Long term Performance of 12 Species of Indian Timbers Treated with CCA in Cochin Harbour

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Performance of 12 common timbers *(Alstonia kurzi, Bombax insigne, Albizzia sp., Tetrameles nudiflora, Pinus roxburghii, Polyalthia fragrans, Shorea robusta, Terminalia paniculata, Pterocarpus dalbergioides, Dipterocarpus indicus, Tectona grandis* and *Xylia xylocarpa)* treated with Copper-Chrome-Arsenic (CCA) at 16 kg/m^3 (AI series) and 32 kg/m^3 (A2 series) absorptions and exposed in the Cochin Harbour waters along with untreated ones is presented. The results show that (1) CCA treatment has greatly enhanced the durability of all the 12 species, (2) *T. nudiflora, P. roxburghii, D. indicus* and *T. grandis* of A2 series suffered only 50% to 97% destruction at the end of 22 years (3) performance of timbers in A2 series in superior to that in A1 series in most of the cases, and (4) treated nondurable species like *T. nudiflora* and *P. roxburghii* exhibited better life or borer resistance than treated durable timbers such as *P. dalbergioidess, T. grandis* and *X. xylocarpa.*

In recent years, Cheriyan & Cherian (1983), Krishnan *et al.* (1983), Tiwari *et al.* (1984), Srinivasan & Leelavallabhan (1986 & 1988), Cheriyan *et al.* (1988) and Santhakumaran *et al.* (1984 & 1988) have reported the performance of some Copper-Chrome-Arsenic treated timbers in marine environment. However, since more and more works of long term nature are essential for evaluating the performance of preservative treated timbers, the tests conducted by Cheriyan & Cherian (1983) were continued upto 22 years in the Cochin Harbour and the results are reported.

Materials and methods

Materials and methods were described in detail earlier by Cheriyan & Cherian (1983). The performance of the 12 species with Copper-Chrome-Arsenic (CCA) treatment (Table 1) for the first 8 years was also reported by them. Now the data collected during the subsequent 14 years (1976-89) are presented.

Results and Discussion

The wood boring and fouling organisms that infested the panels consisted of the same species as reported by Cheriyan & Cherian (1983).

Cheriyan & Cherian (1983) stated that in A1 series *T. grandis* (Madras) and *D. indicus* showed the maximum resistance to borer attack undergoing only 11% and 14% damage, respectively, followed by *T.grandis* (Andhra) and *X. xylocarpa* with 23 and 31% destruction, respectively at the end of 8 years. *A. kurzi, S. robusta* (West Bengal), *T. paniculata, P. fragrans, Albizzia* sp. and *S. robusta* (U.P.) lasted for 7, 7, 7, 6, 5 and 5 years respectively while the rest of 5 species suffered a destruction varying between 32 and 83%.

Of the 9 species that remained in the field later, only *D. indicus* and *T.grandis* (Andhra) of A1 series continued till the end of 22 years though sustaining a damage of 80 and 95%, respectively whereas *B. insigne,*

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S. robusta (Bihar), T. nudiflora, P. dalbergioides, X. xylocarpa, P. roxburghii and *T. grandis* (Madras) gave a durability of 8, 8, 11, 14, 16 and 20 years, respectively (Table 1).

At the end of 8 years Cheriyan & Cherian (1983) reported that in A2 series *D. indicus* and *T. grandis* (Madras and Andhra) offered best performance succumbing just to 4, 13 and 18% destruction respectively and that *A. kurzi, Albizzia* sp. *S. robusta* (W. Bengal), *P. fragrans, P. dalbergioides* and *S. robusta* (Bihar and U.P.) gave a life of 3, 5, 6, 7, 7 and 7 years, respectively while *B. insigne, P. roxburghii, T. nudiflora, T. paniculata* and *X. xylocarpa* were subjected to a damage ranging between 22 and 61%.

Observations during the subsequent years revealed that *D. indicus* exhibited maximum resistance undergoing only 50% destruction in 22 years while *T. nudiflora, P. roxburghii* and *T. grandis* (Madras) suffered 80, 92 & 97% damage, respectively, in A2 series and *T. paniculata, B. insigne, X. xylocarpa* and *T. grandis* (Andhra) registered a durability of 10, 16, 16 and 19 years, respectively (Table 2).

A.kurzi and *B.insigne* gave just one year life in untreated condition and almost an equal durability of 7 and 8 years in Al series, but in A2 series, the former lasted only for 3 years whereas the latter for 16 years (Tables 1 & 2). Untreated panels of *Albizzia* sp., *T.nudiflora,P. roxburghii, P. fragrans, S. robusta* (Bihar, U.P. and W. Bengal) and *T.paniculata* had a life of 2 years each. But their durability varied from 5 to 16 years in Al series and from 5 to over 22 years in A2 series. *P.dalbergioides, D.indicus, T. grandis* (Madras & Andhra) and *X.xylocarpa* having a natural durability of 5 to 8 years showed a durability of 11 to over 22 years in Al series and 7 to over 22 years in A2 series. Hence CCA treatment of timbers prolongs their durability in marine environment to a great extent.

From Tables 1 & 2, it is also seen that A2 series panels exhibited better efficacy in resisting the marine borer attack than Al series panels. The same is quite conspicuous in *B.insigne, T. nudiflora,P.roxburghii, T.paniculata, D.indicus* and *T.grandis* (Madras). But, *P.fragrans, S. robusta* (U.P) and *X.xylocarpa* showed only slight difference and *Albizzia* sp. no difference at all in A1 & A2 series. Further, *A.kurzi, S. robusta* (Bihar & W.Bengal), *P. dalbergioides* and *T.grandis* (Andhra) registered slightly lesser life in A2 series than in A1 series. Similar exceptions were also noted by Cherian *et al.* (1987 & 1988). They have attributed such variations to refractoriness of timbers and also to difference that arise due to early incidence of certain types of borers and their gregarious nature.

The performance of non-durable and durable timbers in untreated and treated conditions (Tables 1 & 2) in marine environment is very interesting. In untreated condition, *A.kurzi, B.insigne, Albizzia* sp., *T.nudiflora, P. roxburghii, P.fragrans, S. robusta* (Bihar, U.P & W.Bengal) and *T.paniculata* lasted only for 1 or 2 years and as such can be classified as non-durable timbers. The remaining species, namely, *P.dalbergioides, D.indicus, T. grandis* (Madras & Andhra) and *X.xylocarpa* that recorded 5 to 8 years durability can be regarded as durable timbers. Due to CCA treatment, all non-durable timbers registered as good a life as those of durable timbers (5 to 8 years) and the performance of some of them is equal or superior to that of the treated durable timbers. Moreover, two non-durable timbers *T.nudiflora* and *P.roxburghii* presented better performance than all the durable species except *D.indicus.* Even the performance of non-durable timbers *B.insigne* in A2 series and *P.roxburghii* in A1 series is alike that of durable timber

Table 1. *Average per cent destruction of A1 series (16kg/m^2 of CCA treatment) test panels*

Species of Timber	Locality	ND[@]	8th* yr.	9th yr.	10th yr.	11th yr.	12th yr.	13th yr.	14th yr.	15th yr.	16th yr.	17th yr.	18th yr.	19th yr.	20th yr.	21th yr.	22nd yr.
Alstonia kurzi (Pala)	Andamans	1yr.	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Bombax insigne (Semul)	"	1yr.	78	R	—	—	—	—	—	—	—	—	—	—	—	—	—
Albizzia sp. (Siris)	"	2yr.	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tetrameles nudiflora (Maina)	"	2yr.	77	78	79	79	R	—	—	—	—	—	—	—	—	—	—
Pinus roxburghii (Chir)	Kashmir	2yr.	32	35	37	39	42	60	61	82	87	R	—	—	—	—	—
Polyalthia fragrans (Debdaru)	Coorg	2yr.	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Shorea robusta (Sal)	Bihar	2yr.	83	R	—	—	—	—	—	—	—	—	—	—	—	—	—
"	UP	2yr.	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—
"	West Bengal	2yr.	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Terminalia paniculata (Kindal)	Bombay	2yr.	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pterocarpus dalbergioides (Padauk)	Andamans	5yr.	49	51	53	55	R	—	—	—	—	—	—	—	—	—	—
Dipterocarpus indicus (Gurjan)	Coorg	7yr.	14	17	19	20	22	22	24	29	54	59	62	67	70	75	80
Tectona grandis (Teak)	Madras	6yr.	11	14	16	18	26	27	44	48	52	58	75	90	93	R	
"	Andhra	7yr.	23	26	29	30	34	40	42	63	79	82	82	83	87	91	—
Xylia xylocarpa (Irul)	Bombay	8yr.	31	33	36	39	59	62	79	R	—	—	—	—	—	—	95

ND - Natural durability; yr. year(s); R - Rejected; [@] Data from Cheriyan & Cherian (1978);
* Data from Cheriyan & Cherian (1983)

Table 2. *Average per cent destruction of A2 series (32 kg/m^3 of CCA treatment) test panels*

Species of timber	Locality	ND[@]	8th[*] yr.	9th yr.	10th yr.	11th yr.	12th yr.	13th yr.	14th yr.	15th yr.	16th yr.	17th yr.	18th yr.	19th yr.	20th yr.	21st yr.	22nd yr.
Alstonia kurzi (Pala)	Andamans	1yr.	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Bombax insigne (Semul)	"	1yr.	54	78	79	79	80	81	82	85	88	R	—	—	—	—	—
Albizzia sp. (Siris)	"	2yr.	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tetrameles nudiflora (Maina)	"	2yr.	35	37	39	40	52	53	54	55	56	63	65	70	75	75	80
Pinus roxburghii (Chir)	Kashmir	2yr.	22	24	26	27	29	30	32	38	43	50	55	68	74	87	92
Polyalthia fragrans (Debdaru)	Coorg	2yr.	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Shorea robusta (Sal)	Bihar	2yr.	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—
"	U.P.	2yr.	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—
"	West Bengal	2yr.	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Terminalia paniculata (Kindal)	Bombay	2yr.	61	83	83	R	—	—	—	—	—	—	—	—	—	—	—
Pterocarpus dalbergioides (Padauk)	Andamans	5yr.	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dipterocarpus indicus(Gurjan)	Coorg	7yr.	4	6	8	9	10	10	12	13	15	22	26	30	38	45	50
Tectona grandis (Teak)	Madras	6yr.	13	15	17	21	23	25	26	38	53	80	86	94	96	97	97
Xylia xylocarpa (Irul)	Bombay	8yr.	31	35	37	56	58	58	59	68	87	R	—	—	—	—	—
Tectona grandis Teak	Andhra	7yr.	18	21	25	26	30	31	34	38	48	65	70	80	R	—	—

ND - Natural durability; yr. - year (s); R - Rejected; @ - Data from Cheriyan & Cherian (1978)
* - Date from Cheriyan & Cherian (1983)

X.xylocarpa. Cheriyan *et al.* (1988) also made similar observations. After 11 years of tests the authors found *Abies pindrow* a non-durable species with CCA treatment as the best performer among the 12 timber species and noted that other treated non-durable species performed either equally well like treated durable timbers or better than them.

Few more important aspects in the performance of treated timbers are highlighted by Tables 1 & 2. By suffering only 31 and 32% damage, respectively *X.xylocarpa* and *P.roxbughii* showed more or less equal resistance at the end of 8 years in A1 series. But the former lasted only for 14 years whereas the latter for 16 years. Similarly, in A2 series *T.grandis*(Andhra) and *P.roxburghii* exhibited more or less the same performance at the end of 8 years by sustaining 18 and 22% damage, respectively. But, the former lasted for 19 years while the latter is in the field though with 92% destruction even after 22 years. In the same manner *X.xylocarpa* and *T.nudiflora* suffered almost equal destruction (31 and 35%, respectively) in A2 series at the end of 8 years. *X.xylocarpa* lasted for 16 years only whereas *T.nudiflora* is undergoing exposure tests after 22 years also though registering 80% damage. Contrary to these observations. *P.dalbergioides* and *T.nudiflora*, which were showing as wide a difference as 49 and 77% damage respectively in A1 series at the end of 8 years lasted for an equal period of 11 years only. In the same way, *X.xylocarpa* and *B.insigne* had wide difference in the destruction suffered by them (31 and 54%, respectively) in A2 series at the end of 8 years, but both gave 16 years durability only. The reasons for such reversals in the performance of timbers during prolonged exposure tests are not very clear. The diversity and changing pattern of the boring communities (in the panels), the initial and subsequent preservative contents, variable leaching rates of the preservatives and the ever changing hydrographical conditions influence the deterioration of timber panels and so such results are possible.

Most of the non-durable timbers commonly available can be profitably used after proper preservative treatment in marine environment as substitutes to durable timbers that are becoming scarce and costly.

The authors are grateful to Dr.V.V.Srinivasan, Head, Institute of Wood Science & Technology, Bangalore for his encouragement and to the Cochin Port Trust authorities for the facilities provided by them for conducting the tests in the harbour waters.

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