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TENSION WOOD IN RUBBERWOOD

by

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Introduction

The occurrence of tension wood is a common phenomenon in rubberwood (*Hevea brasiliensis*). Several studies on rubberwood, both locally and abroad, indicate that the presence of tension wood in rubberwood may be serious (Lim 1985, Rao & Hermavathi 1989). Thus, a knowledge of tension wood is necessary as tension wood affects the ultimate utilisation of the timber.

Tension wood is commonly found in branches and leaning trunks (Figure 1), the trees growing on slopes or as a result of exposure to prevailing wind or due to various other causes under normal forest conditions such as the competition for light. It is believed that the formation of tension wood is a natural reaction of the tree to 'pull'the tree into a more normal, upright position. Thus, tension wood is formed in connection with movements of orientation in woody plants and is associated with eccentric pith. Generally, eccentric pith is nearer to the lower side, with the tension wood occurring above the pith. However, studies carried out on tension wood indicate that tension wood fibres, though more abundant on the upper side, occur on all sides of some logs. Observations made on Malaysian rubberwood logs also indicate that tension wood may be in the form of concentric or crescent-shaped zones distributed throughout the cross-section of the stem (Lim&Ani 1994, Lim &Mohd. Nadzri 1995).

Figure 1. A typical example of leaning trees in a rubber plantation

Characteristics of tension wood

Generally, tension wood is harder and denser than normal wood; the vessels are fewer and smaller and there is presence of gelatinous layers (G -layers) which are nearly pure cellulose and are not lignified. It can be easily detected by its lustrous, silvery appearance on a clear-cut end surface (Figure 2). Tension wood can also be recognised by dipping the cross-section of the wood in chemical solution comprising 1 g of phloroglucino in 50 mI of ethanol (95%) and 50 mI of concentrated hydrochloric acid for a period of 1 min. The tension wood zones, which lack lignin, do not stain, whereas the normal wood turns crimson after reacting with the chemical solution. During sawing, tension wood in rubberwood can be detected by the presence of unsually rough or woolly surface with signs of torn fibres. The sawing of the timber may be extremely troublesome as the fibres tend to choke the saw cut, increasing resistance and blunting the teeth quickly.

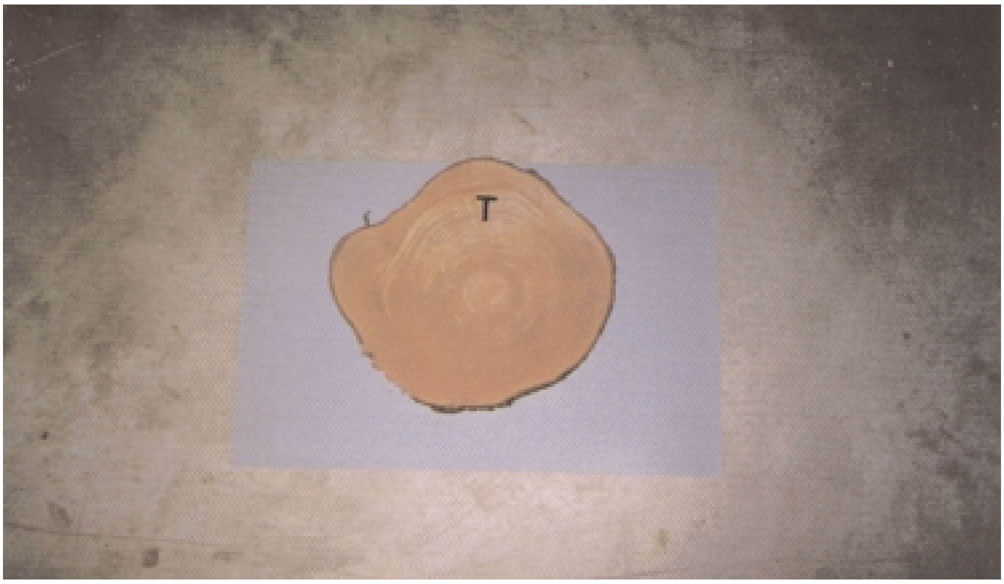

Figure 2. A disc from the stem of a rubber tree (the light-coloured zones indicate the presence of tension wood) (T)

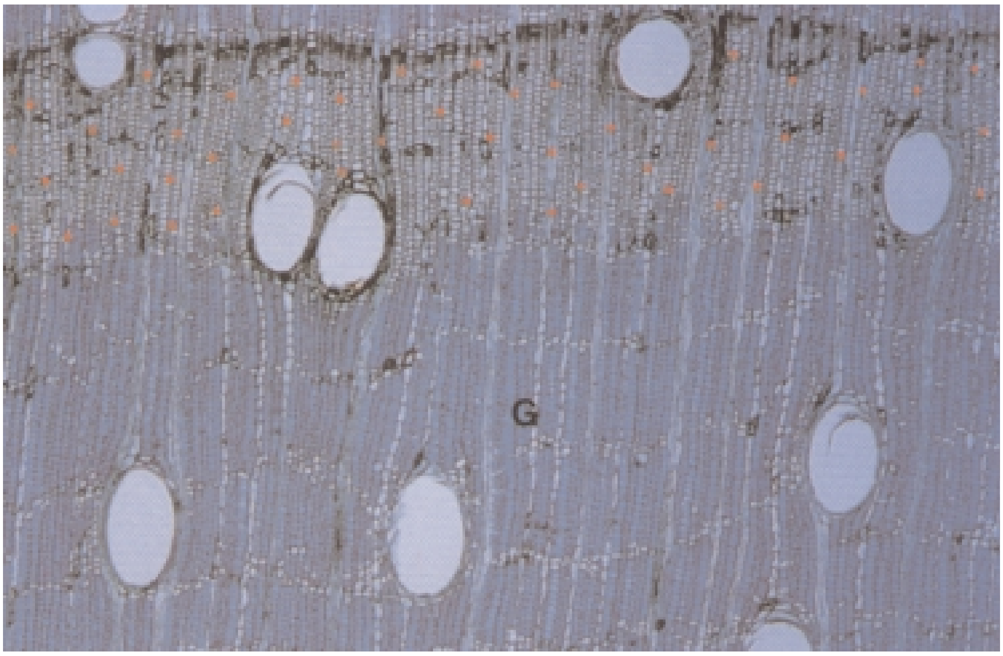

Figure 3. A photomicrograph of the cross-section of rubberwood showing the normal and tension wood zones (stained blue) (G)

Microscopically, tension wood can be readily recognised because of the presence of gelatinous layers (or G -layers) in the fibres. As the G -layers is unlignified, it does not accept safranin stain and thus, when double-stained with astra blue, the tension wood zones will stain blue, whereas the normal wood zones will stain red (Figure 3).

The presence of tension wood in the rubberwood may be fairly substantial. For example, in India, the proportion of tension wood has been found to range from 15 to 65% (Rao *et al* 1983). In Malaysia, the percentage of tension wood present varies with clone and age. For example, it has been reported that for clone RRIM 600, there is a gradual decrease in the amount of tension wood as the tree grows older. When clones RRIM 600 and PB 260 were compared, clone PB 260 was found to contain a slightly higher percentage of tension wood than clone RRIM 600 (Ani & Lim 1992, Lim & Mohd. Nadzri 1995) (Table 1). When comparison was made between the stem and branch (Lim & Mohd. Nadzri 1995), it was found that the percentage of tension wood in the stem (range 13 - 41 %) was slightly higher than that found in the branches (range 10 - 34%).

However, the difference in the amount of tension wood between the stem and branch woods is not significant enough to give fise to great variation in their properties, especially those associated with tension wood,e.g. shrinkage.

Table 1. Percentage of tension wood in two different clones of rubberwood at various ages and tree heights

Age	Clone							
	PB 260				RRIM 600			
	B	M	T	Mean	B	M	T	Mean
3	35	40	57	44	-	-	-	-
8	27	29	37	30	42	33	25	33
14	49	36	52	45	-	-	-	-
24	-	-	-	-	39	29	25	31
29	-	-	-	-	25	30	30	28
29	-	-	-	-	24*	24*	20*	22*

Note: B: basal; M: middle; T: top; *: branch wood

Sources: Ani & Lim (1992),
Lim & Mohd. Nadzri (1995).

Utilisation of tension wood

The utilisation of wood containing tension wood has given rise to various problems. The problems may be considerable or insignificant depending on the amount and the distribution of tension wood tissue, the degree of abnormality of the fibres and the use of the wood. Generally, tension wood differs from normal wood in physical, chemical and anatomical features. The presence of G -layers makes the wood surface lustrous, woolly and rough, causing various problems in utilisation. Some of the problems associated with the presence of tension wood are:

(1) Machining and woodworking properties

It has been found that in some extreme cases, saws and cutters get blunted fairly easily. Rough and woolly finish is often produced in sawing and peeling green material as fibres tend to be partly torn out rather than cut cleanly. The woolliness is caused by lack of adhesion between the G -layers and the other cell-wall layers, and these layers tendto be pulled out during the cutting action.

(2) Drying properties

In the drying process, timber containing tension wood tends to have abnormally high longitudinal shrinkage and may cause distortion in the form of bow, cup, spring or twist, especially in relatively thin boards and small dimension stock (Choo & Hashim 1994). Dried boards containing tension wood may suffer further distortion like splitting and resawing or machining because of stresses set up during drying.

Collapse during seasoning may also be due to tension wood. This is especially liable to occurwhere the tension wood is in well-defined bands. Unlike collapse in normal wood, it is not remediable by any form of conditioning treatment. However, in the case of rubberwood, the incidence of collapse is rarely reported.

(3) Strength properties

Information pertaining to the strength properties of tension wood seems to be rather limited and is not always consistent. Generally, tension wood is weaker in most strength properties than normal wood, the differences are usually not large enough to constitute a hazard if the material containing tension wood is used in the usual specifications for construction purposes (Hughes 1965).

Basing on the above, the use of rubberwood containing tension wood may cause serious degrade and reduction in quality of wood, depending on the intensity of its occurrence and the purpose for which the wood is used. Its effects can be minimised by careful selection and manufacturing, starting with detection either in the log or at an early stage in processing. In breaking down logs, tension wood should be included, if possible, in short and thick pieces, where it is less liable to warp, and not in sizes where shape and stability in the finished article are important.

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