TOPICAL REVIEW

Dynamic mechanical behavior of mono/synthetic-natural fiber composites—a review

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Abstract

Recently, fiber-based polymer composites have been subjected to direct and indirect dynamic loads in various applications. However, the dynamic behavior of the fiber composites is crucially influenced due to excitation frequency, temperature, fiber length, fiber loading, and other geometrical constraints. The effectiveness of viscoelastic property on fiber composite ensures reliability and minimizes the effects of dynamic loading in structural applications. Limited reviews have reported the viscoelastic performance of natural fiber composite through DMA. Notably, the previous review articles lagged in addressing the performance affecting parameters such as frequency, temperature, fiber type, fiber loading, filler type, etc. This review has two parts: the viscoelastic performance of mono and synthetic natural fiber composites. The present review aims to express a broad understanding of natural fiber polymer composites, DMA analysis, and viscoelastic performance. Also, this study detailed DMA performance affecting factors. Comprehensively, the reviewed works revealed that Visco elastic performance of mono (Matrix-natural) /synthetic-natural fiber composites is extensively influenced by excitation frequency, temperature, length of the fiber, fiber loading, and type/size of filler particles. Further, a boundless opportunity is available to enhance the DMA performance fiber reinforced composites.

1. Introduction

Last two decades, researchers have been investigating polymer-based composites to estimate design and performance. The composites are categorized as metal matrix, ceramic matrix, and polymer matrix composites. The polymer matrix composite is highly preferred among the composites because of its significant advantages such as eco-friendly, low density, specific strength, specific modulus, and cost-effectiveness [1]. Generally, the composite material is prepared (figure 1) using a matrix with one or more reinforcements of dissimilar constituents. The individual constituents are identified to eliminate drawbacks of existing materials.

The natural fiber polymer composite (NFPC) was primarily focused on its green environmental attributes like biodegradability, recyclability, reduction in CO_2 emissions, and competitive price. NFPCs often contain a thermoset polymer matrix (figure 1) embedded with low-density fiber bundles, micro/nanoparticles, and structural reinforcements. In addition to the previous statement, fiber composites bring significant growth and production volume in NFPC applications in automotive, aircraft, civil, and marine industries [2, 3].

1.1. Fabrication process

The NFPCs are fabricated using hand layup, compression molding, vacuum molding, fiber stacking, resin transfer, and pressure bag molding. Moreover, other techniques also involved in composite fabrication like continuous lamination, centrifugal casting, cold press molding, filament winding, and vacuum forming are also employed based on the end product/applications.

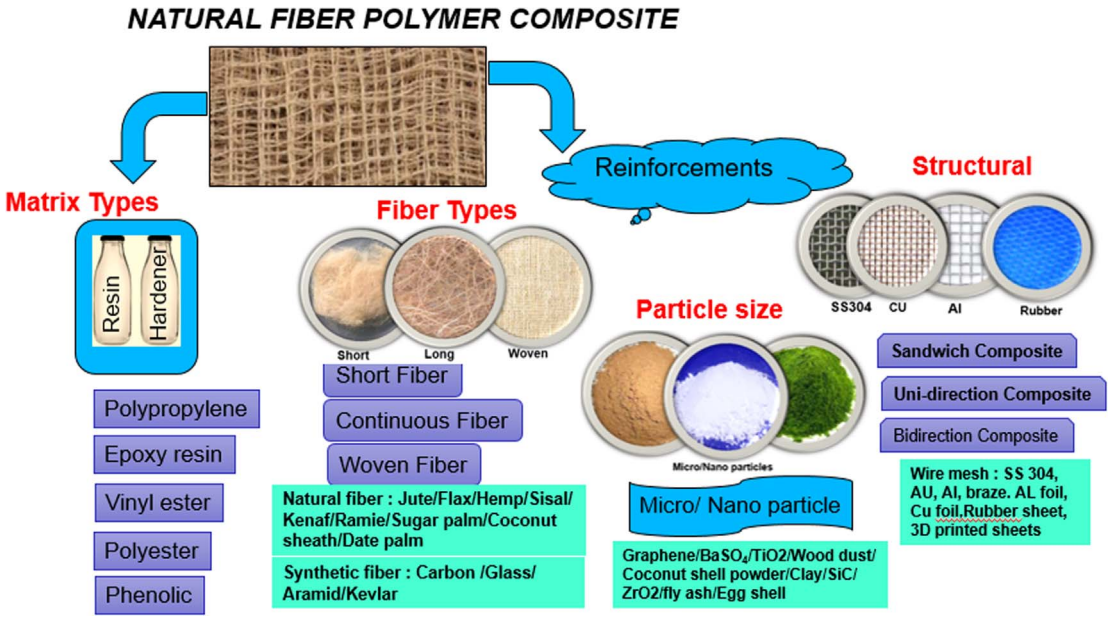

Figure 1. Natural fiber polymer composite.

NFPCs can be fabricated with manufacturing methods used for conventional composites of thermoset matrix and thermoplastic composites. These traditional composite fabrication methods include resin transfer molding (RTM), vacuum infusion, compression molding, direct extrusion and compounding, and injection molding. Different manufacturing techniques and constituents result in composite materials with diverse properties.

The hand layup technique is popular among researchers due to its adaptability and complexity. Initially, the fibers are chemically treated to enhance their physical properties. A mold is prepared as per the size of the composite, and a polythene sheet is placed on top of the mold. The wax/gel is applied to the polythene sheet as a releasing agent. The fiber layers are arranged according to the stacking sequence, and the matrix is uniformly applied to the fiber surface. The exact process is repeated until to obtain the required thickness. Finally, deadweight is placed on top of the mold until its curing (24 h) [4]. The fabrication process is typically shown in figure 2.

However, the benefits and drawbacks of hand layup fabrication are listed below [4, 5].

1.1.1. Advantages

- It requires a simple mold, equipment, minimum cost, and reliability.
- The process doesn't have size and shapes limitations.
- The possibility of joining with other materials is a supplementary benefit.
- Production of large products is possible with minimum risk factor.
- Complex contours and complicated shapes can be fabricated.

So the applications are vast in automotive, aerospace, building science, sports utilities, household products, etc.

1.1.2. Limitations

- Production efficiency is low compared to other fabrication processes.
- Adaptability for mass production is challenging due to low efficiency.
- The quality of the output products depends on environmental conditions, labor skills, matrix, and reinforcements.

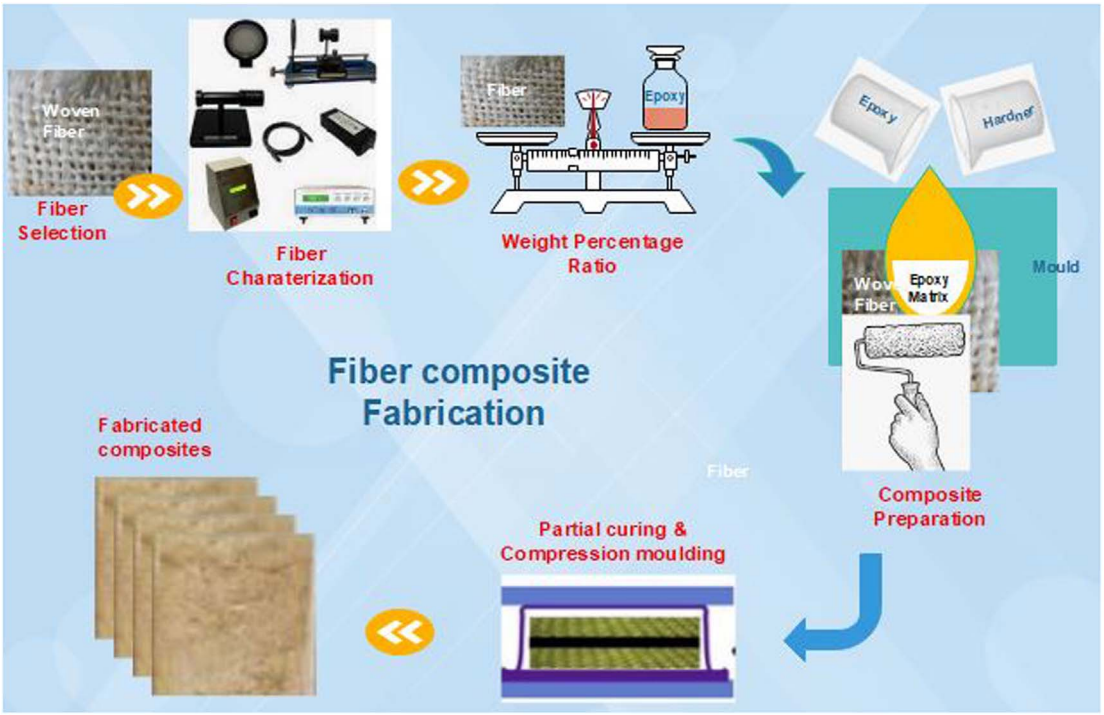

Figure 2. Fabrication process of polymer matrix composite.

Table 1. Application of natural fiber polymer composite in various automotive vehicles [6].

Manufacturer	Model	NFC composite parts
Audi	A2, A3, A4, Avant, A6	Seat backs, side and back door panel, boot lining, hat track, and spare tire lining.
BMW	3,5 and 7 series and others	Door panels, headliner panel, noise insulation panels, seat backs, molded foot, and well linings.
Daimler/Chrysler	A, C, E and S Class Evo Bus (exterior)	Door panel, windshield, dash board, business table and pillar cover panel.
FORD	Mondeo CD 162, FOCUS	Door panels, B-Pillar, and boot liner.
Mercedes-Benz	Trucks	Internal engine cover, engine insulation, Sun visor, interior insulation, bumper, wheel box, and roof cover.
Toyota	Brevis, Harrier, Celsior, RAUM	Door panels, seat backs, and spare tire cover.
Volkswagen	Golf, Passat Variant, Bora, Fox, Polo	Door panels, seat backs, boot liner, and boot lid finish panel.
Volvo	C70, V70	Seat padding, natural foams, and cargo floor tray.

1.1.3. Applications

The dynamic performance plays a vital role in the new material development. However, limited reviews have reported the viscoelastic performance of natural fiber reinforced composite through DMA. Notably, the previous review articles lagged in addressing the performance affecting parameters such as frequency, temperature, fiber type, fiber loading, filler type, etc. The application of natural fiber polymer composite for various automotive vehicles is shown in table 1.

This review has two parts: the viscoelastic performance of mono and synthetic natural fiber composites. The present review aims to express a broad understanding of natural fiber polymer composites, DMA analysis, and viscoelastic performance. Also, this study detailed DMA performance affecting factors. Comprehensively, the reviewed works revealed that viscoelastic performance of mono (Matrix-natural)/synthetic-natural fiber composites is extensively influenced by excitation frequency, temperature, fiber length, fiber loading, and type/size of filler particles. The current review deals with the importance of the dynamic performance of the polymer matrix composite. Figure 3 depicts the directions of the review starting from a material selection (fibers, matrix, and filler), fabrication methods, fiber composite types, DMA analysis, and performance affecting parameters on viscoelastic performance attributes.

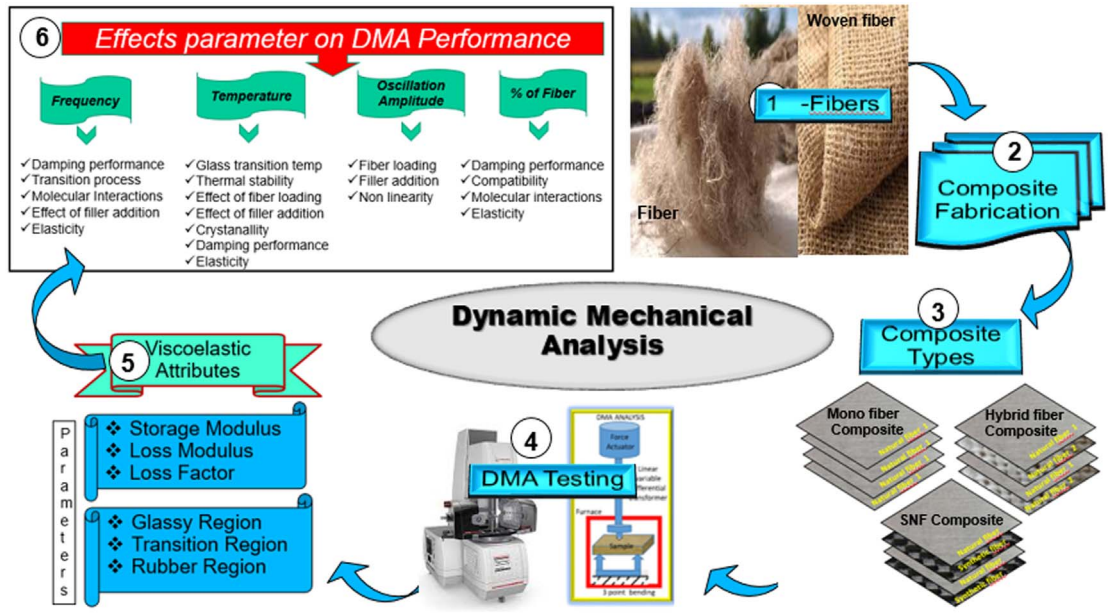

Figure 3. Review Footpath.

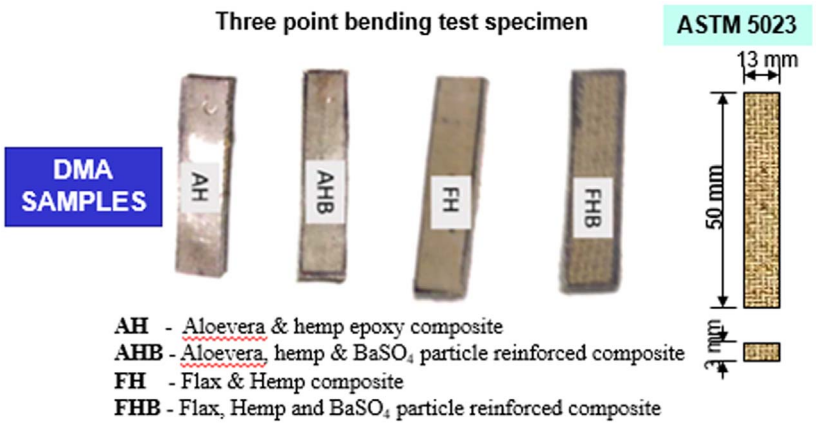

Figure 4. DMA test specimens [4] [License No: 1223029-1].

2. Overview of DMA analysis

Dynamic mechanical analysis (DMA) is a vital technique for estimating the dynamic performance of different materials such as thermoplastics, thermosets, elastomers, ceramics, and metals. Primarily it is used to estimate the viscoelastic behavior of polymeric composite under a thermal environment [7]. Apart from DMA, thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) analyses are used to estimate the thermal behavior of fiber-reinforced polymer composites [8]. The DMA analysis is used to determine the glass transition temperature (T_g), dynamic mechanical (viscoelastic) properties like storage modulus (E'), loss modulus (E'), and Tan δ (damping factor) of polymer composites through the functions of temperatures, frequencies, and time [9, 10].

The ASTM D5023, D4065, D4440, and D5279 are primarily used to prepare the DMA specimens. In general, the ASTM D5023 is commonly preferred under three-point bending mode with the specimen dimension of 50 $\times$ 13 $\times$ 3 mm [figure 4] [11]. In torsion mode testing, the ASTM D5279 is used for the DMA of plastics. Further, the rheological properties of thermoplastic resins and other types of molten polymers are estimated through ASTM D4440. Also, DMA can be utilized for evaluating the different types of polymers by various deformation modes. Like shear, three-point bending, dual cantilever, compression, and tension modes. The appropriate mode is preferred based on the specimen's modulus, shape, and measurement purpose. The

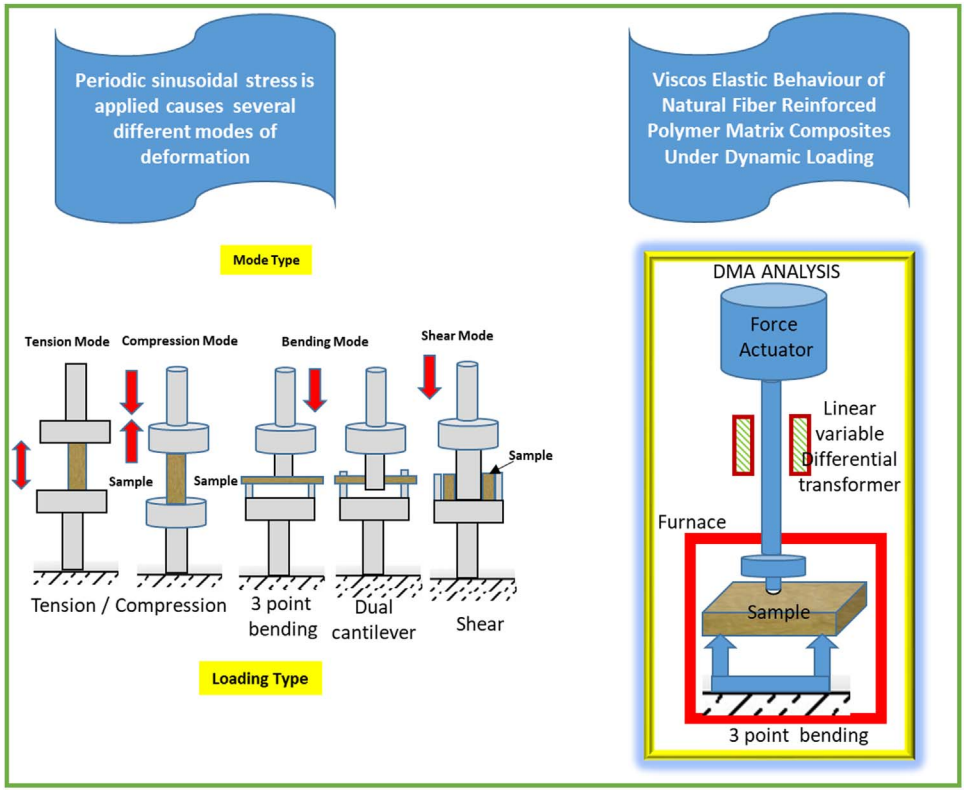

Figure 5. Schematic DMA setup and deformation mode types.

specimens are clamped between the fixed and movable fixtures and placed in an electronic controlled thermal chamber (figure 5). The developed sinusoidal force from the electric motor is transferred through the probe to the specimen.

The sinusoidal force causes the material deformation and the relationship between the applied force Vs. deformation (viscosity and elasticity) is analyzed. At different frequencies, the material's response to a gradual rise in temperature is evaluated.

The appropriate frequency (0.2 to 10 Hz) and temperature (25 °C–180 °C) range are selected for the material with a 2 °C min^{-1} heating rate. The materials deform within their viscoelastic limits and are successively cooled by liquid nitrogen. Further, the viscoelastic properties are analyzed by the complex modulus and cole-cole technique [4].

The DMA performance of the polymer composite is analyzed through different regions (glassy, transition, and rubber regions) based on the material state (figure 6). The glass transition region infers the material changes from a rigid, glassy solid to a flexible and elastomeric solid. It measures the stiffness and modulus of natural fiber incorporated polymer matrix composite. As the temperature rises, the rigid glass material transforms into soft material. The material is hard and brittle in the glassy region because of a lack of mobility. Rubbery state region showing material soft and flexible at this time has some mobility.

In polymer science, the glass transition is the process of softening polymer by cooling to glass or changing glass on heating to a soft state. The glass-transition temperature (T_g) is the range of temperatures that change from a solid glass state to a soft state and is lower than the melting temperature.

3. Viscoelastic attributes

The viscoelastic performance of natural fiber-reinforced polymer matrix composites is analyzed by classifying the composites into subclasses like mono fiber, hybrid, and synthetic natural fiber composite (SNFC). The fiber stacking sequences of mono and synthetic natural fiber composites are shown in figure 7. The review focused on analyzing mono and synthetic natural fiber composite (SNFC) viscoelastic performance through frequency, temperature, fiber loading, fiber type, and filler type.

Non-uniform fiber dimensions and variations in the physical & chemical configurations influence the composite strength and performance. The researchers found that developing composites as laminates is an effective technique to address the inconsistency of fibers. The single fiber combinations were used to develop the

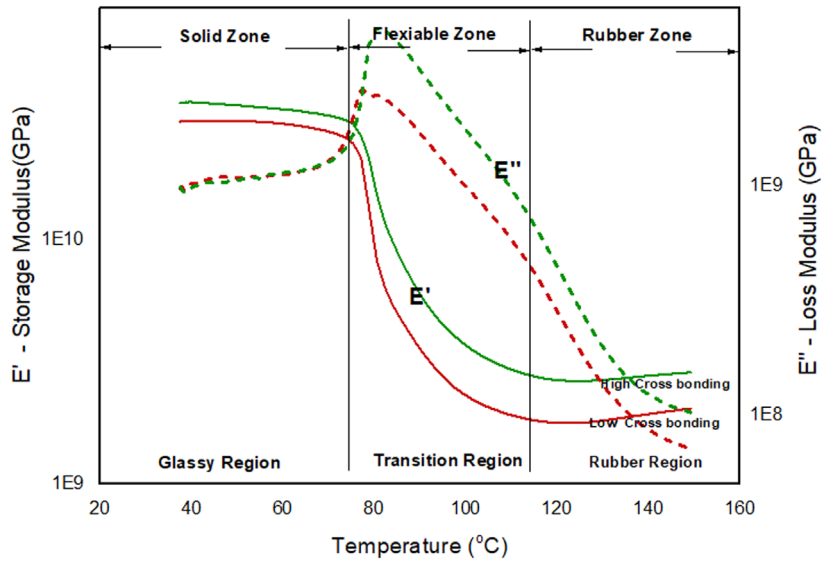

Figure 6. Different regions of response analysis.

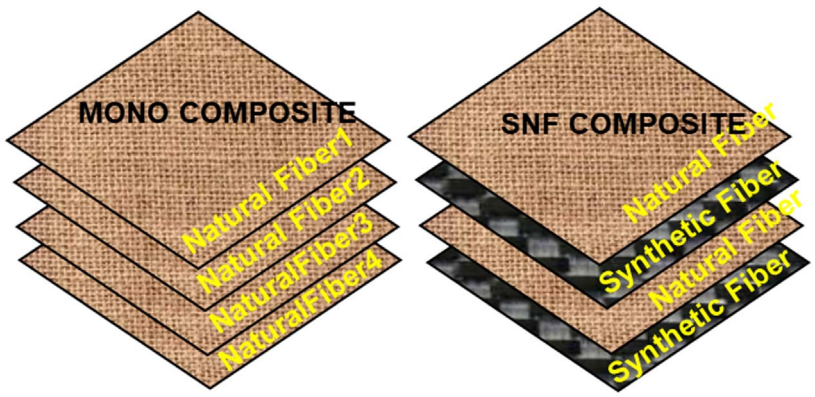

Figure 7. Stacking sequence of mono and Synthetic natural fiber composites.

mono composite laminates. Moreover, the hybridization enriches composite properties further by introducing different types of fibers in the same laminate. The viscoelastic performance of the (Mono/SNFC) composites is primarily influenced by frequency, temperature, loading, type of fiber, matrix, and filler. The effect of above mention parameters is systematically explained in figure 8.

3.1. Mono composites

The viscoelastic performance of mono-natural fiber (hemp, kenaf, jute, sansevieria, and banana) composites is analyzed through temperature, frequency, type of fiber, filler, and matrix.

3.1.1. Effect of temperature

In the jute fiber composite, the visco-elastic properties such as storage modulus, loss modulus, tan δ, and glass transition temperature are evaluated with the effect of temperature. The magnitude of the storage modulus determines the interfacial bonding between the fiber and matrix. The increasing temperature suddenly decreases the storage modulus in the glassy region. There is a reduction in storage modulus in the transition region, but the temperature rise improves the loss modulus due to internal damping. Increased temperature after softening increases molecular mobility in polymeric composites [12]. In the temperature range of 25 °C–150 °C, the short hemp reinforced polypropylene fiber composite offers better temperature resistance under the frequency of 1 Hz. However, as the fiber content/coupling agents increased, no changes were found in the transition temperature. Simultaneously increasing the fiber content to the maximum offers better results from DMA analysis [13]. The increase in fiber content increases the chance of a higher reinforcing effect at elevated

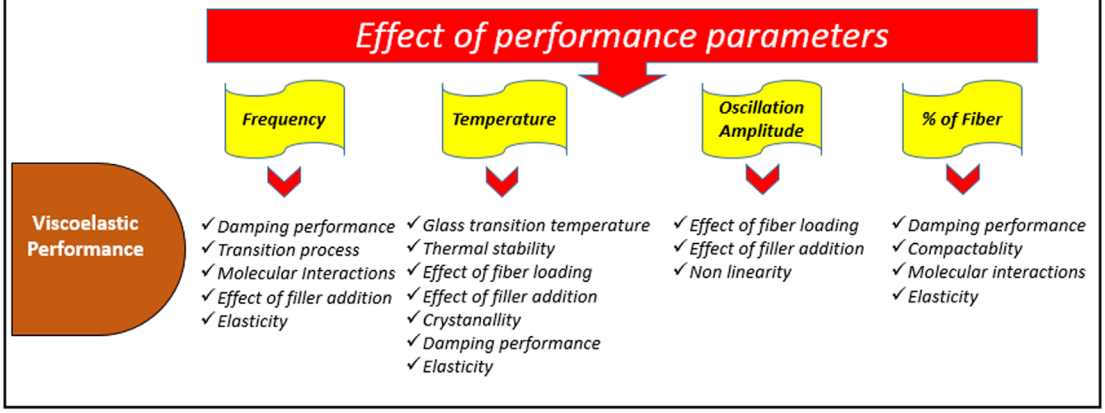

Figure 8. Effect of performance parameters on viscoelastic properties.

temperatures. After reaching the alpha relaxation temperature, the effect is more probable for high fiber content [13]. The effects of extrusion process temperature showed an increasing modulus in rheological and dynamic mechanical analysis of kenaf-polyethylene composites at higher temperatures [14].

The amount of jute/nanofiber reinforcement affects the crystallization and thermal degradation temperature. The higher interaction of polymer and nanofibers restricts the molecular mobility, enhancing the modulus/Tan δ [15]. The banana epoxy composites hold higher Tan δ (0.44) than the sansevieria composite (0.35). The banana composites have weaker interfacial bonding with the matrix, but it holds a higher glass transition temperature of 120 °C than sansevieria composites (100 °C) [16].

3.1.2. Effect of frequency

The varying input frequencies (0.2, 0.5, 1, 2, 5, and 10 Hz) significantly impacted the epoxy composites' dynamic mechanical properties. At 1 Hz frequency, the Tan δ was found to be maximum, whereas further increased frequency reduces the Tan δ peak. Enhancing the input frequency reduces the glass transition temperature and thermal stability. The storage modulus in the glassy region increased proportionally with the frequency [17]. In the type of fiber reinforcement in the nitrogen environment, the storage modulus fluctuates in the glassy region compared to the rubbery region at 1 Hz frequency. The knitted fiber reinforcement enhances Tan δ with better interaction with the matrix, and the change in weaving pattern influenced the behavior [18]. With the increase in frequency from 1 Hz to 10 Hz, the Tan δ peak enhanced from 0.284 to 0.317. Similarly, the loss modulus (E') increased from 68.3 MPa to 87 MPa [12]. The effect of frequency on the viscoelastic behavior (Tan δ and E') on jute fiber composite is typically shown in table 2.

The complex modulus and the loss modulus in doum fiber reinforced polypropylene composite increased with oscillation frequency. Similarly, a gradual fluctuation was recorded during that time [19]. The addition of clay up to 3% in the coconut sheath enhanced the vibration-resistant properties after it was reduced [20]. The increasing frequency of the jute-wire mesh-epoxy composite influences the tan δ (damping factor) peak and shifts with a minor change. Varying frequency from 0.5 Hz−5 Hz, the 45° wire mesh composite (WMC) exhibits low loss modulus (1.15 GPa) than 90° WMC for the same region [11].

At 0.5 Hz, the 45° WMC had higher storage modulus (35.5 GPa) in the glassy region; further, increase in temperature, the high molecular dislocation significantly reduces its storage modulus in the transition region. For the frequencies 0.5, 1, and 5 Hz, a minor variation was found in the Tan δ values (figure 9), but the 90° WMC shows a higher Tan δ than the 45° WMC in the glassy region. The storage and loss modulus were enhanced with increased frequency [11]. It also noticed that the glass transition temperature decreased with an increase in frequency due to the fiber matrix damage. The above effect reduces the interfacial bonding between the fiber and the composite matrix. Thermal stability is also considered the glassy temperature region value mainly depending on the adhesion between fibers and matrix, which restricts polymer chain movement [11, 12]. The storage modulus in the copper and aluminum wires reinforced jute composites was enhanced by 45.38% (45°) and 32.74% (90°) at 1 Hz frequency. A sudden drop was observed in the storage modulus for an increase in temperature in the transition region due to the rheological properties of the fiber and matrix [21].

3.1.3. Effect of fiber

Increase in fiber loading results in better thermal stability and load-bearing capacity of the composites. The viscoelastic performance of pineapple leaf fiber (PALF); short fiber (15 mm), long fiber (30 mm), and mixed

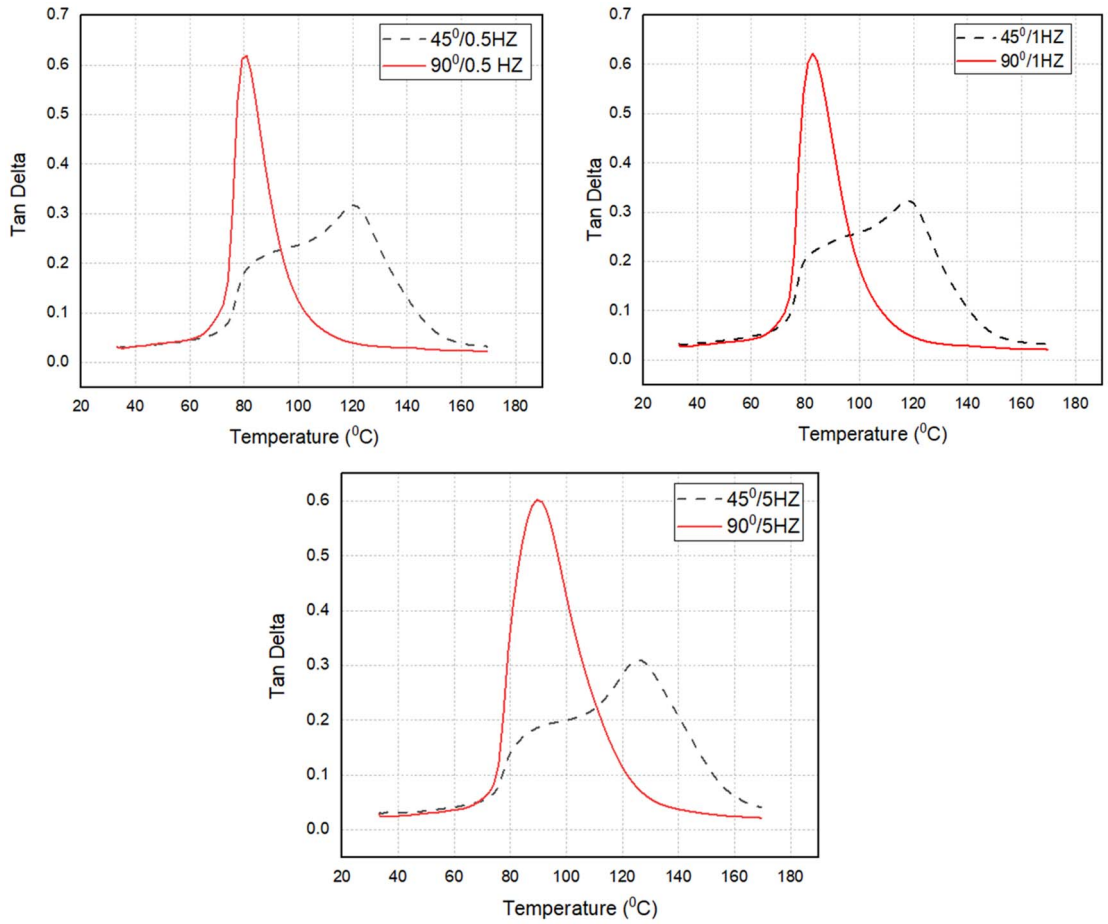

Figure 9. Tan δ at a different frequency.

Table 2. Viscoelastic properties of 30 wt% of jute fiber s loading epoxy composite [12].

Symbols	Input frequency	*Tan δ* Peak	Peak of *E'* (MPa)
J30F1	*1 Hz*	*0.284*	*68.3*
J30F2	*2 Hz*	*0.344*	*85.4*
J30F5	*5 Hz*	*0.372*	*79.9*
*J30F*10	*10 Hz*	*0.317*	*87.0*

(15 mm–30 mm) reinforced vinyl ester (VE) composites (PALF/VE) were analyzed, and better interfacial bonding was observed in the low Tan δ value. The long fiber composite exhibited a better modulus and Tan δ than the short and the mixed one. [22]. The different weight percentages (40, 50 & 60) were compared, and it was found that the date palm fiber reinforced epoxy composite had improved the storage and loss modulus. Among the different composites, the 50% fiber loading significantly improved viscoelastic behavior [23, 24].

3.1.4. Effect of filler

Fillers are the critical component that affects the viscoelastic behavior of the natural fiber composites. The addition of the nanofiber (10–30 nm) enhanced the storage and loss modulus, but the Tan δ decreased the weight by 0%–5%. The viscoelastic performance of virgin (base) composite and nanocomposites was compared and analyzed that in the glass transition region, the storage modulus of all the composite samples dropped drastically at the temperature range between 65 °C–80 °C [15]. The 30 mm coccidia indica fiber provides a better storage modulus, and minimum variation in loss modulus caused significant interlocking between fiber and matrix [25]. The silicate nanocomposite materials had better thermo-mechanical properties for weight 0%–5% filler addition leading to ease production through simple processes. Nanoparticle (silicate) addition enhances the composites' storage modulus, thermal stability, and flame retardancy [26].

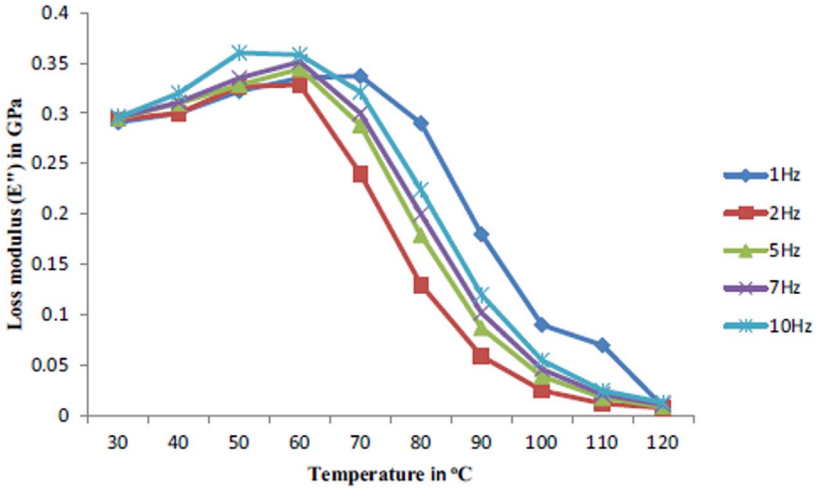

Figure 10. Glass fabric/epoxy composites with different woven structures [46]. [License Number: 5312440506120].

3.1.5. Effect of matrix

In the reinforced fiber-matrix composites, the matrix element holds the fiber in the proper location due to the adhesive property. The meshing characteristic of the matrix is mainly responsible for the better dynamic mechanical properties that are highly affected by temperature (rise), which affects the composite's behavior [11]. The different viscoelastic performance affecting factors on mono fiber composites are summarized in table 3.

3.2. Synthetic natural fiber composites (SNFC)

A composite consisting of natural and synthetic fibers is referred to as synthetic-natural fiber composites (SNFC). Synthetic fibers such as glass fiber, carbon fiber, and kevlar are known for their high strength & modulus, and their composites are extensively used for high-performance applications. The addition of synthetic fibers to natural fiber composites enhances viscoelastic properties. The natural fibers contribute to their low density, non-abrasiveness, non-corrosive nature, biodegradability, low cost, high specific strength, better stiffness properties, easy availability, and recyclability [38–40] to the SNFC composites.

3.2.1. Effect of temperature

Low-temperature composites have minimum damping property in the glass transition region due to fiber carrying maximum stress and allowing only a minor strain of the interface bonding molecules in the matrices. Adding fiber content enhances the loss modulus peak by improving the adhesion between the fiber and matrix in the hemp and glass fiber reinforced composites [41]. There is a sharp reduction in the storage modulus at the temperature range between 60–70° C in the flax and basalt fiber composite. The thermal degradation temperature increases with the increase in the percentage of basalt fiber in the composite pure PLA composite. In the kenaf-basalt, epoxy fiber composite holds maximum loss modulus at the glass transition temperature, which reduces exponentially with increased temperature due to increased polymer mobility [42]. The chemically treated fiber shows lower T_g than the untreated composite, which depicts lower Tan δ [43]. Due to the presence of more lignocellulosic content in flax fiber, the storage modulus of flax samples consistently decreased with an increase in temperature. At degradation temperature of flax fiber composites was lower than that of basalt/flax composites [44]. The kevlar/cocos nucifera composite initially degrades in the range of 100 °C–200 °C due to the water molecules evaporating from the composites and the dehydration brought through alcohol groups. The kevlar epoxy composite shows [39] a higher resistance towards heat, and the higher char residue formation validates.

3.2.2. Effect of frequency

A study of glass/sisal-polyester composite showed a shift of T_g to higher temperatures as frequency increases. It was attributed to a dephasing response shown by the composite at higher frequencies (figure 10). During the activation energy estimation, the composite's relaxation assumes a linear proportionality and the change in the glass transition temperature. Also, the Tan δ peak increases with the input frequency [45].

The storage modulus in the glass/ramie fiber composite was influenced at a higher frequency above T_g. The increasing frequency shifts the tan δ curve to the higher temperature region due to decreased rotational and translational movement of the chains of molecules. The increase in activation energy is held as a function of

Table 3. Effect of parameters on viscoelastic properties in mono fiber composite.

Fiber	Matrix	Effects	References	Fiber	Matrix	Effects	References
Short sisal	Polypropylene	The addition of sisal fiber in polypropylene increases the storage modulus and increases the stress transfers between fiber & matrix.	[1]	Doum palm fibers	Polypropylene	Coupling agent and fibers loading enhanced the rheological properties	[27]
Coconut sheath	Polyester	Organo clay Loading affect the viscoelastic properties and glass transition temperature	[19]	Sugar palm	Phenolic	Seawater and Alkaline treatments affects the viscoelastic behaviors	[28]
Jute	Vinyl ester resin	The storage modulus increase with the increase in fiber loading, and better stress transfer is observed. Chemically treated composites Tg decreased (128° to 125 °C).	[26]	Kenaf	Polyester	Viscoelastic extremely affected by the water presence in the test specimen	[29]
Jute	Polypropylene	The addition of jute fiber reduces the magnitude of the damping factor peak by reducing the molecular movements	[30]	Kenaf	Polyurethane	Increasing natural rubber loading decreasing storage modulus with the decrease in volume percentage of Polyurethane	[31]
Jute	Epoxy resin & Acrylated epoxidized soybean oil	Acrylated epoxidized soybean oil ratio influence the storage and loss modulus fiber and matrix bonding are stronger than single resin composite	[32]	Hemp	Polypropylene	Long fiber increase the storage modulus than the short fibers loading	[33]
Ramie	Epoxy	Viscoelastic stiffness, segmental mobility and damping capacity affected for fiber loading.	[34]	Hemp	Epoxy	Increasing cellulose enhance storage modulus, loss modulus peak due rigid than the matrix. Chemical treatment of fibers lengthening the loss modulus peak	[35]
Ramie	Polylactic acid (PLA)	Sodium hydroxide (NaOH) and ammonia improves the storage modulus and lower damping factor	[36]	Flax	Epoxy	Composite delamination in DMA analysis reduce the storage modulus and improved the loss factor	[37]

Table 4. Viscoelastic behaviors SNF composite.

Fiber	Matrix	Effects	References	Fiber	Matrix	Effects	References
Flax/Basalt	PLA	30 Wt% basalt/flax enhance the storage modulus and higher T_g.	[43]	Carded ensete web/ Glass	Polyester	Mono ensete composite having least storage modulus. Tan delta peak decreases for glass outer layer composites	[54]
Ramie/glass	Polyester	Higher fiber loading, and volume percentage of reinforcement returned lower effectiveness coefficient.	[46]	Bagasse/Kevlar	Vinylester	T_g of the composite increased to 2 °C–6 °C compared to neat vinylester related to damping.	[55]
Jute/carbon	Polyester	The arrangement of fiber layer influence the storage and loss modulus and no effect found in T_g. outer layers yield better viscoelastic propertiesdue to its strength.	[49]	Jute/Glass	Epoxy	Storage modulus of SNFC falls between the mono glass/jute.	[56]
Nylon 66/organic polyethylene terephtalate	Polypropylene	Fibers addition notably increase the storage modulus and demises the tan δ which shows better boding between the fiber and matrix.	[50]	Pennisetum purpureum/glass	Epoxy	Variation in found T_g between the SFC, neat epoxy, untreated, 5%, and 10% alkali-treated fiber composites.	[57]
Bamboo/Glass	Polyester/Vinyl Ester	Higher weight percentage of bamboo fiber decrease the storage modulus and Loss modulus	[10]	Flax/Glass Pineapple and Glass	Epoxy	Treated SNFC showed higher storage modulus than hybrid LCE resin and lowest damping factor (Tan δ) when compared to	[58]
Pineapple leaf/Glass	Polyester	Equal proportion of the fibers shows the higher damping properties.	[51]	Sisal/Glass	Polyester	Fiber stacking sequence predominantly affect and viscoelastic properties of SNFC.	[59]
Bamboo/Glass	Polypropylene	High frequency lean towards weak bonding between reinforcements and matrix. SNFC hold better viscoelastic properties	[52]	Banana/pineapple leaf/glass	Polyester	30 wt% fibers loading produce high T_g and Increasing frequency reduce the Tan delta peak and T_g	[60]

frequency which makes the glass fiber have high rigidity imposed against the activation energy [47]. In another test, the damping properties of the glass fiber reinforced composites
increased with an increase in the frequency of the same thickness. At the same time, frequency influences the fiber-matrix interfacial bonding [48].

3.2.3. Effect of fiber

The fiber hybridization influences the dynamic mechanical properties of ramie/glass fiber composites [46]. The glass fiber inclusion reduces the storage modulus above the T_g [10,49–52]. The storage modulus of glass-jute composites falls between the mano glass and mano jute composites. Abnormal trends were found for the temperature variations in loss modulus and the Tan δ at T_g. The fiber stacking sequence affects the viscoelastic behavior of fiber composites. The outer carbon layer composite holds higher storage modulus than jute fiber layer composites. At 85 °C, the storage modulus drops around 1 GPa irrespective of the composite type. The outer carbon fiber and inner jute layer composites enhance the loss modulus because the carbon fiber resists the force [53]. The viscoelastic behaviors of different SNFC are recorded in table 4.

4. Conclusion

In the survey, the results are summarized by considering the performance influencing parameter of viscoelastic performance in natural fiber mono/synthetic polymer reinforced composites are concluded as follows:

- Various combinations; natural fiber/polymer matrix (Mono natural fiber composites), natural fiber/synthetic/polymer matrix reinforced composites (Synthetic natural fiber composites) literature were reported.
- Increasing frequency (0.2–10 Hz) significantly enhances the storage and loss modulus, but minor variation is observed in tan δ. Similarly, the glass transition temperature (T_g) decreases due to the fiber matrix damage (Interfacial bonding).
- Increasing the weight percentage of fiber enhances the viscoelastic performance within a defined region. Hence, beyond the limit, the composite performance was not adequate.
- The fiber matrix bonding mainly depends on the matrix type and weight percentage, primarily affected by the temperature. It was clearly identified that better bonding influences the composites' viscoelastic performance.
- The temperature increase drastically decreases the storage modulus in the transition region due to higher molecular dislocation.
- Lower Tan δ maximizes the load barring capacity, resulting from better bonding between the matrix and the fiber. At the same time, the storage modulus and loss modulus were significantly enhanced.

Data availability statement

All data that support the findings of this study are included within the article (and any supplementary files).

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