

## Treatability and Natural Durability of Pitali (*Trewia nudiflora* L.) Wood

\*Mozammel Hoque Chowdhury, Mohammad Jakir Hossain, Abdus Salam  
and Mohammad Anisur Rahman

Wood Preservation Division, Bangladesh Forest Research Institute, Chattogram-4211, Bangladesh.

\*Corresponding Author: mhchy.bfri@yahoo.com

### Abstract

The experiment was undertaken to investigate the retention of chromated-copper-boron (CCB) preservatives in Pitali (*Trewia nudiflora* L.) wood applying soaking as well as diffusion method. The assessments were applied for 5, 7, 9 and 11 days for both the method. The retention of the preservatives were recorded 12.29 kg/m<sup>3</sup>, 14.97 kg/m<sup>3</sup>, 15.11 kg/m<sup>3</sup> and 15.72 kg/m<sup>3</sup> in Pitali wood where soaking method applied. Moreover, retention was found 11.43 kg/m<sup>3</sup>, 23.49 kg/m<sup>3</sup>, 24.14 kg/m<sup>3</sup> and 25.38 kg/m<sup>3</sup> in Pitali when diffusion method applied. In case of both the method, highest retention was recorded 15.72 kg/m<sup>3</sup> and 25.38 kg/m<sup>3</sup> in pitali wood after 11 days. Considering the Standard of Bangladesh Standards and Testing Institution (BSTI), i.e., 15.72 kg/m<sup>3</sup> and 25.38 kg/m<sup>3</sup> in Pitali can meet the suitability of the study. According to BDS code, the required retention of CCB is 8–16 kg/m<sup>3</sup>.

### সারসংক্ষেপ

পিটালী কাঠের ধারণ মূল্যায়নের জন্য চুবানো এবং ডিফিউশন পদ্ধতিতে ১০% সিসিবি দ্রবণ দ্বারা পরীক্ষা করা হয়েছিল। উভয় পদ্ধতিতে ৫, ৭, ৯ এবং ১১ দিনের জন্য এ পরীক্ষাটি প্রয়োগ করা হয়েছিল। উক্ত সময়ে চুবানো পদ্ধতি প্রয়োগ করে ১২.২৯, ১৪.৯৭, ১৫.১১ এবং ১৫.৭২ কেজি/ঘনমিটার ধারণ রেকর্ড করা হয়েছে। অধিকন্তু, ডিফিউশন পদ্ধতি প্রয়োগ করে ৫, ৭, ৯ এবং ১১ দিনের জন্য যথাক্রমে ১১.৪৩, ২৩.৪৯, ২৪.১৪ এবং ২৫.৩৮ কেজি/ঘনমিটার ধারণ রেকর্ড করা হয়েছে। উভয় পদ্ধতিতে ১১ দিন প্রয়োগ করে পিটালী কাঠের সর্বোচ্চ ধারণ ১৫.৭২ এবং ২৫.৩৮ কেজি/ঘনমিটার রেকর্ড করা হয়েছে যা (পিটালী কাঠের ধারণ ১৫.৭২ এবং ২৫.৩৮ কেজি/ঘনমিটার পাওয়া গেছে) বাংলাদেশ স্ট্যান্ডার্ডস অ্যান্ড টেস্টিং ইনস্টিটিউশন (বিএসটিআই)-এর মান বিবেচনা করে উপযুক্ত বলে প্রতীয়মান হয়। বিডিএস কোড অনুসারে, সিসিবি-এর প্রয়োজনীয় ধারণ ৮–১৬ কেজি/ঘনমিটার।

**Key words:** Diffusion method, Penetration, Retention, Soaking method, *Trewia nudiflora* L.

## Introduction

Bangladesh is a tropical monsoon country of South Asia. The country covers an area of 147,570 km<sup>2</sup> with about 12.8% under total forest cover (BFD 2015) and only land area is considered, forest cover is 14.1% (BFD 2015). However, the Bangladesh Forest Department (BFD) puts the total forest cover at 17.62% of the surface area of the country. The BFD manages and establishes plantation, harvests and sells the forest products, develops parks and gardens. Bangladesh Forest Research Institute (BFRI), and the Bangladesh Forest Industries Development Corporation (BFIDC) for conducting research and processing timber and forest products respectively. There are many kinds of indigenous and exotic species in Bangladesh. Day by day, indigenous species decreases from our forest all over Bangladesh. In 1871, Teak (*Tectona grandis*) was introduced from Myanmar. Since then, natural forests have been replaced successively with many exotic species and monoculture was started. Among the exotics, *Acacia auriculiformis* and *Acacia mangium*, *Eucalyptus camaldulensis*, and *Leucaena leucocephala* are important (Jasimuddin and Inoue 2012). Village forests are very important suppliers of forest products in Bangladesh. Douglas, 1981 indicate that these forests contribute about 80 to 82% of forest products.

Pitali is a common indigenous species in Bangladesh. *T. nudiflora* occurs in the forests of Chattogram, Cox's Bazar, Chattogram Hill Tracts and Sylhet. It is usually growing on moist ground by the side of streams and rivers. It is also found in villages by the side of ditches, tangs or canals and by river banks on sandy tracts, throughout the country (Das *et al.* 2001). The plant is found almost everywhere in Bangladesh. May be that's why the plant has many local names: pitthalu, pitalu, medda, meragota, lattu, latim, laddu. It has also

vernacular names: *Pitali* (Trade and Beng.), *lattoo*, *sital* (Beng.), *mera*, *merua*, *gotagamar* (Sylhet), *pitagola* (Chittagong Hill Tracts), *bol-diktak*, *bolno-khap* (Garo), *hruprukban* (Magh.) (Das *et al.* 2001). During the rainy season, the village children play with the fruit in the water. More than that, the tree can survive after being submerged for long period. *Trewia nudiflora* is a deciduous tree with spreading branches. Leaves opposite, broadly ovate, long pointed, Chordate or rounded base, young leaves are hairy beneath, acuminate, glabrous later and 2–7 cm long stalks. Male and female flowers on separate trees, males flowers yellow in long lax drooping inflorescences, female flowers on long peduncles, green solitary or 3–4 together in the leaf axis. Fruits are fleshy and globose berry, 3 cm by 3.5 cm. Fruits are a capsule 2–3 cm across, greenish brown, woody, broadly cognate to rounded, pericarp of fruit is very thick; the seeds are globe and ovoid (Ghai *et al.* 2019).

*T. nudiflora* is a light, weak and non-durable wood. It is mentionable that untreated pitali samples were affected by insects, fungus etc. within 7 to 8 months. Natural durability of *Trewia nudiflora* is 7 to 8 months in outdoor condition. It is suitable for packing cases, plywood, sports and athletic goods and matches (Sattar *et al.* 1999). Pitali wood normally use as a fuel wood in the villages also. This wood is soft, light and fine grained, and used for making packing boxes (Das *et al.* 2001). Some physical and mechanical properties of experimental sample are mention herewith. Specific gravity of *Trewia nudiflora* is 0.40, 0.42 and 0.44 in green, airdry and oven-dry condition respectively (Sattar *et al.* 1999). Some mechanical properties of Pitali (*Trewia nudiflora*) wood like as static bending (Modulus of rupture and Modulus of elasticity), Compression parallel to grain, Compression perpendicular to grain, Cleavage and Toughness

are mention herewith. Modulus of rupture (MOR) of *Trewia nudiflora* is 466 kg/cm<sup>2</sup> and 557 kg/cm<sup>2</sup> in green and air dry condition respectively. Modulus of elasticity (MOE) of *T. nudiflora* is 79 kg/cm<sup>2</sup> and 93 kg/cm<sup>2</sup> in green and air dry condition respectively. Compression parallel to grain of *T. nudiflora* is 280 kg/cm<sup>2</sup> and 385 kg/cm<sup>2</sup> in green and air dry condition respectively. Compression perpendicular to grain of *T. nudiflora* is 40 kg/cm<sup>2</sup> and 44 kg/cm<sup>2</sup> in green and air dry condition respectively. Cleavage (Radial) of *T. nudiflora* is 45 kg/cm and 49 kg/cm in green and air dry condition respectively. Cleavage (Tangential) of *T. nudiflora* is 49 kg/cm and 58 kg/cm in green and air dry condition respectively. Toughness (Radial) of *T. nudiflora* is 195 cm-kg/specimen and 235 cm-kg/specimen in green and air dry condition respectively. Toughness (Tangential) of *T. nudiflora* is 190 cm-kg/specimen and 230 cm-kg/specimen in green and air dry condition respectively. (Sattar *et al.* 1999).

Treatability and natural durability of *Trewia nudiflora* has been determined for transferred to the end users. Treatability and natural durability of some non- durable wood viz. Mango, Rubber, Rajkoroï etc. have been determined and technology on this information is being transferred to the end users. Penetration and retention of Rajkoroï (*Albizia richardiana*) wood were recorded 4.60 cm and 16.88 kg/m<sup>3</sup> at soaking method for 28 days (Salam *et al.* 2019). This study was undertaken to determine the treatability and durability of Pitali wood. It might be helpful in maximizing utilization of forest resources as well as improving national economy.

### Materials and Methods

The Wood Preservation Division of Bangladesh Forest Research Institute carried out the

treatability and natural durability of Pitali (*Trewia nudiflora*) wood species which were collected from Patiya Upazila, under Chattogram district. Patiya is located at latitude 22.3000° N and longitude 91.9833°E. The age of the *Trewia nudiflora* wood was 12 years. Then the logs were sawn and dried in shed of Bangladesh Forest Research Institute (BFRI) Laboratory to reduce the moisture content. Average moisture content was 81.5% when the wood was collected. Before treatment, all planks were sized into 50.8 cm × 5.08 cm × 2.54 cm. A total number of 48 wood samples were prepared for experiment (Fig. 1).



**Figure 1.** Untreated pitali wood samples

Then, all specimens were allowed to dry for reducing moisture content up to fiber saturation point (FSP) at 25–30% moisture content for treatment. Out of 48 samples, 24 samples were taken for soaking method and remaining 24 for diffusion method. 10% CCB aqueous solution was applied both the method. The percentage of preservative solution is less than 10%, then retention rate become lower than the standard level. The percentage is higher than 10%, and then retention rate become higher than the standard level but treatment cost become increase, which is not economically viable. Wood will be treated by 10% CCB aqueous solution for obtaining required retention and

reducing experimental period. Many studies have been published on the use of CCB solutions at 10% for having a better result. It will be cost-effective and entrepreneurs can apply the concentration of the solution. The physical and mechanical properties of wood increase after treatment using 10% CCB aqueous solution (Shanu *et al.* 2015). Sample will be shown the light blue color after treatment.

Firstly, for soaking method, every 6 samples were immersed into 10% CCB aqueous solution (2:2:1) for 5 days, 7 days, 9 days and 11 days separately. Twenty four samples were staked after treatment by soaking method using 10% CCB aqueous solution (Fig. 2).



**Figure 2.** Wood samples treated by soaking method

The absorption and retention of immersed samples were determined by weighing the samples. Again the samples were dried. Finally retention and penetration were measured. Slightly dry samples were cross-section for determination of penetration. Then, Chrome-azuro1S solution applied in opened wood samples which reaction with CCB preservatives and change color. The blue color indicates the penetration of treated samples. Depth and intensity of blue color indicates penetration range and treatability group of

treated samples. Finally, average penetration and retention were measured.

Wood specimens maximum and minimum moisture content were 62.38% and 50.72% for diffusion method. Every 6 samples were immersed into 10% chromated-copper-boron (CCB) aqueous solution (2:2:1) for 5 days, 7 days, 9 days and 11 days separately. Twenty four samples were staked after treatment by diffusion method using 10% CCB aqueous solution (Fig. 3).



**Figure 3.** Wood samples treated by diffusion method

The treated samples withdraw from 10% CCB aqueous solution and kept 12 hours for dry. The absorption and retention of immersed samples were determined by weighing the samples before and after treatment. Treated samples were cross-section for determination of penetration. Then, Chrome-azuro1S solution applied in opened wood samples which reaction with CCB preservatives and change color. The blue color indicates the penetration of treated samples. Depth and intensity of blue color indicates penetration range and group of treated samples. Finally, average penetration and retention were calculated of treated wood samples using diffusion method. Treated and untreated wood specimens were stake in BFRI stake-yard for service test (Fig. 4).



Figure 4. BFRI Stake yard

## Results

### Soaking method

24 samples were treated by soaking method using 10% CCB aqueous solution for different duration. Penetration and retention of treated samples were measured. The retention of preservatives in experimental sample was founded 12.29 kg/m<sup>3</sup>, 14.97 kg/m<sup>3</sup>, 15.11 kg/m<sup>3</sup> and 15.72 kg/m<sup>3</sup> when soaked for 5, 7, 9 and 11 days respectively (Table 1). The highest retention was founded 15.72 kg/m<sup>3</sup> in Pitali wood samples with soaking method for 11 days and wood samples are moderately treatable. The lowest retention was found 12.29 kg/m<sup>3</sup> at 5 days in this species applying soaking method.

Table 1. Retention of preservatives in experimental sample (*T. nudiflora* L.) using soaking method.

Charge No.	Sample size (cm)	Treatment period (day)	Retention (kg/m <sup>3</sup> )	F-ratio (ANOVA)
1	2.54×5.08×50.8 52.31	5	12.29±0.30	(p=1.11*)
2		7	14.97±0.30	
3		9	15.11±0.27	
4		11	15.72±0.27	
	F-ratio (ANOVA)	4.23		

Note: (\*) indicates significant at 5% probability level.

### Diffusion method

Twenty four samples were treated by diffusion method using 10% CCB aqueous solution for four different durations. Penetration and retention of treated samples were determined. Retention of preservatives of wood samples were recorded 11.43 kg/m<sup>3</sup>, 23.49 kg/m<sup>3</sup>, 24.14 kg/m<sup>3</sup> and 25.38 kg/m<sup>3</sup> when diffused for 5, 7, 9

and 11 days respectively (Table 2). The highest retention was recorded 25.38 kg/m<sup>3</sup> in wood samples with diffusion method for 11 days and wood samples are treatable. The lowest retention was found 11.43 kg/m<sup>3</sup> at 5 days in the species of Pitali applying diffusion method.

**Table 2.** Retention of preservatives wood sample (Size: 2.54×5.08×50.8 cm) using diffusion method.

Charge No.	Av. moisture content (%)	Treatment period (day)	Retention (kg/m <sup>3</sup> ) ± Standard error	F-ratio (ANOVA)
1	62.38±0.17	5	11.43±0.23	19.0 (p=0.00018*)
2	51.22±0.06	7	23.49±0.53	
3	50.72±0.17	9	24.14±0.49	
4	54.19±0.53	11	25.38±0.37	
F-ratio (ANOVA)			19.05	

Note: (\*) Indicates significant at 5% probability level.

### Discussion

The highest retention is 15.72 kg/m<sup>3</sup> in Pitali wood using soaking method for 11 days which can be supported with BSTI Standard (Anon 1975). The rate of retention increased rapidly at soaking period of 5 to 7 days. On the other hand, the rate of retention increased slowly at soaking period of 7 to 11 days. If treatment period was continued for more than 11 days in soaking method, retention would probably motionless.

The highest retention of Pitali wood is 25.38 kg/m<sup>3</sup> using diffusion method at 54.19% moisture content, which supports with BSTI Standard. According to BDS code, the required retention of CCB is 8–16 kg/m<sup>3</sup> (Anon 1975). Different retention was observed in pitali wood due to applying different moisture content and time period. The rate of retention increased rapidly at treatment period of 5 to 7 days. On the other hand, the rate of retention increased slowly at treatment period of 7 to 11 days. If treatment period was continued for more than 11 days in diffusion method, retention would probably slightly increase.

According to Bangladesh Standard Testing Institute (BSTI), timbers in direct contact with ground or water, especially in outside locations,

such as poles, piles, fence-posts, etc. the required retention for CCA preservative chemical is 8–16 kg/m<sup>3</sup> (Anon 1975). In this study, the retention results of treated samples at 11 days are acceptable for both the methods.

Chandra and Gupta (1972) stated that, 16 kg/m<sup>3</sup> of dry salt was necessary for the effective preservation of the poles in contact with ground. In the experiment, the highest retention was found 15.72 kg/m<sup>3</sup> and 25.38 kg/m<sup>3</sup> for the species which is near up to standard and matched with Chandra and Gupta (1972). Research report of Commonwealth Scientific and Industrial Research (CSIR) (Du Toit 1988) indicated that average sapwood retention levels are required for adequate protection of poles against wood rot and termite attack. Findings of the present study prove that penetration and retention level can be maximized into Pitali wood by applying soaking and diffusion. Accordingly, this wood can be free from wood rot and termite attack resulting in escalating the durability.

### Conclusion

Pitali wood can be treated with 10% CCB aqueous solution. It is mentionable that

untreated samples were affected by insects, fungus etc. within 7 to 8 months. Till now, the treated *Trewia nudiflora* samples are in good condition in the BFRI stake yard. Longevity of Pitali wood was made enhanced in association with soaking and diffusion method. Prescribed to use the wood with the narrated treatment for short time use at outdoor and for life time use at indoor condition.

### Acknowledgement

The authors are grateful to the Director of BFRI for providing the logistic supports to conduct the research work. We are very grateful to Chief Research Officer, Forest Products Wing, BFRI for the spontaneous inspiration and proper direction to write this paper. We are especially thanks to all the colleagues of Wood Preservation Division, BFRI for their cooperation.

### References

- Anon. 1975. code of practice for preservation of timber. Bangladesh Standards of Testing Institution BDS. 819: 1975, Dhaka 33 pp.
- BFD. 2015. Bangladesh Forest Department. ([www.bforest.gov.bd](http://www.bforest.gov.bd)).
- Chandra, A. and Gupta, R.B. 1972. Fence-posts preservation by the Sap-displacement method. *Journal of Timber Development Association India* 8 (4): 5–9.
- Das, D.K. and Alam, M.K. 2001. Trees of Bangladesh. Bangladesh Forest Research Institute, Chattogram. 342 pp.
- Douglas, B.J. and Olsen, R.S. 1981. Soil classification using electric cone penetrometer. *Proceedings of Conference on Cone Penetration Testing and Experience, St. Louis*, 26–30 October 1981, 209–227 pp.
- Du Toit, C.B. and Conradie, W.E. 1988. Preservative retention requirements based on sapwood volume for *E. grandis* and *E. cloziana*, September, 1988. (R20 & GST). ISBN: 9780798843904, 079884390X; OCLC Number / Unique Identifier: 122281310
- Ghai, K.; Bhatt, N.; Bhushan, B. and Nayak, A. 2019. Phneological studies on *Trewia Nudiflora*. *International Journal of Innovative Technology and Exploring Engineering (IJITEE)* 8 (12S3): 29–33.
- Jasimuddin, M. and Inoue, M. 2012. Community forestry for sustainable forest management: experiances from Bangladesh and policy recommendations. *Formath* 11: 133–166 pp.
- Sattar, M.A.; Bhattacharjee, D.K. and Kabir, M.F. 1999. Physical and mechanical properties and uses of timbers of Bangladesh. Bangladesh Forest Research Institute, Chattogram. 57 pp.
- Shamu, S.A.; Das, A.K.; Rahman, M.M. and Ashaduzzaman, M. 2015. Effect of Chromate-Copper- Boron preservative treatment on physical and mechanical properties of Rajkoroi (*Albizia richardiana*) wood. *Bangladesh Journal of Scientific and Industrial Research* 50 (3): 189-192.
- Salam, A.; Akhter, K.; Rahman, M.A.; Chowdhury, M.H.; Mridha, M.N.A. and Chowdhury, F.H. 2019. CCB Preservative treatment of Rajkoroi (*Albizia richardina* King & Prain) wood by soaking method. *Eco-friendly agriculture Journal* 12 (09): 74-77.

