

Strain Rate Effect on Dynamic Behavior of Southern Yellow Pine (SYP) Based Wood Bio-composites

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Extended Abstract

Wood-based bio-composites are becoming increasingly popular due to their low cost, biodegradability, eco-friendliness, relatively robust mechanical properties, and environmental and sustainability benefits [1-3]. The objective of this research was to develop a natural plant-based composite as a viable alternative to traditional petroleum-based composites.

The performance of wood composites is heavily influenced by dynamic loading conditions in a variety of structural applications. The ability of composite materials to absorb and dissipate energy is crucial during short-duration impact events. Experimental techniques such as Split Hopkinson Pressure Bars (SHPBs) have been used for years to evaluate composite materials at high strain rates, including those containing wood [4-6]. To investigate the strain rate effect on newly developed bio-composites made from southern yellow pine (SYP), micronized rubber powder (MRP) and methylene diphenyl diisocyanate (MDI) resin, four different bio-composites (Control, 10%MRP, 20%MRP, and 30%MRP) were tested using the Split Hopkinson Pressure Bar (SHPB) experimental method. The high-speed dynamic events on the specimen were captured by a Shimadzu HPV-2 high-speed video camera. Digital image correlation (DIC) was carried out using Proanalyst to determine the strains in the specimen. The dynamic behavior was modeled using ABAQUS (Dynamic explicit). Five samples of each bio-composites tested during SHPB test. SHPB compression tests using the SHPB were repeated five times at each striker bar pressure and results represent the mean values of the five tests with standard deviations.

The following conclusions were drawn from the results: peak strain, peak strength, and specific energy increased with an increasing strain rate. The values of these parameters grew with higher strain rates, as reported in similar studies on wood-based materials [7-8]. In summary, the effects of strain rate on the mechanical behavior of bio-composites are notable. It has been demonstrated that a combined analysis procedure, consisting of classical Split-Hopkinson bar analysis (SHPBA) and digital image correlation (DIC), yields reliable results. DIC has potential for quality analysis applications. Experimental results and FEA simulations exhibited similar trends for lower values of strain.

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