4.2 Drying Rate Test

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乾燥速度係数測定

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4.2.1 Purpose

The purpose of this study is to clarify the drying speed of some woods from Togian Island, Slawesi, at low moisture content by treating the test specimen at constants temperature and depression.

4.2.2 Experimental Procedures[1)]

From every species, two heart-wood boards were taken which were representative for edge- and flat-grain boards. Each board was kept in green condition, and then it was planned, trimmed and cut-off to get test specimens which have size 2.0 cm x 10 cm x 30 cm in thickness, width and length respectively.

Those test specimens were end-coated by silver paint, and so were done for sides-board. So, only two surfaces indicated by its length and width were open for measurement rate of drying.

The test specimens were put in the room, conditioned at temperature 20°C and depression about 3°C, from green condition until reaching 30% to 25% moisture content. Afterwards, the test specimens were put in the kiln which had air velocity 1-0.3 m/sec and drying condition as expressed in Table 1.

Table 1. Drying Condition for Drying Rate Test.

Moisture Content (%)	Dry-Bulb Temperature (°C)	Depression DBT-WBT (°C)
25 – 20	45 ± 2	7 ± 1
20 – 17	55 ± 2	15 ± 2
less than 17	60 ± 2	25 ± 2

During the drying at temperature 60°C and depression 25°C, the test specimens were measured weight-lost every 10-12 hours until moisture content reached 5%. Therefore, drying rate du/dt was calculated at any point between 15%-6% moisture contents with interval 1%.

The values of drying rate, du/dt, are plotted in the co-ordinate system regarding to its moisture contents. By this correlation, the tangent of drying rate at 10% moisture content is calculated, as expressed as following equation,

$$du/dt = K\,(Ua - Ue)$$

which, du/dt represents the drying rate at a% moisture content, K is the coefficient of drying rate, Ua is the moisture content at a, and Ue is equilibrium moisture content at drying condition.

4.2.3 Result

See Table 2.

Table 2. Coefficient of drying rate of each species

No.	Wood Species	Density[1] (gr/cm^3)	Shrinkage[2]		Coefficient of Drying Rate K (1/h x 10^{-2})
			Tan. (%)	Rad. (%)	
12.	*Santiria sp.* (2)	0.66 ~ 0.67 0.57 ~ 0.58	7.1–7.7 6.7–7.1	5.4–5.7 4.1–4.7	1.9–2.0 3) 1.9 4)
15.	*Terminalia sp.* (1)	0.37 ~ 0.40 0.49 ~ 0.50	4.9–5.8 6.4	2.7–3.2 3.9–4.0	11–13 3) 5.1–5.2 4)
17.	*Terminalia sp.* (3)	0.67 ~ 0.70 0.66	6.8 ~ 7.0 7.6–7.9	4.4–5.2 4.6	4.2–6.2 3) 3.2–3.4 4)
32.	*Litsea sp.* (2)	0.48 0.48 ~ 0.49	6.4–6.6 5.7–6.2	3.5–3.7 3.9–4.4	5.1–5.3 3) 3.9–4.2 4)
40.	*Sandoricum sp.* (1)	0.40 0.39 ~ 0.40	5.9 9.9–10.4	2.2–2.5 3.2–4.1	13 3) 6.1–7.7 4)
56.	*Palaquium sp.* (1)	0.48 0.47 ~ 0.48	7.1–7.3 –	4.2–4.7 –	5.5–5.6 3) 4.8–4.9 4)
61.	*Ailanthus sp.* (1)	0.37 ~ 0.38 0.40	6.2–6.6 5.9	3.7–4.0 3.6–3.7	15–16 3) 10–11 4)
63.	*Duabanga sp.* (1)	0.41 ~ 0.42 0.41	5.7–5.8 4.9	3.5–3.7 2.9–3.0	5.5–6.1 3) 6.7–6.9 4)
67.	*Heritiera sp.* (1)	0.48 ~ 0.49 0.53 ~ 0.55	7.1–8.4 7.7–7.9	4.3–4.5 4.8–4.9	4.8–5.4 3) 4.9–5.0 4)
72.	*Sterculia sp.* (1)	0.23 ~ 0.31 0.34 ~ 0.36	6.1–7.0 7.9–8.1	2.7–3.2 2.7–2.8	36–52 3) 19–23 4)

Notes:

1). At oven-dry condition.
2). Absolute shrinkage.
3). Flat-grain board.
4). Edge-grain board.

4.2.4 Discussion

The comparison of coefficients of drying rate between flat-grain board and edge-grain board is more informative for drying purpose. From ten species which were investigated in this experiment can be classified to three categories. The first-one is both values of K are almost same, i.e. *Santiria sp.* (2), *Duabanga sp.* (1) and *Heritiera sp.* (1). The second-one is the K value of flat-grain is slightly larger than its edge-grain, i.e. *Litsea sp.* (2), *Palaquium sp.* (1). And the third-one is the K value of flat-grain is large different from edge-grain, i.e. *Terminalia sp.* (1), *Terminalia sp.* (3), *Sandoricum sp.* (1), *Ailanthus sp.* (1) and *Sterculia sp.* (1).

Therefore, it can be explained that there is no relation between the density of wood and the K-ratio of flat-grain and edge-grain. But, generally the high density wood has K value of flat-grain much larger than its edge-grain because much more water can diffuse through ray parenchyma in flat-grain than its in edge-grain boards to the board surface. The drying rate ratio of flat- and edge-grain boards corresponding to its specific gravity is shown in Figure 1.

Unfortunately, the discrepancy of this phenomenon can not be recognized, but it can be recognized that the advantage of this characteristics is edge-grain board easy to be dried, so it can be dried together with flat-grain board without serious problem.

References.

1). Shin Terazawa and others: The properties of the important Japanese woods. Drying properties (1), Bulletin of the Government Forest Experiment Station No. 153, (1963).

2). Shin Terazawa and others: The properties of Tropical Woods 12, V, Drying Schedules of Thirteen Species of Kalimantan Woods, Bulletin of the Government Forest Experiment Station No. 218 (1968).

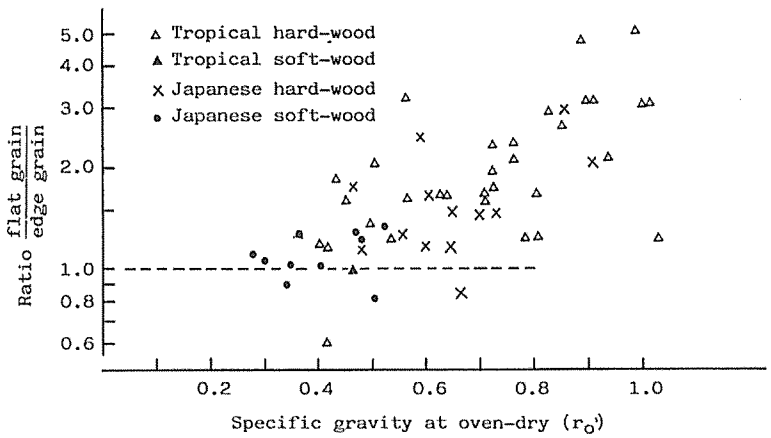

Figure 1. Drying Rate Ratio of Flat- and Edge-Grain Boards.[1)2)]

4・2・5 概　　要

乾燥速度係数測定

2㎝厚の板目，まさ目心材各2枚づつを用意し，含水率約25％になるまで天然乾燥し，その後は順次温度を上昇し，乾湿球温度差を開き含水率約17％に到達した時には乾球温度60℃，乾湿球温度差25℃の一定とし，含水率が約5％になるまで乾燥を継続する。

乾燥の終了した供試材は全乾とし乾燥経過を求め，乾燥速度と含水率との関係に図示し，乾燥速度の低下曲線の含水率10％の位置で接線を引き，$\frac{du}{dt}=K(Ua-Ue)$のKを求める。

供試材は10種類で9属よりなり，実験結果をTable 2に示す。今迄に実験した南洋材や日本産材についてみると板目とまさのKの値の比率は比重が大きくなるとFig 1のように大きくなる場合が多いが，今回の試験ではこのような傾向が明らかでなかった。