RECENT RESEARCH ACTIVITIES

Utilization of *p*-toluenesulfonic acid for a sucrose adhesive

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Introduction

Commercial wood adhesives are generally synthesized using chemicals derived from fossil resources. Therefore, there are concerns about the dependency on fossil resources and environmental impact. To solve these problems, researches on bio-based adhesives such as protein-, tannin-, and lignin-based adhesives have been conducted. We have been focused on sucrose as a raw material of bio-based adhesive. According to our previous paper[1)], sucrose was changed to matter insoluble in boiling water by adding ammonium dihydrogen phosphate (ADP) and heating. Actually, particleboards manufactured by using ADP added sucrose as an adhesive exhibited good mechanical properties and water resistance[2)]. However, high adhesive content and high hot-pressing temperature were required when manufacturing the particleboards. To improve these disadvantages, we are trying to use p-toluenesulfonic acid (PTSA) which is widely known as an acid catalyst. The effect of PTSA content on the insolubility of sucrose in boiling water was measured.

Experiment

Sucrose and PTSA were dissolved in distilled water at various weight ratios: 100:0, 95:5, 90:10, and 85:15. The concentration of the solution was adjusted to 50wt%. Each solution was dried at 60 °C for 24 h, and the dried samples were heated at 120, 140, 160, and 180 °C for a 10 min. The heated samples were immersed in boiling water for 4h, and each insoluble matter rate was calculated. In addition, thermal analyses and FT-IR were measured.

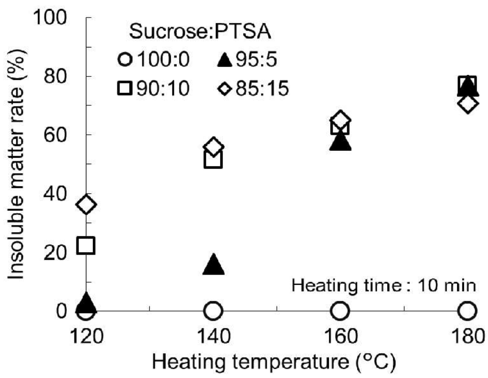

Figure 1. Effect of heating temperature on insoluble matter rate at various sucrose/PTSA ratios.

Results and discussion

Figure.1 shows the effect of heating temperature on insoluble matter rate at various sucrose/PTSA ratios. The insoluble matter rate of sucrose (100:0) was not observed at all, indicating that sucrose was soluble irrespective of heating temperature. The insoluble matter rate of PTSA added sucrose tended to increase with increasing heating temperature. The effective heating time and the mixture ratio at 180 °C were 10 min and 95:5, respectively. Compared with the result of ADP[1)], PTSA was able to insolubilize sucrose by a small amount of addition and a low heating temperature. According to the results of FT-IR, it was suggested that a furan ring and carbonyl group was contained in the heated mixture. This indicated that sucrose was changed to a high water-resistant substance containing furan compounds by the addition of PTSA and heating treatment. Furthermore, thermal analyses revealed that the thermal change of PTSA added sucrose occurred at a temperature lower than that of ADP added sucrose. Sucrose with added PTSA would be expected as a wood adhesive.

References

[1] Kenji Umemura, et al. “Changes in Physical and Chemical Properties of Sucrose by the Addition of Ammonium Dihydrogen Phosphate”, *J. Adhesion Soc. Jpn.*, Vol. 53, No.4, pp.112-117 (2017).
[2] Zhongyuan Zhao, et al. “A Novel Eco-Friendly Wood Adhesive Composed by Sucrose and Ammonium Dihydrogen Phosphate”, *Polymers*, Vol.10, No.11, 1251 (2018).