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Detection of Reaction Wood of Mahagony Using Two Differences Methods

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ABSTRACT
This research focuses on the reaction wood and macerated fibers of Mahagony. Reaction wood as defined by IAWA is a wood with distinctive anatomical and physical characteristics, formed typically in parts of leaning or crooked stems and in branches, that tends to restore the original position of the branch or stem when it has been disturbed, also known as tension wood (in deciduous trees) and compression wood (in conifers)". The samples were taken from the tree at Mulawarman university area. For determining the reaction zone, 'Herzberg's reagent and double staining method were used. Observation on both macroscopic and microscopic feature used IAWA standard, included wood fibers. The result showed that using Herzberg's method the macroscopical and microscopical structure of reaction wood and also the macerated fibers were distinctively clear. Macroscopically the reaction wood was identified by eccentricity appearance of the ring wood and dark brown color with coarse texture in the cross section and interlocked grain in the radial section and also wolly structure in tangential section while microscopical structure using Double staining method showed that the reaction cells and macerated fibers are distinctively not clear.

INTRODUCTION

Wood is a metabolism product of tree which is influenced highly by its outside factors, and it can cause different specific properties of wood (Panshin et.al, 1964). Research on wood properties is a main step which is very important to get the information about its structure and it can also be used as a basic work to define its use and its processing properly. The anatomical of woods are different depend on the species. Because every wood species is formed by cells which has various function and compositions. Unfortunately, information about properties of wood could be a threat and a challenge of its use. Wood properties should be known before its processing or use as a construction, industry materials or households and the important properties include anatomical, physics and its chemical properties (Dumanaw, 2001).

Reaction wood according to Haygreen and Bowyer (2003), is an abnormality of wood where the trunk has been impacted by high pressure from outside due to disturbance its natural stability and the abnormality of the tree will produce thick fibers forms. The bigger pressure to the trunk vertically, the more reaction wood will produce (Tsoumis, 1976; Desch and Dinwodie, 1996). According to IAWA Reaction wood is a wood with distinctive anatomical and physical characteristics, formed typically in parts of leaning or crooked stems and in branches, that tends to restore the original position of the branch or stem when it has been disturbed, also known as tension wood (in deciduous trees) and compression wood (in conifers). Mahogany tree (Switenia mahogany) grow very densely in the campus areal of Mulawarman University, some of them grow in abnormal position, that could be identified as the reaction wood. Accordingly, the tree was cut and taken as sample in this study.

METHODS

One section of Mahagony tree with the thickness of 3cm, which was indicated as reaction wood was taken and observed. First the surface of the disk was cleaned and dropped with Herzberg's reagent or Zinc chloride-iodine solution for five minutes until it changes (Husien et.al. 1996). Sample preparation is shown as follows:

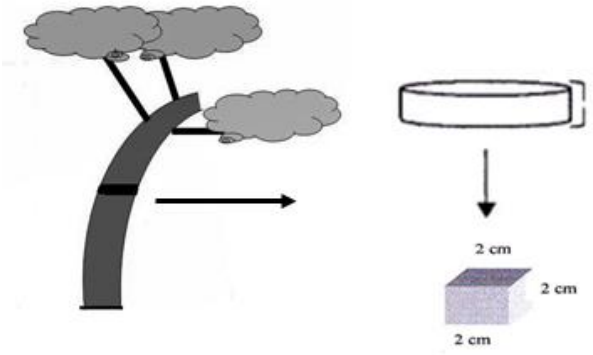

Fig 1. *Sample Position*

Secondly the disk was cut three dimensional sections, namely transversal, radial and tangential sections with the thickness 2x2x2cm then sliced in the transversal section by microtome with the thickness of 20µm-30µm and macerated using HN03 60%. Herzberg's reagent and double staining solution again were dropped on the thin preparates to get the differences among reaction cells more clearly. Then the cells of reaction wood and macerated fibers were observed under microscope, measured and photographed.



Fig 2. *Wood Disk Sample Indicated as Reaction Zone*

RESULT AND DISCUSSION

Macroscopic Feature on Transversal Section

Macroscopic feature of the wood disk can be observed without using microscope, and the appeareance of reaction wood on the cross section, was seen clearly by an eccentricity of pith in disk (fig. 2). To be more clearly, parts of reaction wood in this research is also determined by using Zinc-chloride-iodine solution (Herzberg's reagent), which is swab on it and the parts of the reaction cell will dark purple, different from the colour of non reaction cells (Fig. 3):

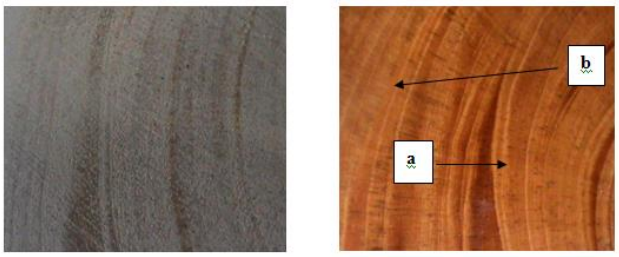

Fig 3. Result in Tranversal Section, before and after dropping test

After dropping test of the Zinc-chloride-iodine, as shown above in Fig. 3, two different coloured parts are scattered in the circumference of the growth ring (Fig 3a), it has a dark brown or darker color, indicating that this zone has more reaction cell, and 3b has a light brown color (brighter than the Fig.3b) indicating normal wood cells. This is similar to the results of Husien.et.al (1996) who studied on particle board, that after the drop of Zinc-chloride-iodine solution, the parts of board containing the reaction cells changed to be darker than normal parts.

Macroscopic Feature on Radial Section

Similar to the transversal section, the subsection of the wood disk, after dropping of Zinc-chloride-iodine solution showed the color change on the wood surface clearly. In the radial part of mahogany (Swiethenia mahagony) which is indicated the reaction cell, the color changed to dark brown, while some are light brown. More clearly the picture of the radial section in the subsection of the wood of mahogany (Swiethenia mahagoni) can be seen in Figure 4 :

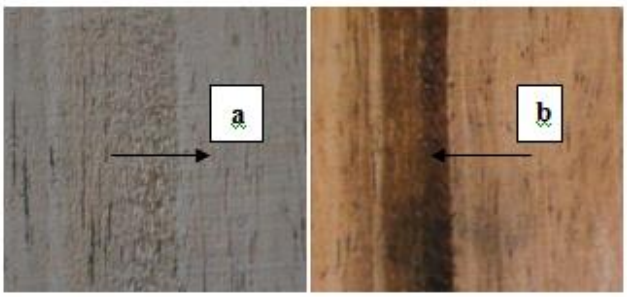

Fig 4. *Result in Radial Section, before and after dropping test.*

Figure 4 above shows the changing of the color of radial section of Swiethenia mahagony. Based on the observation in the radial section and also to the subsection of the radial, before the Zinc-chloride-iodine solution was dropped (Figure 4) the surface of wood is light brown with partial smooth (a) and partially hairy (b). This is exactly what Dadswell (1958) and Jane (1962) said, that the properties of reaction wood tend to produce curly surfaces." Similarly, Casperson (1968) noted that pieces of longitudinal section, wood fibers which containing reaction cell tend to be hairy.

In wood, the part that indicated as wood reaction, tends to have a dark brown color naturally, due to the vertical stem forming reactions or force the growth of the stems inclined to be straight up. Other clues to the existence of reaction wood is its surface, when is exposed to a saw machine or exposed to a craft

machine on a number of wood species, it forms a typical reaction with the dark brown. This characteristic can be found on a number of tropical hardwoods. Unfortunately, all of these are not a hint, so the identification will become more complicated because cell of the reaction wood are rarely composed but often in groups with normal cells (Scurfield, 1973). Therefore, with the dropping treatment of chemical zinc chloride iodine solution (Herzberg's Reagent), it is known that with this treatment the differences between normal cell wood and abnormal cells can be distinguished (Husien.et.al.1996).

Microscopic Structure

The Fig 5. below shows a cross section structure (a) and macerated fiber of normal cells (b) of *mahogany*.

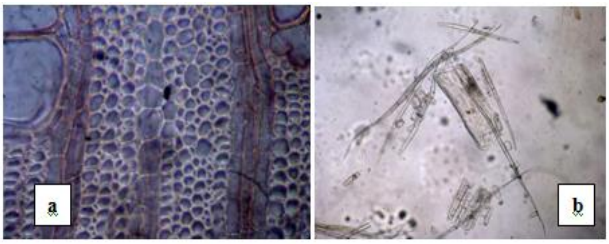

Fig 5*. Transversal Section of normal cell (a) and Macerated Fibers (b)*

According to Pandit (2005) the form of wood fiber reaction cells, in the cross section is seen no longer round, but changed into irregular shapes. There is a conformity of the study of Nurcahyo (2006) to sengon wood (*Paraserianthes falcataria*) that the form of the visible cross-sectional area of the wood is no longer round, but tends to be irregularly. This is also in accordance with what has been expressed by (Haygreen and Bowyer, 1989), that the arrangement of cell walls depends on the level of development of a particular cell at the time of the tilt of the stem. The cells have the S-1 and S-2 secondary walls which will immediately stop normal development when the trunk is tilted and will change with the development of layer G (gelatinous).

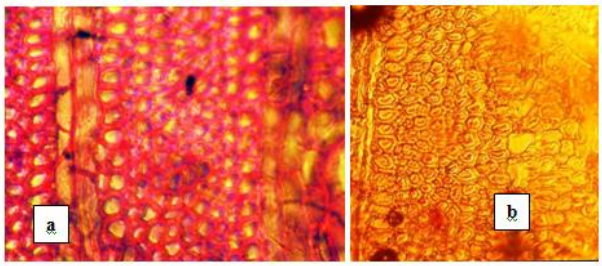

Fig 6. *Transversal Section. By Double staining Method (a) Herzberg's Method (b)*

In the figure 6 (a) it can be seen that by using the double staining method, the cells of reaction and normal wood can not be clearly distinguished, cells of reaction wood are indistinguishable. Whereas by using herzberg's solution, the difference between reaction cells of normal wood cells can be seen clearly, where the cell shape of the wood cell reaction is irregular and filled by the layer of gelatin (G-layer). This is in accordance with what is described by Husien. et.al (1996), which examines the wood fiber reaction of lamina boards of the Papel species (*Populus* sp) that the reaction wood cell can be distinguished from normal cells due to the presence of layers of gelatin cells in the cell wall, in addition to treating the liquid Chlorzinc Iodine the reaction can be easily distinguished from normal fibers, as shown in the Fig. 6.

Macerated Wood Fibers

The presence of fibers that have been macerated can also be seen easily. It was done by dropping liquid into fiber tubes, then observed them under the microscope, the differences between reaction and normal fibers are seen, that the fibers containing the reaction cell will be dark, because the sockets react with the chemical of liquid.

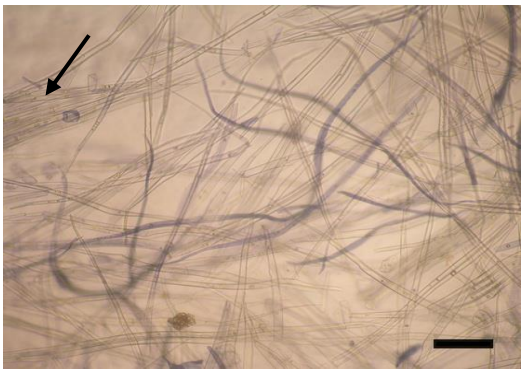

Fig 7. *Reaction cell of Macerated fiber by Herzberg's Reagent*

Figure 7 show that these results are accordance with the research by Jayme (1958) as well as Husien.et.al (1996), explaining that normal fibers with zinc chloride iodine solution are generally colorless (b), while the wood fiber reaction cells are dark blue or darker (a). This is due to the reaction with cellulose in the cell wall which is not lignificated.

CONCLUSIONS

Macroscopically, the part of reaction wood of Switenia mahogany can be known easily, especially in transversal section characterized by an eccentricity of pith. The Herzberg's method is more effective to detect the reaction wood both macroscopically and microscopically. but the double stanning method can not be used effectively to detect the reaction wood either macroscopically nor microscopically. The macerated fibers of reaction wood are characterized by dark blue that covers all parts as well.

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