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Inhibition of fiber crosswise swelling in two simultaneous anatomic directions for scots pine humidified sapwood

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Abstract*: Inhibition of fiber crosswise swelling in two simultaneous anatomic directions for scots pine humidified sapwood.* Swelling pressure is an undesirable phenomenon. *This paper presents how it is possible to measure wood swelling pressure in one, and two anatomic directions. It also presents and analyzes research results which were carried out on modern scientific workstations for examination and for measurement of wood swelling pressure.*

Keywords: wood anatomic directions, scientific workstation, wood swelling pressure

INTRODUCTION

Wood which is built into constructions is limited in terms of its unrestricted swelling. In building, engineering, and furniture constructions, especially floors, wood is not allowed to increase its dimensions as it runs into obstacles restraining its swelling in one or two directions. Swelling inhibition initiates a phenomenon described as swelling pressure. For measurement of wood swelling pressure, the pressure is used which during the initial humidification phase needs to be exerted from the outside on the wood subject so that it does not swell and it preserves its original dimensions (***Gonet 1965, Moliński 2000***).

In order to measure swelling pressure of partly confined wood (depending on the direction of force in operation) a wood sample is placed in a special apparatus preventing swelling in one selected anatomic direction or two anatomic directions of wood. Inhibiting swelling in radial direction is accompanied by compacting layers of young thin-walled wood, which results in the final tangential swelling deformations being insignificant. It is different than inhibiting swelling in radial direction for thick-walled cells of old wood, which can acquire room necessary for swelling through arched curves of cells and strong swelling in radial direction. Along with inhibiting of wood swelling, in both, radial and tangential directions simultaneously, there may occur minor swelling intensity changes longwise the fibers (***Raczkowski 1960, Krzysik 1975***).

RESEARCH METHODOLOGY

In the adopted methodology, own design and construction workstation was used for measurement, and examination workstation was prepared with innovatory systems for sample mounting and soaking.

Measurement workstations measuring swelling pressure

Measurement workstation is composed of two tensometers KMM30-5kN (Fig.1.) which can read maximum tension measurements of 5000N. If they are mounted with a wood sample they can measure deformation extent for a sample with dimensions of $35^{x}35^{x}35$mm. They are placed in a steel measurement frame. The entire setting is submerged in a vessel with distilled water. In order to avoid soaking of tensometers and ensure even distribution of measuring tension on the whole surface of the sample, steel spacers were applied (Fig.1.).

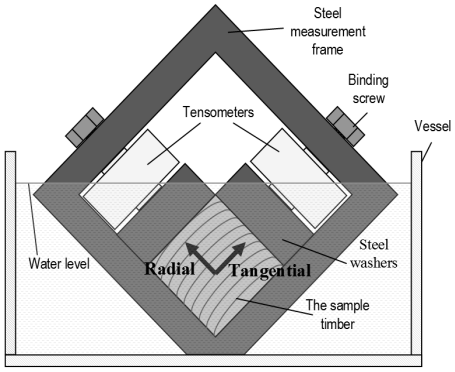

Fig. 1 Measurement system schematics

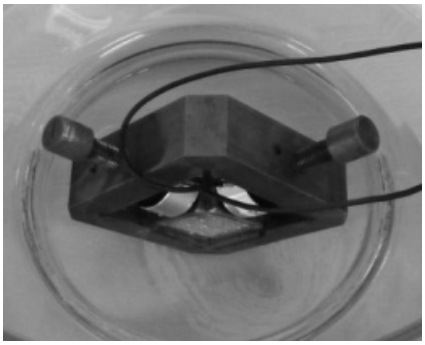

Fig. 2 The examination workstation overview

With the support of data acquisition software, signals from a deforming samples were collected with the frequency of 0,1Hz (every 10 seconds). The examination workstation including a mounted sample is presented in Figure 2.

The signal form sensors went through measurement amplifiers and was received on the analogue input of PCI DaqBoard 3000 extension card. Measurement readings were directly saved in MS Excel application, which enabled real-time outcome observation on PC screen (Fig. 3.).

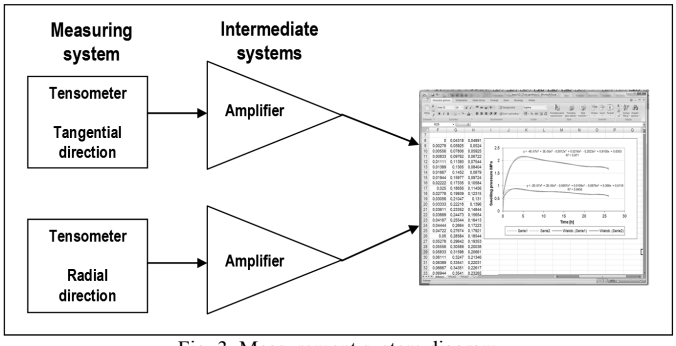

Fig. 3 Measurement system diagram

The workstation may be applied for any wood species samples testing, but with strictly specified dimensions and carried out in the following manner:

- swelling inhibition in any single anatomic direction,
- swelling inhibition in two anatomic directions simultaneously.

RESEARCH RESULTS

20 scots pine sapwood samples with the dimensions of 35x35x35mm were examined. The samples were dried until they reached constant mass and loaded with 10N force.

Swelling pressure examination results in tangential and radial directions simultaneously

Acquired outcome is presented in the graph (Fig. 4).

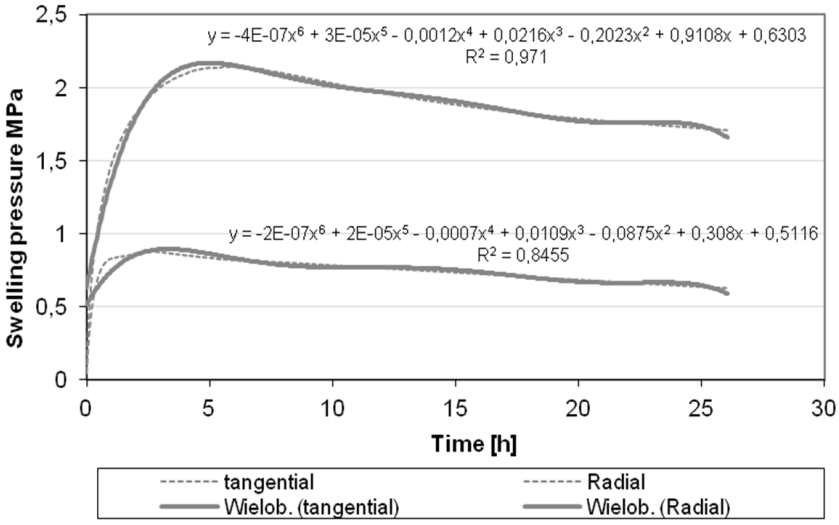

Fig. 4 Swelling pressure examination results in tangential and radial directions simultaneously

In the light of the acquired data analysis it can be assumed that: The two swelling directions graphs have similar characteristics; in the radial direction after approximately 55 minutes the maximum pressure equals approximately 0,85MPa, after that time it does not increase and has a tendency to decrease (graph series 1); in the tangential direction after approximately 300 minutes the maximum pressure equals approximately 2,25MPa, after that time it does not increase and has a tendency to decrease (graph series 2).

Swelling pressure examination outcome in tangential direction at unconstraint swelling in radial direction

Results are presented in the graph (Fig. 5).

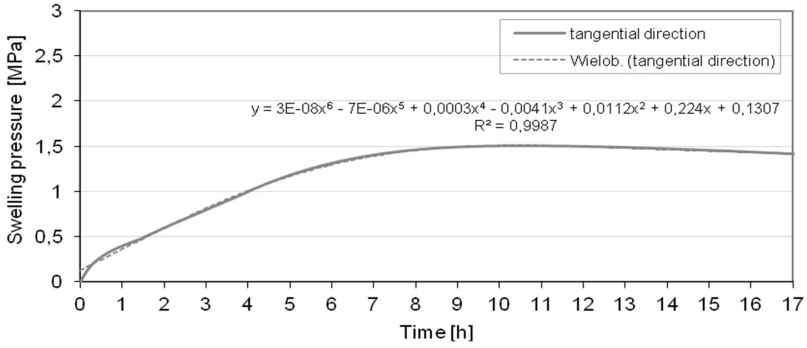

Fig. 5 Swelling pressure examination outcome in tangential direction

In the light of the acquired results one can conclude that: the graph for tangential direction has slightly different characteristics than that of the previous testing; in tangential direction after approximately 600 minutes maximum pressure equals approximately 1,5MPa, after that time, the pressure has a tendency to decrease; maximum pressure is much lower as compared to inhibition in two simultaneous directions.

Swelling pressure examination outcome in radial direction at unconstraint swelling in tangential direction

Acquired outcome is presented in the graph (Fig. 6).

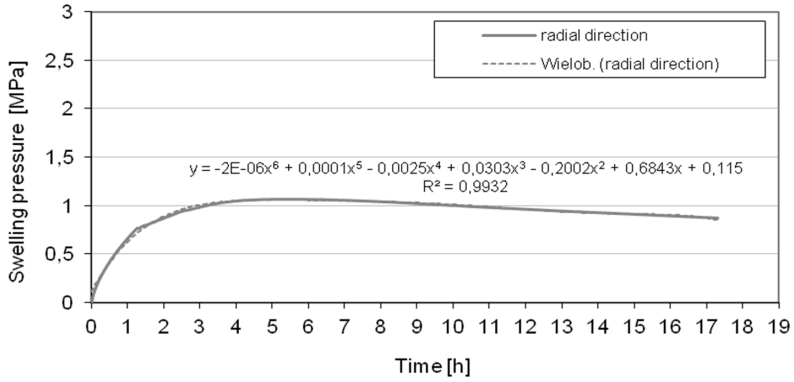

Fig. 6 Swelling pressure examination outcome in radial direction

Analysis of the acquire data results in the following conclusion: the graph for radial direction has very similar characteristics when it is compared to the previous testing; in the radial direction after approximately 250 minutes maximum the pressure reaches 1,05MPa, after that time swelling pressure tends to decrease by much higher than in the case of inhibiting in both directions simultaneously, maximum pressure takes slightly lower values in comparison to inhibiting in both directions simultaneously.

SUMMARY

For the examined anatomic directions of wood, swelling pressure graphs have similar characteristics, as after they have reached their maximum pressure, it slightly begins to decrease. In tangential direction, maximum swelling pressure values are higher than in radial direction. Presented results are inceptive in their character and require further investigation. Due to high level of polymorphism in the structure of wood, the problem under investigation seems to be quite complex.

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Streszczenie: *Hamowanie pęcznienia w poprzek włókien w dwóch kierunkach anatomicznych równocześnie nawilżanego drewna bielu sosny zwyczajnej.* Zjawisko ciśnienia pęcznienia jest zjawiskiem bardzo niepożądanym. Pokazano możliwości badania ciśnienia pęcznienia drewna w jednym i w dwóch kierunkach anatomicznych. Przedstawiono i przeanalizowano wyniki badań przeprowadzonych na nowych stanowiskach: badawczym i pomiarowym do pomiaru ciśnienia pęcznienia drewna.

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