《造纸与生物质材料》(英文)2020年第4期摘要
Abstract, *Paper and Biomaterials*, Vol.5, No.4, 2020

Behavior of Decayed Spruce (Picea abies) during Kraft Pulping

Markku Halonen　Raimo Alén*

Laboratory of Applied Chemistry, Department of Chemistry, University of Jyväskylä, FI-40014, Finland

(*E-mail: raimo.j.alen@jyu.fi)

Abstract: This study indicated that by applying an improved classification system to decayed large-diameter Norway spruce (Picea abies) wood, its use as raw material for kraft pulping without loss of pulp quality could be essentially increased. This is based on the fact that although the cooking yield of decayed spruce material which has been sorted according to these new recommendations is somewhat lower and Kappa number higher than those of sound wood material, the greatest part of the decayed stem (the outer part of the stem) contains long-fiber wood material which produces pulp of good quality. Therefore, large-diameter spruce logs can also be separately used, for example, in the manufacture of reinforcement pulp.

Key words: Norway spruce; kraft pulping; wood decay; fungal decay; soft rot

DOI: 10.12103/j.issn.2096-2355.2020.04.001

Biotreatment of Wastewater from Soda-pretreatment Process of Corn Stover Using White-rot Fungus Z-6

Xuezhi Li　Jian Zhao*

State Key Laboratory of Microbial Technology, Shandong University, Qingdao, Shandong Province, 266237, China

(*E-mail: zhaojian@sdu.edu.cn)

Abstract: Alkaline pretreatment of straw materials prior to enzyme hydrolysis is a key step for bioconversion of lignocellulose to bioethanol and chemicals. Wastewater from the alkaline pretreatment process must be treated before discharge to minimize its environmental impact. In this study, biotreatment of the wastewater from soda-pretreatment process of corn stover was investigated using fungus Z-6, and some indexes such as color, chemicaloxygen demand (COD), and lignin content of wastewater before and after biotreatment were determined to assess the effect of the biotreatment. Results showed that fungus treatment could remove color up to approximately 72% after 2 d, and decrease COD and lignin content by about 63% and 60%, respectively after 3 d. The wastewater was fractionated using dynamic ultrafiltration method, and the changes in lignin contents of the effluent fractions with different molecular weights before and after biotreatment were analyzed. Some compounds produced by the fungus during treatment were identified using gas chromatography-mass (GC-MS) spectrometer, which revealed that depolymerization of lignin occurred during the biotreatment process.

Keywords: wastewater; white-rot fungus; lignin; alkaline pretreatment; corn stover

DOI: 10.12103/j.issn.2096-2355.2020.04.002

Optical and Mechanical Properties of CMCNF-dispersed MMT/CMC-Na Nanocomposite Films: Influence of the Degree of Substitution of CMCNFs

Guanhui Li[1]　Gaoyuan Hou[1]　Hong Xie[1]　Dejian Zhang[1]　Jinyi Cui[1]　Zhiqiang Fang[1,2,*]

1. State Key Laboratory of Pulp and Paper Engineering, Guangzhou, Guangdong Province, 510640, China

2. Key Laboratory of Pulp and Paper Science & Technology of Ministry of Education/Shandong Province, Qilu University of Technology (Shandong Academy of Sciences), Ji′nan, Shandong Province, 250353, China

(*E-mail: mszhqfang@scut.edu.cn)

Abstract: Carboxymethylated cellulose nanofibril (CMCNF) is an effective green dispersant to prepare well-dispersed monolayer montmorillonites (MMTs) in water, thereby facilitating the preparation of a high-performance MMT/polymer nanocomposite film. However, not enough attention has been paid to correlating the degree of substitution (DS) of CMCNFs with the mechanical and optical properties of the final nanocomposite films. In this study, a series of homogeneous monolayer MMT nanoplatelet dispersions was prepared initially using CMCNFs with different DS as a dispersant, and the as-prepared CMCNF-dispersed MMT dispersions were then mixed with sodium carboxymethyl cellulose (CMC-Na) to fabricate nacre-like nanocomposite films with different contents of MMTs through self-assembly. The layered nanostructure and optical and mechanical properties of the as-prepared CMCNF-dispersed MMT/CMC-Na nanocomposite films were investigated, which demonstrated that CMCNFs with lower DS have a positive effect on their optical and mechanical properties. This study sheds light on the preparation of MMT-based nanocomposite films with superior optical and mechanical properties.

Keywords: carboxymethylated cellulose nanofibril; degree of substitution; green dispersant; montmorillonite; nanocomposite film

DOI: 10.12103/j.issn.2096-2355.2020.04.003

Triethylamine-catalyzed Isomerization of Glucose to Fructose under Low Temperature Conditions in Aqueous Phase

Xiao Zhang Banggui Cheng Qixuan Lin Xiaohui Wang Rui Li Junli Ren*

State Key Laboratory of Pulp and Paper Engineering, School of Light Industry and Engineering, South China University of Technology, Guangzhou, Guangdong Province, 510640, China

(*E-mail: renjunli@scut.edu.cn)

Abstract: Isomerization of glucose derived from lignocellulosic biomass is an important step in biorefinery. Fructose isomerized from glucose, is used as a highly attractive sweetener in the food and beverages industries. However, the prevalence of side reactions at high glucose concentrations is a serious issue, leading to a significant reduction in the fructose yield, especially in the aqueous phase. In this study, an efficient method for the conversion of highly concentrated glucose into fructose under low temperature conditions using triethylamine as the catalyst was developed. It was demonstrated that high fructose yield could be maintained at high glucose concentration. At 60℃, fructose yield of 38.7% and fructose selectivity of 80.6% were achieved in 1 mol/L (approximately 17 wt%) glucose. When glucose concentration was increased to 2 mol/L (approximately 31 wt%), the fructose yield and selectivity were maintained at 34.7% and 77.4%, respectively. ^{13}C nuclear magnetic resonance (NMR) spectrometer was used to examine the glucose isomerization reaction. Compared to the NaOH catalytic system, triethylamine acted as a buffer to provide a stable alkaline environment for the catalytic system, further maintaining a high level of catalytic efficiency for the isomerization of glucose to fructose.

Keywords: glucose; isomerization; fructose; homogeneous catalysis; triethylamine; low temperature

DOI: 10.12103/j.issn.2096-2355.2020.04.004

Preparation of Hydroxypropyl Methylcellulose Acetate Succinate with a Narrow Molecular Weight Dispersion

Liangliang Zhang Shiyu Fu*

State Kay Laboratory of Pulp and Paper Engineering, School of Light Science and Engineering, South China University of Technology, Guangzhou, Guangdong Province, 510640, China

(*E-mail: shyfu@scut.edu.cn)

Abstract: Hydroxypropyl methylcellulose acetate succinate (HPMCAS) was successfully synthesized from the reaction of hydroxypropyl methylcellulose with succinic anhydride and acetic anhydride in an acetone/pyridine system. Products with different contents of succinyl groups and acetyl groups were prepared by varying the reaction conditions. In the acetone/pyridine system, equipment corrosion does not occur, the product is easy to wash, and the solvent can be recycled. By varying the concentration of the esterifying agents, products with different ratios of acidic groups can be obtained. Under the optimum conditions, the obtained products had an average molecular weight between 5.39×10^4 and 5.41×10^4, a number average molecular weight from 4.97×10^4 to 5.13×10^4, and a polydispersity index from 1.05 to 1.08. The products dissolved well in acetone and methanol, and formed films on a mold. The films had good pH-sensitivity, tensile strength, and thermal stability. The formed films could dissolve in solutions with a pH value ranging from 5.4 to 6.4, and are therefore suitable for use as an enteric coating for pharmaceutical dosage forms.

Keywords: cellulose derivatives; HPMCAS; narrow molecular weight distribution

DOI: 10.12103/j.issn.2096-2355.2020.04.005

A Review on the Structure and Biodegradation of Cellulose-Lignin Complexes

Yimin Xie[1,2,*] Kai Zhang[1] Sheng Cui[1] Yanchao Liu[1]

1. Research Institute of Pulp & Paper Engineering, Hubei University of Technology, Wuhan, Hubei Province, 430068, China

2. Hubei Provincial Key Laboratory of Green Materials for Light Industry, Hubei University of Technology, Wuhan, Hubei Province, 430068, China

(*E-mail: ppymxie@163.com)

Abstract: Cellulose is the most abundant organic macromolecule in nature and is renewable, degradable, and biocompatible. The structure of native cellulose has not yet been completely elucidated. Part of cellulose is tightly combined with lignin macromolecules through chemical bonds to form cellulose-lignin complexes (CLC). The existence of the CLC structure inhibits the complete separation of cellulose from lignocellulosic material, which not only increases the consumption of chemicals in the cooking process and causes environmental pollution, but also makes the cellulose subject to certain degradation during the deep delignification process. Therefore, elucidation of the relationship between the cellulose-lignin connection structure and performance is of great significance for efficient separation of cellulose. This article reviews the current research status of CLC and discusses the research progress regarding its biodegradation characteristics.

Keywords: cellulose; cellulose-lignin complexes; isotope tracer; biodegradation; benzyl ether linkage

DOI: 10.12103/j.issn.2096-2355.2020.04.006