EQUILIBRIUM MOISTURE CONTENT OF WOOD IN HIGH-TEMPERATURE PRESSURIZED ENVIRONMENTS

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ABSTRACT

Experiments were conducted on the water sorption characteristics of three wood species, for both juvenile wood and mature wood, at conditions above and below 100°C. A pressurized chamber was constructed for this purpose. At 50°C, equilibrium moisture content (EMC) behavior deviated only slightly from predictions based on the published data for Sitka spruce. At 160°C, the sorption behavior was distinctly different from the 50°C data, or any extrapolation from published low-temperature data. The data suggested that a change in the sorptive properties of the wood occurred as temperature and moisture conditions exceeded the glass transition temperature for lignin. At 50°C, juvenile wood tended to equilibrate at a higher moisture content than mature wood. At 160°C, however, juvenile wood exhibited a markedly lower EMC than mature wood. Thermal degradation of wood was detected during the experiments. Reduction in the sorptive behavior as a result of thermal degradation is proposed as a possible explanation for differences in EMC behavior for juvenile and mature wood at 160°C.

Keywords: EMC (equilibrium moisture content), wood, thermal degradation, high-temperature, sorption.

INTRODUCTION

This research effort focused on investigations of the wood-water relationship at conditions relevant to the hot pressing of wood-based composites. Very little information has been documented on the equilibrium moisture content (EMC) behavior of wood in environments of elevated temperature and pressure. Such data are essential in understanding the influence of moisture on the viscoelastic behavior of wood. The specific objectives of this study were: to develop apparatus and techniques suitable for collecting sorption isotherm data at high temperatures and pressures, and to characterize the EMC vs. relative humidity behavior of selected wood species in environments relevant to hot pressing.

BACKGROUND

During the hot pressing of wood-based composites, internal mat temperature has been measured in excess of 150°C and relative humidity calculated to reach or exceed 75% (Humphrey and Bolton 1989; Kamke and Casey 1989; Kamke and Wolcott 1991). In some cases, saturation occurs (Kamke and Johnson 1994). Such severe processing conditions are adequate to transcend the glass transition of the viscoelastic wood polymers (Kelly et al. 1987) and have been reported to change the properties of the wood component (Geimer et

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