Original Scientific Paper
UDC: 674.031.632.2-413.047.1

# AIR SEASONING OF OAK BOARDS WITH THICKNESS OF 50,0 MM

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## ABSTRACT

This paper presents the results of the investigation of air seasoning of oak boards. The investigations were performed on row material with 50,0 mm in thickness. A total number of 12 boards were investigated. For each board there are three places for wood moisture measuring. The period of investigation lasted from March until December 2008. The temperature and relative humidity of the air within this period of time varied from 5,6 $^0$C to 28,5 $^0$C and from 49,0 % to 72,0 %. The boards were air dried from initial average moisture content of 47,86% to final average moisture content of 16,05%. The investigations were performed in the Republic of Macedonia.

**Key words:** oak, boards, air seasoning, wood moisture content, temperature, relative humidity of air.

## INTRODUCTION

For centuries, the most popular drying method was air drying. By air drying wood for a year, moisture levels under 15,0 % moisture content could be achieved, depending on the climate, species and board thickness. The air drying influences on reducing the wood developing mold, stain or decay during transit, storage, or use. Because many uses didn't require additional drying, air drying also provided the correct moisture content for many wood products or only little additional kiln drying was required to achieve moisture content below 12,0 %. There are many factors that affect air drying. The rate of drying at which green lumber dries after it is placed in a yard depends upon many parameters such as: wood species, grain pattern, thickness, yard characteristics and climatic conditions. In our case the investigation was performed for air drying of oak lumber with 50,0 mm in thickness.

## MATERIAL AND METHODS

Estimation measurement for wood moisture content was carried out by measuring of the three places within the board. The lumber was piled under the shed. In the pile there were board samples with the following dimensions: 1,50 m length, 20,0 cm width and 50,0 mm thickness.

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The measuring places are positioned about 500,0 mm from the head and in the middle of the sample width. For a correct reading of the wood moisture it is necessary to plant the electrode at a 1/3 of the board thickness.

Mathematical model of formula was used to calculate the corresponding parameters, while some of the data was processed by the method of variation. The measuring places are positioned about 500,0 mm from the head and in the middle of the sample width. For a correct reading of the wood moisture it is necessary to plant the electrode at a 1/3 of the board thickness.

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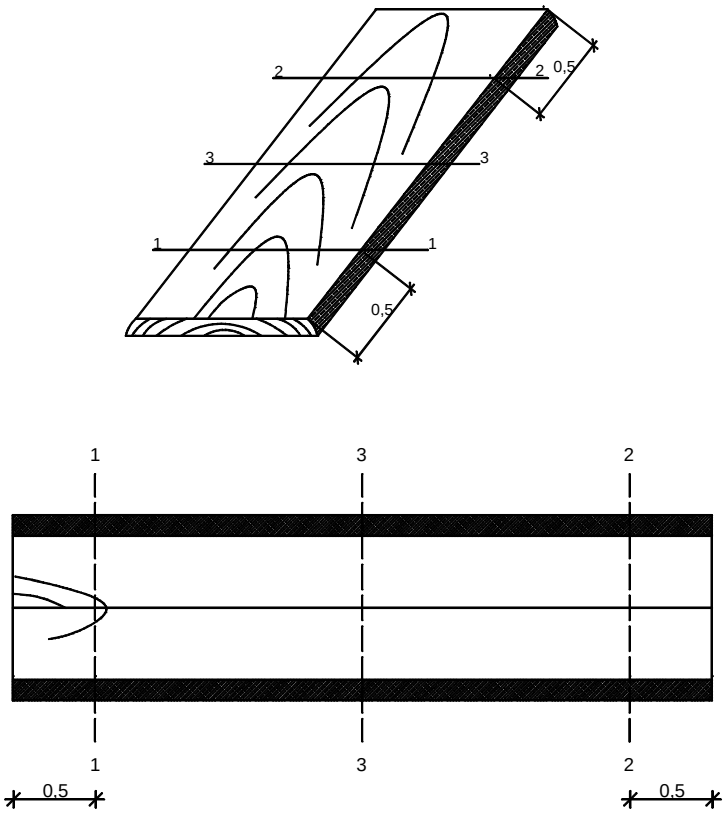


*Fig.1:Measurement points for determination of wood moisture content*

## RESULTS AND DISCUSSION

As mentioned before, the climate of the area or region in which the lumber air drying yard is located greatly influences the air drying rate and yard output. The most influential factors are the temperature and relative humidity of the air. Data from the investigation concerning these parameters is presented in Tab 1.

*Tab. 1:Temperature and relative humidity values from March until December 2008*

| Ordinal number | March | | April | | May | | June | | July | | August | | September | | October | | November | | December | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | temperature of air | relative humidity of air | temperature of air | relative humidity of air | temperature of air | relative humidity of air | temperature of air | relative humidity of air | temperature of air | relative humidity of air | temperature of air | relative humidity of air | temperature of air | relative humidity of air | temperature of air | relative humidity of air | temperature of air | relative humidity of air | temperature of air | relative humidity of air |
| | t ($^0$C) | F (%) | t ($^0$C) | F (%) | t ($^0$C) | F (%) | t ($^0$C) | F (%) | t ($^0$C) | F (%) | t ($^0$C) | F (%) | t ($^0$C) | F (%) | t ($^0$C) | F (%) | t ($^0$C) | F (%) | t ($^0$C) | F (%) |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** |
| **1** | 10 | 64 | 16 | 62 | 18 | 58 | 18 | 58 | 26 | 56 | 22 | 45 | 22 | 50 | 23 | 55 | 16 | 58 | 9 | 65 |
| **2** | 11 | 64 | 18 | 63 | 18 | 58 | 20 | 50 | 28 | 50 | 30 | 46 | 21 | 52 | 24 | 55 | 11 | 60 | 8 | 65 |
| **3** | 12 | 68 | 18 | 62 | 19 | 62 | 21 | 55 | 30 | 48 | 30 | 46 | 26 | 55 | 25 | 56 | 14 | 56 | 5 | 75 |
| **4** | 8 | 70 | 18 | 61 | 20 | 52 | 18 | 56 | 32 | 46 | 31 | 47 | 28 | 56 | 20 | 53 | 15 | 58 | 5 | 80 |
| **5** | 9 | 71 | 19 | 60 | 24 | 55 | 18 | 54 | 32 | 46 | 26 | 52 | 28 | 58 | 19 | 52 | 9 | 72 | 6 | 75 |
| **6** | 12 | 65 | 14 | 64 | 16 | 72 | 20 | 50 | 30 | 47 | 24 | 50 | 26 | 59 | 18 | 55 | 10 | 65 | 4 | 72 |
| **7** | 8 | 68 | 12 | 68 | 16 | 72 | 18 | 60 | 31 | 45 | 24 | 53 | 27 | 55 | 18 | 56 | 11 | 54 | 4 | 74 |
| **8** | 10 | 68 | 12 | 68 | 16 | 70 | 18 | 61 | 30 | 45 | 28 | 51 | 25 | 58 | 18 | 55 | 11 | 54 | 7 | 68 |
| **9** | 14 | 61 | 14 | 70 | 20 | 56 | 19 | 62 | 21 | 50 | 28 | 50 | 24 | 58 | 19 | 57 | 11 | 53 | 8 | 69 |
| **10** | 11 | 62 | 17 | 64 | 17 | 70 | 20 | 55 | 28 | 52 | 25 | 54 | 22 | 60 | 16 | 60 | 11 | 55 | 5 | 69 |
| **11** | 11 | 62 | 20 | 54 | 15 | 62 | 20 | 55 | 29 | 50 | 28 | 53 | 28 | 51 | 18 | 58 | 13 | 56 | 5 | 72 |
| **12** | 12 | 64 | 21 | 55 | 19 | 68 | 20 | 55 | 26 | 54 | 30 | 46 | 30 | 49 | 19 | 57 | 15 | 55 | 5 | 80 |
| **13** | 14 | 62 | 22 | 55 | 21 | 61 | 22 | 55 | 25 | 53 | 30 | 46 | 29 | 49 | 19 | 56 | 10 | 54 | 6 | 65 |
| **14** | 10 | 71 | 18 | 59 | 24 | 61 | 20 | 56 | 31 | 49 | 32 | 48 | 24 | 56 | 18 | 55 | 11 | 57 | 4 | 75 |
| **15** | 11 | 70 | 19 | 58 | 22 | 58 | 24 | 55 | 30 | 49 | 27 | 46 | 28 | 51 | 16 | 60 | 8 | 72 | 8 | 68 |
| **16** | 12 | 68 | 20 | 56 | 22 | 56 | 26 | 53 | 30 | 50 | 27 | 46 | 25 | 57 | 18 | 59 | 8 | 74 | 8 | 69 |
| **17** | 12 | 65 | 21 | 55 | 23 | 56 | 27 | 54 | 30 | 48 | 28 | 50 | 22 | 60 | 19 | 52 | 10 | 70 | 4 | 75 |
| **18** | 10 | 66 | 22 | 55 | 26 | 50 | 24 | 56 | 28 | 52 | 28 | 50 | 20 | 62 | 20 | 56 | 10 | 70 | 8 | 69 |
| **19** | 10 | 66 | 24 | 52 | 18 | 58 | 28 | 56 | 29 | 52 | 26 | 48 | 21 | 59 | 21 | 56 | 9 | 71 | 7 | 70 |
| **20** | 11 | 68 | 21 | 58 | 16 | 72 | 28 | 57 | 27 | 50 | 26 | 44 | 23 | 52 | 21 | 57 | 10 | 75 | 4 | 76 |
| **21** | 12 | 68 | 19 | 60 | 24 | 56 | 27 | 54 | 28 | 48 | 26 | 54 | 20 | 59 | 22 | 55 | 11 | 75 | 4 | 76 |
| **22** | 8 | 71 | 19 | 64 | 20 | 56 | 27 | 55 | 28 | 50 | 30 | 50 | 21 | 60 | 18 | 58 | 9 | 70 | 3 | 78 |
| **23** | 13 | 69 | 18 | 65 | 26 | 53 | 27 | 53 | 26 | 54 | 28 | 52 | 21 | 61 | 18 | 59 | 10 | 73 | 7 | 69 |
| **24** | 10 | 69 | 20 | 60 | 24 | 50 | 29 | 53 | 28 | 49 | 24 | 49 | 24 | 58 | 17 | 58 | 8 | 72 | 4 | 74 |
| **25** | 9 | 70 | 21 | 60 | 24 | 51 | 30 | 50 | 30 | 48 | 28 | 50 | 22 | 59 | 18 | 59 | 8 | 70 | 4 | 72 |

The statistical data was processed in order to obtain relevant results for the temperature and relative humidity of the air. The results are shown in Tab. 2 and Tab. 3.

*Tab. 2:Statistical data for the temperature of the air*

| **Month** | **Xsr ± fxr** | **σ ± fσ** | **V ± fv** |
|---|---|---|---|
| March | 10,8 ± 0,33 | 1,68 ± 0,23 | 15,58 ± 3,26 |
| April | 18,52 ± 0,60 | 3,04 ± 0,43 | 16,43 ± 3,46 |
| May | 20,32 ± 0,68 | 3,41 ± 0,48 | 16,79 ± 3,54 |
| June | 22,76 ± 0,82 | 4,12 ± 0,58 | 18,12 ± 3,86 |
| July | 28,52 ± 0,49 | 2,45 ± 0,34 | 8,59 ± 1,71 |
| August | 27,44 ± 0,49 | 2,48 ± 0,35 | 9,05 ± 1,81 |
| September | 24,28 ± 0,61 | 3,07 ± 0,43 | 12,66 ± 2,61 |
| October | 19,28 ± 0,45 | 2,28 ± 0,32 | 11,83 ± 2,43 |
| November | 10,76 ± 0,45 | 2,25 ± 0,31 | 21,00 ± 4,57 |
| December | 5,68 ± 0,35 | 1,77 ± 0,25 | 31,21 ± 7,45 |

*Tab. 3: Statistical data for the relative humidity of the air*

| **Month** | **Xsr ± fxr** | **σ ± fσ** | **V ± fv** |
|---|---|---|---|
| March | 66,8 ± 0,62 | 3,13 ± 0,44 | 4,69 ± 0,93 |
| April | 60,32 ± 0,94 | 4,74 ± 0,67 | 7,87 ± 1,57 |
| May | 59,72 ± 1,42 | 7,12 ± 1,00 | 11,93 ± 2,45 |
| June | 55,12 ± 0,60 | 3,00 ± 0,42 | 5,45 ± 1,09 |
| July | 49,64 ± 0,57 | 2,85 ± 0,40 | 5,75 ± 1,15 |
| August | 49,04 ± 0,59 | 2,96 ± 0,41 | 6,04 ± 1,20 |
| September | 56,16 ± 0,79 | 3,97 ± 0,56 | 7,07 ± 1,41 |
| October | 56,36 ± 0,44 | 2,21 ± 0,31 | 3,93 ± 0,78 |
| November | 63,96 ± 1,66 | 8,30 ± 1,17 | 12,99 ± 2,68 |
| December | 72,00 ± 0,88 | 4,41 ± 0,62 | 6,13 ± 1,23 |

Based on the data shown in Tab 2, it can be concluded that the temperature of the air varies from minimum of 5,68 $^0$ C in December up to maximum of 28,52 $^0$ C in July.It can be noticed from Tab.3 that relative humidity of the air has minimum value of 49,04 % in August and maximum value of 72,0% in December.

The values of the moisture content of the wood obtained during the investigation are given in Tab. 4 on the basis of 180 measurements min. value of 11,0 % was measured in September and max. value of 48,8% in March.

*Tab. 4:Wood moisture content values from March until December 2008*

| **Place of measurement** | **March** | **April** | **May** | **June** | **July** | **August** | **September** | **October** | **November** | **December** |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Wood moisture content (%)** | | | | | | | | | |
| **1** | 48,2 | 46,0 | 46,0 | 43,3 | 26,2 | 18,0 | 14,1 | 12,4 | 14,9 | 16,1 |
| | 47,8 | 45,2 | 45,2 | 39,0 | 27,2 | 17,1 | 14,2 | 13,4 | 14,0 | 15,7 |
| | 47,2 | 46,0 | 44,2 | 36,8 | 24,8 | 17,0 | 13,0 | 13,9 | 15,0 | 15,8 |
| | 47,6 | 45,0 | 43,0 | 37,0 | 20,3 | 16,3 | 12,0 | 12,9 | 14,2 | 14,9 |
| | 48,4 | 44,8 | 42,0 | 35,4 | 18,0 | 15,3 | 12,1 | 15,2 | 14,0 | 16,5 |
| | 48,2 | 45,2 | 43,0 | 34,4 | 17,5 | 14,0 | 11,6 | 15,1 | 15,1 | 16,2 |
| **2** | 48,5 | 45,5 | 44,5 | 42,8 | 25,8 | 18,4 | 13,8 | 12,8 | 14,4 | 16,0 |
| | 47,0 | 45,8 | 43,8 | 38,8 | 25,6 | 18,2 | 13,0 | 14,0 | 14,6 | 15,7 |
| | 47,4 | 46,6 | 44,6 | 37,0 | 22,5 | 16,5 | 12,4 | 13,5 | 15,1 | 16,0 |
| | 48,0 | 44,9 | 44,0 | 36,8 | 20,4 | 15,8 | 12,8 | 13,0 | 14,2 | 15,0 |
| | 48,2 | 44,2 | 42,5 | 35,2 | 19,6 | 15,5 | 12,7 | 15,0 | 14,6 | 16,6 |
| | 47,4 | 45,0 | 43,3 | 33,0 | 18,1 | 14,0 | 11,0 | 15,8 | 14,9 | 16,5 |
| **3** | 48,0 | 46,6 | 45,6 | 40,9 | 26,1 | 19,2 | 13,6 | 12,2 | 14,9 | 16,7 |
| | 47,6 | 45,7 | 43,5 | 38,5 | 21,8 | 16,9 | 12,9 | 13,8 | 14,7 | 16,0 |
| | 47,5 | 45,0 | 43,0 | 34,0 | 22,8 | 16,6 | 12,5 | 13,3 | 15,2 | 16,1 |
| | 47,9 | 44,8 | 43,5 | 35,6 | 19,4 | 15,2 | 12,4 | 12,7 | 14,8 | 15,6 |
| | 48,8 | 44,3 | 42,1 | 35,0 | 19,2 | 15,0 | 11,0 | 15,3 | 14,3 | 16,8 |
| | 47,8 | 44,1 | 42,8 | 34,5 | 17,7 | 13,4 | 11,8 | 15,4 | 15,0 | 16,8 |

Data shown in Tab.4 was used to estimate the average moisture content during every month within the time period of investigation. Tab.5.

*Tab. 5:Statistical data for wood moisture content*

| **Month** | **Xsr ± fxr** | **σ ± fσ** | **V ± fv** |
|---|---|---|---|
| March | 47,86 ± 0,09 | 0,47 ± 0,06 | 0,99 ± 0,16 |
| April | 45,26 ± 0,14 | 0,74 ± 0,10 | 1,64 ± 0,27 |
| May | 43,7 ± 0,22 | 1,14 ± 0,62 | 2,62 ± 0,43 |
| June | 37,11± 0,58 | 2,94 ± 0,41 | 7,94 ± 1,32 |
| July | 21,83 ± 0,67 | 3,36 ± 0,47 | 15,42 ± 2,63 |
| August | 16,24 ± 0,32 | 1,62 ± 0,22 | 9,97 ± 1,66 |
| September | 12,60 ± 0,18 | 0,94 ± 0,13 | 7,49 ± 1,24 |
| October | 13,87 ± 0,12 | 1,15 ± 0,16 | 8,29 ± 1,38 |
| November | 14,66 ± 0,07 | 0,39 ± 0,05 | 2,66 ± 0,44 |
| December | 16,05 ± 0,11 | 0,55 ± 0,07 | 3,45 ± 0,57 |

From Tab. 5 we can conclude that from March to December the moisture content has a trend of increasing from 47,86 % to 16,05 %. Moreover, the moisture content of the wood has a min. value of 12,6 % registered in September.

## CONCLUSIONS

- The raw material for the investigation is unedged and edged oak boards with thickness of 50,0 mm.
- The period of investigation is March-December 2008.
- Average statistical values for the temperature of air vary from 5,68 ± 0,35 $^0$C to 28,52 ± 0,49 $^0$ C.
- Average statistical values for the relative humidity of air vary from 49,04 ± 0,59 to 72,00 ± 0,88 %.
- Minimal value of wood moisture content of 12,6 % was obtained in September.

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