

ABSTRACTS (MASTER THESIS)

Development of natural wood adhesive composed of sucrose and ammonium nitrate

(Graduate School of Agriculture,
Laboratory of Sustainable Materials, RISH, Kyoto University)

Mitsuki Nomura

Introduction

Increasing demand of wood-based material is expected because of global population increase and economic growth. However, general wood-based materials are made using synthetic adhesives derived from fossil resources. Considering future of fossil resources, it is desirable to replace synthetic adhesive with natural adhesive based on non-fossil resources.

Recently, research on utilization of sucrose as wood adhesives has been investigated. The purpose of this research is to develop a natural adhesive composed of sucrose and ammonium nitrate (AN). It is possible that AN promotes curing of sucrose and brings self-bonding of wood. In this study, the curing properties of sucrose and AN mixture was investigated, and the physical properties of wood-based molding glued with sucrose and AN were clarified.

Methods

Mixture of sucrose and AN with various weight ratios (AN ratios were 0~30wt%) was dissolved in distilled water, which was used as an adhesive. The adhesive was freeze-dried, and the thermal properties were investigated by DSC and TGA. Insoluble matter rate to boiling water for heated adhesive was calculated. In the preparation of wood-based molding, the adhesive was mixed with wood powder. Solid content of adhesive was 20wt% to wood powder. After drying, the mixture was poured into a dumbbell-shape mold for JIS7139-1966 type A3, and hot-pressed. The bending test, insoluble matter rate measurement and FT-IR analysis of the wood-based molding were performed.

Results and discussion

It was clarified that sucrose and AN mixtures have endothermic and exothermic reactions with weight loss between 130~160°C. In the higher AN ratio, the marked behavior of those reactions was recognized. Fig. 1 shows insoluble matter rate of adhesive heated at 180°C for 20min. The adhesive with AN ratio of 5 wt% showed low value. However, the insoluble matter rate increased with increasing AN ratio, indicating that AN promoted the polymerization of sucrose. Fig. 2 shows insoluble matter rate of wood-based molding. Even though AN ratio in solid content of adhesive was low, insoluble matter rate was high value. This tendency was very different from the heated adhesive, indicating AN contributed to self-bonding of wood. The bending properties of wood-based moldings were improved with increasing AN ratio in solid content of adhesive until 10wt%. However, higher AN ratio than 20wt% brought lower bending properties. Based on the results of FT-IR, formations of ester linkage and furan compound were presumed.

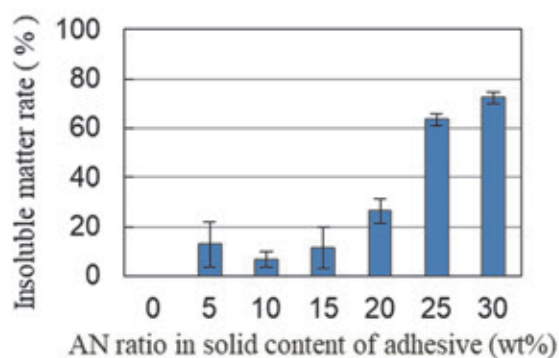


Fig. 1: Insoluble matter rare of heated adhesive.
(Heat treatment : 180°C,20 min)

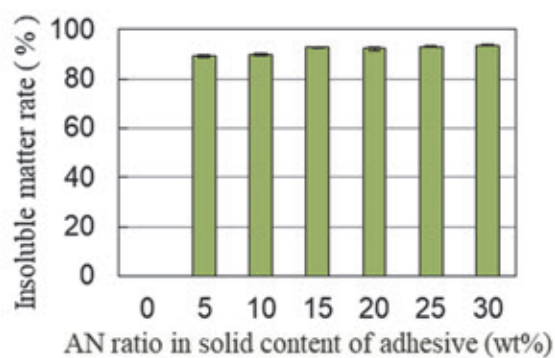


Fig. 2: Insoluble matter rare of moldings.
(Hot press : 180°C,20 min)