Volume 4 No. 2, February 2014 ISSN 2224-3577

International Journal of Science and Technology

http://www.ejournalofsciences.org

The Susceptibility of *Cola nitida* and *Funtumia elastica* to Some Drying Defects

Bernard Effah
Department of Interior Architecture and Furniture Production, Kumasi Polytechnic, P.O. Box 854, Kumasi-Ashanti, Ghana-West Africa
Department of Forest and Wood Science, Stellenbosch University, South Africa

ABSTRACT

Cola nitida and *Funtumia elastica* are two lesser-known species in Ghana that are not used for commercial timber purposes. The objective of this study was to determine the susceptibility of *Cola nitida* and *Funtumia elastica* to some drying defects as the basis for determining the potential uses that may encourage the utilization and promotion of these two lesser known species. The basic drying characteristics were determined using the quick drying test method developed by Terazawa. The experimental results revealed the following degrees of defects; checks in the early stages of drying were less severe in both species (Class 3). There was no honeycombing (Class 1) in both species as well as no deformation (Class 1) in both species. This in turn may be followed by an evaluation of their utilization potential, marketability and performance, so as to serve as suitable substitutes for the fast-diminishing traditional market species in Ghana.

Keywords: *Lesser known, drying defects, quick drying, Cola nitida and Funtumia elastica*

I. INTRODUCTION

Although there are many tree species in the world especially in the tropics, Ghana has considerable wealth in tropical hardwood timber resources. Forest product exports represent about 12% of total export of goods [1]. Before the ban on round logs export in 1994, about 55-65% of the wood exported from Ghana was in the form of round logs and 32-47% in green lumber [2]. The Ghanaian government's policy was aimed at encouraging the production of added value timber products and the export of kiln-dried sawn timber and other machined wood products [3]. There are nearly seven hundred different tree species in Ghana [4]. Approximately 420 of these tree species attain timber size and therefore are of potential economic value [5]. Almost 126 of them occur in sufficient volumes to be considered exploitable as raw material base for the timber industry [6]. However, about 90% of the country's wood exports are covered by 10 species [7], and only 4 species contribute roughly 60% of the total production [8].

Historically, most dealers in the Ghana wood industry have relied mainly on a traditional knowledge based on experience of use of the various species but with little or no information on their properties. Most of the species are also not being put to wider utilization because of inadequate data on the physical and technological properties that relates to the utilization of the species. One such important data is the drying properties of the species. For many lesser-utilized species, there does not appear to be any published record of a recommended kiln schedule [9], among them are *Cola nitida* and *Funtumia elastica*. For many end-uses and secondary manufacturing processes, lumber should be dried to avoid undesirable defects such as excessive shrinkage, warping, splitting and checking, stain and decay caused by fungal attack. Kiln schedules for drying the wood species chosen for the study have so far not been developed and as such their drying behaviour is not known. Since drying improves wood quality and maximum value-addition, the target for the wood industry on drying should be encouraged.

It is, therefore, important that the susceptibility of these two wood species to drying defects (splits, checks, collapse, honeycomb), which are related to their interaction with moisture, be studied to provide important information on the ability of particular species at particular moisture contents to be utilized for specific purposes [1]. Measurements of these physical and technological properties relevant to the drying of wood are also aimed at developing appropriate drying schedules for specific end-uses.

Presently, *Cola nitida* is widely used ceremonially and socially by the people of West and Central Africa and *Funtumia elastica* also gives the best indigenous rubber, and is the only true rubber tree of West African forests whiles their timber is used as firewood. Because few tree species are being utilized commercially, there is an erroneous impression that there is an insufficient raw material base for the timber industry in Ghana. The present kiln-drying schedules in use in Ghana were development for only the so-called 'noble' species.

There is, therefore, the need to investigate the drying behaviour and if possible draw up satisfactory drying schedules for the numerous lesser-known species that may soon be exploited [1]. This means that suitable processing of *Cola nitida* and *Funtumia elastica* which are lesser-known to the timber industry in Ghana are essential for the production of high quality products for national and international markets. It has, therefore, become imperative to adopt systematic and scientific techniques to determine the drying characteristics of *Cola nitida* and *Funtumia elastica* species to promote their utilization. This in turn may be followed by an evaluation of their utilization potential, marketability and performance, so as to serve as suitable substitutes for the fast-diminishing traditional market species in Ghana.

There is also very little information about the variability in timber properties with respect to drying, including how strongly they are correlated [10]. The variability of wood properties further complicates drying. Each species has

Volume 4 No. 2, February 2014 ISSN 2224-3577

International Journal of Science and Technology

http://www.ejournalofsciences.org

different properties, and even within species, variability in drying rate and sensitivity to drying defects impose limitations on the development of standard drying procedures [11]. It is important that *Cola nitida* and *Funtumia elastica* be subjected to these tests.

Proper utilization of a particular wood species must be based on both basic properties and processing properties. Drying properties are a set of the most important processing properties. A proper drying process will be the main key to efficiently utilize and ensure high quality wood products [12] [13]. The purpose of the study was to determine the susceptibility of *Cola nitida* and *Funtumia elastica* to some drying defects as the basis for determining the potential uses that may encourage the utilization and promotion of these two lesser known species in Ghana.

II. MATERIALS AND METHODS

Materials

Three matured logs each of *Cola nitida* and *Funtumia elastica* species were obtained from the South-western part of Ghana to provide wood for the determination of drying properties for the species. The logs were secured from a cocoa farm in the same locality within the open forest of the area. The species were selected because of their availability in the forest as well as their commercial bye products of cola nuts and natural rubber respectively, whiles their timber resource are left unutilized.

Thereafter, each felled tree was cross cut into three sections from the base to the top. To be in line with the conventional sampling strategy of 0%, 20% and 40% of the total tree height, samples were extracted from the bottom, middle and top sections of each tree. Thus, 36 flat sawn (quick drying) test samples were extracted from defects free areas of each tree. All the chosen samples were prepared to specific sizes of 2 cm x 10 cm x 20 cm in thickness, width and length respectively. Measuring positions were marked off on one face of each sample. The ends were also marked to differentiate one end from the other.

Methods

The Quick Drying Test

The quick drying test method was used to determine the basic drying defects. According to Terazawa [14], this method is used as a starting point in developing drying schedule for any timber species. The quick drying method takes cognisance of these drying defects; end and surface checks, deformation and honeycomb. Figure 1 is a flow chart of the quick drying test.

Preparation of samples
↓
Initial weighing and measuring of samples
↓
Start of drying in oven at 103 ± 2°C
↓
Weighing, measuring and observation of defects
↓
End of drying
↓
Crosscutting of samples
↓
Evaluation of defects
↓
Classification of defects

Figure 1: Flow chart of the quick drying test used for the experiment

For each tree species, 36 samples were prepared for the test which was conducted in a set of six samples. The initial weights of the samples were weighed with an electronic scale while the length, width and thickness were measured with an electronic calliper. The samples were then placed edge-wise in an experimental oven at 103 ± 2°C until oven-dry condition was reached. During the first eight hours, the sample weights and formation of both end checks and surface checks on the samples were observed every hour. Afterwards, two observations were made on the 24th and 30th hours on the second day and on the 48th hour on the third day until oven-dry weight was achieved.

At the end of the drying process, the samples were cross cut in the middle to assess the degree of honeycomb, deformation, end checks and surface checks. The bases for assessing the defects were the sizes and number of defects that occurred on the surface of the dried samples. A scale of 1 to 8 was used to evaluate initial checks and deformation while 1 to 6 was used to evaluate honeycomb using the charts by Terazawa [14]. The condition of maximum checking was compared with the criteria set by Terazawa [14], and the samples were then awarded a corresponding checking classification. After cross cutting the samples, the newly exposed faces were examined to determine the occurrence of honeycomb. The samples were then awarded honeycomb classification according to Terazawa [14]. Below is the Terazawa classification for honeycomb.

Table 1 Classification of degree of honeycomb

Classification No.	Number of honeycombs
No. 1	Nil (0)

International Journal of Science and Technology

http://www.ejournalofsciences.org

No. 2	1 major or 2 minors
No. 3	2 majors or 4-5 minors or combination of 1 major & 3 minors
No. 4	4 majors or 7-9 minors or 1 major & 4-6 minors
No. 5	6-8 majors or 15 minors or 4 majors & 6-8 minors
No. 6	15-17 majors or continuous minor one

Source: Terazawa [14]

Likewise, the degree of deformation was evaluated on the cross section of the samples. The maximum and minimum thicknesses of each sample along it freshly sawn face were measured with a micrometer screw gauge.

The difference between the two measurements on each sample was recorded and classified as the cross-sectional spool-like deformation according to the table given below;

Table 2 Classification of degree of deformation

Degree of deformation	1	2	3	4	5	6	7	8
A – B (mm)	0-0.3	0.3-0.5	0.5-0.8	0.8-1.2	1.2-1.8	1.8-2.5	2.5-3.5	3.5+

Source: Terazawa [14]

From every tree, two rounds of drying tests were conducted with an experimental oven.

III. RESULTS AND DISCUSSION

Results of Susceptibility to Drying Defects

The result of the quick drying test is shown in Table 3. The results comprised of initial moisture content, the types of defects (checking, honeycomb and deformation) and classes of drying defects obtained for the two species.

Table 3 Summary of the types and classes of drying defects and their critical drying conditions for *Cola nitida* and *Funtumia elastic*

Species	Types of defects & initial MC%	Defects Types classes			
		Mean for tree No.			**Class adopted**
		1	2	3	
Cola nitida	Initial checks	2	3	3	**3**
	Honey comb	1	1	1	**1**
	Deformation	1	1	1	**1**
	Initial MC%	69	60	64	**64**
Funtumia elastica	Initial checks	3	3	3	**3**
	Honey comb	1	1	1	**1**
	Deformation	1	1	1	**1**
	Initial MC%	87	84	88	**86**

From Table 3, checks in the early stage of drying were not all that severe in both *Cola nitida* and *Funtumia elastica* samples (Class 3). Initial checking in the samples is strictly related to initial relative humidity but less related to initial temperature [14]. Moderately higher initial dry bulb temperature of 60°C for both *Cola nitida* and *Funtumia elastica*, and a larger wet bulb depression of 4.3°C for both species are critical to the drying of the species to prevent them from severe splitting in the early stages of drying.

There were no honey combing (Class 1) in both *Cola nitida* and *Funtumia elastica* species. According to Terazawa [14], honeycomb as a defect is generally related to the initial and final temperatures and the initial relative humidity, but not to the final relative humidity. Since the species did not show honeycomb, an initial dry bulb temperature of 70°C and initial WBD of 6.5°C may be used. There was no deformation (Class 1) in both *Cola nitida* and *Funtumia elastica* species. Deformation is related to the initial temperature and less related to final temperature and also related to the initial relative humidity, but not to the final relative humidity [14]. An initial dry bulb temperature of 70°C and a higher WBD of 6.5°C could be employed for drying both *Cola nitida* and *Funtumia elastica*. From Table 3, the initial moisture content (average) and adopted classifications of defect types used in proposing the drying conditions shows clearly that both species exhibited similar defects, thus class 3 for checks, class 1 for honeycomb and class 1 for deformation. This indicates that *Cola nitida* and *Funtumia elastica* are less susceptible to the drying defects examined and thus dries fairly well as they do not split much, and shows no signs of honeycomb and deformation.

IV. CONCLUSIONS

This study on the determination of the susceptibility of *Cola nitida* and *Funtumia elastica* to some drying defects was necessitated by the over dependence of the timber industry on few species and the lack of technical data on the many species growing in Ghana's forests. The study revealed that checks in the early stage of drying were less severe in both *Cola nitida* and *Funtumia elastica* samples (Class 3). There were no honey combing (Class 1) in both *Cola nitida* and *Funtumia elastica* species. There was no deformation (Class 1) in both *Cola*

International Journal of Science and Technology

http://www.ejournalofsciences.org

nitida and *Funtumia elastica* species during drying. This indicates that *Cola nitida* and *Funtumia elastica* are not prone to the drying defects examined and thus dries fairly well. This in turn may be followed by an evaluation of their utilization potential, marketability and performance, so as to serve as suitable substitutes for the fast-diminishing traditional market species in Ghana.

Acknowledgement

My special gratitude goes to the management and staff of CSIR-FORIG, especially Madam Bridgette Brentuo for her support and assistance on this project.

REFERENCES

[1]. Ofori, J. & Appiah, J. K. (1998). Some drying characteristics of five Ghanaian lesser-known wood species. *Ghana Journal of Forestry.* 6:19-27.

[2]. Ofori, J., Sagoe, J. K. & Hellem, S. (2000). Performance testing of a new drying kiln at a saw mill for air flow and moisture content. *Ghana Journal of Forestry*, 9:27-33.

[3]. Attah, A. N., Bues, C. T. & Sagoe, A. J. (2005). Accelerated kiln drying of Wawa sawn timber. *Bois et forets des Tropiques*, 284: 23-33.

[4]. TEDB, (1994). Timber Export Development Board. The Tropical Timbers of Ghana. Ghana Forestry Commission. Accra. Ghana, pp 1-20.

[5]. Hall, J. B. & Swaine, M. D. (1981). Distribution and ecology of vascular plants in a tropical rain forest: Forest vegetation in Ghana. Geobotany 1. Junk, The Hague.

[6]. Ghartey, K. K.. (1989). Results of the Ghana Forest Inventory project. UK Overseas Development Administration / Ghana Forestry Department. Proceedings Ghana Forest Inventory Project Seminar. Accra, Ghana.

[7]. Jayanetti, L., Ofori, J. & Ayeh, S. (1999). Bridges for rural feeder roads: Sustainable timber solutions. Timber bridges- A Review Report (DFID).

[8]. Upton, D. A. J. & Attah, A. (2003). Commercial Timbers of Ghana. The potential for lesser-used species. Forestry Commission of Ghana, Accra.

[9]. Simpson W. T. & Verrill, S. P. (1997). Estimating kiln schedules for Tropical and temperate hardwoods using specific cravity. *Forest Products Journal*, 47: 7-8.

[10]. Cabardo, S. J. & Langrish, T. A. G. (2006). Within–tree variability in the drying properties for blackbutt timber in New South Wales. *Maderas. Ciencial Y technologia* 8 (1): 15 – 24.

[11]. Simpson, W. T. (1992). Drying technology in tropical countries. Proc. IUFRO All-Division 5(Forest Products) Conference, Nancy, France: 497-507.

[12]. Hoadley, R. B. (2000). *Understanding wood: A Craftsman's Guide to Wood Technology*. The Taunton Press, Newtown, Connecticute, USA.

[13]. Wengert, E. M. (2006). *Principles and Practices of drying lumber*. Lignomat USA ltd., Virginia, USA.

[14]. Terazawa, S. (1965). Methods for easy determination of kiln drying schedules of wood: *Japan Wood Industry*, 20(5): 216 - 226.