Preliminary

Liquid Impregnation in Wood Using a Roller-press In-liquid

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(Received May 31, 2001)

Keywords : compressive deformation, roller-pressing, liquid impregnation

Introduction

Transverse compression techniques have recently been applied to the liquid impregnation of pre-dried wood using either vacuum or pressure treatment chamber[1,2]. However, there are a few disadvantages in these techniques: both the treated impregnation process and compression process are batch processes, and more energy and larger time are required to utilize set recovery for liquid impregnation force.

This paper deals with a new method for liquid impregnation in wood by using large transverse compression technique with a roller-press in liquid. The liquid uptake of this newly developed method was evaluated in various conditions.

Materials and Methods

Sugi *(Cryptomeria Japonica)* sapwood specimens of 300 mm (*L*)×90 mm (*T*)×4 mm (*R*) were prepared. After the measurement of the oven-dried weight and size, the specimens were conditioned to the air-dry moisture contents (MC).

The roller-press and platen-press were used in this study. The former is equipped with a pair of metal rollers with a diameter of 150 mm. The treatment chamber of 400 mm (*W*)×300 mm (*H*)×1,250 mm (*L*) was used for soaking by the roller-press.

To compare the amount of impregnated liquid among the compression and impregnation processes, four types of treated methods were applied ; i.e., (1) Pre-Platen pressing, (2) In-liquid Platen-pressing, (3) Pre-Roller-pressing, and (4) In-liquid Roller-pressing. "Pre-pressing" and "In-liquid" means soaking after compression and soaking during compression, respectively. The specimens were deformed at compressive ratios from 0 to 75%, and soaked in water from 0 to 120 minutes and then the MC of specimens were measured.

Result and Discussion

The effects of different liquid impregnation methods on liquid uptake were shown in Fig. 1. "Control" indicates the treatment condition of only soaking without pressing.

All compressive methods showed the higher impregnation effects than control. The difference between soaking on platen-press and roller-press was not significant. The MC of the specimen treated by soaking in-liquid pressing was bigger than that by soaking after pre-pressing.

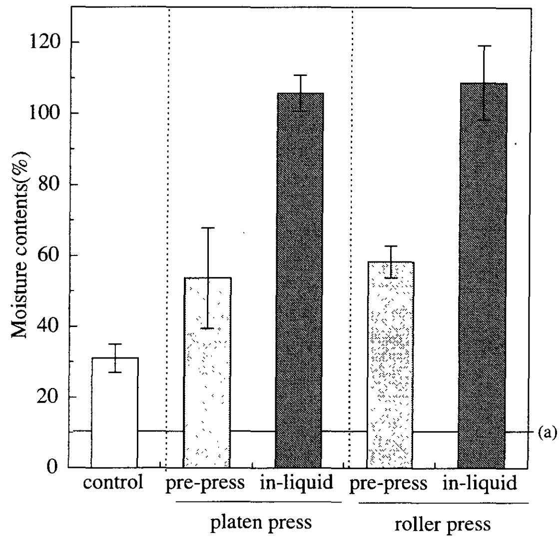

Fig. 1. Comparison of the moisture contents over various liquid pentration treatments. Notes: Control indicates only soaking without pressing. (a): Initial moisture content (air-dried) of specimens. Compressive ratio: 60%, Soaking time: 3 min.

The liquid impregnation into wood by the compression treatment is promoted by the following factors ; (A) the compressive deformation is recovered immediately after unloading ; i.e., elastic recovery, (B) the compressive deformation is recovered by soaking in liquid, (C) penetrating pathway is increased because of degrading pit membranes by compression.

The increase of liquid impregnation by pre-pressing was only observed for the factors of (B) and (C). As an example, the residual deformation by pre-roller pressing before soaking and after soaking was 14.6% and 4.1%, respectively. It is evident that the volume change of cell cavity with the set recovery by water adsorption works as liquid impregnation force. It is reported that the shearing deformation by roller-pressing method improves the moisture conductivity and liquid movement in wood, possibly due to mechanical breakdown of pit membranes[3]. However, large difference between platen-press and roll-press was not observed in liquid impregnation in this study. Therefore, factor (B) is considered to be the main factor of the increase in the liquid uptake by pre-press.

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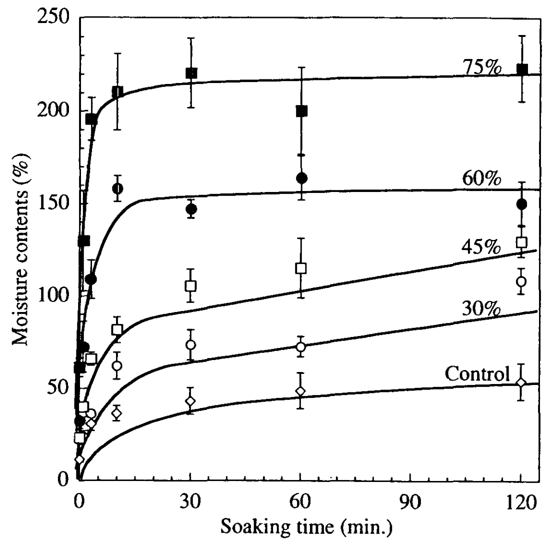

Fig. 2. Relationship between soaking time and the moisture contents after soaking under various compressive ratio by roll press in water. Compressive ratio: ◇: 0% (Control), ○: 30%, □: 45%, ●: 60%, ■: 75%. Notes: Control means only soaking without pressing.

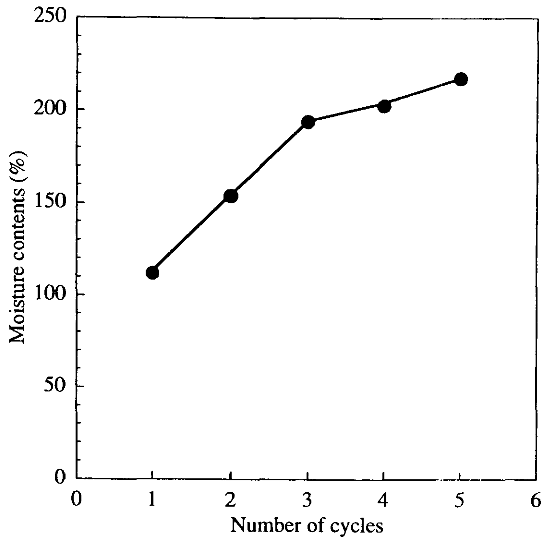

Fig. 3. Effect of number of cycles on the moisture contents after treatment by roller-pressing in liquid. Notes: Compressive ratio: 60% Soaking time: 3 min.

Both factor (A) and factor (B) act for liquid impregnation by in-liquid pressing. Especially, factor (A) gave a great influence on liquid impregnation when short soaking time under normal pressure was applied.

Fig.2 shows that relationship between the MC after soaking and soaking time under various compressive ratios using a roller-press in-liquid. The higher the compressive ratio is, the more the MC increases. The MC rapidly increased until 10 minutes, and after then almost leveled off. Because the thickness of specimens after loading were almost fixed within 3 to 10 minutes after soaking, the increase of MC after soaking means the occurrence of the liquid impregnation force which is caused by set recovery. When the compressive ratio is occurred higher, the more the liquid uptake by elastic recovery of cell wall immediately after loading is occured. Therefore, it is guessed that the recovery of residual deformation is promoted and set recovery is finished in a short time.

Cyclic compression of the specimens by in-liquid roller-pressing increased the liquid uptake as shown Fig.3. This result indicates that high impregnation efficiency can be obtained by increasing the number of pressing cycles with short soaking time.

In-liquid roller-pressing method is expected to lead the industrial-scale application by the development of continuous process of liquid impregnation.

Reference

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