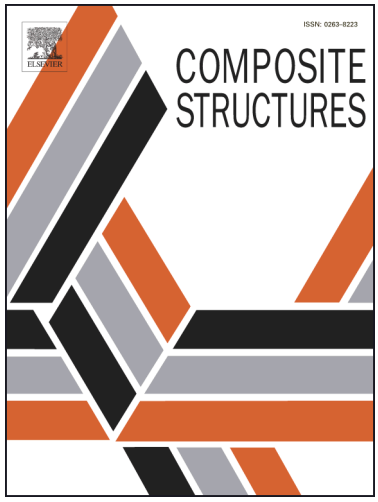

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Effect of Strain rate and temperature on press forming of extruded WPC profiles

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Wood-plastic composites (WPCs) are experiencing rapid market growth in manufacturing industries. In view of the attractive qualities of this material and on-going development of new production processes and post-production processes, great potential for widespread utilization of WPCs clearly exists. This paper evaluates the temperature effects on forming of an extruded WPC material in a post-production process. The press-forming process described in this work is used to form a pre-determined profile shape for the final product. After preliminary tests to find suitable temperature ranges, a diverse set of material behavior tests were conducted on pre-heated sheets of the WPC material. Numerical simulation was also performed using LS-DYNA software to evaluate formability of the WPC. Simulated and experimental values were in good agreement, indicating the feasibility of using the simulation approach for preliminary evaluation of formability of WPCs.

Keywords: Wood plastic composite forming; Thermomechanical analysis; Strain characteristics; Numerical simulation

1. Introduction

Wood-plastic composite (WPC) refers to a broad range of composite materials containing plant fibers that use thermosets or thermoplastics as the bonding matrix. The material properties of these materials depend fundamentally on the wood and plastic contents. In WPCs, the wood material that can be either wood flour or wood fiber, usually contains 30% to 60% of the total material [1].

WPCs have recently gained increased market share in a number of customer products, such as flooring elements and fencing, because of their desirable material properties of consistent quality, splinter-free structure and good durability, and their use of sustainable material sources while still being economically viable [2]. Profile extrusion is the most commonly used process for production of WPCs [3]. Lack of expansion in post-production processes means that current WPC products available on the market are mainly limited to extruded profiles. However, there is a huge demand for more complex product shapes and geometries that require post-extrusion processing after the material fabrication stage. Presently, more complex shapes can only be produced by assembling extruded profiles, which is labor-intensive and may not enable the full diversity of demanded product shapes to be met [4].

Previous research has exhibited that WPCs as polymer-based materials are highly related to the temperature of material and also the matrix polymer group, and that the performance of high-density polyethylene (HDPE) and HDPE-based composites is greatly dependent on the temperature and processing time of manufacturing [5], [6].

Most research found in the literature has focused on fabrication of WPCs [4], [7] and post-processing of WPC materials has received only limited attention and thus needs more investigation. Forming and cutting are among the most commonly applied post-processing procedures for complex WPC products. Among important parameters that affect forming and cutting of WPCs, temperature and forming tolerance of the mold tool have been highlighted [8], [9]. The general performance of WPCs is