Preparation of Insulation Boards from Water Hyacinth, Textile Waste and Corn Cob

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ABSTRACT

This study explores the potential of repurposing textile waste, water hyacinth, and corn cob residue—byproducts of industrial and agricultural processes—into thermal and acoustic insulation panels. Polyvinyl alcohol served as a binder, while citric acid acted as a cross-linking agent and corn cob as a filler. The panels were fabricated through hot pressing at 150°C for 70 minutes, followed by additional pressing at room temperature for 20 minutes. Results revealed that a 50:50 ratio of water hyacinth to textile waste achieved the highest bending strength of 6.42 ± 1.58 MPa. Additionally, incorporating 1.0–1.4 mm corn cob particles at 25–75% by weight enhanced thermal insulation and sound absorption performance.

INTRODUCTION

Agricultural and textile waste pose significant environmental concerns. However, these materials can be repurposed to develop eco-friendly wall panels. One of the key properties of such panels is insulation, which plays a crucial role in both safety and practical applications. Corn cob, also an agriculture waste, has the potential to be used as a sustainable building material for thermal and sound insulation.

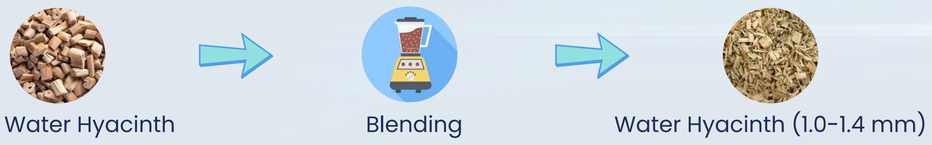
OBJECTIVES

1. To investigate the optimal conditions for forming wall panels from textile waste and water hyacinth using polyvinyl alcohol as a binder.
2. To study the effects of corn cob addition on thermal and acoustic insulation properties.

EXPERIMENT

RAW MATERIAL PREPARATION

- Water Hyacinth



- Textile Watse
- Corn Cob

PREPARATION OF THE SOLUTION

STUDIED PARAMETERS

- Optimum molding condition
- Ratio of Water Hyacinth to Textile Waste
- %Corn Cob

CHARACTERIZATIONS

- Bending Strength
- Density
- Moisture Absorption
- Thickness Swelling
- Morphology
- Insulation

CONCLUSION

- The optimum molding condition of wall panels was hot compression molding at 150 °C for 70 minutes followed by cold compression molding for 20 minutes with a ratio of 50:50 water hyacinth to textile waste.
- The Addition of corn cob enhances thermal insulation property; 75% corn cob showed slow temperature decrease.

RESULT

OPTIMUM MOLDING CONDITIONS (Samples were hot pressed at 150°C)

- Ratio of Water Hyacinth to Textile Waste

Fig.1 Samples with different ratio of Water Hyacinth to Textile Waste

- Water Hyacinth to Textile Waste (50:50) with %Corn Cob

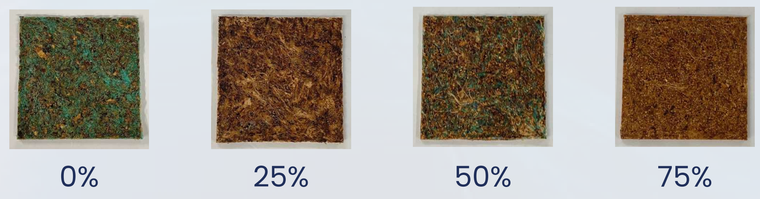


Fig.2 Samples with different % of Corn Cob

MORPHOLOGY

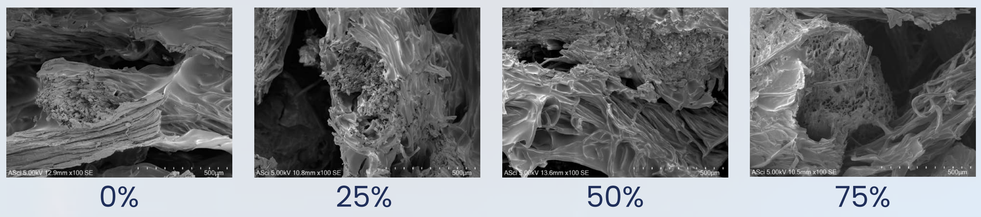
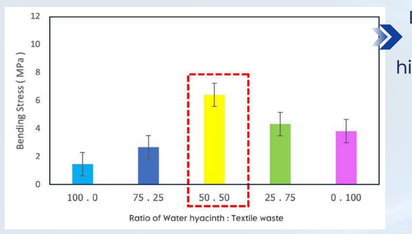
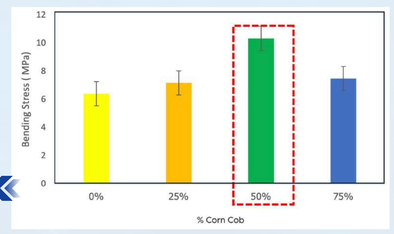


Fig.3 SEM image of samples with different %Corn Cob

BENDING STRENGTH



Ratio of 50:50 resulted in highest strength

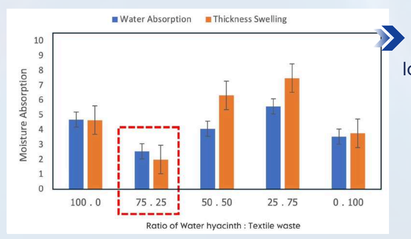


50% Corn cob resulted in highest strenght

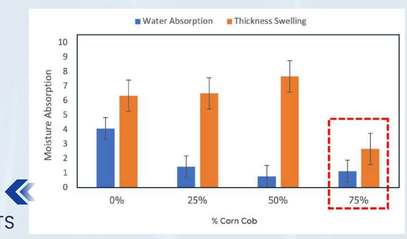
Fig.4 Effect of Ratio of Water Hyacinth to Textile Waste

Fig.5 Effect of %Corn cob

DIMENSION STABILITY



Ratio of 75:25 resulted in lowest WA and TS



75% Corn cob resulted in lowest WA and TS

Fig.6 Effect of Ratio of Water Hyacinth to Textile Waste

Fig.7 Effect of %Corn cob

DENSITY PROPERTY

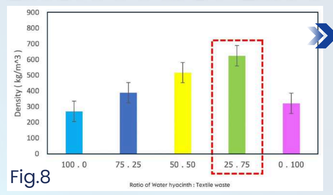


Fig.8

Density is in the range of 272-626 kg/cm^3

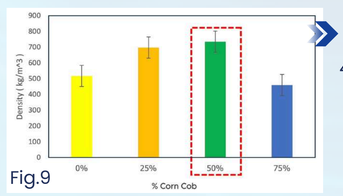
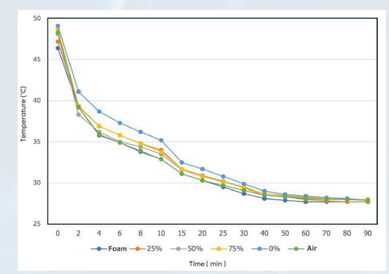


Fig.9

Density is in the range of 461-736 kg/cm^3

Fig.8 Effect of Ratio of Water Hyacinth to Textile Waste
Fig.9 Effect of %Corn cob

THERMAL INSULATION



Sample with 75% corn cob shows the slow rate of temperature decrease.

Fig.10 the temperature decrease profile of wall panel samples

Reference : Owodunni A.A., Lamaming J., Hashim R., Abdulwahab Taiwo O.F., Mohamad Kassim M.H., Sulaiman O., Hussin M.H., Bustami Y., Mohamad Amini M.H., and Hiziroglu S. 2020. Properties of Green Particleboard Manufactured from Coconut Fiber Using a Potato Starch Based Adhesive." BioResources 15 (2): 2279–92.