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Extended Abstract

Influence of Geometrical Shape on the Crashworthiness Performance of Tubular Jute Mat/Epoxy Composite Specimens

Sabah Salim Hamza, AL Emran Bin Ismail[1], Mohd. Yuhazri Yaakob, Salih Meri AL Absi
University Tun Hussein Onn Malaysia (UTHM)

Abstract

Nowadays, the interest in using natural fibers reinforced plastic have been increased dramatically in many engineering applications due to its distinctive properties such as low density, good Energy-absorbing capacity, and is considered environmentally friendly. In the present paper investigated experimentally the crashworthiness characteristics and corresponding energy-absorbing capability of different geometrical shapes under quasi-static loading of natural tubular jute mat/epoxy composite structures. The purpose is to determine the appropriate design of natural compounds, which can provide the potential to substitute conventional structures currently in use. Two different geometrical shapes (corrugated and circular tubes) were fabricated by a combination manual lay-up and vacuum-bagging moulding techniques, specimen thickness (2, 3 and 4 laminate plies), tulip triggering and 100mm in length, and then the post-curing has been conducted on graded temperature treatment. The influence of cross-section shape, number of laminate plies, and temperature treatment on crashworthiness characteristics under quasi-static loading were examined and discussed. From this unique study, Laboratory results indicate that most of the specimens failed in a stable and progressive manner. However, the corrugated cross-sectional shapes with three layers are considered optimum design in terms of energy-absorbing, peak load, average load, and crushing efficiency for crashworthiness tubes application.
Recently, interest in environmental problems has been increased among researchers; the natural fibers are gaining considerable attention by authors and manufacturers in the direction of replacement of synthetic composite fibers especially in the automotive industry field due to their characteristics such as lower weight, good in strength and elastic modulus, biodegradable, renewable, recyclable, ecofriendly, available abundantly, and low cost. Fundamentally, weight is a key criterion as well as to crashworthiness in the motor vehicle Engineering field. The minimum weight corresponds with a decrease in fuel consumption and carbon dioxide emissions, thus it contributes to the protection of the environment.

Nowadays, the usage of transportation, especially automotive have become an important part of daily life. However, the rapid development of the vehicle industry and increasing their numbers, so that drive to more traffic accidents, that lead to death or serious injuries. Therefore, the safety factor is a very important issue. The major function of the crashworthiness is absorption of the impact energy, protecting the occupant's compartments and to ensure the maximum force transmitted to occupants is lower in case a collision event. Several investigates have been conducted on crashworthiness performance by using metals, and synthetic composite materials, whilst few of the number of studies by using the natural composite fibers. According to previous researches, to understand absorption of the impact energy, a few parameters such as type of material, cross-section shapes, and specimen geometry (layers numbers, length, and diameter to thickness ratio) in addition to the temperature treatment and so on. That influence the crashworthiness of structure (e.g.: maximum peak load (Pmax), Mean load (Pm), energy absorption (EA), and crushing efficiency ηc) are chosen.

As a part of industrial applications, large interest is given to fabricate natural composite structures and testing them to replace metallic and synthetic composite products. The authors employ these studies in axial crushing behaviours and total energy dissipation. An enormous of published papers have used quasi-static compression to investigate the crashworthiness characteristics of composite and metal specimens. The merit of this approach is that the testing procedures take place at a slow speed, thereby it provides a means to control the crushing process and capture pictures for each phase of the test sample. Thus, it can present a better choice to reject the composite specimen which shows catastrophic or non-progressive failure modes.

Index Term— Natural fibres, geometrical shapes, quasi-static, Crashworthiness, energy absorption, peak load

Sabah Salim Hamza
Ministry of Industry and Minerals, Iraq Email : hd160005@siswa.uthm.edu.my