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DURABILITY PERFORMANCE OF TWELVE SPECIES OF INDIAN TIMBERS TREATED WITH CREOSOTE : FUEL OIL IN COCHIN HARBOUR WATERS

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ABSTRACT

Durability of 12 species of Creosote Fuel Oil (CFO) treated timbers (*Bombax ceiba, Mimusops* sp., *Acrocarpus fraxinifolius, Chukrasia velutina, Abies pindrow, Callophyllum apotalum, Pterocarpus marsupium, Mesua ferrea, Hopea parviflora, Terminalia alata, Anogeissus latifolia* and *Lagerstroemia microcarpa*) in Cochin Harbour is discussed in detail. Compared with the natural durability all the treated panels demonstrated excellent life. After 17 years of exposure tests also as many as six species are continuing in the field. Non-durable timbers *viz. B. ceiba, A. fraxinifolius, C. velutina, Mimusops* sp. and *A. pindrow* accomplished equal or superior durability like such durable species as *C. apotalum, P. marsupium, M. ferrea, H. parviflora, A. latifolia* and *L. microcarpa*; after CFO treatment. A single species selected from different geographical localities exhibited no consistency in its performance either in untreated or treated condition. Results of similar tests conducted at other harbours of the country when compared with the present ones revealed that the performance of a species after preservative treatment also may vary from one harbour to the other.

INTRODUCTION

KNOWLEDGE on the efficacy of Creosote-Fuel Oil (CFO) in prolonging the durability of various Indian timbers in marine environment is available (Cheriyan and Cherian, 1980; Krishnan *et al.*, 1983; Tiwari *et al.*, 1984; Santhakumaran *et al.*, 1984, 1988; Cheriyan *et al.*, 1987; Srinivasan and Leelavallabhan, 1986, 1988). However, for better and rational utilisation of timbers in sea water more information is essential. Therefore, works of similar nature were undertaken at Cochin Harbour using 12 species of commercial timbers. The results of these tests for the period 1973-'89 are presented in this paper.

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MATERIAL AND METHODS

Test panels of size 30.48 × 3.81 × 3.81 cm were obtained from the heartwood of the species enlisted in Table 1 and pressure treated with CFO at 160 kg/m^3 (C1 series) and 320 kg/m^3 (C2 series) absorptions. Except panels of *H. parviflora, L. microcarpa* and *M. ferrea*, all others absorbed the desired quantity of preservative. CFO content in them ranged from 64.08 to 112.14, 22.43 to 168.21 and 32.04 to 120.15 kg/m^3 respectively. Among them the panels with high intake were incorporated in C2 series and others in C1 series. Untreated

and treated panels chosen as triplicates of each of the 12 species were exposed in Cochin Harbour waters as prescribed by Purushotham and Rao (1971). The methodology described by Cheriyan and Cherian (1978) was followed for conducting the tests.

RESULTS

Test panels of all the 12 species were encrusted by various fouling organisms of which the most abundant macrofoulers are *Bimeria franciscana, Ficopomatus macrodon, Mercierella enigmatica, Balanus amphitrite, Schizoporella unicornis, Victorella pavida, Bowerbankia gracilus, Modiolus undulatus, M. striatulus, Perna viridis* and *Crassostrea madrasensis*. Free living forms such as *Perinereis cavifrons, Corophium triaenonyx, Melita zeyalanica, Cirolana fluviatilis* and *C. willeyi* were also present. In addition the panels were infested by *Sphaeroma terebrans, S. annandalei, S. annandalei travancorensis, Martesia striata, Teredo clappi, T. furcifera, Lyrodus pedicellatus, Bankia companellata* and *Nausitora hedleyi* to varying degrees. The combined activity of some or all of these borers resulted in gradual destruction of the panels over the years (Table 1 and 2).

Out of the 12 species, T. alata (Bihar and Bombay) offered the best resistance in C1 series, sustaining just 38% and 40% destruction even after 17 years. Among others, *Mimusops* sp., *A. pindrow, A. latifolia, P. marsupium, C. velutina, H. parviflora* and *L. microcarpa* (Coorg) gave a very good durability of 16, 16, 16, 14, 11, 11 and 11 years, respectively and *L. microcarpa* (Bombay), *M. ferrea, A. fraxinifolius, B. ceiba* (U.P.) and *C. apotalum* registered reasonably good life of 9, 9, 8, 8 and 8 years respectively, while *B. cieba* (Sourashtra) recorded the least durability of 7 years.

Under C2 series *T. alata* (Bihar) with a meagre damage of 16% in 17 years showed the best performance. Immediately succeeding it are *T. alata* (Bombay) and *P. marsupium* with 24% and 35% destruction after 17 years. *A. latifolia* and *A. fraxinifolious* followed them with 57% and 60% deterioration respectively at the end of 17 years. *L. microcarpa* (Coorg) and *C. apotalum* also performed well, suffering a damage of 83% and 85% respectively in 17 years. All others *viz. Mimusops* sp., *C. velutina, A. pindrow, L. microcarpa* (Bombay), *H. parviflora, B. ceiba* (Sourashtra) and *M. ferrea* gave a very good durability of 16, 16, 16, 15, 12, 12, 11 and 11 years respectively.

DISCUSSION

A glance at Table 1 and 2 indicates the excellent performance of the 12 treated timbers both under C1 and C2 series. Cheriyan and Cherian (1980) also observed that 'viewed in the light of the natural durability studies... treatment with creosote : fuel oil (50:50) has definitely improved the durability of ... timbers to a great extent'. Similarly, Srinivasan and Leelavallabhan (1988) stated that treatment with CFO (1:1), both in lower and higher absorptions, greatly enhanced the durability of timbers.

The data further ascertain merits in treating timbers at higher absorption levels (C2 series). As many as 12 varieties distinctly show superior performance in C2 series than in C1 series. Even after 17 years 7 species of C2 series panels are remaining in the field in contrast to just 2 in C1 series. Cheriyan *et al.* (1987) and Srinivasan and Leelavallabhan (1988) also noted the efficiency of C2 treatment over C1 treatment in increasing the life of timbers.

At times, a species may exhibit more destruction in C2 series than in C1 series. For instance, *Mimusops* sp. showed more damage in C2 series (Table 1 and 2) during 3rd to 8th year of exposure, *A. pindrow* during 2nd to 6th year and *A. latifolia* during 2nd to 11th year. However, eventually C2 series panels

gave more durability or atleast equal life when compared to C1 ones. Such anamolies can also be noticed in the data of Cheriyan and Cherian (1980) and Cheriyan *et al.* (1987), although not pointed out by them. The data show that *Bombax insigne, Shorea robusta* (U.P. and W. Bengal), *Tectona grandis* (Madras) and *Xylia xylocarpa* suffered more destruction in C2 series than in C1 series during 1st to 4th, 5th to 9th, 7th to 15th, 4th to 12th and 3rd to 10th years respectively; but at the end, C2 series panels turned out to be superior to C1 series panels in their performance. Variations in the intensity of borer attack and differences in the initial and subsequent CFO content in the panels may be responsible for such fluctuations. Cheriyan *et al.* (1987) also mentioned that differences in the performance of C1 and C2 series panels became more evident with longer duration of exposure. These observations point out the need for testing treated timber for prolonged periods before arriving at any conclusion based on short term experiments and also to facilitate perfect assessment of the durability of a species at different treatment levels.

After treatment with CFO non-durable timbers, *viz. B. ceiba, Mimusops* sp., *A. fraxinifolius, C. velutina* and *A. pindrow* have accomplished an equal or better durability as those of durable timbers like *C. apotalum, P. marsupium, M. ferrea, H. parviflora, T. alata, A. latifolia* and *L. microcarpa* (3-11 years) and more over most of them achieved comparable or even longer life (9-16 years) than many of the treated durable timbers. Similar observations were made earlier by some others also. Krishnan *et al.* (1983) stated that 'timbers with poor natural durability like *B. ceiba* and *A. pindrow* when treated with ... creosote have atleast twice the length of life of the untreated timber'. Cheriyan *et al.* (1987) found that 'non-durable treated timbers ... gave a duration of life comparable to those of relatively more durable species ... with treatment'. Srinivasan and Leelavallabhan (1988) reported that '... a considerable increase of durability in non-durable timber was also observed. The performance of non-durable timber was found to be equivalent to that of the naturally durable timber by treatment with higher absorptions of CFO (1:1)'.

A timber species selected from two geographical localities may show equal or differential performance in treated and untreated conditions (Table 1 and 2). Krishnan *et al.* (1983) also reported that 'as in the case of timber species against local pests there appears to be some specificity of resistance exhibited by the same species of timber growing in different soils and climatic conditions'. Similarly Cheriyan *et al.* (1987) noted that 'the performance of the same species from different localities varied'. *B. ceiba* selected from Sourashtra and Uttar Pradesh gave same natural durability (1 year), but showed 7 and 8 years life in C1 series and 12 and 11 years in C2 series. In contrast, *T. alata* from Bihar and Bombay despite wide differences in their natural durability of 5 and 8 years are performing almost equally in C1 and C2 series. In the same way, *L. microcarpa* chosen from Coorg and Bombay having 6 and 11 years natural durability exhibited more or less equal performance in C1 and C2 series. Such variations in the performance of a species obtained from different places emphasize the importance of screening timbers from all the places of their availability instead of relying upon specific characters alone while selecting timbers for end uses.

Results of similar tests conducted at a few other harbours in the country are available for comparison.

P. marsupium 'was found to be relatively unattacked with creosote treatment after 5 years of exposure' in Madras water by Krishnan *et al.* (1983). In 5 years the condition of the species was same in Cochin also.

In Madras water *B. ceiba* 'when treated with higher concentrations of creosote only 10 to 20% destruction was seen after 5-6 years

of exposure' (Krishnan *et al.*, 1983). In Bombay this timber suffered only less than 25% damage in 7 years (unpublished data) whereas in Cochin it endured only 9% destruction in C2 series after 6 years.

Krishnan *et al.* (1983) noted that in Madras water *T. alata* 'showed greater durability after treatment with higher concentrations of creosote after 5-6 years'. The species gave more or less the same durability at Cochin and Visakhapatnam also (unpublished data).

C. velutina 'was also found to be highly durable after creosote treatment after 5 years' by Krishnan *et al.* (1983) in Madras. The same trend was noticed in Cochin and Visakhapatnam in 5 years.

In case of *L. microcarpa* Krishnan *et al.* (1983) stated that 'with creosote treatment under higher concentrations only few borer holes were observed while 15% of the timber was found to be destroyed in lower concentrations of creosote' within 5-6 years in Madras. The performance of the species as also similar at Cochin during the first 5-6 years. But in Bombay it suffered 25% damage in 7 years and 25% to 50% destruction in Visakhapatnam.

A. latifolia 'in higher concentrations of creosote only 15% of the panel was destroyed' in Madras after 5-6 years (Krishnan *et al.*, 1983). However, at Cochin this species registered only very negligible damage in the same period.

Mimusops sp. showed about 25% deterioration in Bombay water in 7 years. But, the same species had 14% to 39% destruction in 7 years at Cochin.

A. fraxinifolius, A. latifolia, L. microcarpa, M. ferrea, P. marsupium and *T. alata* treated with CFO were reported to be heavily attacked within 13 months in the harbour waters of Goa (Santhakumaran *et al.*, 1988).

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