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Energy Absorption Characteristics of Biodegradable Sugar Palm/PLA Composite with Periodic Two-Dimensional Square Honeycomb Sandwich Structure

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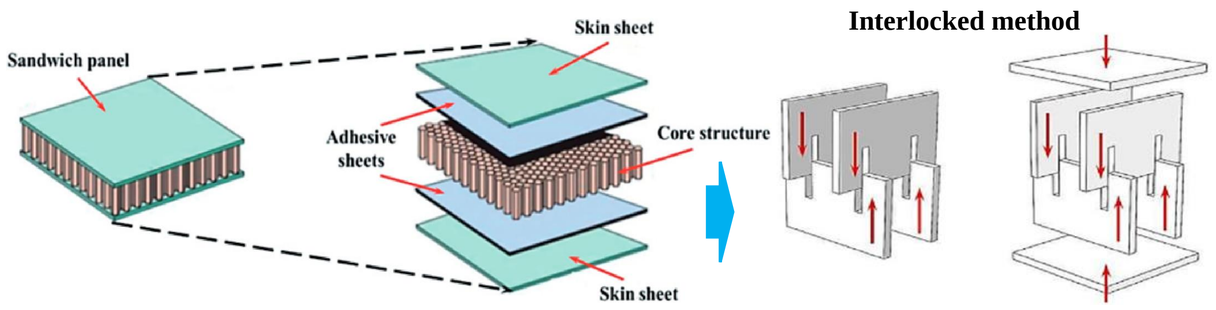
INTRODUCTION & AIM

The growing demand for sustainable engineering materials has accelerated the development of fully biodegradable composites, such as those combining natural sugar palm fibres with polylactic acid (PLA) matrix. Recently, the pursuit of lightweight, high-performance structures have established sandwich panels with honeycomb cores as superior solutions for energy absorption. However, the potential of merging these two concepts, which creates a periodic two-dimensional square honeycomb sandwich structure from a biodegradable sugar palm/PLA composite. Investigating this novel system is crucial, as it promises a synergistic combination of environmental sustainability and mechanical performance, which makes it a viable candidate for applications in eco-conscious industries like automotive and packaging where impact resistance is critical.

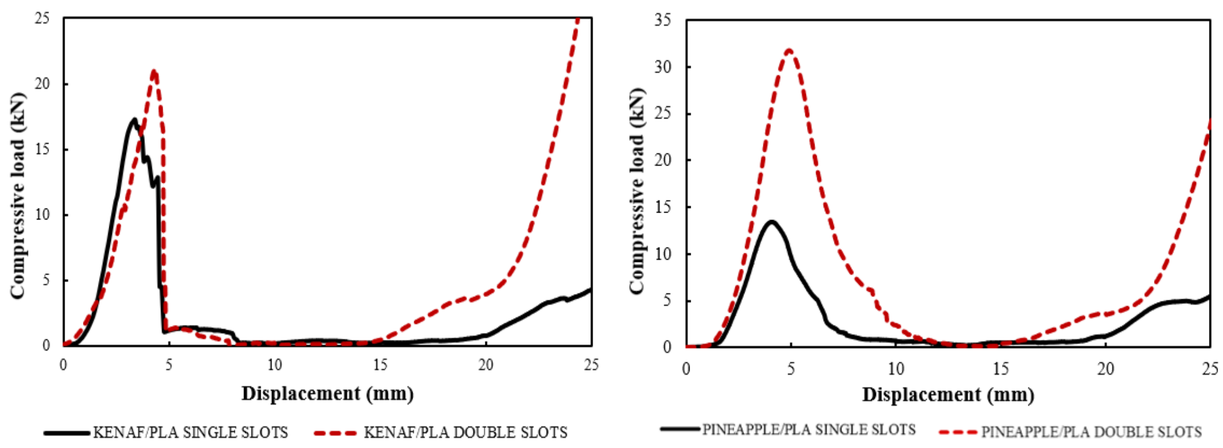


METHOD

Each type of the short fibres then were combined homogenously with PLA using a batch mixer. The PLA was pre-melted for 20 mins before the fibres were slowly added to avoid overflowed and aided in obtaining a homogenous mixtures. These small pallets then underwent hot pressed process using a mould size 150×150×3 mm in thickness and each press utilized 300 g of the pallets. The fibre/PLA plates were further cuts into designated sandwich square honeycomb of single slots (1×1) and double slots (2×2). Both single and double square honeycomb design undergo quasi-static compression test using Universal Testing Machine INSTRON 3366 according to ASTM D1621 standard.

RESULTS & DISCUSSION

It was investigated the effect of scaling factor on the compression strength and energy absorption value of the structure. It was shown the load versus displacement curve for both single and double slots design for all three types of fibres. At the beginning all fibres displayed the same pattern of initial plastic behaviour before reaching the maximum force and declining upon rupture. The maximum compressive load increased when the number was double, but the pineapple/PLA composite displayed the highest increment at 136.9%. The sugar palm/PLA composite came in second with 44.6% and followed by kenaf/PLA composite at 22.6 %.



CONCLUSION

This study was conducted on the energy-absorbing characteristics of periodic two-dimensional square honeycomb sandwich structures, which were made from short sugar palm, kenaf, and PALF reinforced with PLA. The biodegradable sugar palm/PLA composite sheets underwent the hot compression process and were cut into single and double-slot square honeycomb panels. The results indicated tensile strength for the recycled sugar palm/PLA composite. It was revealed that the double-slot design of the pineapple/PLA sandwich structure significantly increased by 1.33 times compared to the sugar palm/PLA sandwich structure. It notably reduced the compressive strength of pineapple/PLA with 66.4% and sugar palm/PLA with 31.5% composite sandwich structure.

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