EFFECT OF OPEN-AIR STORAGE ON THE PHYSICAL DEGRADATION OF WOOD

by

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Abstract

This paper presents the results of the study to assess the degree of degradation caused to wood during open air storage at Changa Manga forest plantation. Four different species viz; Shisham (Dalbergia sissoo), Mulberry (Morus alba), Poplar (Populus spp.) and Semal (Salmalia malabarica) were tested for loss of strength in relation to storage time. The results indicated that both poplar and semal were severely decayed even after a storage period of few months while the other two species were least affected.

INTRODUCTION

It is a common practice in this country that logs are left in the forest or stored in the sale depots for quite some time before these are sold to the consumers. This practice may have some advantages such as reduction in the growth stresses (Nicholson 1973) and in moisture content, but the wood exposed to the weather undergoes considerable physical and chemical degradation due to the combined effects of light, water, heat, air-pollutants and micro-organisms. The rate of deterioration of logs depends on three factors, viz., (i) the kind of timber (ii) the weather at the time of felling and during storage and (iii) the prevalence of fungi and insects in the area.

Several techniques have been used in the past to quantify the biodegradation of wood. The changes in the physical properties especially the weight loss has long been used as a measure of the degree of decay (Findlay, 1962). A number of non-destructive techniques for the measurement and detection of decay have been described by Friis Hansen (1984). More recently the reduction in strength expressed as a percentage of the non decayed wood has been developed as a standard technique to measure the degree of

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deterioration. (Glas, 1989). Kim and Bang (1987) studied the changes in chemical and strength properties of Japanese red pines exposed to air pollution. This study was conducted to find out the degradation of the wood of four species during storage in quantitative terms and devise measure to reduce it.

MATERIALS AND METHODS

The material for this study was supplied by the Divisional Forest Officer, Kasur Forest Division at Changa Manga in the form of logs each measuring 1.2 meters in length and more than 20 cms in diameter. The details of the logs are given in Table 1. The physical condition of all logs was recorded immediately after their arrival at the Institute. Samples for different strength properties were cut from each log along the mutually perpendicular radii in accordance with the ISO standard specifications. The testing was done in air-dry condition and the results were adjusted to 12% moisture content. The average initial moisture content of all logs was also determined both at ends and at the center.

Table 1 Details of logs received from Changa Manga

Species	Storage time	Log No.	Girth (cms)
Semal	Fresh	1	102
		2	109
	One year	1	132
		2	127
Poplar	Fresh	1	97
		2	71
	One year	1	84
		2	84
	Two years	1	81
Mulberry	Fresh	1	79
		2	94
	One year	1	86
		2	79
	Two years	1	107
		2	112
Shisham	Fresh	1	91
		2	102
	One year	1	94
		2	86
	Two years	1	91
		2	91

RESULTS AND DISCUSSION

General condition of the logs

The general condition of the logs is given in Table 2. From the table, it may be seen that the wood of semal and poplar is readily attacked by fungi causing decay and sap stain as well as by the insects. One year old logs of semal and two years old logs of poplar showed severe attack of pinhole borers. Large decay pockets were also observed in one year old logs of semal wood. Poplar wood was found to be slightly more resistant to decay as compared to semal wood. All the logs (including those freshly felled trees) of both poplar and semal were attacked by sap-stain fungi.

The logs of shisham and mulberry both from fresh and from one and two year old fellings showed no signs of decay or insect attack. In the case of mulberry wood, however, drying degrade i.e. deep cracks which run all along the length of the logs was recorded in the case of material from one year and two year old fellings. Shisham wood was found to develop minimum drying degrade amongst all the species of this study.

Table 2 General condition of logs received from Changa Manga

Species	Storage period	Big & deep cracks all along the length	Small cracks just at the ends	Decay pockets	Insect attack	Sap-stain
Semal	Fresh	x	P	x	x	P
Salmalia malabarica	One year	P	x	P	Pinhole borers	P
Poplar	Fresh	x	P	x	x	P
Populus spp.	One year	x	P	P	x	P
	Two years	P	x	P	Pinhole borers	P
Mulberry	Fresh	x	P	x	x	x
Morus alba	One year	P	x	x	x	x
	Two years	P	x	Just on surface	P	P
Shisham	Fresh	x	P	x	x	x
Dalbergia	One year	x	P	x	x	x
sissoo	Two years	x	x	x	x	x

P:Present. x:Absent.

Initial moisture content of logs

The average initial moisture content of all the logs from different fellings at their ends and in the center part is given in Table 3.

The results indicate that moisture continues to decrease with the increase in storage time. With the exception of mulberry, the moisture content of logs of all other species was still higher than the fibre saturation point (29-42%) even after a storage period of 1 year. This means that they can be easily rewetted. After a storage period of two years, the moisture content of all the species is considerably reduced.

Table 3 Initial Moisture Content of Logs

Species	Storage period	Average moisture content%	
		End	Center
1. Semal	Fresh	54.02	100.97
Salmalia malabarica	One year	11.07	37.63
2. Poplar	Fresh	44.85	102.64
Populus spp.	One year	12.85	42.40
	Two years	10.78	12.67
3. Mulberry	Fresh	20.91	39.41
Morus alba	One year	11.31	16.93
	Two years	10.64	13.07
4. Shisham	Fresh	15.47	35.40
Dalbergia sissoo	One year	13.57	29.52
	Two years	10.29	12.95

Strength properties

The results of strength properties of material of different species and with different storage periods are given in Table 4. From the results it can be seen that large reductions in the strength of wood of semal and poplar is caused when it is stored in the open for a certain period. In the case of semal wood, on the average, the reduction in different strength properties has been of the order of 35 to 62%. The strength of poplar wood was also reduced considerably with increase in storage time but the degree of reduction has not been the same as that of semal wood. After one year's storage, the strength of poplar wood was reduced by 19 to 26% of that of fresh material. This reduction further increased to 25 to 41% of the fresh material when the timber was stored for two years. In any log the decay normally starts in the

form of small decay pockets and with the passage of time spreads all over the log surface. The strength properties of samples taken from the portion of the log with active decay were, in fact, very low as compared to that of the undecayed wood. This is also evident from the range of strength data for different properties given in Table 4.

No biodegradation could be recorded in mulberry and shisham woods during their storage at Changa Manga sales depot. The strength of either of these two species was not affected (Table 4). The minor differences in the average strength properties of fresh, one-and two-years old material are within the normal range of variations for the woods in respect of their properties. However, in the case of mulberry, the risk of termite attack is always present due to its low resistance to insects. In such a case the quality shall have to be reassessed. The material which was supplied to this Institute was, however, free from any insect attack.

Some weathering effect was recorded on the outer surfaces of two years-old shisham logs which was only confined to the outer few millimeters of the log surface and had not, at all, affected the strength.

Table 4 Physical and Mechanical Properties of different wood species from Changa Manga adjusted at 12% Moisture Content

Property		Poplar			Semal		
		Fresh felling	1 year felling	2 years felling	Fresh felling	1 year	2 years
Density= A.D.wt. / A.D.vol. (g/cm^3)	$\bar{X}$	0.391	0.370	0.350	0.380	0.267	-
	R	0.308-0.474	0.282-0.453	0.197-0.457	0.250-0.469	0.181-0.384	-
Modulus of rupture (N/mm^2)	$\bar{X}$	65	50	49	58	36	-
	R	34-98	23-83	18-81	38-95	18-67	-
Max. Compression parallel to grain (N/mm^2)	$\bar{X}$	27	20	16	26	12	
	R	15-40	13-35	5-344	16-37	4-26	-

Table 4 continued

Impact bending ($m\text{-}N/4cm^2$)	$\bar{X}$	8.69	7.07	5.83	11.45	4.31	-
	R	2.35-16.86	2.55-16.97	1.57-15.00	7.06-18.34	0.49-8.34	-
Hardness (N):							
side	$\bar{X}$	2130	1594	1532	1748	1020	-
	R	932-3570	961-2452	304-2579	912-2707	353-1228	
end	$\bar{X}$	3228	2588	2367	2613	1498	-
	R	1863-4021	1373-2825	1177-4119	1491-3707	490-2883	-

Property		Mulberry			Shisham		
		Fresh felling	1 year felling	2 years felling	Fresh felling	1 year	2 years
Density= A.D.wt./A.D.vol. (g/cm^3)	$\bar{X}$	0.686	0.642	0.666	0.751	0.767	0.720
	R	0.641-0.763	0.497-0.837	0.606-0.837	0.695-0.796	0.650-0.843	0.666-0.763
Modulus of rupture (N/mm^2)	$\bar{X}$	122	134	112	119	116	134
	R	78-130	92-150	96-142	101-134	91-125	99-162
Max. Compression parallel to grain (N/mm^2)	$\bar{X}$	45	43	41	47	47	51
	R	32-60	32-59	28-70	39-56	39-55	44-61
Impact bending ($m\text{-}N/4cm^2$)	$\bar{X}$	70	67	69	40	46	51
	R	48-84	13-71	18-75	36-41	18-86	42-88
side	$\bar{X}$	5957	5800	5717	5630	6225	7022
	R	4756-6522	4119-8140	4805-6865	4854-6963	5511-6978	6473-7600

Table 4 continued

Hardness (N):						
end	$\bar{X}$	7095	6558	6865	7175	6676	6894
	R	5786-7257	4413-8042	6080-9022	5413-7875	4609-8080	5884-7944

$\bar{X}$ = Average values R = Range

CONCLUSION

On the basis of the results of the study, the following conclusions are drawn:

1. Both semal and poplar woods are highly perishable and are readily attacked by insects and decay fungi. Semal wood in particular, is completely destroyed in few months time. Poplar wood is though comparatively more resistant than semal wood, also undergoes considerable degradation during storage. In view of the drying degrade and the biodegradation which takes place during storage, the wood of both semal and poplar becomes useless for many purposes especially for the plywood and match manufacturing units which are the major consumers of these two species. Even if their strengt is not reduced, the quality is anyhow reduced considerably due to the attack of staining fungi.

2. No biodegradation of wood of mulberry and shisham is caused during storage. Unless otherwise attacked by some insects, the quality of wood of both species is not at all, affected during storage.

3. Most of the mulberry wood in this country is consumed in the manufacture of sports goods especially for the manufacture of the hockey stick blades where the impact bending and compressive strength of wood are important properties that affect the quality of the product. It may be seen from data in Table 4 that both the properties are not affected during storage. In case of mulberry wood, however, some drying degrade does take place during long period of storage for which about 5-10% allowance in the price may be allowed to the purchasers. The drying degrade may affect the recovery of useable

material in the log. A separate study should be conducted to find out the effect of drying degrade and size of log on the recovery of useable material.

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