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# The anatomical characteristics of hot compressed poplar wood boards

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**Abstract:** The goal of this study was to investigate the influences of thermal modification by hot pressing on the anatomical characteristics of poplar wood boards. The boards were thermally modified by hot pressing method under different temperature stages. After that samples were cut in cube shapes for microtome. Very thin samples were taken from cross section of wood blocks and the slides were prepared with them. In consequence of microscopic analyses, it was seen that lumens shrank due to removing of water in the cell gaps and some of cell walls disintegrated. Besides it was determined that rays moved and had cracks while they were passing from late wood to early wood and it was seen separations in annual ring borders. Thanks to this study, anatomical characteristics can be regarded when other characteristics (mechanical, physical and surface characteristics) of thermal modified wood are researched.
**Keywords**: Thermal modification, Hot pressing, Anatomical characteristics

## 1. Introduction

It is thought that physical, mechanical and discoloration properties of thermal modified wood and wood boards with hot press can be improved (Yeo et al., 2010). Various thermal processes like Retification Process, Thermowood Process, Plato Process, Oil-Heat Treatment Process and Boise Perdure are used in the wood product sector (Militz, 2002). Seborg et al. (1945) stated as *Staypak* wood boards pressed and modified with hot press. Tarkow and Seborg (1968) performed studies related to surface density of modified wood thermally. After 1980s because of their low density and cost, modified wood boards as thermal attained a big market in Asia (Norimoto, 1994; Wang et al. 2000). The thermal modified wood and wood boards exhibit advanced physical and mechanical properties. For instance thermal modified wood boards can be preferred in furniture production, roof panelling, flooring materials, window and door carpentry, environmental planning and architectural construction, interior and exterior planking of structures, light and sound barrier (Korkut et al. 2008; Korkut and Kocaefe, 2009).

There are wide range of researches in terms of anatomical properties of hot compressed wood boards in the literature (Boonstra et al. 2006; Awoyemi and Jones 2010; Dogu et al. 2010; Icel and Simsek 2016). It was aimed investigation of influences on anatomical properties of wood boards of varied temperatures, times and pressures in these studies. In this study, it was researched anatomical properties of modified poplar wood boards as thermal with different temperatures.

## 2. Material and method

The samples obtained from boards produced with different thermal processes were used in this study. Poplar wood (*Populus* spp) timber without defects and with dimensions of 500 by 100 by 25 mm were compressed by using a laboratory hot press at 130$^{o}$C, 150$^{o}$C, 170$^{o}$C, 190$^{o}$C and 210$^{o}$C and for 45 min under 1 atm pressure. Before hot pressing, average moisture contents of the boards were 14.74%, yet after process it was determined that average moisture content of the hot-compressed boards diminished to 7.22%. 6 for each treatment group, totally 36 boards were used.

To carry out anatomical analyses, after hot press and acclimatization, the cubic samples were cut from wood boards. The cubes were soften by boiling during 6 hours/5 days. Thin samples were slivered from cross section of the cubes with a Thermo Shandon Finesse 325 microtome and the slides were prepared. The slides were stained with safranin to achieve brilliant images which indicate early and late wood zones in the wood structure. The images were observed under a Leica DM3000 light microscope.

**3. Results and discussion**

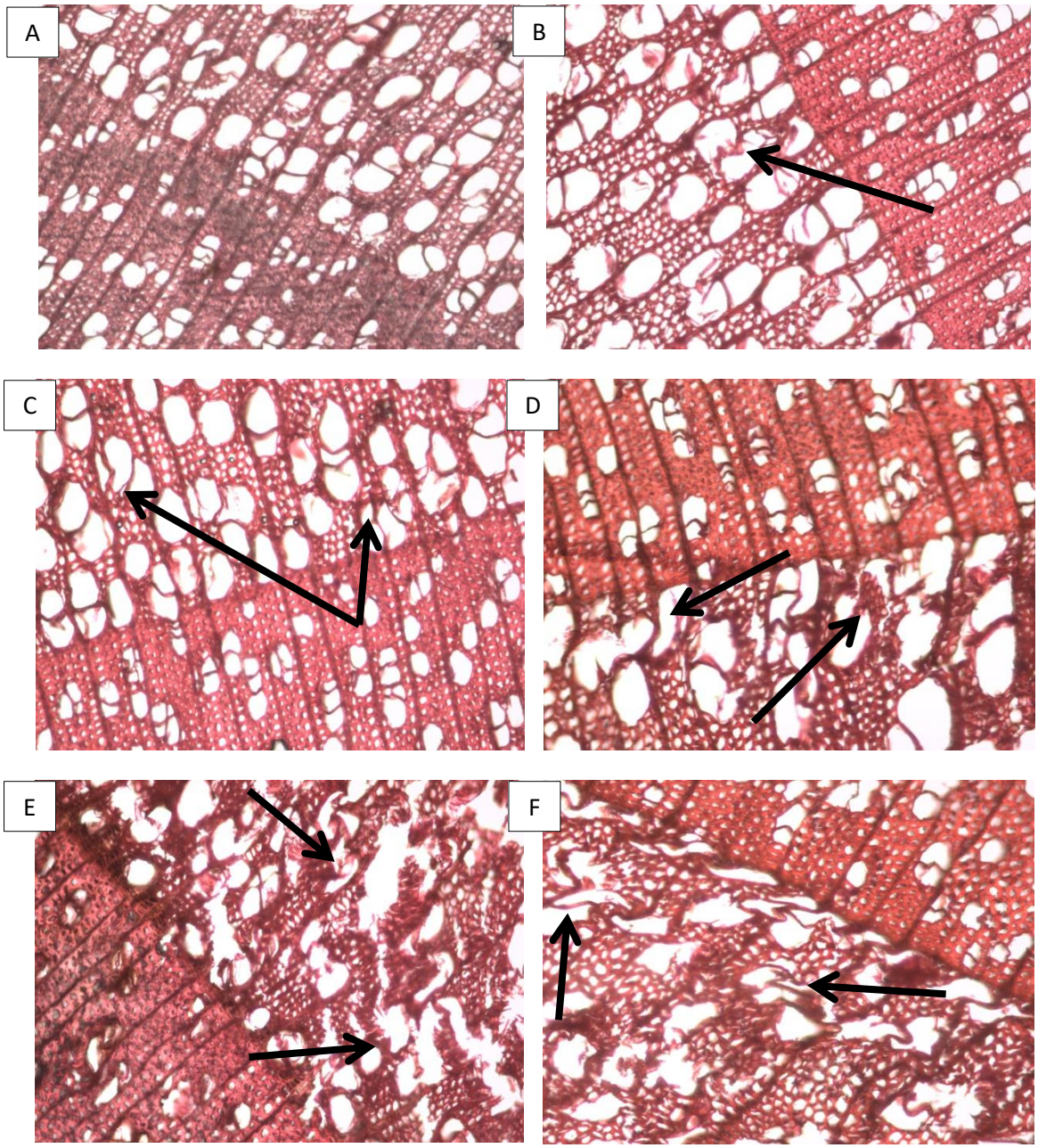


Figure 1. The microscopic pictures of hot compressed wood samples A)Control, B)130$^{o}$, C)150$^{o}$, D)170$^{o}$, E)190$^{o}$, F)210$^{o}$

Microscopic analyses were performed in cross sections of control and thermal modified samples to see the effects of hot pressure on the anatomical structure of the wood. Anatomic images of untreated and hot-compressed wood samples were shown in Figure 1. Collapses in lumens and disintegrations in cell walls of earlywoods of hot-compressed samples with 170$^{o}$, 190$^{o}$ and 210$^{o}$ were seen in images. Besides, it was noticed that rays weaved in earlywoods of these samples. Because latewood zone is denser and tighter than earlywood zone, any disintegration and collapse didn't occur in latewood zone. Disintegration of lumens in earlywood zone led to a fluctuant structure in this zone, but latewood of hot-compressed samples remained smoothly. It wasn't observed any disintegrations in control samples and treated samples in 130$^{o}$ and 150$^{o}$, however very little deformations happened compressed samples in 130$^{o}$ and 150$^{o}$. Dogu et al. (2010) attained the similar results in their anatomic studies conducted with hot compressed Scotch pine (*Pinus sylvestris* L.) boards and they confirmed anatomical changes in earylwood zone and latewood zone depending pressure and temperature. In a similar way, Icel and Simsek (2016) were utilized from ash (*Fraxinus excelsior*) and spruce (*Picea abies*) woods in their study. They determined that hot press led to any deformations in anatomic structures of wood boards.

## 4. Conclusions

The effect of varying temperature ($130^o$, $150^o$, $170^o$, $190^o$ and $210^o$) and stable pressure (1 atm) as well as time (45 min) on the anatomical structure of thermal modified wood boards were researched in this study. Consequently, it was seen that if the press temperature increases in the event of the press pressure is stable, anatomic deformation of hot-compressed wood increased during process. It was noticed that cell walls of the samples started to warp in $130^o$ and $150^o$, whereas they splintered in $170^o$, $190^o$ and $210^o$ according to microscopic images. Furthermore microscopic images indicated that hot-press didn't affect borders of growth rings excessively, however deformations in earlywood cells increased step by step as press temperature increased.

This study revealed that there are some important relations between thermal modification and anatomical structure of wood. Specification of alterations in anatomical structure of thermal modified wood is very significant in respect to end-usage place of these materials. Within this framework, different thermal modification methods should be developed to implement the wood types in varied anatomical structure. Thus, manufacture of novel products can be supplied for different sectors in industry.

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