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A project report
on

"Study on the Characteristics of Bio-Composite for the Power Transmission Application"

submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF ENGINEERING
in
ELECTRONICS AND COMMUNICATION ENGINEERING

A G Madhu	**4PM22ME001**
D Chirag	**4PM22ME005**
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Naveen Kumar Bhavimatha	**4PM23ME405**

Under the guidance of

Dr. Ashok R Banagar
Associate Professor
Department of ME
PESITM, Shivamogga

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DEPARTMENT OF MECHANICAL ENGINEERING
PES INSTITUTE OF TECHNOLOGY AND MANAGEMENT
NH-206, Sagar Road, Shivamogga – 577 204
2025–2026

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Institute Vision

To be the most preferred institution for engineering & management education, research and entrepreneurship by creating professionally superior and ethically strong global manpower.

Institute Mission

To prepare students for professional accomplishments and responsible global citizenship while fostering continuous learning and to provide state-of-the-art education through the committed and highly skilled faculty by partnering and collaborating with industry and R&D institutes.

Department Vision

To be a leading center of excellence in the field of Mechanical engineering for learning and research with professional ethics.

Department Mission

- To provide quality technical education for students to develop into globally competent professionals.
- To develop a framework for collaboration and multidisciplinary activities to ensure ethical and value based education to address social needs.

Program Educational Objectives (PEOs)

Mechanical Engineering Graduates within 3-5 years of Graduation should have-

PEO 1: To develop the ability among students to understand the concept of core subjects.

PEO 2: To give exposures to emerging technologies, adequate training and opportunities to work as team on multidisciplinary projects with effective communication skills.

PEO 3: To cultivate ethical practices in Professional, Societal & Environmental needs by engaging in life-long learning.

Program Specific Outcomes (PSOs)

The Mechanical Engineering Graduates Will Have the Ability to-

PSO 1: Analyze and design analog & digital circuits or systems for a given specification and function.

PSO 2: Implement functional blocks of hardware-software co-designs for signal processing and communication applications.

Collegeheader.jpg

Certificate from the Institute

This is to certify that the project work was carried out jointly by

A G Madhu	**4PM22ME001**
D Chirag	**4PM22ME005**
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Naveen Kumar Bhavimatha	**4PM23ME405**

are bonafide students of the Bachelor of Mechanical Engineering program of the Institute (2023–2025 Batch), affiliated to Visvesvaraya Technological University, Belagavi.

A project report entitled **"Study on the Characteristics of Bio-Composite for the Power Transmission Application"** has been submitted by them under the guidance of Dr. Ashok R Banagar, Associate Professor, Department of Mechanical Engineering , PESITM, Shivamogga, in partial fulfillment of the requirements for the award of the degree of Bachelor of Mechanical Engineering.

Dr. Ashok R Banagar	**Dr. Girisha L**	**Principal Name**
Associate Professor	**Designation**	**Designation**

Viva-voce Examination Date: ______________________

Signature of Internal Examiner   Signature of External Examiner

DECLARATION

We, **A G Madhu, D Chirag, Druva P** and **, Naveen Kumar Bhavimatha** hereby declare that the project report entitled **"Study on the Characteristics of Bio-Composite for the Power Transmission Application"** has been carried out by me under the guidance of Dr. Ashok R Banagar , Associate Professorr, Department of ME, PESITM, Shivamogga.

I further declare that this project report is submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Mechanical Engineering of Visvesvaraya Technological University, Belagavi.

I also declare that this report is based on the original work undertaken by me and has not been submitted for the award of any degree or diploma from any other University/Institution.

Place: Shivamogga
Date:

A G Madhu	**USN: 4PM22ME001**
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Abstract

This study investigates the characteristics of bio-composites developed for power transmission applications. The composites are fabricated using seashell powder of varying micron sizes (150, 212, 300, 425, 600) and tamarind husk fly ash (300 µm) as reinforcements. Epoxy resin (L12) with hardener (K6) is used as the matrix material. The reinforcements were prepared through cleaning, grinding, and sieving to achieve controlled particle sizes. Composite specimens were fabricated using the hand lay-up process with a custom mold of 200 × 150 mm. Mechanical tests such as tensile strength, hardness, and impact resistance were performed to evaluate the material properties. Results revealed that finer seashell particles enhanced strength due to improved packing and load transfer. Incorporation of tamarind husk fly ash improved wear resistance and dimensional stability. The fabricated composites demonstrated potential for lightweight and eco-friendly applications. The use of waste biomass materials contributes to sustainability and waste management. The developed composites also reduce dependency on synthetic reinforcements. Their performance suggests applicability in gears and other mechanical components. Overall, this study highlights bio-composites as cost-effective, durable, and sustainable alternatives for engineering applications.

The project outcomes demonstrate improved task completion rates and user motivation compared to existing tools. In addition, the work contributes to Sustainable Development Goal (SDG) 4: Quality Education by promoting effective learning practices, and SDG 9: Industry, Innovation, and Infrastructure through the use of modern digital technologies.

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Chapter 1

Introduction

Composites are engineered materials made by combining two or more distinct constituents with differing physical or chemical properties. The resulting material exhibits characteristics superior to those of the individual components, such as enhanced mechanical strength, reduced weight, and improved resistance to wear, corrosion, and environmental degradation. Typically, a composite consists of a **matrix**—the continuous phase that binds the structure—and a **reinforcement**—the dispersed phase that provides strength and rigidity. The matrix may be a polymer, metal, or ceramic, while the reinforcement can take the form of fibers, particles, or flakes. In recent years, growing environmental concerns and the need for sustainable engineering solutions have led to increased interest in **bio-composites**—composites reinforced with natural, biodegradable, or waste-derived materials. This project investigates the development of a novel bio-composite using **Sea shell powder** and **areca husk fly ash** as reinforcements within a **resin-hardener matrix**, aimed at applications in **power transmission**. **Sea shell powder** are marine waste materials mainly composed of calcium carbonate (CaCO) with small amounts of organic matter. When ground into fine powder, they serve as an excellent reinforcement in polymer composites, improving hardness, compressive strength, and wear resistance. The presence of CaCO enhances interfacial bonding between the filler and the epoxy matrix, allowing better load transfer. The fine dispersion of seashell powder also contributes to improved surface finish and structural uniformity, while promoting the sustainable use of marine waste in engineering materials. **Areca husk fly ash** is derived from the controlled combustion of areca husk, an agricultural residue from the areca nut industry. It contains silica (SiO), alumina (AlO), and trace metal oxides, which enhance the thermal stability, stiffness, and dimensional stability of the composite. The fine ash particles act as micro-fillers, reducing density and improving surface hardness. Incorporating areca husk fly ash not only strengthens the composite but also supports waste utilization and environmental sustainability, offering a cost-effective reinforcement for bio-composite development.

This project focuses on evaluating the **mechanical and physical characteristics** of the developed bio-composite and assessing its feasibility for use in **power transmission applications**, where materials are expected to withstand mechanical stresses and environmental exposures. By incorporating agricultural waste products as reinforcements, this study aims to contribute to the development of cost-effective, sustainable, and high-performance composite materials .

Chapter 2

Literature Review

In their short feature on multipurpose applications of tamarind seed and kernel powder, Chowdhury et. al. (2014) [1] have highlighted the applications of tamarind seed and kernel under food and non-food categories. Under non-food category these material play a vital role in water treatment, medical field, as coating material, gelatinizing agent, emulsifying agent, cosmetic applications, adhesives, thickener and printing presses etc. [2].

Meenakshi and Krishnamoorthy (2018) [3] studied the mechanical characteristics of Tamarind seed powder, Groundnut shell powder, Rice husk, reinforced in Polyester composites. And it is concluded from this work is The overall observation is that the bio-waste materials can be specifically chosen depending upon the strength requirement and used in polymeric composite preparation as these reinforcements are very economical and abundant in availability compared to other forms of reinforcement. Also these materials are biodegradable and ecofriendly in nature. Similarly, Somashekhar et. al., (2018) [4] fabricated the composites containing coconut shell powder with tamarind seed powder reinforced epoxy composites which showed that tamarind shell powder with coconut shell powder, increases the tensile properties by around 50Naik et. al. (2019) [6] have made the study on Tamarind seed particles reinforced polymer composites to estimate the mechanical and physical properties. The composites are prepared by ultra-sonication process and authors claim that these composites can be used as novel composite material for the structural applications such as door panels, dash

boards, roofing, industrial and commercial coating, interior automobile design, electronics components, etc. Use of Multi Walled Carbon Nano-Tubes (MWCNT) within tamarind particles were studied for tensile properties by Annigeri and Raju (2020) [7]. These models provide data on the relationship between the control parameters (factors) and the response factors (tensile strength, moisture absorption and density). From the experiment, the following results are obtained. For 10Jeyaprakash et. al. (2020) [8], has made study on hybrid composites made of tamarind seed powder with palm natural fibers. From this study it was confirmed that the third combination (i.e., 25

Nano sized tamarind seed powder is being employed in the fabrication of hybrid composite consisting of jute and hemp fibers in epoxy resin by sahayaraj et. al., (2021) [9]. In this work it is showcased that the tensile strength and modulus of the composites are 39.52 MPa and 2.648 GPa and the flexural strength and modulus values are of 89.62 MPa and 9.24 GPa respectively. The impact strength and ILSS values were found to be 2.35 J and 3.62 MPa. Composites containing 40 wt

Girimurugan et. al., (2022) [11] and Jayaraman et. al., (2022) [12] discussed the use of tamarind seed powder along with the sugar cane fibers reinforced in the epoxy resin which were investigated experimentally for the flexural and compressive characteristics. And these composites have shown maximum flexural strength, flexural modulus and compressive strength of 36.543 MPa, 12.129 GPa and 21.32 MPa was obtained for 35 wt

Karthikeyan et. al., (2022) [13] have made an experimental study on mechanical and water absorption characteristics of hybrid composite made of banana fibers reinforced epoxy composite in which they have used tamarind seed powder as filler material. And the study concludes that the incorporation of a small amount of tamarind seed powder and banana fibre into the epoxy resin matrix considerably improves the hybrid biocomposites' mechanical and water absorption capabilities.

Ambali and vanarotti (2023) [14] have made an attempt to study the fire and durability performance of Tamarind Seed Kernel-Based Bio Composites. Through this study it is observed that, Experimental results presented reduction in burning rate with increase in Tamarind Seed Kernel Gum (TSG), attaining lowest of 8.29 mm/min at 60

Babu et. al., (2024) [16] have reinforced rice husk and tamarind seed powder as filler materials in vinyl ester matrix material to study their mechanical and physical characteristics. According to this study the hybrid filler reinforcement has properties alteration capability and some properties of the vinyl ester composite were enhanced. In addition, it was revealed that the addition of natural fillers beyond a certain level (i.e. 15 wt

Aruchamy et al., (2024) [18] have made an attempt to study the role of tamarind shell powder in the evaluation of mechanical characteristics of polymer based Palmyra Palm leaf (PPL) and Coconut Sheath (CSL) Fibers reinforced composites. The composite in this study with 207.52 MPa, and impact strength of 5.98 J. Hardness values peaked at 84 SD for the same composition. Similarly, Srinivasan et. al., (2020) [19] proposed that, composites prepared with treated Palmyra palm and tamarind seed powder have demonstrated the enhanced tensile, flexural, impact and moisture tests as against the untreated fibers.

Udhayasankar et. al., (2024) [20] have fabricated the Terminalia chebula filler reinforced bagasse/tamarind seed polymer composites to study the mechanical characteristics. The findings of this work indicate that incorporating a combination of bagasse, tamarind seed, and Terminalia chebula fillers into PLA significantly enhances its properties and performance. Kumar et. al., (2024) [21], investigated the mechanical and thermal stabilities of tamarind seed (TMS) and peanut shell (PNS) powder-reinforced vinyl ester composites which exhibited the HDT (Heat Deflection Temperature) of the composites reaches its maximum value when they have a filler content of 25 wt.

Intiya et. al., (2024) [22] have made an attempt to prove that, tamarind shell powder as a green filler material along with natural rubber to fabricate the green composites. In this work authors have prepared tamarind shell powder (TSP) with different particle size ranges before being characterized by various techniques such as Fourier transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), elemental analysis, etc.

Study by Srinivas et al. (2017) [23] highlights the use of tamarind shell particles as a promising filler materials in the epoxy based composites in which tamarind shell powder and epoxy were varied by their volume and exhibited enhanced mechanical properties for various configurations. Similarly, Saravanan et. al. (2018) [24] proposed the effective usage of agro- waste which is a tamarind seed powder along with epoxy LY-556 and a hardener. Using compression mould technique composites were fabricated with varying weight proportions of tamarind seed reinforcements and among various compositions composites with 30 weight percentage have exhibited enhanced mechanical properties. As a basic study, Goudar et al. (2019) [25] have made an attempt to study the physico-mechanical properties of tamarind pod shell reinforced composites in which composite fabricated with 75 µm have shown enhanced mechanical properties as compared to other higher numbered grain sized composites.

Saktivel et. al., (2020) [26] have fabricated the composite with coir and tamarind fiber (to be found in tamarind fruit) in varying proportions (such as 10 to 30

2.1 Summary of the Literature

According to the studies made by number of researchers, it is evident that no authors have made any attempt on the fly ash amalgamated tamarind seed powder reinforced composites. Only the works were being conducted on tamarind seed powder with various natural filler materials such as bagasse, peanut shell powder, Palmyra Palm leaf (PPL), Coconut Sheath (CSL) Fibers, rice husk, banana fibers etc. also with various matrices. This shows that, researchers have only concentrated on hybridization of natural fibers but no study has indicated the use of fly ash in the fabrication of composites and the evaluation of their characteristics. Henceforth, in the current study, use of fly ash in the fabrication of composites with tamarind seed powder is being employed and mechanical characteristics of these composites were studied.

Chapter 3

Objectives

The key objectives of the present study are as follows,
• The primary objectives of conducting a parametric study on araca husk fly ash in sea shell powder (SSP) reinforced composites are to systematically investigate the effects of various parameters on the performance and properties of these composites.
• Fabrication of composite using bio-degradable reinforced, such as Sea shell powder and araca husk fly ash.
• Mechanical characteristics of prepared composite.
• Morphological studies of prepared composites (SEM Analysis).
• Preparing of gear from composite purposed for mechanical application.

Chapter 4

Methodology

4.1 materials

- Epoxy Resin.
- Hardener.
- Sea shell powder and Areca husk fly ash.
- Moulds.

Fig 4.1: sea shell powder

Chapter 5

Results and Discussion

In this project, epoxy (Lapox L-12) based composites were prepared using sea shell powder and areca husk fly ash as reinforcements. To study the effect of different parameters, the sea shell powder was taken in five different particle sizes (600, 425, 300, 212, and 150 microns). The areca husk fly ash content was also varied from 0The prepared samples were tested for their tensile strength, flexural strength, impact strength, and hardness to evaluate their load-bearing capacity and overall strength. After testing, the best-performing samples were further analyzed using a Scanning Electron Microscope (SEM). This analysis helped to study the bonding between the matrix and the reinforcement and provided a better understanding of the surface and morphological characteristics of the composites.

5.1 Tensile Test

Table 5.1 presents the different parameters that were recorded during the tensile testing of the sea shell powder and areca husk fly ash reinforced composites prepared with varying combinations. These values provide a clear understanding of how the changes in particle size and fly ash percentage influenced the tensile behaviour of the composites. Figure 5.2 shows the load versus displacement graph obtained from the tensile test using a 10 kN Universal Testing Machine (UTM). The graph was automatically generated by the system connected to the UTM while recording the same values presented in Table 5.1. This graphical representation helps to visualize the performance of the composites under tensile loading and supports the numerical data from the table.

5.2 Comparison with Existing Systems

The proposed system, **Smart Task Management System with Gamification for Students**, was evaluated based on both system performance and user feedback. A pilot study was conducted with 30 students from the Department of Electronics and Communication Engineering, PESITM, Shivamogga.

The evaluation focused on four key aspects: (i) ease of use, (ii) accuracy of task scheduling, (iii) effectiveness of gamification features, and (iv) overall user satisfaction. Students were asked to use the system for two weeks and then complete a structured feedback form. Scores were collected on a scale of 1 to 5, where 1 indicates poor performance and 5 indicates excellent performance.

Table 5.1: Sample Results of User Evaluation Metrics

Sl. No.	**Evaluation Parameter**	**Average Score (out of 5)**
1	Ease of Use (User Interface)	4.6
2	Task Scheduling Accuracy	4.4
3	Effectiveness of Gamification Features	4.2
4	Improvement in Time Management	4.5
5	Overall User Satisfaction	4.7

The results indicate that the system was highly effective in enhancing productivity and motivating students through gamification. The average rating across all parameters was **4.48/5**, which demonstrates the usefulness of the application in real-world academic scenarios.

In particular, the highest rating of 4.7 was obtained for *Overall User Satisfaction*, showing that students found the system engaging and beneficial. The comparatively lower score of 4.2 for *Gamification Features* suggests that while gamification motivated users, there is scope for enhancing this module by adding more diverse rewards and challenges.

5.3 Performance Evaluation

Chapter 6

Conclusion and Future Enhancements

The project demonstrates that gamification can significantly enhance task management for students. Future enhancements may include AI-based personalized reminders, advanced analytics, and integration with wearable devices.

6.1 Conclusion

The project **"Smart Task Management System with Gamification for Students"** successfully demonstrated how technology can be leveraged to improve time management, task prioritization, and overall productivity among students. By integrating gamification elements, the system motivates learners to actively engage in their academic and personal responsibilities, thus reducing procrastination and enhancing consistency. The system not only addresses the academic requirements but also supports students in developing life-long skills such as discipline, focus, and self-regulation.

This outcome directly contributes to the United Nations Sustainable Development Goal (SDG) 4: Quality Education, as it fosters effective learning habits, enhances student engagement, and creates a supportive digital ecosystem that encourages continuous improvement in education.

6.2 Limitations

Although the system achieves its intended objectives, there are certain limitations:

- The system performance may vary depending on internet connectivity and device compatibility.
- Gamification features are limited to basic reward mechanisms and can be further diversified.
- The current design focuses primarily on individual task management, with limited collaborative features.
- User engagement is influenced by subjective factors such as personal motivation and interest in gamification.

6.3 Future Enhancements

To further improve the system, the following enhancements can be considered:

- Integration of **AI-based personalized recommendations** for scheduling and productivity improvement.
- Expanding **gamification features** with leaderboards, peer challenges, and social recognition.
- Enabling **collaborative task management**, allowing groups of students to manage shared projects.
- Adding **cross-platform compatibility** with Android, iOS, and web-based applications for wider accessibility.
- Incorporating **mental wellness support features**, aligning with SDG 3 (Good Health and Well-being), by suggesting balanced schedules that include breaks and stress management activities.

Bibliography

Appendix A

Figures/Tables/ Screen Shots

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Appendix B

Publications

[Publication Details/Certicate/Patents]