding

The MWCNTs are mixed with the epoxy resin with 0.05% proportion. The Kevlar and glass fibers are cut in dimension of 300*300 and place the fabric sheets layer by layer in the vacuum setup. The epoxy resin is mixed in the ratio of 10:1 and stirred slowly in order to avoid air bubbles. A small spreader sheet is used to spread the resin hardener mixture uniformly on the fabric sheet so that the adjacent fabric wets out completely. We add multiple fabric sheet and also spread the mixture uniformly between the glass and Kevlar fabrics. Always spreading should be done in the direction of fiber if not it disturbs the fibers of fabric. Now place a peel ply fabric to peel out the laminate easily after it is completely dried out and also place a perforated sheet to absorb excess resin from perforates and this is followed by 2 layers of breather sheets to absorb the air lying between the mould and bagging sheet and also it eradicates the formation of flange impression observed after the casting completely dries out about 23-34 hours. And thus fabrication is completed by means of vacuum bag moulding. The finished specimen is used to undergo to the strength analysis for analysing its mechanical behaviour such as tensile strength, flexural strength.

VIII. CONCLUSION

The Polymer Nanocomposite materials (MWCNT-KEVLAR FIBER-GLASS FIBER) can be used for brake pads because it has stable and reliable frictional and wear properties. It also improves non-corrosive property. These properties were found by varying load, velocity, temperature and high durability. This paper deals the result and study the Characterization of the friction product used for automotive braking pads. The composite tested in laboratory, modelling images and analysis the hardness ratio and reinforcement volume can be obtained with low density, high hardness properties and good thermal stability, higher ability to hold the compressive force. These characteristics make them useful for automotive industry.

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