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## WOOD DRYING QUALITY OF BEECH WOOD 25,0 MM IN THICKNESS

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### ABSTRACT

Defining the final moisture content distribution across thickness of the beech boards during convective kiln drying has been studied. Boards from beech, 25,0 mm thick, 250 -300 mm wide and 1,80 long have been used as testing materials. The boards have been kiln dried from initial moisture content of 39,23 % to final moisture content of 9,13% for 15 days. In a drying schedule there are four stages: heating, active drying, equalizing and conditioning. The moisture content difference i.e. moisture content gradient between core and surface of the boards is 1,52 %.

It was found that by influence of schedule on moisture content distribution, it was possible for beech boards to achieve the „Q“ drying quality according to the European Drying Group.

**Key words:** Beech, convective drying, drying schedule, moisture content gradient

### 1. INTRODUCTION

In wood drying technology, there are several different types of wood dryers. As the most representative dryer is the one which works with convective drying method. This dryer is known as classical dryer. For our tests in this paper we have chosen exactly that type of model dryer manufactured by the company BascHild - Italy, with a capacity of 117 m<sup>3</sup>.

The work of the dryers is based on imitation of natural phenomena such as sun, rain and wind in closed space. In this way, the wood drying is realized for a certain period of time. In these dry kilns the phenomenon of the sun is achieved by using heating elements that are heated with hot water. Wind or air movement is achieved by fans, while rain is formed using the device for moistening and change of air. A big advantage of such dryers is that during drying, temperature and humidity of the air are measured, and thus the control of the wood moisture evaporation is realized.

On basis of the previous statement, the main objective in the overall problem of wood drying is defining the optimal drying schedule followed by determining the quality of drying.

### 2. MATERIAL AND METHODS OF WORK

For this investigation a total quantity of 117 m<sup>3</sup> beech boards were dried. Their origin was from central part of Serbia.

The information on the temperature and equilibrium moisture content of the air as content of wood as well as moisture content of wood were obtained with the following probes: In order to define the drying schedule, the change in temperature and equal moisture content (EMC) of the air in the kiln chamber has to be registered, as well as the changing in the wood moisture content (MC) during all stages of the drying schedule: stages of heating, active drying, equalizing (Figure 1,2,3 and 4).

Drying of the beech boards was performed in the convective kiln drier equipped with automatic system control of drying (Figure 4).



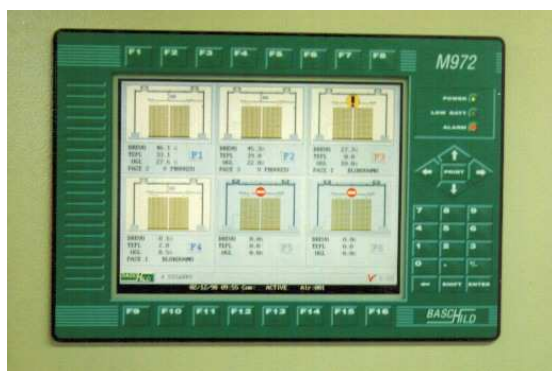
**Figure 1.** Measuring of temperature and equilibrium moisture content of air



**Figure 2.** Measuring of wood moisture content



**Figure 3.** Slicing test (specimen production) for determining wood moisture gradient across the board's thickness



**Figure 4.** Dry kiln for convective drying

### 3. RESULTS AND DISCUSSION

Based on the values of temperature and humidity of the drying air and the values for the wood moisture content for 25,0 mm thick beech boards, the drying schedule shown in Table 1 was defined. From the table it can be noticed that the drying schedule starts with air temperature of 29,10 °C, equilibrium moisture content [EMC] of 20,20 % and average moisture content in the wood of 39,23%.

Further, the air temperature increased with small oscillations to the value of 60,00 °C at the end of the drying schedule (phase of conditioning). The process of evaporation of wood moisture started with EMC of 20,20% and finished with 3,40%. Average moisture content in the wood measured by four probes reached its max. value of 39,23% and its minimum value of 9,13 % at the end of the drying schedule. The drying duration of beech wood was 15 days.

**Table 1.** *Drying schedule of 25,0 mm thick beech planks*

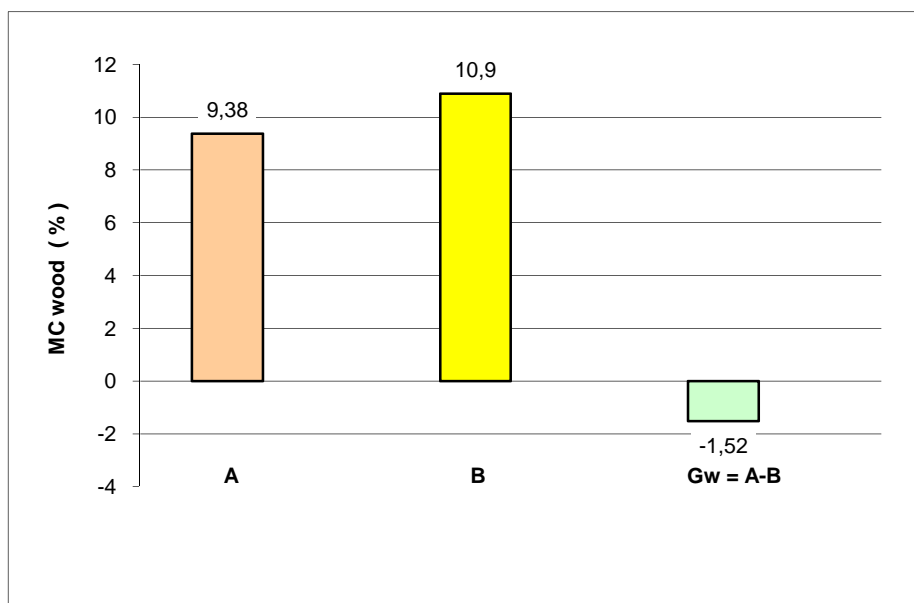
Time	Drying schedule phase	Temperature of the air in dry kiln	Equilibrium moisture content	Moisture content Probe Number 1	Moisture content Probe number 2	Moisture content Probe number 3	Moisture content Probe number 4	Average wood moisture content
[day]	F	T [°C]	[%]	[%]	[%]	[%]	[%]	[%]
1	Heating	29,10	20,20	37,90	42,60	38,40	38,00	39,23
2	Heating	31,8	15,00	36,00	40,70	34,60	32,80	36,03
3	Drying	31,70	15,00	33,00	39,00	31,30	30,40	33,43
4	Drying	31,0	15,20	31,50	38,50	28,10	28,90	31,75
5	Drying	32,0	13,50	30,30	37,00	27,20	27,80	30,58
6	Drying	31,8	13,70	28,40	35,80	25,40	26,60	29,05
7	Drying	32,0	13,60	26,20	34,40	23,70	25,20	27,38
8	Drying	33,70	12,70	23,90	33,00	22,20	23,60	25,68
9	Drying	32,0	13,50	21,90	32,10	21,00	22,30	24,33
10	Drying	41,10	12,00	17,80	30,80	18,80	19,60	21,75
11	Drying	59,60	6,10	16,10	29,50	18,30	17,40	20,33
12	Drying	54,0	9,70	13,50	28,30	16,20	15,60	18,40
13	Drying	60,0	4,20	9,90	21,20	12,60	11,40	13,78
14	Equalizing	60,0	3,70	8,10	14,70	10,80	9,70	10,83
15	Conditioning	60,0	3,40	7,90	10,00	9,80	8,80	9,13

**Table 2.** *Data on surface and core moisture content of beech boards*

Thickness of the wood [mm]	Layer of the wood surface (mark)	Layer of the wood core (mark)	Average moisture content $X_{sr} \pm f_{xs}$	Standard deviation $S \pm f_s$	Coefficient of variation $V \pm f_v$
25,0	A		$9,38 \pm 0,056$	$0,354 \pm 0,039$	$3,778 \pm 0,422$
		C	$10,90 \pm 0,106$	$0,475 \pm 0,075$	$4,354 \pm 0,688$

Based on the data shown in Table 2, it can be concluded that the surface moisture content of the board is 9,38 % (layer A). The core moisture content (layer C) of the boards is 10,90 %.

The moisture content gradient, which is moisture content differences between the board's core moisture content (MC core) and the board's surface moisture content (MC surface), is 1,52% (Figure 5).



*Figure 5. Wood moisture content distribution (gradient) across the board*

#### 4. CONCLUSION

According to the presented data and results obtained during the drying of beech boards, the following can be concluded:

1. The schedule and quality of drying beech boards was investigated. There are four phases in the drying schedule: heating, drying, equalizing and conditioning. It was found that the boards were dried from their initial average moisture content of 39,23 % to their final average moisture content of 9,13 % for a period of 15 days.

2. Air temperature increases from 29,10 °C to 60 °C. Equilibrium moisture content decreases from 20,20 % to 3,40 %. Under these drying conditions, the beech wood loses 30,10 % moisture in 15 days.

3. According to European Drying Group recommendations on assessment of Drying quality of timber, the quality of drying corresponds to quality class marked with “Q” (quality dried)

4. The surface moisture content of the boards is 9,38 % (layer A)

5. The core moisture content of the boards is 10,90 % (layer C).

6. The moisture content distribution (moisture gradient) across thickness of beech boards during convective drying is 1,52 %, which is suitable for production of products from solid wood.

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