Evaluation of sodium alginate as a wood adhesive

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INTRODUCTION

Recently, it has been indicated that fossil-based adhesives have serious problems for human health and environment. Natural adhesives derived from non-fossil resources are considered as the alternatives to solve the problems. However, the use of conventional natural adhesives is currently limited because of low bonding properties, especially low water resistance. In addition, conventional natural adhesives need to add some harmful chemical agents for high bonding strength and durability. Therefore, it is extremely important to develop safe natural adhesives with good bonding properties.

Although sodium alginate (SA) is water-soluble natural polysaccharide derived mainly brown seaweeds, water-insoluble property is developed by adding multivalent cations. In this study, the SA was evaluated as a new natural wood adhesive.

MATERIALS and METHODS

The molecular weight and manuronic acid/gulironic acid (M/G) ratio of SA (Kimica-algin IL-2) produced by Kimica Corporation. were 102,000 and 0.71, respectively. Calcium chloride ($CaCl_2$), calcium carbonate ($CaCO_3$) and borax were used as a gelling agent. Plywood was manufactured using rotary-peeled lauan veneer of 1.6mm thickness and the SA as an adhesive. The 3-ply plywoods coated with the SA of 8-48 g/m^2 solid spread rate were hot-pressed at 130°C under 1MPa for 15minutes. Particles were prepared using recycled chips. The SA was added with a solid content of 10%, and the target densities of the boards were 0.4, 0.6, and 0.8 g/cm^3. The particle mats were hot-pressed at 125°C for 40 minutes, and then immersed in 10wt% $CaCl_2$ solution for 5 - 15 min. Finally, the mats were dried at 125°C for 45 - 90 min. The physical properties of plywoods and particleboards bonded with SA were evaluated by JIS K 6851 and JIS A 5908, respectively.

RESTLTS and DISCUSSION

Fig.1 shows the dry bond strength of 3-ply plywood glued with various amounts of SA alone. The bond strength increased with increasing SA to 32g/m^2 and then decreased slightly. In case of the addition of gelation materials, the bond strength was not improved. The water resistance of SA was extremely low.

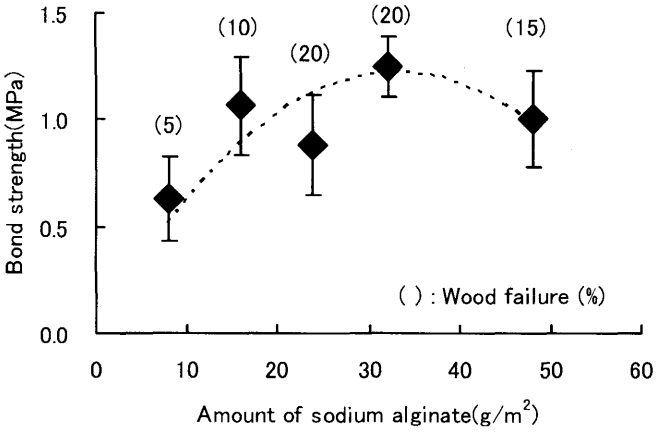

Fig.1 The relationship between SA spread rate and bond strength.

Fig.2 shows the thickness swelling (TS) of the particleboard. The good dimensional stability was observed in the particleboard with the density of 0.4 and 0.6 g/cm^3, but the remarkable swelling was recognized in the particleboard with the density of 0.8g/cm^3. The value of the internal bond strength of the board of 0.8 g/cm^3 was worst. It seemed that the gelled SA was collapsed partially by the drying process after $CaCl_2$ solution immersion. The results indicated that careful consideration must be given to the gelation mechanisms when using SA as a wood adhesive.

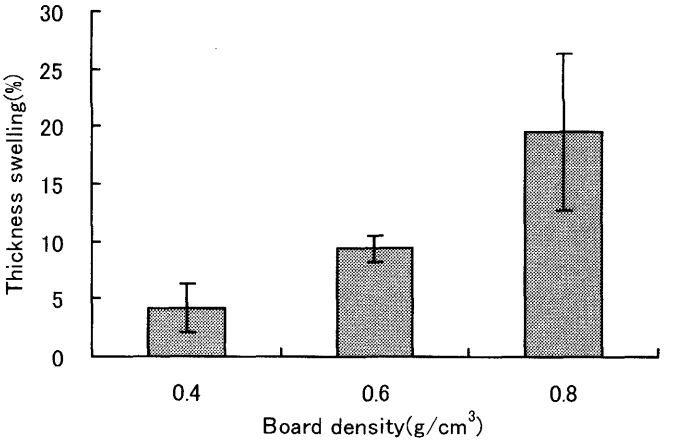

Fig.2 The relationship between TS and board density.