Dual Preservative Treatment for Small Fishing Vessels - Observations on the Biodeterioration of Mango Wood

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This communication deals with the effect of dual preservative treatment techniques using a water borne preservative (Copper- chrome-arsenic) followed by an oil borne preservative (creosote) on *Mangifera indica*, commonly used in the construction of traditional fishing craft. Qualitative and quantitative analyses of dual preservative treated timber showed better retention of residual strength after exposure to marine conditions, compared to timber treated with copper-chrome-arsenic composition and creosote separately.

Wood is largely employed in fishing boat construction in India. Wood undergoes biodeterioration leading to considerable economic loss. Becker & Kohlmeyer (1958) estimated an annual loss of 25,00,000 rupees to the traditional fishing sector of Kerala by way of replacement of damaged timber. Santhakumaran & Jain (1983) estimated an annual loss of 94 million rupees to the fishing sector in India due to biodeterioration of timber. Commercial timbers have been classified based on the bioresistance properties into durability classes such as very durable, durable, moderately durable, non-durable and perishable (Satish Kumar, 1971). To enhance the service life of timber under marine conditions, suitable preservative treatments are employed (Balasubramanyan & Menon, 1964, Purushotham & Rao, 1971 and Nair *et al.*, 1972 a,b).

Durability of preservative treated timber is assessed by exposing standard size treated specimens under graveyard, marine exposure, weathering and accelerated tests under laboratory conditions. In the present study an attempt is made to evaluate the comparative efficacy of single and dual treated timber (*Mangifera indica*) by copper-chrome-arsenic (CCA) compound followed by an oil borne creosote. Assessment of strength loss after exposure to marine conditions was measured and is used as an index for deterioration. Visual estimation of borer holes is commonly employed for assessing deterioration. The strength as a beam, strength as a post and allowable stresses when forces act at right angles to the grain were estimated after exposure to marine conditions for a specified period of time.

Materials and Methods

300 x 100 x 35 mm specimens of Mango wood (*Mangifera indica*) were employed for preservative treatment. The panels were conditioned to a moisture of approximately below 25%. CCA (Ascu) of concentration 4.5% and 7.5% were used separately and in combination with creosote (CCA followed by creosote with an intermittent drying period of 24 hours). Creosote treatment alone was given to a separate set of panels. The preservative retention was calculated soon after treatment (Table 1). Preservative treatment was by the full cell process in a 400 litre pressure impregnation chamber at 7.03 kg/cm^2 (100 PSI) and a vaccum range of 0 to 700 mm Hg. The preservative loading cycle is shown in Fig.1.

The treated panels were allowed to season before marine exposure and along with untreated control panel were immersed below low water line by fastening

Table 1. *Treatment data of test blocks*

Panel No.	Preservative treatment	Preservative loading (in g) CCA	Creosote	Retention (in kg/m3) CCA	Creosote
CR-I	Creosote	NA	288	NA	274.29
CCA-1	CCA-4.5%	230	NA	9.85	NA
CCA-2	CCA-7.5%	256	NA	18.28	NA
CCA-1+CR	CCA-4.5%+ Creosote	243	270	10.40	297.14
CCA-2+CR	CCA-7.5%+ Creosote	257	256	18.35	243.80

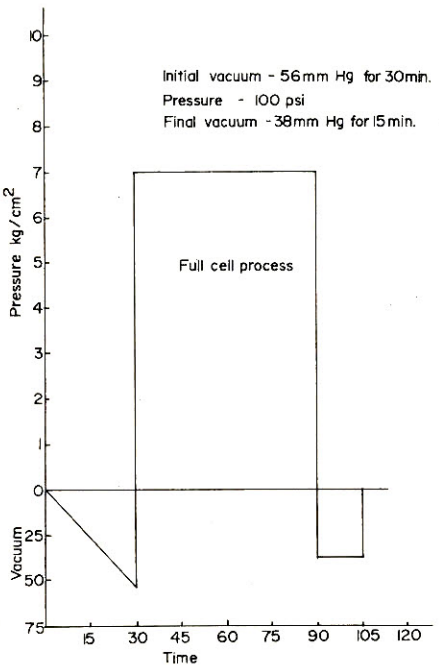

Fig. 1. Preservative loading cycle.

to an iron rack in the Ernakulam channel of Cochin Harbour. The panels were examined every 30 days through 19 months. The system adopted for grading marine borer attack was as per ASTM 2481-82. Contributors of the attack are Sphaeroma, Martesia and shipworms. After retrieval the panels were tested to find out the residual strength by the following tests (i) static bending test (ii) compression parallel to grain and (iii) compression perpendicular to grain.

Table 2. *Grading of panels treated with preservatives and exposed for 19 months in Cochin harbour*

Month	Control	CR-I	CCA I	CCA II	CCAI+CR	CCAII+CR
1	9	10	10	10	10	10
2	9	10	10	10	10	10
3	7	10	10	10	10	10
4	7	10	10	10	10	10
5	7	10	10	10	10	10
6	4	10	10	10	10	10
7	4	10	10	10	10	10
8	0	10	10	10	10	10
9	9	10	10	10	10	10
10	9	10	10	10	10	10
11	9	10	9	10	10	10
12	9	10	9	10	10	10
13	7	10	9	9	10	10
14	4	10	9	9	10	10
15	4	10	9	7	10	10
16	0	10	7	7	10	10
17	9	9	7	7	10	10
18	9	9	7	7	10	10
19	9	9	7	7	10	10

Rating trace = 10 (less than 10 borer holes)
Light = 9 (borer holes between 1 to 40)
Moderate = 7 (borer holes between 41 to 80)
Heavy = 4 (borer holes between 81 to 150)
Destroyed = 0 (borer holes between 151 and above)

Tests were conducted in the ZWICK 1484 Universal Testing Machine of 200 kN capacity.

Results and Discussion

Observations throughout the exposure period show different degrees of borer attack at various stages of exposure. The performance of panels is given in Table 2. The extent of damage can be gauged from the fact that control panels lasted for 8 months only after which it was replaced

Table 3. *Results of the strength tests of Mango Wood panels*

Preservative	Compression parallel to* gain strength in N/mm^2	Compression perpendicular to gram** strength in N/mm^2	Static bending strength*** in N/mm^2
Control (untreated & unexposed)	33.81	15.49	77.87
CCA I CCA II	Could not be tested as more than 50% damage had taken place		
Creosote	19.42	11.46	55.18
	(42.56)	(26.02)	(29.14)
CCA I+	23.76	13.95	68.75
Creosote	(29.72)	(9.94)	(11.71)
CCA II+	26.91	15.22	75.73
Creosote	(20.41)	(1.74)	(2.53)

*Fibre stress at maximum load; ** Fibre stress upto 2.5 mm compression; *** Modulus of rupture
Figures in paranthesis show percentage reduction in strength when compared to the untreated and unexposed controls.

by fresh one. But both sets of dual treated panels showed no more than trace attack at the time of retrieval. The other treatments exhibited varying degrees of attack (Table 3). The control panels and CCA I and CCA II panels were destroyed beyond 50%.

The dual treated panels showed better retention of strength than the creosoted and CCA treated panels. Among the two sets of dual treated panels the one in which CCA with higher retention of 18 kg/m^3 showed better resistance as indicated by greater strength values.

The American Wood Preserver's Association recommends dual treatment for areas of extreme borer hazard. India being an area of heavy borer activity (Barnacle, 1976) dual treatment can be used here. Tests conducted by Baechler *et al.*, 1970 (Quoted by Barnacle 1976) using ACA (Ammoniacal Copper arsenate), CCA and double diffused copper arsenate or nickel arsenate plus high retentions of creosote ($256 + 54$ kg/m^3) have performed well after exposures ranging from 5-10 years. Johnson (1977) conducted studies on small panels with CCA, ACA and creosote and found that a combination of salt and creosote provides a margin of protection over that of salt alone. Results of similar studies by Richards (1977) was different in that it showed, that the overall performance of dual treated coupons was similar to these containing salt treatments alone.

Study reveals that the dual treated panels were free from borer attack from an extended period of 19 months of underwater exposure. Johnson (1977) noticed that embrittlement in CCA treated timber of high salt retention is offset by creosote in the dual treatment which also prevents leaching of salt components. The proper-

ties of timber for fishing boats are totally different when compared to timber for piling or for other marine constructions. The traditional craft are operated from open beaches and after fishing they are kept exposed to sun which leads to development of splits and cracks. This is reduced by dual treatment as it imparts some pliability to the timber in addition to enhanced resistance to biodeterioration. As noticed by Johnson, the performance of swan and treated panels are different from treated logs and is only indicative of the comparative performance of various preservatives. The results have to be further confirmed by service trials.

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