

Development of New Natural Polymer-based Wood Adhesives: Effects of glucose addition on film and bonding properties of chitosan

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【Introduction】 Recent adhesives used in wood products are derived from petroleum resources. These adhesives contain organic compounds which are harmful for human health and environment. Therefore, the development of environmentally friendly wood adhesives derived from biomass resources is required. Chitosan which is a deacetylated of chitin is an abundant polysaccharide on Earth. It is known that, chitosan have good dry and wet bond strengths but have poor bond strength in dilute acid solution. Recently, it was reported that glucose-added chitosan film was almost insoluble in dilute acetic acid solution.

In this study, the physical and mechanical properties of glucose-added chitosan films were evaluated by changing the molecular weight of chitosan and the addition amount of glucose. In addition, the detailed bonding properties of glucose-added chitosan were investigated.

【Materials and Methods】 Chitosan powder (Molecular weight: 35000~350000, degree of deacetylation 70-80%) and glucose were used. In film preparation, chitosan (0.5 g) and glucose were dissolved in 1% acetic acid solution. The weight ratios of chitosan and glucose were adjusted to 10:0, 9:1, 8:2, 5:5, and 3:7. After removal of air in vacuo, the solution was poured into a plate, dried in an oven at 50°C, and washed thoroughly to yield chitosan films. The films were examined for weight increase, color, free amino groups, tensile strength, solubility in water and in 5% acetic acid, and thermal properties. To evaluate the bond strength, three-ply plywoods (size 30 × 30 cm) were prepared using rotary-peeled lauan (*Shorea spp.*) veneers of 1.6 mm thickness. When chitosan and glucose were used as an adhesive, they were dissolved in 1% acetic acid solution. The hot-press temperature and pressure were 130°C and 1 MPa, respectively. The total pressing time was 15 min. A normal, water immersion and repeated boiling tests were performed based on JIS K 6851. Resistance to dilute acetic acid was also measured.

【Results and Discussion】 In film properties, the tensile strength of pure chitosan films increased with increasing the molecular weight. The all films were almost insoluble in water, but soluble in 5% acetic acid solution. When glucose was added to chitosan, 10wt% glucose addition for a low molecular weight chitosan was effective for the tensile strength. Acid resistance developed by addition of >10wt% glucose regardless of the molecular weight of chitosan. 10wt% addition of glucose for low molecular weight was effective for the enhancement of film properties.

Fig. 1 shows the bond strength of 3-ply plywood glued with chitosan (M.W. 35000). As a whole, the bond properties were improved by addition of glucose. In the case of high molecular weight chitosan, the improvement of bonding properties was hardly observed. It was clarified that 50wt% addition of glucose for low molecular weight chitosan was effective for the improvement of the bonding properties of chitosan.

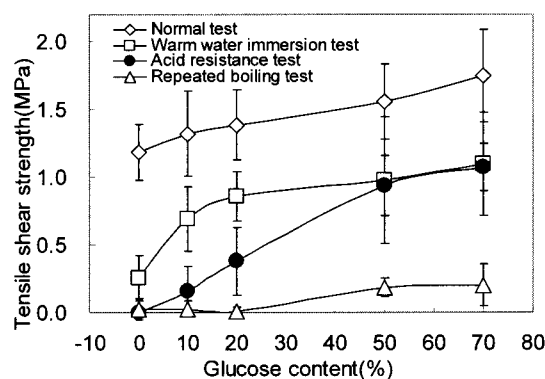


Fig. 1 Tensile strength of 3-ply plywood glued with chitosan and glucose