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Preparation and properties of a chitosan-lignin wood adhesive

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ABSTRACT

A highly efficient method was developed for preparing chitosan-lignin wood adhesives with high performance using chitosan and ammonium lignosulfonate as main raw material and performance of the resulting adhesives was evaluated by manufacturing medium density fiberboard (MDF). The effects of chitosan-lignin adhesive content and lignin/chitosan weight ratio on the physical and mechanical properties of MDF and the optimal method to prepare and utilize chitosan-lignin wood adhesives were investigated. The results indicated that chitosan had important effects on bonding strength and water resistance and the performance of chitosan-lignin adhesive improved significantly with the optimal method: chitosan-lignin adhesive content of 6% and lignin/chitosan weight ratio of 1:2. The fractures in the bonded joints and the chitosan-lignin adhesive were analyzed via scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR) and thermogravimetric analysis (TGA). The SEM image analysis verified the high performance of the chitosan-lignin adhesive. The FTIR analysis indicated that interactions due to hydrogen bonding between chitosan and lignin occurred. The results of thermal stability analysis validated this and showed that the thermal stability of the interactions was not high.

Keywords: A Adhesives for wood, C Infrared spectroscopy, C Thermal analysis, D Mechanical properties of adhesives, Chitosan, Ammonium lignosulfonate

1 Introduction

In recent years the growing problem of timber shortage in China has drawn the attention of specialists, who are trying to develop multiple methods for efficient utilization of timber resources. One of the methods generally used for this purpose is to use waste materials and small diameter timbers or some remains to make medium density fiberboard (MDF) as a substrate of panel-type furniture and hence it requires a lot of wood adhesives [1]. In the MDF industry, urea-formaldehyde (UF) resin, phenol formaldehyde (PF) resin and melamine formaldehyde (MF) resin are the most widely used wood adhesives but they produce environmental and human health hazards because of the release of free formaldehyde [2-5]. To overcome the shortcomings of adhesives containing formaldehyde, specialists are trying to find low toxicity or non-toxic wood adhesives through reducing the molar ratio and adding a formaldehyde catcher in the preparation process [6,7]. However, it cannot address the problem at its roots. Besides, oil resources, which are being used to produce UF, PF and MF resins, are running out rapidly. Therefore, it is of great importance to develop

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Abbreviations which are not standard: chitosan-lignin adhesives (CLA); ammonium lignosulfonate adhesive (ALA); lignin/chitosan weight ratio 1:2 (CLA 1), 1:1 (CLA 2) and 2:1 (CLA 3).

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