

THE DURABILITY AND TREATABILITY OF *POPULUS DELTOIDES* MARSH

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Introduction

Poplar is a well established source of raw material for plywood. Being a fast growing species, there is a growing industrial demand of Poplar wood for plywood, particle board, fibre board, match splints, furniture and many other specialized timber products. Large scale plantations are therefore being raised throughout the country to cater to the needs of the wood-based industries.

It is also well known that for the rational utilization of any wood species, its natural durability and treatability should be known in advance. Though Poplar wood has been found to be non-durable but no scientific data is available, therefore it requires to be tested for its natural durability and treatability classification. Preservative treatment for protection against biodegrading agencies i.e. insect, termite and fungi, and the performance of treated wood depends upon the absorption and penetration of chemicals to desired level (Anon., 1982). This depends upon the wood structure and the moisture conditions at the time of treatment. The penetrability in the different anatomical tissues by the

preservative chemicals depend on the ease of penetration of a particular wood species depending upon the absorption and penetration. All the wood species are classified in five treatability classes i.e. "a" to "e" as given below :

- (a) Heartwood easily treatable.
- (b) Heartwood treatable, but complete penetration is not always obtained.
- (c) Heartwood only partially treatable.
- (d) Heartwood refractory to treatment.
- (e) Heartwood very refractory to treatment, penetration of preservative being practically nil even from the side or end.

Treatability evaluation is essential to develop treatment schedules for various end utilisations. Poor treatability in case of non-durable fast growing plantation timber species may be a bottleneck in end uses, as in the absence of treatment it may not give adequate service life. Most of these fast growing species have large percentage of sapwood and have a non-durable

heartwood. Their use for value added products economically can only be made after preservative treatment, which provides durability equivalent to any traditional hardwood species recommended for such uses. Poplar is a fast growing species and has been planted on irrigated lands as a cash crop to meet the needs of plywood industry and can be harvested on short rotation to ensure good financial return to the growers.

The wood of Poplar species has been studied for treatability behaviour using normal hot and cold non-pressure or pressure treatment processes (Anon., 1982). Presently a new method to classify treatability in terms of penetrability has been developed and applied to many hardwoods, bamboos and softwoods (Kumar and Dobriyal, 1983; 1992; 1993). This quantitative approach can help in improving performance of treated wood to make treatment schedules after studying

each tissue after penetration of preservative chemicals and combined penetration indices can be calculated to define the treatability class. For this Kumar and Dobriyal (1995), studied the treatability of poplar heartwood on the basis of combined penetration indices.

The Penetration Index (PI) for Poplar with each preservative was calculated as per procedure developed for hardwoods (Kumar and Dobriyal, 1993; Dobriyal and Kumar, 1999) as given below :

$$PI = \sum_{i=1}^4 W_i P_i / 27$$

where 'W' is the weight factor for each tissue and 'P' is the degree of penetration and summarized in Table 1. The values obtained in Table 1 with three chemicals were averaged and treatability class was

Table 1

Average data on flow path for different chemicals and treatability on the basis of Penetration Indices of Poplar

Species	Chemical	Vessels (w=3)	Fibres (w=3)	Rays (w=2)	Parenchyma (w=1)	PI	Treatability class
<i>Populus</i>	C	+++	+++	+++	+++	1.00	a
<i>deltooides</i>	D	++	++	++	++	0.65	
	S	++	++	++	+	0.63	
Average						00.76	

C = Creosote; D = Dye wax; S = Silver nitrate

+++ More than 60 per cent of cell penetrated

++ Between 30 to 60 per cent cell penetrated

+ Between 10 to 30 per cent cell penetrated

- Less than 10 per cent cell penetrated

assigned on the basis of average penetration index. The treatability of Poplar showed that all the tissue i.e. pores/vessels, fibres, rays and parenchyma were uniformly penetrated with creosote : fuel oil and treated better than with wax dye and silver nitrate stain respectively. The average penetration index is 0.75 and thus fall under treatability class "a". The treatability of *Populus deltoides* has also been studied by Dev and Kainth (1989) by hot and cold process with creosote : fuel oil (50 : 50) under low hydraulic pressure with CCA and reported the class as "a".

Sapwood of all the wood species is perishable but in some wood species the heartwood possesses toxic chemicals, called extractives, which resist fungi and insects, whereas other species during heartwood formation do not possess such toxic extractives, therefore the heartwood of such species and sapwood of all the species require preservative treatment. The resistance to bio-degradation is generally called natural durability of wood and this durability is determined by the "Test Yard" (Purushotham *et al.*, 1968) method.

In the present paper natural durability and performance of preservative treated specimens of *Populus deltoides* in the Test Yard at Forest Research Institute, Dehra Dun from 1997 to 2000 has been discussed.

Material and Methods

Logs of *Populus deltoides* were obtained from the Silviculturist F.R.I. Dehra Dun and converted into planks. The planks were then seasoned to 15% moisture content. Samples of size 30 cm long and 3.81 cm cross section were prepared entirely from the defect free heartwood (pith and

sapwood excluded) portion. The test specimens were then treated with two types of preservatives at three retention levels and buried half in the soil and rest half above the ground and one set kept as control of six replicates in the same condition to compare the periodic performance with the treated specimens.

Coal tar creosote : Fuel oil (50 : 50)
Ascu/CCA/As₂O₃, 2H₂O : CuSO₄, 5H₂O;
Na₂Cr₂O₇, 2H₂O; in the ratio of 1 : 3 : 4).

Both the treatments were given at three levels of absorptions c₁, c₂, and c₃ for creosote : fuel oil (50 : 50) and a₁, a₂ and a₃ for CCA from lower to higher retention of each preservative. There are six replicates of Poplar for each absorption. The treated specimens were allowed to dry for fixation of preservatives and installed in the field as per procedure standardized by Purushotham *et al.* (1968). The inspection of Poplar samples were carried out quarterly in the first year, half yearly in the second year and yearly in the subsequent years.

Results and Discussion

The results of periodic inspections after three years are given in Table 2. The service life of Poplar untreated specimens showed deterioration just after a period of six months after installation in the test yard at F.R.I., Dehra Dun by termite and the average service life obtained is 16 months. As regards the creosoted specimens at lower absorption, deterioration varied from very slight termite and fungus attack to slight termite attack from 18-24 months except few specimens, where as at higher absorption the very slight termite and fungus attack started from 24 months and the samples are still in good condition. In

Table 2

*Performance of Poplar wood untreated/treated with different wood preservatives
in the Test Yard at Dehra Dun (1997-2000)*

Preservative	Retention (kg/m ³)	Incidence of degradation agencies			Remarks
		Fungus	Termite	Fungus/Termite	
Creosote Fuel oil (50 : 50)	47.8 (c ₁)	-	Sw-1 Vsw-2	Swf-2	Samples running in good condition
	77.8 (c ₂)	Vsf-1 Sf-1		Vswf-2 Mwsf-1	Samples running in good condition and one sample attacked by mod. Termite and fungus.
	145.8 (c ₃)	Vsf-1	Vsw-1	Vswf-1	All the samples running in good condition.
CCA	4.6 (a ₁)		Dwf-2		Two samples destroyed by termite and four are in good condition.
	7.9 (a ₂)		Sw-1 Vsw-2	Vswsf-1	All samples running in good condition.
	15.5 (a ₃)		Vsw-3 Sw-1		All samples running in good condition
Untreated		Df-1	Dw-4	Dwf-1	All samples destroyed by termite and fungus.

Sf - Slight fungus attack; Vsf - Very slight fungus attack; Vsw - Very slight termite attack;
Vswf - Very slight fungus and termite attack; Vswsf - Very slight termite and slight fungus attack;
Sw - Slight termite attack; Swf - Slight fungus and termite attack;
Mwsf - Moderate termite attack and slight fungus attack
Bw - Badly termite attack; Dw - Destroyed by termite; Df - Destroyed by fungus;
Dwf - Destroyed by termite
- 1 to -4 — Number of samples
c₁, c₂, c₃, a₁, a₂, and a₃ - various levels of absorptions

the CCA treated samples at the lower absorption of 4.6 kg/m³ dry salts, four samples are in good condition and two samples are destroyed by termite and fungus during the same period. Regarding at higher absorption all samples are running in good conditions.

For determining the importance of the preservative treatments even the lowest absorption of CCA and creosote : fuel oil showed superiority over the untreated specimens of Poplar wood within the period of three years. As regards the preservatives, Ascu treated two specimens at lower retention were destroyed at 36 months and rest are running in normal conditions. The creosote treated specimens are giving better performance than the untreated sample, which have been destroyed within an average period of 16 months.

Conclusion

Poplar is a fast growing species and has been planted in many States of the country as a cash crop to cater the needs of plywood industries. It has been classified in treatability class 'a'. Though it has been supposed to be a non-durable species but no systematic and scientific data is available in the literature about its natural durability and performance of preservative treatment on the service life of the wood used.

In the present study natural durability and performance of preservative treatment has been carried out. The results showed the normal life of the Poplar wood is 16 months in the field test and thus classified as a non durable class. The preservative treatment with different preservatives has shown good performance in higher doses.

SUMMARY

Treatability of Poplar wood on the basis of penetration indices has shown that it is a easily treatable wood. Regarding the natural durability, it is non durable species at ground contact and require preservative treatment to get adequate service life for better end utilisation.

पोपुलस डेल्टायडिस का टिकाऊपन और उसकी उपचार्यता

पी०बी० डोबरियाल, के०एस० चौहान व इन्द्रदेव

सारांश

पारगम्यता निर्देशांकों के आधार पर पोपलर की लकड़ी की उपचार्यता ने दिखाया है कि इसकी लकड़ी का सरलता से उपचार किया जा सकता है । जहां तक स्वाभाविक टिकाऊपने की बात है भूमि से संपर्क करते स्थानों में उपयोग की जाने पर यह अटिकाऊ काष्ठजातियों में आती है तथा पर्याप्त अवधि तक काम में लाते रहने तथा श्रेष्ठतर अन्त-उपयोजन के लिए इसका परिरक्षी उपचार करने की जरूरत पड़ती है ।

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