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THE STUDY OF WOOD-CEMENT BONDING BY THE STICK TEST METHOD

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ABSTRACT

The preliminary study on wood–cement bonding by the stick test method was carried out by investigating the compatibility of 13 timber species with Diamond–brand portland cement, which is available on the domestic market. Based on the results, the method provided a quick sorting of the suitable species for making the wood–cement products. There is still no better way to assess the overall suitability of a species than to produce the products and to test them.

INTRODUCTION

In Thailand, there are only two types of the mineral-bonded board products currently being manufactured for the building industry. The gypsum board, commonly known as plaster board in the United States, is mainly sold in the domestic market. It consists of a gypsum core faced on both sides with thick paper as the loading panel material. Another type of mineral–bonded is the excelsior board in which excelsior fibers (wood–wools) are combined with portland cement to produce a porous board. Its size is smaller than the gypsum board, and is commonly known as "cellocrete" in the market. It is used as a plaster and stucco base and to some extent also as an acoustical tile for sound absorption and ceiling decoration.

The Wood–Cement Research of the Royal Forest Department has devoted many years to the development of mineral–bonded panel products involving the use of a wood derivative and inorganic binders which would possess the necessary strength and the weather resistance desired. The only wood–wool industry in Thailand has traditionally made use of Som–pong (*Tetrameles nudiflora* R.Br.) for the production of wood–wool cement board. No other species has been accepted by the existing industry as the suitability of others has yet to be proven. Therefore, the objective of this study was to determine the compatibility of some Thai wood with cement and it is the comparative study of stick test method as adopted by Bison–Werke (pers. comm.), followed with slight modification by the Forestry Research Institute, Kepong, Malaysia, (Wong and Ong, 1982)

MATERIALS AND METHODS

Several medium hardwoods were selected for testing. This study also covered some compensatory plantation species. Test sticks of dimension 200 mm × 15 mm × 5 mm were prepared from each test species. Six test sticks from each species were used for each test.

The cement slurry was prepared by mixing 400 gm of Portland cement with 160 ml of water. The cement slurry was poured into the moulds (paper cups) and test sticks which were previously soaked in water for 24 hours then embeded in the slurry up to a depth of 50 mm and held upright throughout the experiment by the jig.

After curing for 48 hours, the removal of the cement blocks was tested by pulling up with the use of a Universal testing machine, instead of pulling out the stick manually as suggested by Bison-Werke Method. This was done so that the force in Newtons required to pull up the sticks could be recorded.

RESULTS AND DISCUSSION

For thirteen species selected in this study, the force required to pull out the test stick from cement blocks are given in Table 1. An average force of 582 N was required to pull the Som-pong test sticks out from the cement blocks. Since Som-pong is the only currently acceptable species of wood-wool slab manufacture and has been for over 29 years, this timber species is intended to be used as a yard-stick for measuring the relative compatibility of other species with Portland cement. Based on the results of the stick test, species other than Som-pong could also be used for wood-wool slab manufacture. The fact that Som-pong is the only timber species used by the industry of present could be due to other unfavourable processing characteristics of the compatible species.

There may be some difficulties in preparing excelsior for eventual slab making-lack of pliability of the excelsior and availability, etc. Timber species with abnormal anatomical features such as pronounced interlocked grain, or of high density, are normally rejected as it is difficult to convert the wood into excelsior.

In Thailand, Som-pong is the suitable species for only wood-wool board factory whose annual production is about 68,394 slabs or 1,264.32 cu m (for the year 1982) : it is a lesser known species and has favorable processing characteristics.

Table 1. Wood–cement bonding strengths of some Thai hardwoods by stick test method.

No.	Wood Species	Family	% M.C. at test	Failing Load (Newtons)	Standard Deviation (Newtons)
1	Ailanthus fauveliana Pierre.*	Simaroubaceae	16.6	220	81
2	Anogeissus acuminata Wall.	Combretaceae	16.7	1386	645
3	Anthocephalus cedamba Miq.*	Rubiaceae	20.8	0	0
4	Chukrasia velutina W & A.	Meliaceae	19.2	97	55
5	Cynometra bijuga Span.	Leguminosae	17.5	202	59
6	Diospyros ferrea Bakh.	Ebenaceae	15.8	1739	83
7	Elaeocarpus sp.	Elaeocarpaceae	15.8	439	166
8	Hevea brasiliensis Muell. Arg.	Euphobiaceae	—	249	170
9	Leucaena leucocephala Lam.	Leguminosae	19.4	407	146
10	Melia azedarach Linn*	Meliaceae	19.2	97	55
11	Peltophorum petrocarpum Becker*	Leguminosae	19.6	322	138
12	Terminalia tripteroides Stapf.	Combretaceae	16.5	1295	181
13	Tetrameles nudiflora R. Br.*	Datiscaceae	16.9	582	207

*Wood species obtained from Lan–sak Forest Plantation, Utai–tanee Province, age : 8–9 years old.

For other species investigated, the magnitude of the force attained is lower than the test results made by the Forestry Research Institute of Malaysia (Wong and Ong, 1982). For example, the rubberwood (*Hevea brasilieusis* Muell. Arg.) has an average force of 249 N (Standard deviation = 170 N) when compared with 340 N (Standard deviation = 81 N) respectively. This may be caused by the slight modification of the method of testing in a different way, e.g., the different sort of Portland cement, the speed of testing seems influence the pulling force etc.

For this preliminary study, the species selected is limited for grouping the suitable and unsuitable classes. Further work should be confined to the other compatible hardwoods with the effect of mineralising fluids in order to evaluate the effectiveness of those types of fluids to reduce the inhibitory effect of wood on the setting of the wood–cement mixture.

CONCLUSIONS AND RECOMMENDATIONS

Further investigation, after the grouping of Thai wood species and the studying of the effect of those modification methods on the actual assessment, will comprise the comparative evaluation of various tropical hardwoods to improve the compatibility with different types of cement. As Chittenden *et al.* (1975) have noted, many tropical hardwoods are high in cement poisioning extractives and the study of the effect of the amount of extractives on the ***inhibitory index*** (I) by using the hydration temperature method, Sandermann and Kohler (1964) developed by Hofstrand *et al.* (1984) is very interesting. It is worthwhile therefore to include this study in further research programmes.

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