

STRUCTURE AND PROPERTIES RELATIONSHIPS OF DENSIFIED WOOD

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ABSTRACT

The objective of this research was to investigate the effect of applied compressive strain in various environments, on the strength and stiffness of compressed wood samples. It is believed that transverse compression of wood at specific conditions of temperature and moisture will result in improved mechanical properties, which can be attributed to increased density and perhaps other physical or chemical changes.

Specimens of both mature and juvenile southern pine (*Pinus taeda*) and yellow-poplar (*Liriodendron tulipifera*) were compressed radially at three different temperature, and moisture content conditions relevant to the glass transition of wood.

Ultimate tensile stress and longitudinal modulus of elasticity were obtained by testing compressed, uncompressed and control samples in tension parallel-to-grain. Strain measurements were performed using laboratory-built clip-on strain gauge transducers. Results of the tensile tests have shown an increase in the ultimate tensile stress and modulus of elasticity after all densification treatments.

Scanning electron microscopy was employed for observing changes in cellular structure of densified wood. Existence of the cell wall fractures was evaluated using image processing and analysis software. Changes in cellular structure were correlated with the results of the tensile test.

Chemical composition of wood samples before and after desorption experiments was determined by acid hydrolysis followed by high performance liquid chromatography (HPLC). The results of the chemical analysis of the wood specimens did not reveal significant changes in chemical composition of wood when subjected to 160 °C, pure steam for up to 8 hours.

The results of this research will provide information about modifications that occur during wood compression and will result in better understanding of material behavior during the

manufacture of wood-based composites. In the long run, modification of wood with inadequate mechanical properties can have a significant effect on the wood products industry. Low density and juvenile wood can be used in new high-performance wood-based composite materials instead of old-growth timber.

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