RECENT RESEARCH ACTIVITIES

Application of impact elastic waves in liquid to impregnation of wood

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Introdution

Chemical treatment, or introduction of chemicals into wood, is one of the major methods to enhance the performance and reliability of wood and wood-based materials. In the conventional treatment, however, distribution of chemicals in wood was irregular, leading to the inadequate performance and reliability. This irregularity can be categorized to macroscopic irregularity, indicating that the chemically treated wood includes the untreated cells in its structure; and microscopic irregularity, indicating that each cell includes the untreated regions in its amorphous structure. The macroscopic irregularity is mainly caused by the obstacle that blocks the liquid flow, e.g., the aspirated pits in tracheid of coniferous wood. This study focuses on the impact elastic waves transmitted through liquid to penetrate the obstacle as follows. If the liquid fills up the cell cavities between the wood surface and the tip of the liquid permeation in wood, or the obstacles, the abrupt increase in the liquid pressure from one to another on the wood surface is expected to cause the damping oscillation in the liquid pressure at the obstacles, leading to penetrate them. The purpose of this study is to promote the liquid permeation into wood by applying the impact elastic wave in the liquid. The test equipment was fabricated, and distilled water was used as a liquid. The temporal variability of the liquid pressure was examined to confirm the generation of the waves in liquid. The effect of the waves on the liquid permeation into wood was also examined.

Experiment

To generate impact elastic wave, a vessel (named V_A) filled with liquid at an ordinary pressure (0.1 MPa) was connected by a valve to another vessel (named V_B) filled with liquid at higher pressure (1.1 MPa). The temporal variability in liquid pressure in VA was measured using the pressure gauge (named PG) after the valve was opened with various rate. The temporal variability was analyzed by a theory being based on the fluid dynamics.

To examine liquid permeation, wood samples with a dimension of 15 mm (T) × 15 mm (R) × 100 mm (L) were prepared from a block of yellow cedar (*Chamaecyparis nootkatensis Spach*). The samples at oven-dry state were injected by the liquid after vacuuming, and subsequently remained to be immersed in the liquid for 48 h. The sample after immersed was fixed to the region closed to P_G in the V_A with an ordinary pressure. The valve was opened with various rate after the inside of V_B was pressurized to 1.1 MPa. Amount of the liquid taken up to the sample was measured for each rate.

Results and discussion

The pressure at P_G without sample showed damping oscillation behavior when the valve was opened quickly, called quick pressurization. With sample in the quick pressurization, the pressure showed the similar behavior. By slow opening of the valve, called slow pressurization, the pressure gradually increased to a constant value. These findings indicate that the impact elastic waves occurred by the quick pressurization. The amount of the liquid taken up to the sample, however, showed no significant difference between the quick and slow pressurization. Analysis of the pressure variation suggests that the impact elastic waves in this experiment was not so much large as affecting the penetration of the obstacle in wood. To enhance the energy of the elastic wave, the amount of liquid passing through the valve per unit of time should be larger.