ScienceDirect

Materials Today: Proceedings

Volume 72, Part 4, 2023, Pages 2021-2026

An experimental study on two body abrasive wear behavior of natural fiber reinforced hybrid polymer matrix composites using Taguchi analysis

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https://doi.org/10.1016/j.matpr.2022.07.400

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Abstract

In earlier days the synthetic fibre composite material was considerably used for the secondary structures of automobile and aircrafts. But by knowing the performance at critical and elevated conditions natural fiber reinforced polymer matrix composites have been receiving considerable attention as the attribute for synthetic fiber reinforced composites for its functional efficiency, tailorable properties and strength to weight ratio. In the present study, abrasive wear behavior of natural fibre reinforced hybrid polymer matrix composite was carried out using pin-on-disc wear testing rig for abaca, basalt and hybrid abaca- basalt fibre reinforced epoxy using L9 orthogonal array. The tests were carried out on silicon carbide paper with a grit size of 320μm with varying parameters of Load, Speed, and Time. From the obtained results, it is concluded that the optimal parameters for minimum weight loss is observed at load 10N, speed 200rpm and time of 10min for basalt fibre reinforced epoxy composite and the maximum weight loss is observed for abaca fibre reinforced epoxy composite at load 30N, 300rpm and time of 20min. The results also reveal that the material composition is the most influencing factor affecting the weight loss of the specimen followed by load, time and speed for the adopted testing conditions.

Introduction

Natural fibres are extremely important due to a variety of factors, including the potential to provide farm and off-farm based businesses to a large segment of the population, the use of “waste” to create wealth, thereby providing additional job opportunities, and the consideration of good and green economy, which would also contribute to the nation's green front, among others [1], [2]. When compared to traditional FRP composite materials, hybrid composites are the most improved composite materials. Normally, a low modulus fibre is mixed with a high modulus fibre. Different mechanical properties can be achieved in these fibre composites by varying the volume ratio and stacking grouping of distinct piles. Hybridization of the two filaments and fillers (strong lubricants) in a polymer matrix has been demonstrated as a solid elective material to be used in medium stacking tribological applications in the new material plan. This signals the tribologist to look for biodegradable reinforcements for tribo-composites and investigate their suitability for related applications [3], [4], [5]. Basalt texture, which is separated from the underlying natural components, is one such degradable support (volcanic stone). They are made from molten volcanic basalt rock through a spinning process. This procedure is quite similar to the manufacturing of glass fibres, except that no additives are necessary in the case of basalt. As a result, the chance of being exposed to harmful substances is reduced. As a result, the manufacturing process is more environmentally friendly [7], [8]. The fibres have good chemical stability, with great corrosion resistance and thermal stability; they can be used at temperatures ranging from 200 to 800°Celsius. While fibre strength declines above 300°C, basalt fibres have stronger thermal stability than glass fibres [9], [10].

In addition to basalt, one of the most durable natural fibres available is abaca and is also called as Manila hemp. It is a Musasea family plant native to Asia, and it is commonly found in wet areas such as the Philippines and East Indonesia. Ropes, woven textures, tea bags, and other items are all made from abaca strands. Abaca fibres generally find their application as reinforcing material for aerospace composite materials and in under floor insurance for Daimler Chrysler passenger vehicles in a novel inventive application [11], [12], [13]. Burman.et.al., [1] The static and fatigue behaviour of basalt fibre reinforced with two types of matrices, vinyl-ester and epoxy, as well as the variation of their mechanical properties as a consequence of the different types of matrix utilised, were investigated. Experimental tests are also watched using a thermocamera, which focuses emphasis on the specimens' gradual degradation. Li. Xue, L.G. Tabil.et.al., [3]