A Review on Tribological Behaviour of Natural Fiber Reinforced Polymer Composites

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Abstract. In the past, asbestos and copper were preferred as friction materials because they have good ability to dissipate heat, but have proven to be harmful to the environment. Recently, more researchers are focused on non-asbestos friction composite materials due to its non-toxicity and biodegradability. Despite synthetic fiber composites having eco-friendly nature, because of its cost and pollution most of the researchers show interest on natural fiber composites. Hence, there is a need to explore the analysis on the tribological behavior of composite materials. The availability of natural fibers and the ease of manufacturing have tempted researchers to study their feasibility of their application as reinforcement and the extent to which they satisfy the required specifications in tribological applications. Hence, the aim of this review is to demonstrate the tribological behavior of natural fiber reinforced composites and find knowledge about their usability for various applications that tribology plays a dominant role. This review presents the reported work on natural fiber reinforced composites with special reference to the type of fibers, matrix, polymers, treatment of fibers and test parameters to understand their usability for various automotive applications.

Keywords: Natural fibers; Friction materials; Tribological behaviour; Natural fiber reinforced polymer composites

1. Introduction
The modern world today is preoccupied with the speed and efficiency of machines and structures. It needs quality fabrics in the designer's hands to be used for the applications. Scientists have produced and are improving newest and older technologies for many specific applications such as space, aircraft, marine, and industrial, and structures, and it is important to study existing products in order to further understand them in service condition. One third of our global energy consumption was wastefully devoured in friction. Beyond the main energy saving, very important additional economics will be rendered by rising the costs involved with producing and removing unnecessarily burned out parts. Wear dissipation of energy strongly impairs the national economy and most people's lifestyle. Therefore, the effective diminution and control of metal wear is always desired.
1.1 Animal fibers
Yunhai Ma [1] researched the impact of wool fiber on wear and friction properties as the friction material reinforced. The fabrics strengthened with 3%wt wool fiber is stable with coefficient of friction and lower wear intensity. While temperature rises, reliability of the coefficient of friction increased. Rockwell stability reduced, and the impact force rose as the contents of wool fibers grew. Concluded the wool-fibre-enhanced fabrics were effective in elastic use and abrasive use. I Oladele [2], investigated the effects of fiber fraction on the abrasion properties of reinforced polyester composites in treated cows hair fiber. Abrasion resistance is optimum at 4 weight% CHF content. T Narendranath Babu[3], tribological and brinell hardness of Angora, Kenaf and Ramie by combining the standard fibers in a particular proportion with Epoxy LY556 pitch and Hardener HY951. It has been discovered from the observation that Kenaf natural composite exhibits superior tribological properties compared to Angora and Ramie.

1.2 Mineral Fibers
U K Navin Chand [4] Studied tribological behaviour of ultra-high molecular weight polyethylene (UHMWPE) filled with epoxy gradient composites. Samples were prepared for different centrifugation time periods. The rising wear rate of composites at an increasing centrifugal period. Sliding wear rate reduction in composites was attributed due to the lubricating effect and smooth surface of UHMWPE. It is strongly entangled chain structure.

B Naga Raju [5] investigate the tribological properties of ZnO filled polymer nano composites. Materials were prepared by mixing 1wt%, 2wt%, 4wt%and 6wt% of ZnO nano particles with polyester resin. polyester composite of 1% ZnO has outstanding wear properties relative to pure polyester. The loading of nano ZnO particles in polyester improved the polyester microstructure and avoided the degradation of banded polyester structure during the friction cycle which may be one of ZnO is anti-wear mechanisms. The composite ’s enhanced and better Tribo-performance can be attributed due to unique mechanical properties of nano particles. Antaryami Mishra [6] Studied wear behavior rubber dust- epoxy composite. Under dry sliding condition, materials exhibited very low friction coefficient and low wear levels. The lowest wear levels by weight are 10% rubber mud. Nevertheless, a strange finding was obtained, i.e. declining tendency while rubbing at different speeds against steel with 20% rubber reinforcement in epoxy. This may have arisen from the high surface finish of the disks and the composites, creating a thin film of transition. A Ayman[7] Reviewed extensively the friction and wear of polymer composites filled with nano-particles and concluded that composites formed by the addition of nano-scale particles to a polymer matrix result in improved electrical , mechanical and thermal properties of the composites..

Punyapriya Mishra [8] developed a mathematical model for predicting an abrasive wear behaviour of bagasse fiber-reinforced polymer composite. A second order polynomial model for predicting wear loss has been achieved. The model was developed using Surface Response Method (RSM). Analysis of the variance technique (ANOVA) at the confidence level of 95% was used to check the model ’s validity. results are strong correlation, which means that analytical models derived from the response surface method can be used to describe the composite's tribological behavior. S Supreeth [9] Studied the effect of fiber length on the tribological behavior of short pulp reinforced bisphenol-a composite and the result shows that wear levels increase with load increases for composite specimens with lower interfacial bond strength. For this experimental research, it was observed that the wear properties of strengthened composites are greatly affected by the fiber length.

N.Mohan [10] Studied SiC tribological properties of glass-epoxy composites filled at high temperatures. The introduction of these ceramics (Al2O3, SiC, TiC, etc.) as in the matrix significantly improves the friction coefficient and eliminates wear loss. In both composites the wear rate increases with higher temperature / applied load and under the same conditions. Silicon carbide particulate composite packed with G-E experiences a lower wear intensity relative to virgin G-E composite with a higher friction
factor. Mahdi Alajmi [11] researched the interaction between Fillers / Epoxy composite mechanical properties and tribological behaviour. Performance has affected tribological resources favorably.

F Chegdani [12], Investigated effect of fiber type on tribological actions of natural fibre reinforced plastics during the profile milling process. Three different reinforced polypropylene (PP) composites of short natural fibers (bamboo, sisal and miscanthus) are estimated. The consistency of the NFRP machined surface is quantified using a multi-scale, wavelet decomposition-based process. Bamboo fibers reinforced plastics shows in height contact stiffness after machining shows smoother surface finish.

T Narendiranath [13], Reviewed Tribological Properties, SiO2, TiO2, BaSO4, Al2O3, CaO, MgO, K2O, Na2O, Fe2O3 Strengthened with Basalt Fibers. The mineral fiber reinforced with polymer such as thermoplastic and thermostet, metal and concrete, for an overview of the application of this fiber in biodegradable matrix was presented. the studies have been reviewed on the industrial applications of composites reinforced with basalt fibre. B S. Kanthraju [14] systematically investigated the wear resistance using bidirectional fibers (E-glass and basalt) and polytetrafluorooethylene fillers (PTFE) and graphite. It indicates that the introduction of PTFE and graphite in G-B / E hybrid composites has a major impact on wear behavior under varying sliding distance / loads. PTFE filled G-B / E composites revealed lower similar wear levels than unfilled and graphite filled G-B / E hybrid composites. The most important opinion of this work is to highlight the significance of fibers and practical fillers in the design of wear-resistant polymer matrix composites.

Jyothish J Nair [15] Studied vibration analysis and wear characteristics of shell powder filled glass fiber reinforced epoxy composite. Sea shell powder percentage was varied by 5%, 10%, and 15% by volume. With more load, sliding velocity, and distance the weight loss increased Modal analysis is conducted using the accelerometer of the Fast Fourier Transform analyser and an impact hammer to assess the vibrational characteristics of the Glass / Epoxy composite. NX Nastran gets the analytical results. The experimental and analytical results are compared, and they have been in good agreement. Glass / Epoxy showed good vibration characteristics with 5 per cent sea shell powder filler.

A lakshumu [16], Studied Chemical treatment of natural fibers that can clean the surface of the fibre, chemically modify the surface, stop the absorption of moisture and increase surface roughness. For chemical modifications of these composites a variety of different chemicals are used. Thus, to ensure their long-term stable behaviour in practical applications, it becomes necessary to take care of the chemical properties of composites. G Vikas [17] studied an overview of tribological properties of polymer composites enhanced by basalt fibre. Yusuf Sahin [18], Investigated the tribological behaviour of carbon-reinforced epoxy composite (CFRC) and its nano-based composites, including Al2O3 and PTFE powders developed using molding techniques. Response surface methodology was used to model the impact on weight loss under dry sliding conditions of different variables such as material types,applied load and rotational speed.

C H Shreenidhi [19], Conducted a tribological study of polymer composite content with different filler materials and examined the positive impact of commercially usable nano-additives on the tribological properties of the polymer composite. This describes the tribological actions of specific forms of composites of glass, jute, metal powder as filler material, epoxy resin, and numerous filler styles varying from particulates, chips, and chopped branches. P Gopal [20], developed hybrid natural fiber epoxy materials that are used as body shells for the automotive. Composite material used as epoxy composite of bio-material characterisation with the lowest density is used. It finds that tribological properties are improving significantly.

Robin Zuluaga [21], Studies Tribological work has an impact on the global production of natural composites. The composites filled with Musaceae fiber bundles and cured with two hardeners; rises of about 15% in global styrene double bond conversion observed using both hardeners for tidy matrix and
composites, indicating that any changes in resin structure occur during the tribological study. Determining the usable alternatives for controlling the therapeutic environment to monitor tribological behaviour. P A Udaya Kumar [22], Studied the effect of hybrid reinforcement on dry sliding wear behaviour of vinyl ester (VE) composites. With the coconut shell powder (CSP) content the specific wear rate fell more rapidly. Percentage CSP is more protective against wear from sliding Reinforcement form, geometry and dispersion lead to improved wear resistance. These outcomes are very important for the manufacture a new composite integrated with surface-treated reinforcing materials such as Carbon fiber and CSP that will have foremost application in automotive sliding or bearing components.

Aneta Krzyżak [23], Analyzed the abrasive wear in different abrasion conditions of selected aircraft materials. In contemporary aircraft construction, the mass percentage of epoxy resin composites is generally higher than 50% and these materials must meet increasingly demanding requirements. Investigated the influence of external factors on the abrasion process, each group of samples was subjected to abrasion in an insulated environment under different external conditions, in the presence of water and loose abrasives, brown fused alumina (BFA) and white fused alumina (WFA). The results allow us to conclude on which type of filler and in which concentration it contributes most to improving the abrasion resistance of the composite material. Additionally, it has been found that the conditions in which abrasion occurs have a very important effect on the course of this process.

1.3 Plant Fibers
1.3.1 Bast Fiber
A S Singha [24], Studied on new series of green composites involving Hibiscus sabdariffa fiber as a reinforcing material in urea formaldehyde (UF) resin based polymer matrix. Initially urea formaldehyde resin prepared was subjected to evaluation of its optimumal properties. Then reinforcement of the resin with Hibiscus sabdariffa fiber was attained using engineered resin in the particle sizes of three different types, short fiber and long fiber. Reveals traction resistance. N Vijaya Kumar [25], Investigated Properties of Wear on Jute Reinforced Polypropylene Composites at different loads and at different sliding velocities. The composites with varying percentage of fiber weight (5%, 7.5%, 10%, 12.5% and 15%) using injection moulding process. The friction and wear loss coefficient is studied for different loads and sliding speeds. A Thimmana Gouda [26], Studied wear characteristics on Natural Fiber Hybrid Polymer Composite for Orthopedic Implants. Identified foremost changes in tribological properties of 36% Hybrid Natural Fiber Polymer Composite compared to 12% and 24%. Finally, 36% Material can be used for orthopaedic implants or replacement of human bone.

Temesgen [27], Studied Sliding Wear Properties of Jute Fabric Reinforced Polypropylene Composites. Adding woven Jute fabric to the PP matrix increases the wear resistance properties and the coefficient of friction was reduced by 45-65%. R Karthik [28], studied tribological behavior of rice husk and eggshell with particulate coir-polyester. The effects of egg shell and rice husk polyester composites on surface roughness properties were investigated.

Priyadarshi [29], Studied Abrasive Wear Behavior of Surface Modified Jute Fiber Reinforced Epoxy Composites. Three-body abrasive wear research was conducted in conjunction with ASTM-G65 using a rubber wheel abrasion system (dry sand wears tester) at room temperature through varying factors such as fiber quality, abrasive particle scale, standard load and sliding speed. The result indicates that the wear-resistance ability is increased by chemical treatment of jute fiber. B Sudhabindu [30], Studied the effect of tri-biological properties of polymer composites reinforced with jute / e-glass fibre. Wear loss is very minimal and is observed for 180 minutes. F Z Alshammaria, [31], Studied the tribological efficiency of Jute Fiber Reinforced Epoxy Composites with Fiber Orientation. Fiber orientation has a very significant effect on the wear and frictional efficiency. The composite is testing in both parallel and antiparallel orientations. better wear resistance found in the antiparallel orientation.

Sandeep Kumara [32], Investigated sliding wear properties of Bauhinia-vahlii-weight (BVW) and Bauhinia-vahlii-weight / sisal (BVWS) hybrid composites. The rice husk was hybridized by with BVW and BVW-Sisal fiber reinforced epoxy composites. The evaluated results show that the addition of
optimally varied rice husk fillers reveals the increase in wear efficiency of natural fiber based epoxy composites.

1.3.2 Fruit Fiber
L Boopathi[33], Studied the wear properties of Borassus fruit fiber reinforced epoxy composites. wear properties improved with the alkali treatment of the fibres. Alkali treated fibre-reinforced composites exhibited greater wear properties than others. P Chandu [34], Experimentally Evaluated Wear Behavior of Banana/ Pineapple Hybrid Composites. It shows friction coefficient remains almost constant. Find that there is a direct relationship between the sliding distance and the wear rate. Hemant Patel [35], Studied on Mechanical Behaviors of Banana/ Sisal Hybrid Composite Reinforced with Epoxy Resin. The properties, such as tensile and flexural properties of hybrid bananas and sisal-reinforced epoxy composites used in combination with plastics.

Abhishek Kumar [36], Studied Natural Fiber Composites Tribological Characterization. There have been attempts to explore the potential use of natural fiber in composites as a filler material. To evaluate their (banana fiber) potential for strengthening wear performance and mechanical properties; There are numerous human, mechanical and wear efficiency studies of the composites. From the experiments conducted, it can be seen that as far as wear performance is concerned a banana fiber is concerned, as the study shows that erosion wears performance of composites based on banana fibre. Banana fiber also has a very low specific gravity, and the composites are very low in density. From other mechanical characteristics it can be said that as in potential application, banana fiber-epoxy composites are also used in terms of strength.

1.3.3 Grass and Reeds Fiber
Mukesh Kumar Mann [37], Studied Kans grass fiber (KGF) polyester composites friction and wear behaviour. It was found that at virtually all sliding conditions, the tidy polyester specimen had less wear resistance than the KGF composites. Friction activity was significantly affected by the fiber quality and variability in sliding velocity. The rise in the fiber Vol percentage from 10 to 20.08 slightly increased the KGF composite specimens average friction coefficient at 0.5 m / s and 1.5 m / s, while fluctuating behavior was observed at moderate sliding level.

1.3.4 Leaf Fiber
Kamal Kumar Basumatary [38], Studied the impact of fiber loading on Ipomoea carnea's abrasive wear actions in reinforced epoxy composite. The incorporation of Ipomoea carnea into the epoxy significantly reduces the loss of abrasive wear. Addition of fiber (40 weight percent) removed particulates from the matrix resin due to poor interfacial adhesion. Abrasive wear is very sensitive to normal load relative to sliding speed and increases slightly with increasing sliding speed. The average wear intensity increases with a rise in the sliding distance, when the debris occupies the area between the abrasive that limits the extent of abrasive surface penetration through the composite sample.

With through sliding space, wear rate slowly decreases and in multi-pass condition achieves an Almost steady state. The composite 's average wear rate decreases with an increase in the sliding gap as the debris fills the space between the abrasive, which increases the degree of penetration of abrasive particles into the composite sample. Further, surface modification is found to have a significant impact on wear performance. Manu Prasad [40], investigated the effect of PALF Reinforced Bisphenol-A Composite Fiber Orientations on tribological behavior. Upon PALF reinforcement, the wear resistance of pure Bisphenol-A resin is found to be increased. Among three types of composite fiber orientation, bidirectional composite shows the least specific wear rate and friction coefficient The Coefficient of friction for all three types of composite fiber orientations decreases with an increase in normal load, As the usual load rises, more material is removed due to self-lubrication of the test samples and the removed material is placed on the mating surfaces of the composite and abrasive disk resulting in self-lubricating.
The tribological behavior of PALF reinforced Bisphenol-A composite is thus greatly influenced by the orientation of fibre.

TMadhusudhan [41], Reviewed study of tribological behavior on polymer hybrid composites reinforced by natural glass fibres. In this study the tungsten carbide (WC) filler enhances erosion resistance. TNarendiranath Babu [42], Studied mechanical and tribological behavior of epoxy composites strengthened by sisal, abaca, and sun-hemp hybrids. It is observed from the tests that the Sun-Hemp exhibited superior Tensile and Flexural properties, while Sisal exhibited high resistance to impact and hardness. Sun-hemp has better wear properties when compared with two other composites with the lowest wear rate of 85 micrometers. With these findings design engineers will be able to pick the correct composite for industrial purposes. Nitin Mukesh Mathur (2017) [40], Reviewed on Sugar Cane Bagasse Composite Material and scope. Discussed on various recent work or review report on natural fibers and fillers used in the manufacture and application of cost-effective composite materials.

This research focuses on the degree to which sugarcane bagasse particles are used as reinforced material for producing composite material. Researchers have done much research on natural fiber-reinforced polymer composites, but SCB dust particles have never been used at low cost in the manufacture and application of epoxy-based composite. There is definite scope of study of mechanical behavior under various test conditions for polymer composite reinforced by SCB dust. Cost and quality control of natural composite reinforced filler is the major stone to be used by product designers and manufacturers as an alternative material. In addition to all these, the main motive is the manufacture for commercial use of an economic natural fiber based composite material.

S Vigneshkumar [43], studied the tribological actions of composites reinforced by fibre. Polyester was used as the binding medium for the preparation of a composite model reinforced with compositions from sisal, banana, kenaf, carbon fiber and rice husk. The Tribological operating parameters illustrate the effect on the friction and wear efficiency of fibre-reinforced composites by incorporating load, sliding velocity and sliding width. The specimens' wear reaction was found to be determined by the load applied, the sliding distance and the velocity.

Nitin Doifode [44], Studied Epoxy Composite Friction and Wear Behavior Reinforced under Dry Condition with Ipomoea Carnea Fiber. This paper describes the effect of normal wear load (micron) and friction coefficient of reinforced / reinforced Ipomoea Carnea epoxy composites with different weight percentage of the fiber fraction (10 percent, 20 percent, 30 percent, 40 percent wt). To measure the micron wear and friction coefficient of Ipomoea Carnea reinforced epoxy composites, the 12 mm diameter fiber composite pin was manufactured and tested for each fiber weight concentration under three separate loading conditions (10N,20N,30N). Measurement of friction and wear was done by load cell and LVDT, respectively. The Pin-on - Disk Tribometer acquired wear data in real time, and time (Sec) friction coefficient. Each test was performed under dry condition for 10 min (600 Sec), and data for wear (micron) and friction coefficient with time variation (100 Sec interval) were recorded from the monitor.

1.3.5 Seed Fiber
H Aireddy [45], Examined tribological actions of polymer matrix composites reinforced by Bio-waste. The composite is observed to show the maximum corrosion intensity at an impingement angle of 90 °. Weared rate of erosion is minimised by increasing coir dust volume. Abrasive wear resistance declines with decreased usual load, and improves with increased amount of fibre. JT Siva [46], Studies Effect of Naturally Woven Coconut Sheath Polyester Composite on Tribological Properties and treated with Alkali. Hybrid composites (polyester resin with naturally woven coconut sheath (N) and glass fibers (G)) were tested in a pin on the disc configuration against the hardened steel counter-face. From the results all hybrid combinations excluding (NNN) with the alkaline treatment show deteriorated wear properties. For all combinations, except for NGN and GGG hybrids, the friction properties are changed by having low friction coefficient. In untreated specimen for which the fibers are highly visible, partial
removal of individual phase (resin) is prevail. Such phenomenon, however, is not dominant in the alkali treated material, which shows better reinforcing behavior that compliments low friction properties. The alkali treated specimen the the size of the fiber relative to the untreated specimen resulting in low resistance to wear. The untreated fibers are best suited for tribological applications by a compromise between friction and wear properties.

Umar Nirmala [47], Studies the impact of betel nut fiber treatment and contact conditions on the adhesive wear and friction performance of polyester composites. Composite wear and traction quality were seen to be increased by about 54% and 95% relative to dry under wet contact conditions.

R Abraham [48], Examined the impact of date palm seeds on tribological polyester composite behavior under Various Research Conditions. It revealed that the friction coefficient for polyester composites packed with date seed powder falls by 15% with a rise in filler under heavy contact strain. In addition to rising the size, the friction coefficient rises by up to 10%. Unfortunately, the date seed filler continuously decreases from 15% to 25% lower the wear resistance of the planned composites under heavy contact pressure and fast slipping pace. The load applied (contact pressure) and the sliding velocity have a direct impact on the polyester composite wear rate which is filled with date seed.

Prafull Sharma [49], Evaluated the Impact Resistance of Cotton Fiber Reinforced Polymer Composites Cotton fabric is used as an epoxy-based polymer composite reinforcement material. it shows that for engineering applications the manufactured cotton fiber-reinforced composite has promising characteristics. G Rajasekhar [50], Studied on Coconut Fiber Reinforced Polyamide Matrix Composite to its Wear Behavior. The coconut fiber reinforced composites have substituted the most commonly produced plastic fiber (Glass, Kevlar) strengthened polymer composites in many applications. Concluding with an increase in normal force results in an increase in wear rate due to bonding between the coconut fiber and matrix is inadequate to withstand normal force resulting in damage to the matrix thereby increasing wear rate. The coefficient of friction decreased with regular force, but it declines less with extreme force.

1.3.6 Stalk Fiber
Yunhai Ma [51], Studied tribological characterization of Stalk-reinforced friction composites from waste grain. The composites for traction were formulated with specific amounts of maize stalk fibre. The addition of corn stalk fibers was found to have a positive impact on the coefficients of friction and the wear levels of friction composites. The results revealed that the satisfactory performance of wear resistance was related to the secondary plateaus formed on the worn surfaces. The wear output of coconut shell powder (CSP) and coir fiber reinforced polyester resin composites was experimentally investigated by K Vignesh [52]. The effect of the concentration of coconut shell powder and coir fiber and the sliding distance in the composite weight loss was analyzed. The result shows that the friction coefficient increases with load increases in composites containing polymer matrix in the CSP and coir fiber. The wear rate is observed to increase with the increases in the load applied. With the addition of CSP and coir fibre, the wear rate decreases. When the load applied increases, friction also increases at the material's contact surface and spinning disk. For the polymer matrix composites, the addition of the CSP and coir fiber serves as reinforcement. The wear resistance improves thanks to this addition.

1.3.7 Wood Fiber
S S Mahapatra [53], Analyzed abrasive composite wear performance using Taguchi approach. Fiber length has been found to play a significant role in the phenomenon of wear. Using a popular evolutionary technique known as particle swarm optimization (PSO), and neural network, the fiber length was optimized. The study suggests that for minimal composite wear, the duration of the fiber should be 7-8 mm. Abrasive wear (weight loss) increases with increased load as high temperature is produced at higher load, which causes degradation of the composite surface. The factor, sliding speed, doesn't contribute significantly to weight loss. Nevertheless, abrasive wear plays a significant role in surface degradation due to the size of the chopped sugar cane fibre. At the lowest fire scale, i.e. 1 mm, limited wear resistance
is observed. Again, the wear (weight loss) increases with the maximum length of fiber, i.e. 10 mm. Minimum wear is observed 5 mm long fiber. The explanations for these actions can be clarified as the fibers don't get support from the matrix at lower length due to weak interface adhesion. As the fiber length becomes too large, the composite's anisotropy may increase due to the fiber's random orientation, which causes weight loss to increase. Vijay Kumar Thakur[54], studied on Characterization of Lignocellulosic Fibre-Made Phenolic Composites. properties of composites were observed to increase on reinforcement with lignocellulosic Saccharum cilliare fibres.

P SnehaLatha [55], investigated the impact of stacking tribological properties series of reinforced polymer hybrid composites woven cloth of bamboo-glass. The results revealed that the erosion rate is lower when hybridized with glass fiber compared with pure glass fiber, the composite of bamboo is more susceptible to erosion. Narendra Kumar [56], Studied on Short Fibers Reinforced Polymer Composites for Tribological Characterization and Damage Analysis. Centered on the erosion wear actions of short bamboo fiber reinforced composites filled with alumina (Al$_2$O$_3$) particulate matter.

2. Conclusions

Natural fibre-reinforced polymer composites are desirable and challenging materials to replace traditional materials and address important environmental issues. As demands for the use of biodegradable materials are growing due to environmental issues and government regulations and policies, many industries are attempting to substitute traditional automotive materials with biodegradable materials where friction and wear are important. However, there is much less information available in the literature on the tribological performance of bio-polymer composite material reinforced by natural fibre. This review discusses the ability of natural reinforced polymer composites, which tests structure which tribological properties at various operational conditions. Many experiments are linked to the dry friction state, but lubrication may be implemented in practical action.

- The main element affecting a composite's porosity is humidity, which influences tribological properties although experiments are performed without knowledge of humidity.
- The tribological properties studied with the benefit of lubrication will contribute to improved use of natural fibers as friction material.
- The tribological properties studied with a lubrication effect can enhance the application of natural fibers as friction materials.
- The Tribological behavior of Natural fiber reinforced polymer composites produced with three different compositions was analysed to fulfill the objective of this research work.

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