Development of a board containing bark-tannin with cellulose nanofibers as a binder

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INTRODUCTION

Tannins, one of the polyphenols, have many attractive capabilities such as protein adsorption, antioxidant, metal chelating and antifungal properties. The purpose of this research is to develop a novel material utilizing these abilities of tannin. In this study we made a composite consisting of *Acacia mangium* bark powder with a large content of condensed tannin, artificial zeolite having a porous structure with the ability to control humidity, and cellulose nanofibers as a binder.

MATERIALS and METHODS

Manufacture of composites

Artificial zeolite (Kimura Chemical Plants Co., Ltd) was mixed in a water suspension of 1wt% cellulose nanofibers (DAICEL CHEMICAL INDUSTRIES, LTD.). The water was removed from the blend by filtration and centrifugation and the *Acacia mangium* bark powder was added and mixed on a Laboplasto-Mill equipped with a twin rotary roller mixer (Toyo Seiki Seisaku-sho, Ltd.). The mixing was carried out for 15min at a rotary speed of 70rpm at room temperature. A moderate amount of water was added to this mixture and a cold dewatering press molding with a die was performed. By drying it at 55℃ for one day and 110℃ for another day the composite was obtained. Based on preliminary experiments, the ratio of cellulose nanofiber was adjusted to 10wt% of the composite.

Performance evaluation of composites

(A) Bending strength property: Specimens were cut from the composite into predetermined sizes. Bending strength test was performed with an Instron 3365.

(B) Humidity conditioning property: Relative humidity change was measured in a steel box(23.5×23.5×35cm) enclosing the composites, which was put in a climatic chamber. The C value was calculated from the results. The C value was defined as the ratio of the amplitude of humidity changes in the steel box with the composites to that in the empty steel box.

(C) Antioxidant property: 10mg of the ethyl docosahexaenoate (DHA) and 10mg of the ethyl stearate (reference substance) were dispensed in vial containers. Those and the composites were put into a desiccator set in a chamber at 20℃. In addition, a desiccator without the composite was also prepared. The quantity of non-oxidized DHA in the vial containers collected periodically was measured by gas chromatography. The antioxidation property was evaluated by comparing the quantity of non-oxidized DHA with that of ethyl stearate.

RESULTS and DISCUSSION

The results of the composites consisting of 10wt% cellulose nanofibers, 30wt% bark powder and 60wt% artificial zeolite are as follows:

(A)The average values of Young's modulus, bending strength and density of the composites were 3.82GPa, 25.3MPa and 1.22g/cm^3, respectively. These bending strength values were little less than these of MDF in Japanese Industrial Standards (JIS-A5905).

(B) The C value of the composites exhibited excellent humidity conditioning property. This value was more than that of Japanese cedar and commercial porous ceramics.

(C) Fig.1 shows the ratio of non-oxidized DHA. Because the ratio of non-oxidized DHA in the desiccator containing the composites was larger than that of control (desiccator without composites), it was confirmed that the composites have antioxidant property.

Therefore, we would say that we could produce composites having enough strength without hindering the characteristics of artificial zeolite and condensed tannin when using cellulose nanofibers as a binder.

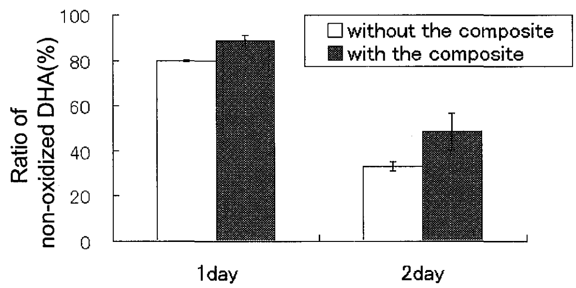

Fig.1 antioxidant property of the composite