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主　論　文　の　要　旨

論文題目　Research on hygrothermal properties of tension wood G-fiber
（引張あて材ゼラチン繊維の熱・水分物性に関する研究）

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論　文　内　容　の　要　旨

Forest resource, unlike other natural resource, can be replenished. Nevertheless, people coincide on a consensus that natural forest should strictly be conserved. Forest resource, the majority of which currently are artificial forest, be it softwood or hardwood. If we look into the tropics and sub-tropics, the major constituents are fast-growing hardwoods. *Eucalypts*, *Tectona grandis*, *Acacia mangium*, *Hevea brasiliensis* are just a fraction of fast-growing hardwoods. Fast-growing hardwood grows rapidly, hence, they gain volume that are equitable to harvestable threshold in much reduced time. However, when quality of wood is an issue, they stand out because the wood so produced during early stage of life such as 10~15 years, soon after planting, is juvenile. In addition, they have high proportion of reaction wood. The upper side of inclined trunk of hardwood produce tension wood that are characterized basically by higher magnitude of tension, where typically G-layer in the innermost of cell wall is visible. On the contrary, lower side of inclined trunk of softwood produce high magnitude of compression.

Wood cannot be used until they are dried to lower than fiber saturation point. Hence, trees that have been felled for wood has to go through kiln-drying before being put to use. During kiln-drying, water is evaporated off so that wood is increasingly dry. With the departure of water below fiber saturation point, wood shrinks. The coefficient of drying shrinkage of temperate species is 0.1~0.2% in longitudinal direction, 3~5% in radial direction and 6~10% in tangential direction. However, this does not apply for tension wood. Timber containing tension wood shrinks 10 times as much as that of normal wood in the longitudinal direction. The reason for tension wood to shrink that unusually or the mechanism behind it has been sought in this thesis.

Early into kiln-drying when wood has near green state moisture content, heating produces similar effects as heating wood under water. Hence, hygrothermal treatment has been employed to reconstruct the effect of heating early on into kiln-drying. The result is thought to unfold the real nature of hygrothermal recovery.

Thesis starts with the background information in the first chapter. This involves definitions, introduction of tension wood and problems surrounding the usage s of tension wood. Second chapter introduces macroscopic deformation phenomena of tension wood hygrothermally treated at 120 ◦C. *Quercus serrata*, *Hevea brasiliensis* and *Acer rufinerve* were the subject tree species in this chapter. When hygrothermally treated, a significantly large contraction soon after being heated was seen; this was named as initial recovery. Continuum contraction followed initial recovery. Initial recovery combined with continuum contraction is understood as what formerly used to be hygrothermal recovery. The trend line obtained were fitted with exponential function that allowed parametrization. This trend was thought to be relevant with the property of gelatinous -layer of G-fiber.

Third chapter explores if hygrothermal recovery was temperature-dependent. *Quercus serrata* tension wood samples were hygrothermally treated at three different temperatures:- 120, 100, 80 ◦C. The parameters obtained after fitting was compared among the groups. The results revealed that parameters were quite temperature-dependent.

In the fourth chapter, I have tried to examine if retarded recovery could be induced by drying and wetting over multiple times. Samples of *Quercus serrata* tension wood was given multitude cycles of treatments, each cycle consisting drying and wetting. Retarded recovery in tension wood along the longitudinal direction was contractive and significantly large in magnitude. Over repetition of cycles the magnitude of recovery grew. Retarded recovery in normal wood is expansive and insubstantial. In tangential direction, retarded recovery was contractive and insubstantial.

The finding from these studies suggest that hygrothermal recovery is an inevitable mechanism when tension wood is kiln-dried. Furthermore, hygrothermal recovery is a temperature-dependent behavior. Last but not least, I suggest the possibility of drying that does not apply heat to be used to induce retarded recovery in tension wood to make it stress free.