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DYNAMIC MECHANICAL AND FLEXURAL PROPERTIES OF GRANITE DUST FILLED ARENGA PINNATA (SUGAR PALM) FIBRE BASED HYBRID COMPOSITES

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ABSTRACT

Natural fibre is one type of reinforcement materials obtained from natural resources that is decomposable, biodegradable, renewable, and cost effective. Among all natural fibres exist, Arenga Pinnata fibre (plant based) and basalt fibre (mineral based) are identified as an attractive option for reinforcement materials due to its good mechanical and thermal properties, abundantly available and high tolerate to harsh environmental conditions. However, limitation arise when this natural fibre is combined with thermosetting resin namely fibre reinforced polymer (FRP) composites in which this will be used as mechanical structure. This limitation is due to the mechanical properties of the thermoset resin itself that has inherently cross-linked structure thus resulting in brittle behaviour. This leads to relatively poor resistance to crack initiation and crack growth. To overcome this problem, in this study, the thermosetting polymer resin namely polyester was modified using dry fly granite dust (GD) waste of 63 um maximum size filler material. 1-5 wt% GD powder is incorporated into both, polyester composites and FRP composites. The mechanical properties of matrix resin filled granite dust reinforced with hybrid fibres were compared. The main objective of this study is to evaluate the effect of granite dust on dynamic mechanical and flexural properties of polyester composites and hybrid FRP composites. Four (4) different laminate composites systems were prepared using hand lay-up technique and vacuum bag process. These were WG/GCSM, WB/GCSM, WB/GCSM/A1 and WB/ACSM laminates systems. These polyester composites and hybrid FRP composite specimens were subjected to mechanical analysis (DMA) test under three-point bending mode, flexural test, and density test according to ASTM D7028, ASTM D7624 and ASTM D792 respectively. The modified polyester composites exhibited better in storing more energy in terms of storage modulus compared to unmodified polyester. The addition of granite dust up to 3 wt% improved the composite ability to store energy resulted by the limited polymer chain mobilization. Cured polyester with 3 wt% GD (PE/3GD) content exhibited the highest flexural properties among polyester composites which achieved flexural strength of 56.40±19.527 MPa and flexural modulus of 2.30±0.376 GPa. The study found that woven basalt/CSM glass composites exhibited the highest storage modulus at glassy state among all composites, while the lowest storage modulus was exhibited by woven basalt/CSM Arenga composites. The elasticity behaviour or ability of storing energy of FRP composites increases as the inclusion of granite dust increases up to 3 wt% that strengthens the FRP composites into becoming more brittle and stiffen The presence of CSM Arenga in the composite laminates of woven basalt/CSM Arenga/Al has improved the elasticity behaviour with the lowest damping factor (tan *6* = 0.283) which made them the most elastic composites among others. The density values of composites were increased as the contents of granite dust increased in weight percentage. In terms of flexural behaviour, the addition of micro filler up to 3 wt% into the composite laminates contributed positive effect in flexural properties for all hybrid composites. It is identified that the effect of granite dust shows better properties in woven basalt/CSM glass composites with higher modulus and strength compared to other composites.

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