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**Mohd Mustafa Al Bakri Abdullah,
Liyana Jamaludin, Rafiza Abdul Razak,
Zarina Yahya and Kamarudin Hussin**



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Tensile Properties Evaluation of Paper Pulp Packaging at Different Sections and Orientations on the Egg Tray

MASNI-AZIAN^{1,a}, A., CHOUDHURY^{2,b}, I. A., HAERYIP SIHOMBING^{3,c}
and YUHAZRI^{4,d}, M.Y.

¹Engineering Design Department

³Management Manufacturing Department

⁴Engineering Material Department

Faculty of Manufacturing Engineering

Universiti Teknikal Malaysia Melaka

Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, MALAYSIA.

^amasni.azian@utem.edu.my, ^cphaery@utem.edu.my, ^dyuhazri@utem.edu.my

²Department of Engineering Design and Manufacture

Faculty of Engineering, Universiti Malaysia

50603, Kuala Lumpur, MALAYSIA.

^bimtiazi@um.edu.my

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Abstract. Paper-based material has been frequently used as part of packaging solution as an option towards reducing municipal solid waste generation. Various studies on mechanical behaviour of paper-pulp packaging material have been conducted based on the machining direction and cross machining direction. However, there is still gap of information on paper-pulp packaging material behaviour at diagonal direction. A study has been conducted to investigate the variability to tensile properties of paper-pulp packaging at various packaging section (draft and base surface) and different specimen orientation (horizontal, vertical, and diagonal direction). In this research, results from the stress-strain relationship obtained from tensile and compression tests are presented. The data obtained are further analysed using ANOVA to find out whether material variations are significantly different with varying sections and orientations. Findings in this research supported the anisotropic properties of paper-based packaging material. Draft surfaces exhibit weaker strength than base surface. Also, the variability of stiffness and strength of specimens are more significant in horizontal and vertical direction compared to diagonal direction.

Introduction

Paper pulp packaging is basically a composite made of recyclable waste paper [1]. The main composition of paper is cellulose fibres and constituted by natural material containing wood fibres [1,2,3] and matrix consists of lignin and hemicellulose [1]. The wood fibre of the material consists of three major polymers in the form of matrix namely lignin, hemicellulose and cellulose, but the percentage varies from one location to another in the same fibre [1,4,5,6,7]. Variability to fibre length was caused by the manufacturing process. During pulping, raw materials were dissolved in water and fibres were separated to produce pulp slurry. This process damages the fibre, which causes majority of pulp particle to be in the form of broken fibres and fibre fragments [3]. Therefore, most of fibre surface area must be bonded to other fibre surface to have a solid sheet instead of loose fibres [3].