UNTYPICAL LEVELING MOISTENING TREATMENT OF WOOD

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Abstract

Untypical leveling moistening treatment of wood. Two treatments joining leveling moistening and cooling of dried wood were performed. Oak samples were used as a test material. Moisture content increase was determined, time of combined operation was compared to traditional moistening and cooling operations. Energy savings coming from shorter kiln fans operation were determined. Performed research is introductory tests describing possibility of practical application of modified moistening/cooling treatment.

Key words: *wood, drying, moistening, equalizing moistening, cooling*

INTRODUCTION

Typical run of drying process performed in cyclic type kiln is shown on fig. 1.

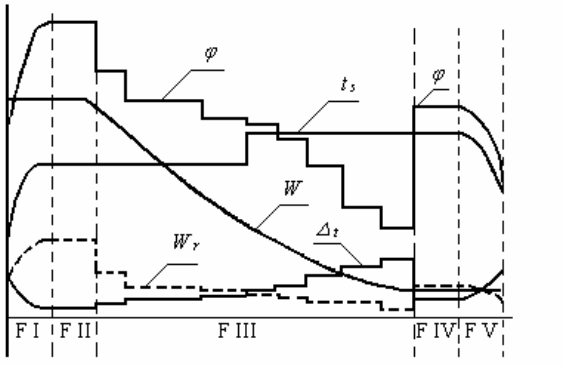

Fig 1. Typical drying run in cyclic-ype kiln. F I, F II, F III, F IV, F V – process phase, φ – relative air humidity, t_s – dry thermometer temperature (air temperature), Δt – difference between wet and dry thermometer, W – wood moisture content, W_r – equlilibrium moisture content of wood (Glijer 2005)

Phase I is heating. Temperature increase gradient must be controlled and adjusted to the timber thickness.
Professional literature (Glijer 2005) suggests following temperature gradients:

- 16 ÷ 29 [mm] thickness – 8 °C/h,
- 32 ÷ 60 [mm] thickness – 5 °C/h,
- 63 ÷ 100 [mm] thickness – 3 °C/h.

In this phase air in kiln heats up to the initial phase III temperature.

Phase II is initial moistening. When drying of freshly sawn timber this phase can be skipped. Air temperature equals to initial phase III temperature, psychrometric difference reaches 1 °C.

Phase III is the main drying. Along moisture content of wood drop air temperature increases and air humidity decreases.

Phase IV is equalizing moistening (conditioning). Aim of this process is to moisten external layers of dried wood which by leveling humidity lowers stresses resulting in cracking of wood. Example of humidity distribution along thickness of wood and after leveling moistening is shown on following picture:

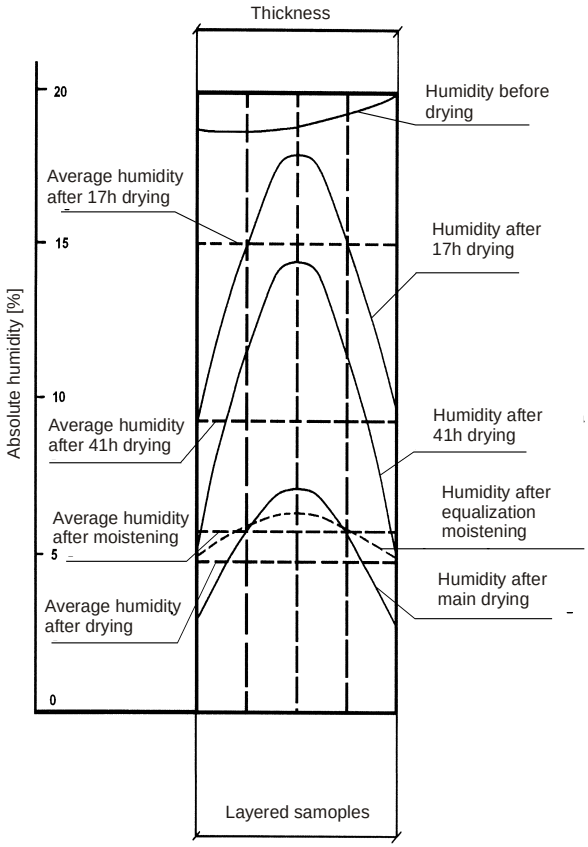

Fig 2. Moisture content distribution on the cross-section of 40 mm pine timber. (Janik 1965)

In this phase temperature should be equal to the final phase III temperature, air humidity should be sufficient that with set air parameters equilibrium moisture content was 2 percentage point higher than final moisture content of dried wood.

Leveling moistening time depends on timber thickness (Glijer 2005):

- normal drying
  - for softwood 2 h/cm,
  - for hardwood 2,5 h/cm,
- intensive drying extends time by 30%
- low-speed drying shortens time by 30%.

Phase V is cooling. Temperature drop in kiln should not by higher than °C/h. Cooling ends when temperature in kiln is not higher than timber storage temperature plus 25 °C (Glijer 2005).

It was decided to combine leveling moistening and cooling of wood determine results of such process.

MATERIAL AND TEST METHOD

Untypical leveling moistening was the last phase of regular drying process, made in industrial conditions. Test material was oak timber of $370^{\pm 2}$ mm length , $82^{\pm 2}$ mm width and $29^{\pm 1}$ mm thickness. Drying was performed in DQKR – 2/3 kiln, with around 11. m^3 capacity of timbers stacked in 16 trays.

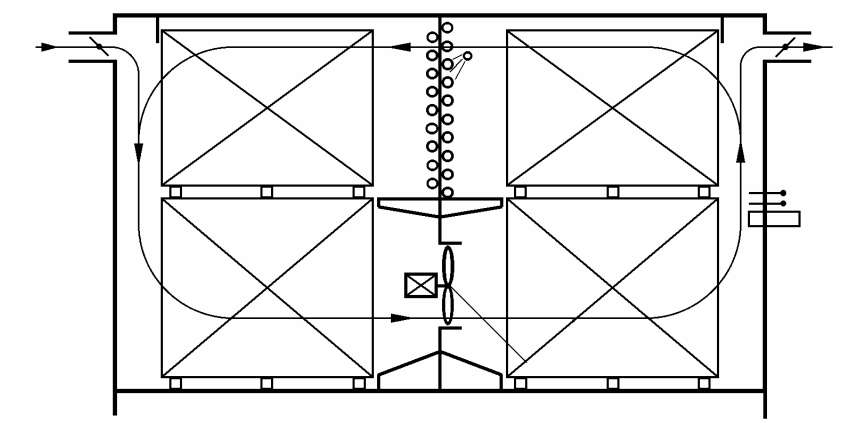

Fig 3. DQKR kiln (M. Domański)

After drying 32 timbers were picked (2 from each tray). Timbers were marked weighted with 0,1 g accuracy and were put back into the kiln. Hot water inlet to kiln heaters was stopped, ventilation was shut and water spraying was started. with working fans moistening was conducted by 1,5 hour, until psychrometric difference of 7 K was reached. After that water sprayers and fans were shut down. Timber was left in kiln for 13,5 h with moist and steadily cooling air. After that process control samples were weighted and their moisture content determined. Both untypical moistening processes were conducted in May.

RESULTS AND ANALYSIS

In table 1 following values are presented:

- air temperature in kiln – t_s,
- relative humidity of air in kiln – φ,
- equilibrium moisture content of wood – W_r,
- moisture content of wood – W_0.

Presented values are measured after main drying process, after moisturizing by water spraying and after combined cooling-moisturizing process.

Table 1. Air parameters and wood moisture content in untipical moisturizing process

Process number	End of main drying				End of air humidification			End of untypical moisturizing process			
	t_s [°C]	φ [%]	W_r [%]	W_0 [%]	t_s [°C]	φ [%]	W_r [%]	t_s [°C]	φ [%]	W_r [%]	W_0 [%]
I	50,2	17,0	3,5	5,8	47,4	65,0	10,4	26,5	86,0	18,4	6,6
II	53,8	22,0	5,7	7,3	50,3	65,0	10,4	25,8	82,0	16,9	7,9

As data presented in table shows untypical moistening increases moisture content of wood by 0,8 and 0,6 percentage point. With typical process moisture content increase is higher and reaches around 1,0 ÷ 1,5 percentage point.

For 29 mm hardwood timber typical moistening time equals 7,25 h (2,9 x 2,5).

Cooling time with kiln air temperature drop 6 °C/h, should equal as follows:

- in process I — 4 h,
- in process II — 4,7 h.

Combined typical moistening and cooling time would be:

- in process I — 11,25 h,
- in process II — 11,95 h.

Untypical process reaching 15 h would be then longer than combined typical moistening and cooling performed with maximum speed. With lower cooling speed times reached would be similar.

In typical moistening process going on 7,25 h, kiln fans were switched on. In untypical processes fans were on only 1,5 h. This gives 70,5 MJ energy savings in both processes.

Timber in machining into wood flooring performed similarly as traditionally moisturozed timber.

CONCLUSION

After two conducted untypical moistening processes following conclusions may be withdrawn:

- obtained results justify the need of further research on untypical moistening process of wood,
- research should contain:
  - various timber,
  - variable timber thickness,
  - various kilns,
  - variable outside air temperature,
  - moisture content distribution on timber thickness after processing,
  - development of optimal psychrometric difference after air humidification for specific timber (type, thickness, difference between expected and reached moisture content after main drying),
  - hardwood and softwood species.

REFERENCES

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