UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Mechanical and Manufacturing Engineering Technology

RESEARCH AND DEVELOPMENT OF ACOUSTICAL PANEL MADE FROM KENAF CORE

Nur Sima Syazwani Binti Hamzah

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RESEARCH AND DEVELOPMENT OF ACOUSTICAL PANEL MADE FROM KENAF CORE

NUR SIMA SYAZWANI BINTI HAMZAH

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in fulfillment of the requirements for the Bachelor of Manufacturing Engineering Technology (Process and Technology)

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DEDICATION

Dedicated to

my beloved father, Hamzah bin Uran

my appreciated mother, Aminah binti Mahmud

my sweet brothers, Mohd Hafizal, Mohd Iftitah, Mohd Nizam, Mohd Zamri

my lovely sisters, Nur Nadirah and Rafidah binti Abd Rahman

my little heroes Mohd Darwisy Mieqael, Mohd Fieras Mieqael, Mohd Nazmie Mieqael, Mohd Muqrie Mieqael and Mohd Ziqrie Mieqael

my sweetheart, Kim Seok Woo

for giving me moral support, cooperation, encouragement and understandings.

Thank You So Much & Love You All Forever

ABSTRACT

Natural fibers such as kenaf core have the high potential to replace synthetic fibers because they offer high absoprtion properties, eco-friendly, low cost and low density. Therefore, the development of natural fibers has increased the interest of researchers and many fields of the manufacturers such as aircraft and automotive have been used as reinforcement to fabricate a high strength property of composite materials. In addition, there are many researchers focusing on the natural fibers based composite in the form of laminate, but there is no specific study on the kenaf core in acoustical applications. In this study, an experimental investigation was conducted to explore the kenaf core with different size to develop acoustical panel. There are three (3) size of kenaf core has been used in this research which is 3 mm (A), 20 mesh (B) and 40 mesh (C). Kenaf core was used as reinforcement, polyurethane (PU) and natural rubber latex (NRL) as a matrix. The raw materials were mixed with the composition of matrix which is kenaf core filled with PU and kenaf core filled with NRL. The method used to develop acoustic panel is cold press machine. The laminated technique was used to develop the acoustic panel to propose the best layup sequence of kenaf core acoustic panel layout for optimum properties. The acoustic panel testing was conducted by using impedance tube testing. This types of acoustic panel typically deals with the low, medium and high frequency range. Furthermore, all the fabrications and testing method are based on ASTM E1050-09 standard. Next, the morphological characteristic is identified by using scanning electron microscope (SEM). At the end, due to their cost effectiveness, good performance and eco-biodegradable composite, kenaf has high potential to develop through this research. The use of natural fibres can reduce the cost of material compared synthetic fibre. For suggestion, the sound insulation materials must be placed on the wall to allow the sound vibration passed through the wall. The addition of art on the acoustic panel can be discretely integrated and simple to install as painting hanging up. The findings of this study suggest that kenaf core filled with NRL samples for AAB layup with coefficient of 0.90 at 1000 Hz has a good airflow resistivity and porosity for the application in the low frequency. It is very interesting to find out that natural fibres from kenaf plants are capable of absorbing sound at low frequency range. For medium frequency application, ABB layup with 0.88 at 1000 Hz. The layup sequence for high frequency range are ACC with coefficient of 0.96 at 3150 Hz is the most suitable layout that can be utilized as an acoustic panel at high frequency because it reveals high absorption coefficient compared to the other kenaf core filled with PU samples. This kenaf core reinforced natural rubber latex is promising light-weight materials used and naturally biodegradable for acoustical panel.

ABSTRAK

Serat semulajadi seperti teras kenaf mempunyai potensi yang tinggi untuk menggantikan gentian sintetik kerana mereka menawarkan ciri serapan tinggi, mesra alam, kos rendah dan ketumpatan rendah. Oleh itu, pembangunan serat semulajadi telah meningkatkan minat penyelidik dan banyak bidang pengeluar seperti pesawat dan automotif telah digunakan sebagai pengukuhan untuk menghasilkan sifat kekuatan yang tinggi bahan komposit. Di samping itu, terdapat banyak penyelidik yang memberi tumpuan kepada serat semulajadi berasaskan komposit dalam bentuk lamina, tetapi tidak ada kajian khusus mengenai teras kenaf dalam aplikasi akustik. Dalam kajian ini, satu siasatan eksperimen telah dijalankan untuk meneroka teras kenaf dengan saiz yang berbeza untuk membangunkan panel akustik. Terdapat tiga (3) saiz teras kenaf telah digunakan dalam kajian ini iaitu 3 mm (A), 20 mesh (B) dan 40 mesh (C). Teras kenaf digunakan sebagai tetulang, poliuretana (PU) dan lateks getah asli (NRL) sebagai matriks. Bahan mentah ini dicampur dengan komposisi matriks yang kenaf teras diisi dengan PU dan teras kenaf diisi dengan NRL. Kaedah yang digunakan untuk membangunkan panel akustik adalah mesin tekanan sejuk. Teknik laminasi telah digunakan untuk membangunkan panel akustik untuk mencadangkan jujukan terbaik untuk susun atur panel akustik inti teras kenaf untuk sifat yang optimum. Ujian panel akustik dijalankan dengan menggunakan ujian tiub impedans. Jenis panel akustik ini biasanya berkaitan dengan julat frekuensi rendah, sederhana dan tinggi. Tambahan pula, semua fabrikasi dan kaedah ujian adalah berdasarkan ASTM E1050-09 standard. Seterusnya, ciri morfologi dikenalpasti menggunakan pengimbasan elektron mikroskop (SEM). Pada akhirnya, disebabkan keberkesanan kos, prestasi yang baik dan komposit eko-biodegradasi, kenaf mempunyai potensi yang tinggi untuk membangunkan melalui kajian ini. Penggunaan serat semula jadi boleh mengurangkan kos bahan berbanding serat sintetik. Untuk cadangan, bahan penebat bunyi mesti diletakkan pada dinding untuk membenarkan getaran bunyi yang diluluskan melalui dinding. Penambahan seni pada panel akustik boleh secara tegas bersepadu dan mudah untuk memasang sebagai lukisan tergantung. Dapatan kajian ini mencadangkan bahawa teras kenaf diisi dengan sampel NRL bagi AAB dengan pekali 0.90 pada 1000 Hz mempunyai aliran udara yang baik kerintangan dan porositi untuk permohonan dalam frekuensi rendah. Ia adalah sangat menarik untuk mengetahui bahawa serat semulajadi dari tumbuh-tumbuhan kenaf mampu menyerap bunyi pada julat frekuensi rendah. Untuk aplikasi frekuensi sederhana, ABB layup dengan 0.88 pada 1000 Hz. Jujukan layup untuk julat frekuensi tinggi ACC dengan pekali 0.96 pada 3150 Hz adalah susun atur yang paling sesuai yang boleh digunakan sebagai panel akustik pada frekuensi tinggi kerana ia mendedahkan pekali penyerapan tinggi berbanding dengan sampel teras kenaf lain yang diisi dengan PU. Teras kenaf getah asli menjanjikan bahan berat ringan yang digunakan dan secara semulajadi boleh dikompos untuk panel akustik.

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LIST OF ABBREVIATIONS

PU	-	Polyurethane
NRL	-	Natural rubber latex
UF	-	Urea-formaldehyde
ASTM	-	American Society for Testing and Material
SEM	-	Scanning electron microscope
KCPU	-	Kenaf core filled with polyurethane
KCNRL	-	Kenaf core filled with natural rubber latex
NA	-	Not available