COMBUSTION AND WEATHER RESISTANT PROPERTIES OF WOOD COMPOSITES TREARED WITH WOOD ASH BASED HYDROXYAPATITE

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INTRODUCTION

In our previous study, a new wood-inorganic mineral composite was manufactured by reusing of the wood ash; the wood ash was converted into Hydroxyapatite (HAp; $Ca_{10}(PO_4)_6(OH)_2$) solution by a reaction with phosphoric acid, and then it was penetrated and fixed into woods in order to make the HAp-wood composites. The HAp is well-known as eco-friendly biomaterials and it has a potential to be used as a fixative in wood preservative formulations because of its water insolubility. Besides HAp contains a phosphoric component like some kinds of fireproof agents; therefore the HAp treated woods would improve their fire retardance. In this study, the weathering resistance and fire retarding properties of the HAp-wood composites were examined.

RESULTS

1. WEATHERABILITY TEST

[SPECIMES PREPARATION]

- Test piles 600×30×30mm (L, R, T) from five types of woods; Sapwoods and Heartwoods from Japanese cedar, Japanese cypress Yellow cedar and Spruce
- After the HAp impregnation under 1.1 MPa for 24h and drying, these stakes were planted to their half length depth at test area in Miyazaki, Japan.
- On their underground parts, the degrees of decay progress were periodically checked in five-grade evaluation based on the JIS K1571.
- Color changes of their over ground part during 2 years have been measured.

⇒ Photo.1 Outdoor weathering test.

Fig.1 Degrees of decay progress after 2 years.

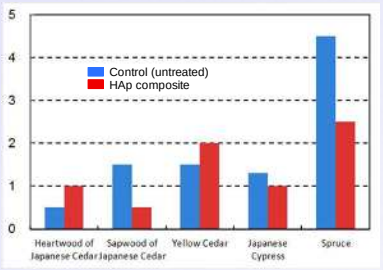
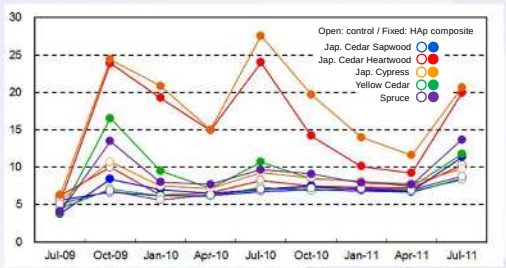
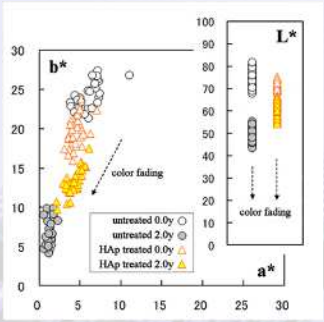


Fig.2 Mean moisture contents of test stakes .





⇙ Fig. 3 Color alterations of woods with or without HAp from Japanese cedar sapwoods.

Table 1 Color changes (ΔE^*) of HAp composites and controls.

	control	HAp composite
Sapwoods of Japanese Cedar	27.9	11.0
Heartwoods of Japanese Cedar	19.8	10.0
Japanese Cypress	34.0	11.6
Yellow Cedar	38.5	18.8
Spruce	38.4	15.6

⇐ Photo.2 Test stakes of Japanese cypress without (upper) and with (lower) Hap after 2 years outdoor exprosures.

[Results]

- At a lapse of two years exposure, the decay progress of HAp composites was comparable in those of controls, untreated wood stakes (in Fig.1).
- The moisture contents of the HAp composites tends to be higher than that of controls (in Fig.2) and this may militate against their weather resistance.
- Compared with the controls, the HAp treated specimens were less subject to fading at after 2 years exposure (in Fig.3, Table 1 and Photo 2).

⇒ These results indicate that the HAp treatment on woods have some weatherproof efficacy against a sunlight irradiation, although no retarding effects against a wood rotting progress were confirmed at two years exposure passed.

2. COMBUSTION PROPERTY

[SPECIMES PREPARATION]

- Specimens 50×30×4mm (L, R, T) cut from edge-grained sliced veneers of the same five wood types with those used in the weathering resistance tests.
- After the HAp impregnation under 1.1 MPa for 24h and drying, the powdered samples were studied with a DTA-TG thermogravimetric analyzer.
- In addition, the powdered samples from those in the outdoor exposed stakes were also studied by the DTA-TG analyzer every 0.5 exposure periods.

[Results]

- Two exothermic peaks were observed from the control, (in Fig.4a), and these peaks were weakened by the HAp treatment (Fig.4b). Also the HAp composites show a similar burning characteristics to those treated with the other phosphoric fireproof agents (e.g. Arima 1974).
- After 0.5 year outdoor exposure (Fig.4c-f), their exothermic peaks sharpened again. As a result, the DTA curves of the HAp composites were distorted in shape through the HAp leaching into those before the HAp injection.

⇒ These results indicate that the HAp treatment is effective for the thermal property enhancement, the HAp leaching loses this potency though.

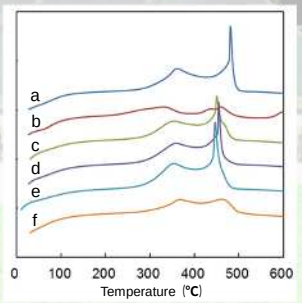


Fig. 4 DTA curves of Jap. Cedar sapwood a) control, b) HAp composite, c-f) outdoor exposed for 0.5, 1.0, 1.5 and 2.0 years, respectively.

SUMMARY

HAp wood composites were manufactured by the injection of HAp suspension, which was made from the wood ash. As a result of the 2 years outdoor exposure test, it was revealed that the HAp treatment on woods have some weatherproof efficacy against a sunlight irradiation, although no retarding effects against a wood rotting progress were confirmed at two years exposure passed the color fading of woods were delayed by the HAp treatment. Also from DTA-TG studies, it was indicated that the HAp treatment is effective for the thermal property enhancement, the HAp leaching loses this potency though.

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