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Amelioration of Eco Shield Insulation with Exhaustive Paradigm

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ABSTRACT
Building materials made from horticultural and modern waste are gaining traction in structural design due to their sustainability and ease of use. This study explores biodegradable composites made from rice husk, wheat husk, wood fibers, and fabric waste strands, combined with a PBAT/PLA binder processed by hot pressing. The PBAT/PLA binder bonds better with wood and fabric fibers than with wheat and rice husks. The composites show thermal stability up to 250°C, compressive strength of 11–40 MPa, and flexural strength of 0.8–2.25 MPa, suitable for construction. Rice husk composites have a low density (378 kg/m³), good insulation (thermal conductivity 0.08 W/mK), low water absorption (42%), and remain durable after 24 hours in water, making them excellent insulation materials.
The Eco Shield Rice Husk Insulation builds on this by producing high-performance insulation from rice husks, reducing waste and offering a sustainable alternative to energy-intensive materials like fiberglass and polystyrene. Its manufacturing process lowers environmental impact through reduced energy use and emissions while supporting a circular economy by converting waste into valuable resources. Computational methods optimize the design, enhancing the system's overall efficiency and cost-effectiveness.
Keywords:-Poly Butylen Adipate-co-Terephthalate (PBAT), Poly Lactic Corrosive (PLA)

I. INTRODUCTION

The undertaking plans to advance a reasonable and inventive arrangement by changing rice husks, a farming result, into superior execution protection material for Eco-accommodating structure applications. It includes laying out a framework for gathering rice husks from farming sources and creating normalized processes for handling these husks into protection material. The extent of the Eco Insulation Rice Husk Protection Task envelops a few key regions, including the practical obtainment of rice husks, the improvement of energy-proficient assembling methods to change over husks into protection material, and the enhancement of the material's warm properties for prevalent energy productivity in structures. Moreover, the task centers on decreasing ecological effect through low-energy creation processes and adding to a round economy by utilizing farming waste. By offering a financially savvy and harmless to the ecosystem option in contrast to customary protection materials, the task plans to satisfy the developing need for reasonable structure rehearses and essentially decreases development squander. Consistent observing and assessment frameworks will guarantee arrangement with maintainability objectives and cultivate a culture of development and information partaking in manageable material turn of events. In addition, the project aims to collaborate with stakeholders in the construction and agricultural industries to establish a network that encourages the wide spread use of rice husk insulation. Instructive drives and effort projects will be carried out to bring issues to light about the advantages of this inventive material among manufacturers, planners, and purchasers. Also, innovative work endeavors will be continuous to additional improve the protection's properties and investigate extra applications in green structure arrangements.

1.1 . Purpose of the System

- ✓ Processing client requirements can be done efficiently.
- ✓ Immediate authority action is accessible because the action that needs to be performed is transmitted immediately by email with the press of a button, with no communication latency.

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- ✓ Reports generation can be done immediately after calculation of amount of materials required for processing client data.
- ✓ Testing ionic stability, thermal stability and mechanical stability can be done very easily.
- ✓ Processing data for fillers can be efficiently done in production process which is crucial in the part of production.
- ✓ Very little time needed to go through the information for approval of reports for production.

1.2 . Problems in Existing System

- ✓ Conventional materials like fiberglass, mineral wool, EPS, and polyurethane are widely used.
- ✓ High energy consumption and non-renewable raw materials increase environmental impact.
- ✓ Non-biodegradable, leading to landfill waste and pollution at end of life.
- ✓ Health risks such as respiratory irritation due to synthetic fiber exposure.
- ✓ Limited accessibility in rural or low-income regions due to high costs.
- ✓ Agricultural waste unused, contributing to pollution (e.g., burning rice husks).
- ✓ No circular economy focus, with minimal recycling or reuse of materials.

1.3.Advantage of Proposed System

- ✓ Processing client requirements can be done efficiently.
- ✓ Immediate authority action is accessible because the action that needs to be performed is transmitted immediately by email with the press of a button, with no communication latency.
- ✓ Reports generation can be done immediately after calculation of amount of materials required for processing client data.
- ✓ Testing ionic stability, thermal stability and mechanical stability can be done very easily.
- ✓ Processing data for fillers can be efficiently done in production process which is crucial in the part of production.
- ✓ Very little time needed to go through the information for approval of reports for production.

The following sections are organized as follows. Section 2 described with related work. Section 3 deals with the implementation of proposed system. Section 4 discussed with conclusion and future work.

II. RELATED WORK:

The present tendency in the building industry to decrease and safeguard environmental effects necessitates the design and production of more ecological and sustainable building materials [1, 2]. As a result, it is a crucial goal of the modern building industry to research environmentally friendly and efficient insulation materials, and biomass insulation materials will be promising. Biomass waste–derived materials have emerged as one of the alternatives that can be used to develop thermal insulating materials, as has become increasingly clear [3–5]. One of the goals established by the European Union in its road map to a low-carbon economy by 2050 is to reduce energy use in buildings. In comparison to 1990, CO2 emissions must be reduced by 80–90% by 2050 if the world's temperature rise is to be limited to 2 °C [6, 7]. Additionally, heating and cooling space in buildings consumes more than 10% of world energy [8], while producing close to 30% of global CO2 emissions. Enhancing a building's thermal insulation capacity is one of the most cost-effective ways to reduce energy usage in buildings [8].

In the context of green thermal insulation materials, natural renewable biomass, i.e., Washingtonia plant biomass biochar [9]; sawdust wastes [10]; agro-industrial [11, 12].With rice husk serving as the biomass-derived material, geopolymer acting as the binder, and hydrogen peroxide as the foaming agent, Wangetal. [13] conducted experimental research on a novel environmentally friendly bio-insulation

III. IMPLEMENTATION OF PROPOSED SYSTEM

The system Architecture is shown in **Fig.1**. The following subsections deal with hardware, software requirements, module descriptions and result and discussion.

3.1. HARDWARE REQUIREMENTS

- Processor: Intel (R) Pentium (R)
- Speed: 1.6 GHz and Above
- RAM: 4 GB and Above
- Hard Disk: 120 GB
- Monitor: 15'' LED SVGA
- Input Devices : Keyboard, Mouse

3.2. SOFTWARE REQUIREMENTS

- Operating system: Windows 8 / 8.1 / 10
- Coding Language: JAVA / J2EE
- Java Version: jdk 8
- IDE: Eclipse Oxygen

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- Database : MySQL v5.1
- Database Tool: HeidiSQL v11.0
- Application Server : Apache Tomcat 8.X / 9.X

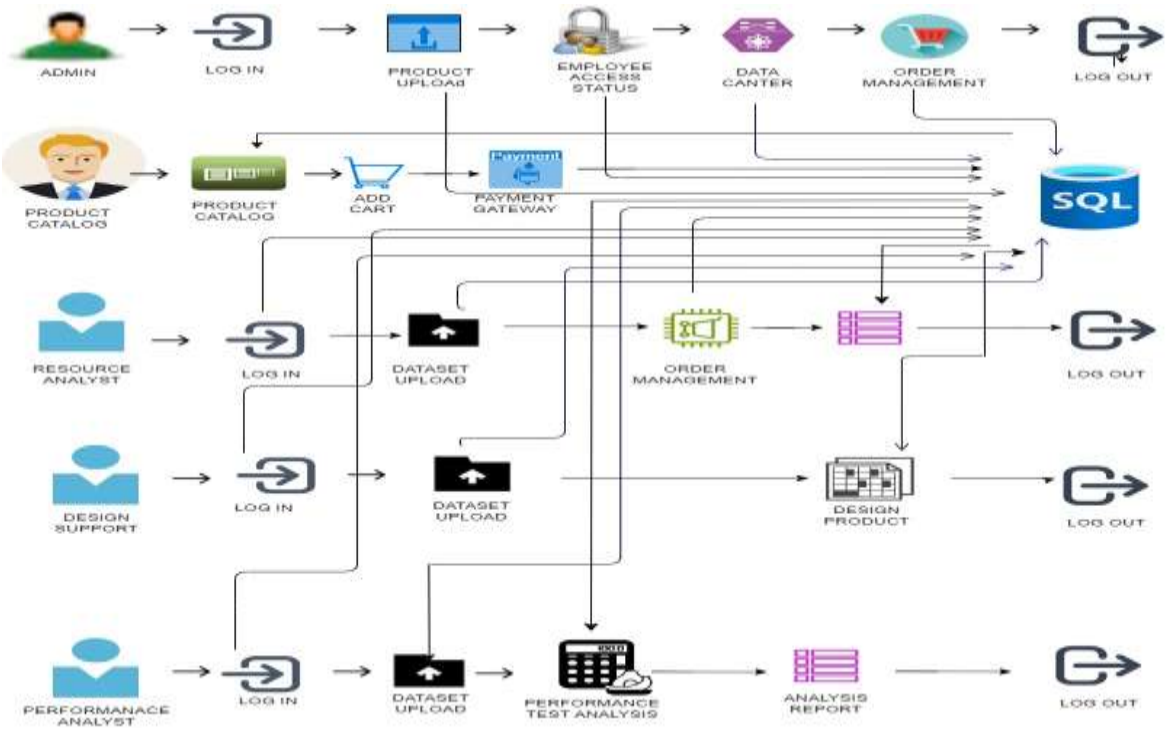

Fig.1. System Architecture

3.3. MODULE DESCRIPTIONS

3.3.1 ADMIN :-The admin logs into the system to manage employee registration for roles in Resource Analyst, Design Support, and Product Efficiency modules. They handle admission details, upload product information for client access, and manage the Data Center sub-module, including resource analysis and design support reports. The admin also approves refurbished product data, oversees performance reports for materials like Moisture Control Agent and Thermal Control Enhancer, and updates order details via the order management page. Admin page shown in **Fig.2, Fig.3.**

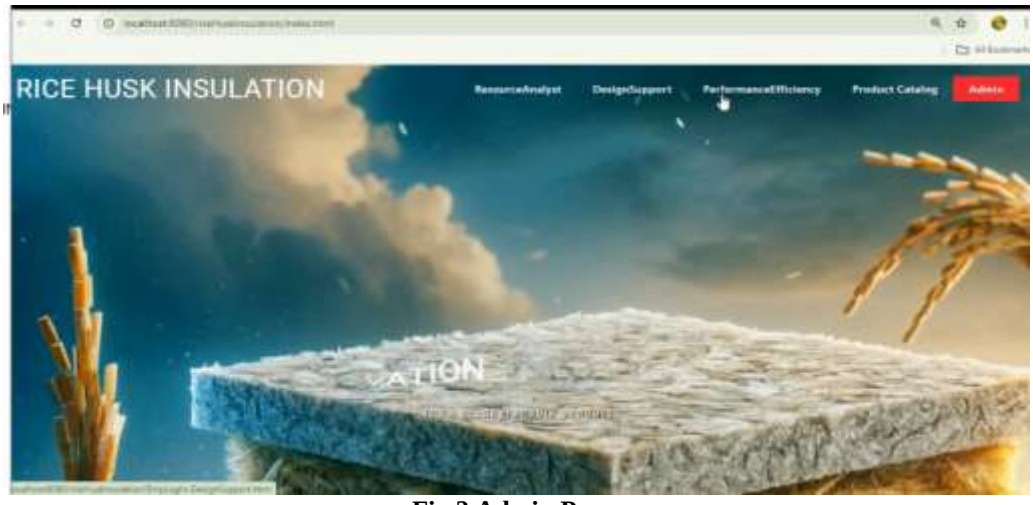

Fig.2.Admin Page

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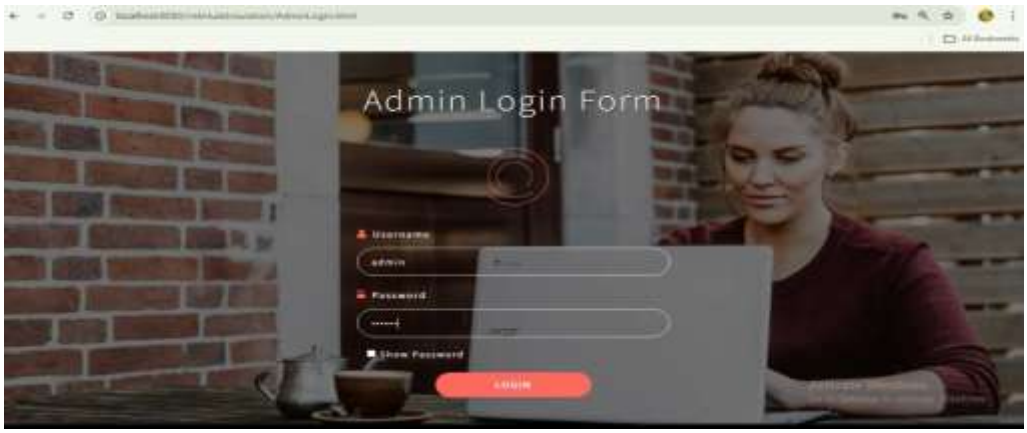

Fig.3. Admin Login Form

3.3.2. CLIENT:- In this module, clients register and log in with a password, receiving a unique user ID. After login, they can view products uploaded by the admin, including descriptions and prices. Clients can add items to their cart, update quantities, remove items, and proceed to checkout. During checkout, they complete the payment form, and a unique order ID is generated upon successful order placement. The order appears in the order management section with a default status of "null," which the admin later updates to "accepted" or "denied." Clients then log out of the system.
The Client Pages Shown in **Fig.4, Fig.5, Fig.6, Fig.7, Fig.8**.

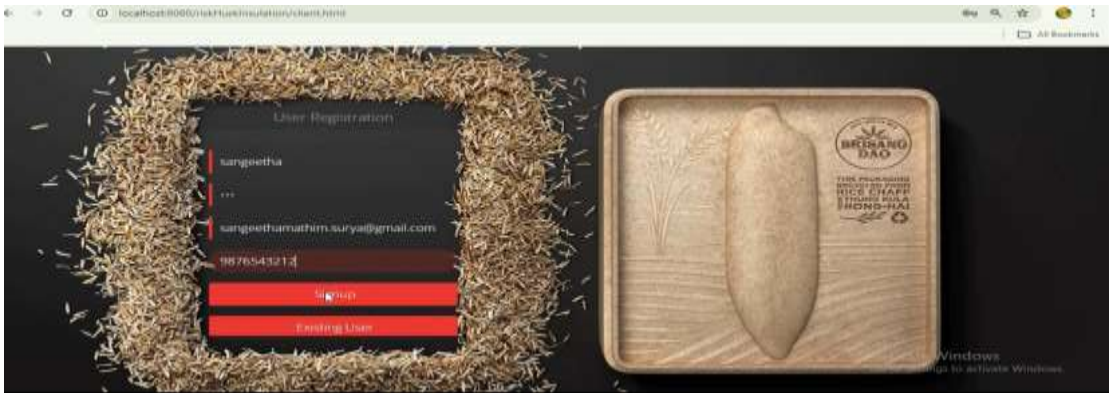

Fig.4

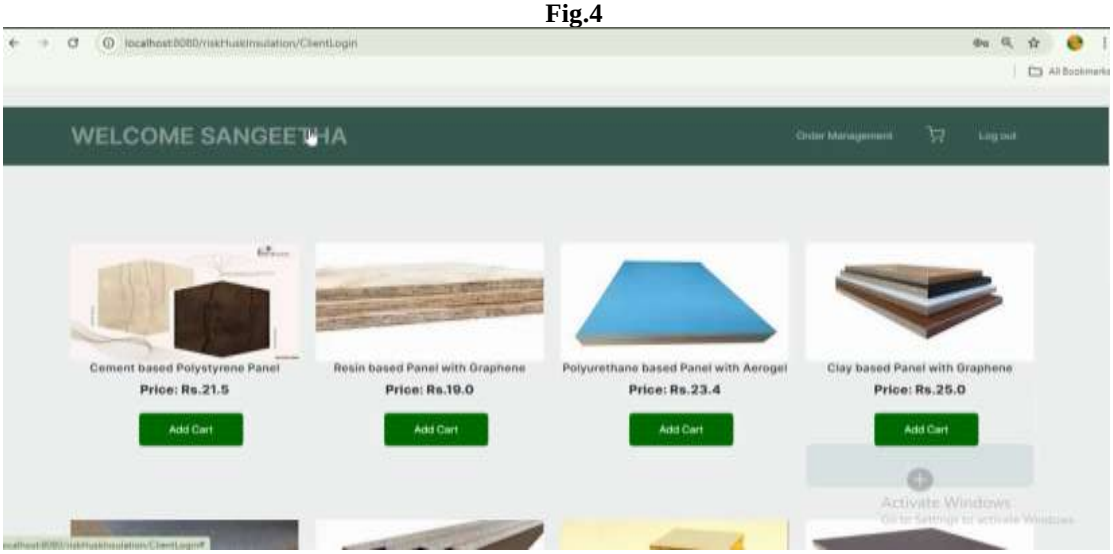

Fig.5

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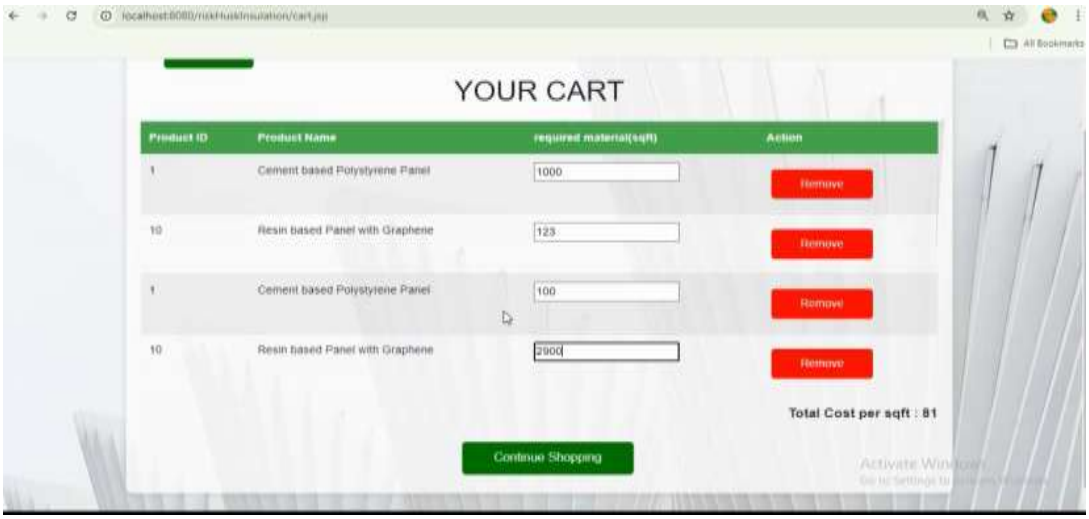

Fig.6

Fig.7

Fig.8

3.3.3. RESOURCE ANALYST:- The resource analyst registers on the sign-up page and logs in using an admin-approved password sent via email. After login, they upload material data categorized by type, required quantity per square foot, and stock levels. They manage approved orders by calculating needed amounts of materials like binders, anti fungal agents, thermal and moisture control agents. The results, including total product weight, are displayed in a table and submitted to the admin. The analyst then logs out. The Resource Analyst page shown in **Fig.9, Fig.10**.

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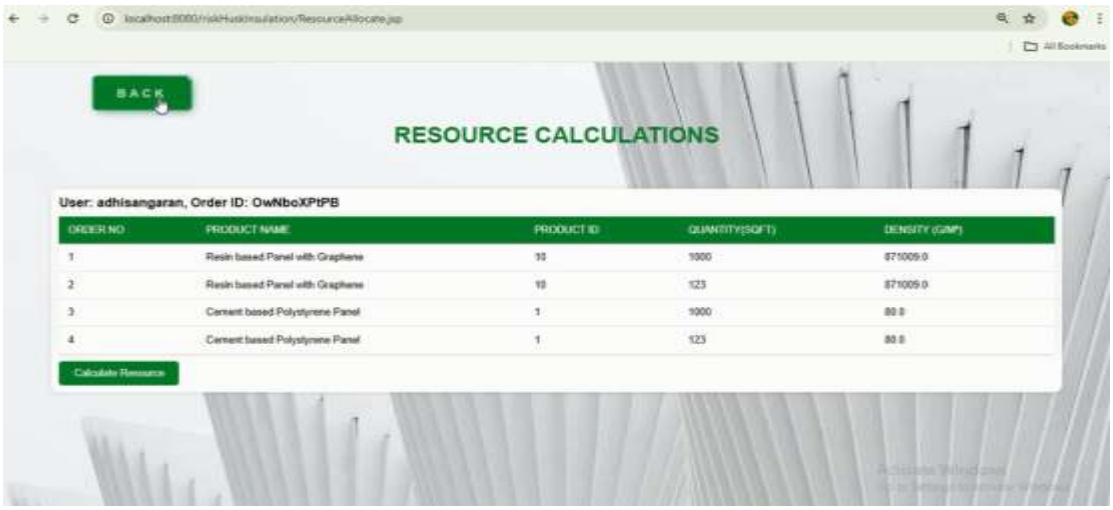

Fig.9

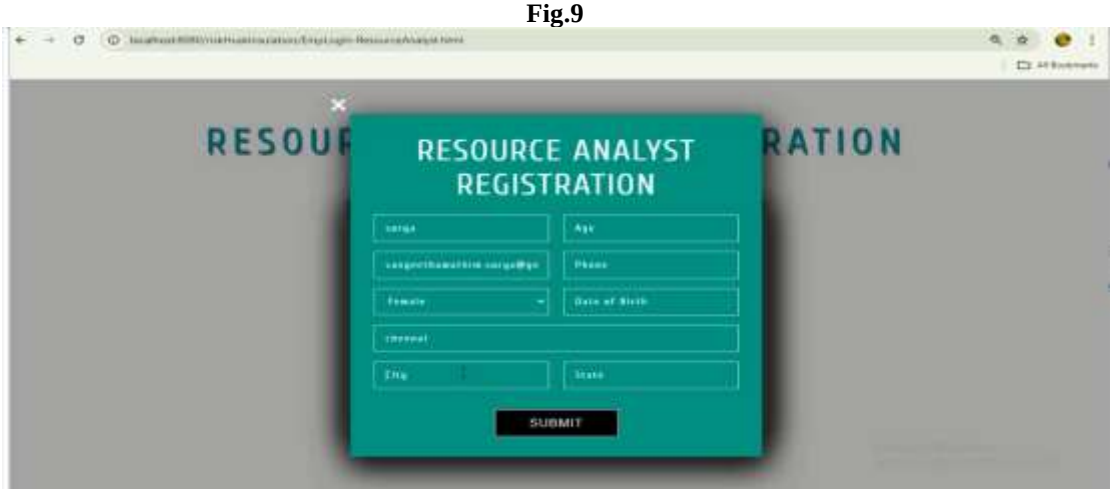

Fig.10

3.3.4.DESIGN SUPPORT:- The design support employee registers their details and logs in using an admin-approved password. They upload new product details in the "Designed Product Update" sub-module, which are submitted to the admin for approval. Once approved, the products appear in the catalog for clients to order. In the "Product Upload" sub-module, they also upload practical results of new products, which are added to the dateset for future updates. After completing tasks, the employee logs out.

3.3.5.PERFORMANCE ANALYST:- The performance analysis employee registers and logs in using an admin-approved password. In the "Durability Check" sub-module, they evaluate material performance through various tests:

Binder (e.g., Polystyrene, Resin): Durability, Structural Strength, and Density Tests
Newspaper Cellulose: Mix Ratio and Density Tests
Moisture Control Agent: Moisture Absorption, WVTR, Swelling, and Shrinkage Tests
Thermal Conductivity Agent: Thermal Conductivity, Expansion, Heat Transfer Rate, Stability, and Enhancement Ratio Tests
Test results are displayed in the "Performance Report" sub-module, where a genetic algorithm determines the optimal material mix for insulation panels. The employee can also upload refurbished product quality check data before logging out..The Performance Analyst page shown in **Fig.11, Fig.12.**

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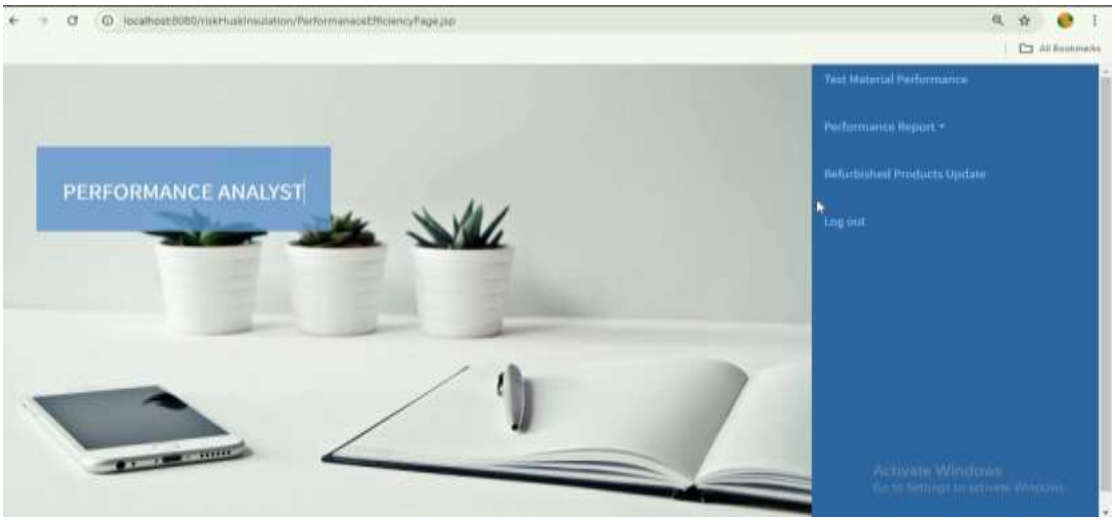

Fig.11.

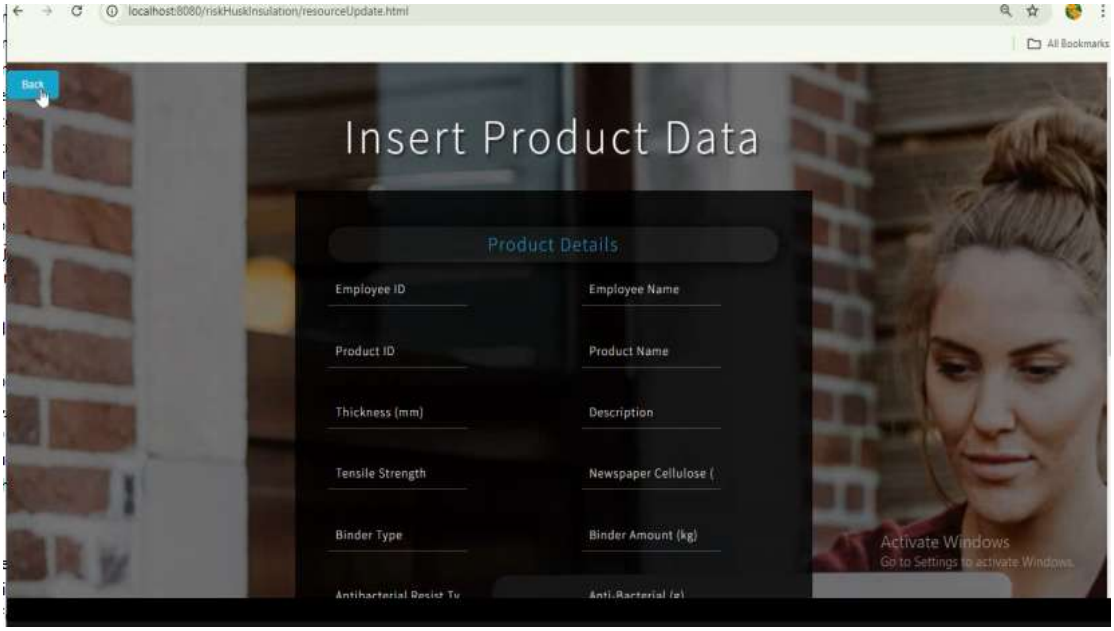

Fig.12.

3.4 RESULT AND DISCUSSION:- The rice husk insulation project offers an eco-friendly solution for managing product sales, material analysis, design support, and performance evaluation. It uses shredded rice husks, recycled newspaper cellulose, borax (for fungal resistance and fire retardance), and glue as a binder. Initial compositions began with 14% newspaper, 9% rice husk, 15% borax, and 62% glue, later increasing rice husk while keeping borax and glue constant.

Test results showed:

- **Thermal conductivity (k-value)**: 0.0409–0.04607 W/mK
- **Tensile strength**: 1.31–1.76 MPa
- **Compressive strength**: 20.19–21.23 MPa

These values demonstrate strong potential for use in construction and packaging. Future research will test performance in varied climates and explore enhanced configurations. The project supports sustainability while offering a durable, cost-effective insulation alternative.

IV. CONCLUSION & FUTURE ENHANCEMENT

4.1. CONCLUSION

This project integrates client management, resource analysis, design support, performance evaluation, and admin oversight into a single

platform to boost efficiency, product quality, and sustainability. By leveraging technologies like genetic algorithms and automated resource management, it addresses the environmental and economic drawbacks of traditional insulation. The result is a high-performance, cost-effective, and eco-friendly solution that supports sustainable development and sets a benchmark for future innovations in green construction materials.

4.2. FUTURE ENHANCEMENT

Future enhancements could include automated resource optimization using historical data, smart inventory management with real-time tracking, and personalized client recommendations based on user behavior. IoT integration could monitor material conditions like temperature and humidity to maintain product quality. Advanced reporting and dashboards would improve decision-making, while machine learning could enable predictive maintenance for better reliability. Real-time messaging and project tracking would enhance collaboration, and a robust feedback system would support ongoing improvement. Together, these upgrades would make the system more efficient, intelligent, and user-focused.

REFERENCES

[1]. Liu LF, Li HQ, Lazzaretto A, Manente G, Tong CY, Liu QB, Li NP (2017) The development history and prospects of biomass based insulation materials for buildings. Renew Sustain Energy Rev. 69:912–932. https://doi.org/10.1016/j.rser.2016.11.140

[2]. Adekomaya O, Majozi T (2023) Sustainable application of biodegradable materials for thermal shield in electronic devices. Mater Sci Eng B 288:116197. https://doi.org/10.1016/j.mseb. 2022.116197

[3]. Wang W, Lu C, Li Y, Li Q (2017) An investigation on thermal conductivity of fy ash concrete after elevated temperature exposure. Constr Build Mater 148:148–154. https://doi.org/10.1016/j. conbuildmat.2017.05.068

[4]. Zou S, Li H, Wang S, Jiang R, Zou J, Zhang X, Liu L, Zhang G (2020) Experimental research on an innovative sawdust biomass based insulation material for buildings. J Clean Prod 260:121029. https://doi.org/10.1016/j.jclepro.2020.121 029

[5]. Duque-Acevedo M, Lancellotti I, Andreola F, Barbieri L, Belmonte-Ureña LJ, Camacho-Ferre F (2022) Management of agricultural waste biomass as raw material for the construction sector: an analysis of sustainable and circular alternatives. Environ Sci Eur 34:70. https://doi.org/10.1186/s12302-022-00655-7

[6]. Díaz AV, López AF, Bugallo PMB (2022) Analysis of bio waste-based materials in the construction sector: evaluation of thermal behaviour and life cycle assessment (LCA). Waste Biomass Valorization 13:4983–5004. https://doi.org/10.1007/ s12649-022-01820-y

[7]. EC, COM (2011) 112 Communication from the Commission to the European Parliament, the Council, the European Economic and social committee and the Committee of the regions of 8 March 2011. "A Road map for moving to a competitive low carbon economy in 2050". Brussels.http://eur-lex.europa.eu/LexUr iServ/LexUriServ.do?uri=COM:2011:011 2:FIN:EN:PDF.

[8]. Li D, Huang C (2022) Thermal insulation performances of carbonized sawdust packed bed for energy saving in buildings. Energy Build 254:111625. https://doi.org/10.1016/j.enbuild. 2021.111625.

[9]. Boumaaza M, Belaadi A, Bourchak M, Juhany KA, Jawaid M, Marvila MT, Azevedo ARG (2023) Optimization of fexural properties and thermal conductivity of Washingtonia plant biomass waste bio char reinforced bio-mortar. J Mater Res Technol 23:3515–3536. https://doi.org/10.1016/j.jmrt.2023.02.009

[10]. Tsalagkas D, Börcsök Z, Pásztory Z (2019) Thermal, physical and mechanical properties of surface overlaid bark-based insulation panels. Eur J Wood Wood Prod 77:721–730. https://doi.org/ 10.1007/s00107-019-01436-5

[11]. Cintura E, Nunes L, Esteves B, Faria P (2021) Agro-industry wastes as building insulation materials: a review and challenges for Euro-Mediterranean countries. Ind Crops Prod 171:113833.

https://doi.org/10.1016/j.indcrop.2021.113833

[12]. Dirisu JO, Oyedepo SO, Fayomi OSI, Joseph OO, Akinlabi ET, Babalola PO, Udoye NE, Ajayi OO, Aworinde AK, Banjo SO, Oluwasegun KM (2022) Thermal-emission assessment of building ceilings from agro-industrial wastes. Fuel Commun 10:100042. https://doi.org/10.1016/j.jfueco.2021.100042

[13]. Wang S, Li H, Zou S, Zhang G (2020) Experimental research on a feasible rice husk/geopolymer foam building insulation material. Energy Build 226:110358. https://doi.org/10.1016/j.enbuild.2020.110358