

**UNIVERSITI TEKNOLOGI MARA**

**MATERIAL AND COMPOSITE  
ANALYSIS OF NATURAL-BONDED  
BOARD MANUFACTURE FROM  
GIGANTOCHLOA ALBOCILATA  
(BULUH MADU) FIBER**

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Thesis submitted in fulfillment  
of the requirements for the degree of  
**Master of Science**  
**(Materials Science and Technology)**

**Faculty of Applied Science**

**March 2023**

## ABSTRACT

The main objective of this study was to investigate the material attributes of young (less 3 years old) and old (above 3 years old) *Gigantochloa albociliata* (Madu bamboo), and to evaluate some of the composite performance (physical and mechanical properties) of natural-bonded bamboo fiberboard between the age. The comprehensive knowledge of these properties helps to promote the uses of this bamboo's fiber for natural-bonded composite products. The different age levels of bamboo can be an indicator in evaluating the significant differences in term of chemical contents and thermal stability of bamboo. The chemical contents were determined in accordance to the standard outline in Technical Association of Pulp and Paper Industry (TAPPI) test method, while thermal stability was conduct by using Shimadzu TGA 50 analyzer in accordance to previous research on thermal degradation of bamboo materials. Based on the results, *G. albociliata* culm exhibited different chemical contents between young and old/matured age, in which, young bamboo showed higher hot water extractives and ash contents compared to old bamboo. On the other hand, old bamboo contained higher alcohol-toluene extractives, holocellulose,  $\alpha$ -cellulose and lignin than the young ones. Hence, more resin and possible bamboo gum in old bamboo that is beneficially for natural-bonded composite product. The thermal analysis of extracted bamboo fiber has some indication on the thermal degradation behavior of both young and old bamboo culm. The maximum temperature degradation of young and old bamboos was 413°C and 404°C respectively. Therefore, old bamboo was degraded at the lower temperature compared to young bamboo, which indicates lower thermal stabilities in young bamboo. The composite performance of natural-bonded fiberboard from *G. albociliata* showed modulus of elasticity (MOE) value of young bamboo sample at 15, 20 and 25 min. pressing time was 655 MPa, 749 MPa, and 925 MPa, respectively, while for old bamboo sample was 1142 MPa, 1605 MPa, 1693 MPa, respectively. Board made from young bamboo fiber/25 min. pressing time and old bamboo fiber/20 and 25 min. pressing time has achieved the minimum requirement of Japanese Industrial Standard (JIS) A5905-2003 in term of MOE. The highest modulus of rupture (MOR) was 16.03 MPa for board made from old bamboo fiber /25 min. pressing time, while the lowest MOR was 4.80 MPa for board made from young bamboo/15 min. pressing time. The MOR of most of the board groups met the minimum requirement of MDF type 5 and type 15 in JIS. Internal bonding (IB) strength of board has a similar trend with MOR, and the IB value obtained for all groups met the minimum JIS requirement. However, all board groups have failed to fulfil the minimum requirement of water absorption (WA) test and thickness swelling test (TS) required by JIS.

## ACKNOWLEDGEMENT

Alhamdulillah, Praise be only to Allah S.W.T for making this research and thesis possible to its completion.

Firstly, I wish to thank God for giving me the opportunity to embark on my MSc and for completing this long and challenging journey successfully. My gratitude and thanks go to my supervisor Dr. Shahril Anuar Bahari who has been very kind and patient in guiding me. I highly value the knowledge and advice given throughout my time under his supervision.

My appreciation goes to my co-supervisor the Dr. Mohd Nazarudin Zakaria for guidance and knowledge me through this journey and closes lecturer, Ts. Azrena Abd Karim for her moral support and guidance. I also would like to thanks a lot to Mr. Azli, Mr. Akmal and Mr. Sahari for helping me in conduct machine for sample production and sample testing.

I would also like to give special thanks to my wife, Wan Nur Syahirah binti Wan Ruslan for her continuous support and understanding when undertaking my research and writing my project. Thanks again for accompany me through thick and thin of my studies life. Your prayer for me was what sustained me this far.

Not to forget to my siblings, Siti Noor Syahirah, Adib Ibrahim, Noor Syazurien Nabila and Noor Syamimi Najwa who give me strength to accomplish this thesis. Finally, this thesis is dedicated to the loving memory of my very dear parents, Yusoff bin Seman and Rasidah binti Hussin for the vision and determination to educate me. This piece of victory is dedicate to both of you. Alhamdulillah.

Special thanks to my colleagues, Raja Muhammad Amirul Ashman, Khairul Naseem, Aina Munirah and Nik Syazwani for helping me with this project. I feel blessed with having dear friends who stood by me throughout my laboratory work and thesis writing. I would like to wish them triumph and success in all they endeavor.

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# CHAPTER ONE

## INTRODUCTION

### 1.1 Research Background

Bamboo is a great plant and an important raw material for wide variety of uses. Rural peoples in many tropical countries have traditionally acknowledged the importance of bamboo. It is frequently use in traditional applications with lack of understanding of its characteristics. Therefore, improving the understanding of its basic properties and product performance could further develop the uses of bamboo especially in modern application. However, bamboo materials for modern and high-end products are still in an initial phase of utilization. Bamboo should be fully utilized because of its availability, short maturation period, comparative strength, good material attributes and relatively cheaper than wood. These findings are very useful in promoting the potentials of bamboo as an alternative raw material, especially in wood-based industry.

This study is focusing on the fabrication of natural-bonded composite from bamboo fiber with bamboo ages and hot-pressing time/temperature as the main parameters. *Gigantochloa albociliata*, or locally known as Buloh Madu, was used as major raw material. Some material properties of young and old bamboos (chemical composition and thermal resistance) measured and related to its composite board properties. The performance of composite (physical and mechanical properties) measured for performance indication of its end use.

### 1.2 Problem Statement

Environmental is the main issue in wood-based industries due to the formaldehyde release from composite panel products that can be very toxic, which consequently may increase the risk of human health problems. Formaldehyde is a volatile organic compound (VOC) that can found in high amounts both indoors and outdoors. The most common sources of indoor formaldehyde are construction materials and furniture products composed of composite wood bonded with formaldehyde-containing adhesives. These items include plywood, particleboard, and medium density