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Wood Composites and Chemistry

Session 4 " Wood Chemistry and Biotechnology"

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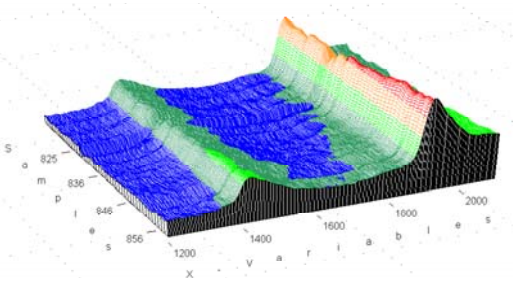
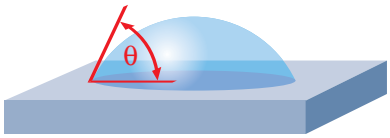
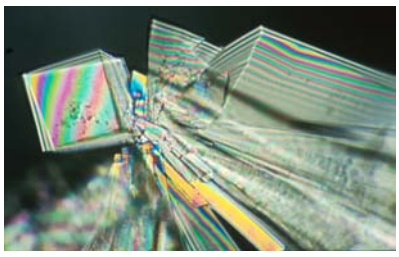


Wood Modification and Processing



Adhesives and Glueing

Compound Materials and Glued Products



Wood Chemistry and Biotechnology

Post Conference Edition of the Proceedings of the International Symposium „Wood Based Materials"

organized by COST Action E13 „Wood Adhesion and Glued Products" and „Wood Kplus"

The issue covers the post conference edition of the proceedings of the symposium „Wood Based Materials – Wood Composites and Chemistry", which was organized by the Competence Centre for Wood Composites and Wood Chemistry „Wood K plus" in cooperation with the COST Action E13 – Wood Adhesion and Glued Products" in Vienna, Sept. 2002. The proceedings comprize 5 key-note lectures and 27 oral presentations, a summary of the Cost Action E13, a presentation of the Austrian Competence Center „Wood Kplus" as well as 30 Posters with following topics:

- Wood modification and processing
- Adhesives and glueing
- Compound materials and glued products
- Wood chemistry and biotechnology

Abstracts and Summaries

Biopulping of spruce wood with *ceriporiopsis subvermispora*: influence of short incubation times on the wood surface properties

Karin Fackler[1,4], Peter Wulz[1], Dominik Schild[1], Manfred Schwanninger[2,4], Barbara Hinterstoisser[2], Pongsak Lamaipis[1], Crtomir Tavzes[3], and Kurt Messner[1]

[1] Institute of Chemical Engineering, University of Technology Vienna, Getreidemarkt 9/ 166, A-1060 Wien, Austria
[2] Institute of Chemistry, Muthgasse 18, University of Agricultural Sciences Vienna, A-1190 Wien, Austria
[3] University of Ljubljana, Biotechnical Faculty, Department of Wood Science and Technology, Rozna dolina, VIII/ 34, SI-1000 Ljubljana, Slovenia
[4] Competence Centre for Wood Composites and Wood Chemistry (Wood K Plus), St. Peter Strasse 25, A-4021 Linz, Austria.

Summary

The influence of the selective white rot fungus *Ceriporiopsis subvermispora* CBS 347.63 on the properties of spruce wood was tested. Besides the changes of extractives and lignin content caused by the fungus during longer fermentation times also changes on the surface that might influence the properties of the resulting wood material were investigated. The decrease in lignin content in consequence of white rot with *C. subvermispora* was determined using wet-lab methods and followed by means of FT-NIR. The spectroscopic results were compared to the ligninolytic enzyme activities of *C. subvermispora* during its cultivation on spruce wood meal and the change of the wood surface colour caused by the selective white rot fungus.

Structural characterization of two crystalline conformers of methyl 4-*O*-methyl-β-D-glucopyranosyl-(1-4)-β-D-glucopyranoside as cellulose model compounds

Paul Kosma[1], Anna Rencurosi[2], Jürgen Röhrling[1], Jutta Pauli[3], Antje Potthast[1], Christian Jäger[3], Anne Imberty[2]

[1] Christian Doppler-Laboratory, Institute of Chemistry, University of Agricultural Sciences, Muthgasse 18, A-1190 Vienna, Austria
[2] CERMAV-CNRS 601 rue de la Chimie, BP 53, F-38041 Grenoble cedex 9, France
[3] Laboratory I.31, Federal Institution of Material Science and Testing; Richard-Willstätter-Strasse 11, D-12489 Berlin, Germany

Introduction

Cellulose, the most abundant polymer on earth, consists usually of a mixture of amorphous and crystalline regions. The crystalline parts of cellulose displays one chain conformation, made up of a 2 fold ribbon, but many possible packing, with either parallel chains (cellulose I, III_I and IV_I) or antiparallel chains (cellulose II, cellulose III_{II} and cellulose IV_{II}) (for a review see Sullivan 1997). Native cellulose is the most abundant form. Its three-dimensional structure is highly complex and not yet completely resolved as a result of the co-existence of two distinct crystalline forms, cellulose Iα and Iβ (Atalla and VanderHart 1984) belonging to triclinic and monoclinic system, respectively. The crystalline phases Iα and Iβ can occur in variable proportions according to the source of the cellulose. The celluloses produced by primitive organisms (bacteria, algae etc.) are enriched in the Iα phase whereas the cellulose of higher plants (woody tissues, cotton, ramie etc.) consists mainly of the Iβ phase (Sugiyama et al. 1990). Study of the cellulose of the outer membrane of marine animals showed that this is uniquely composed of the Iβ phase (Belton et al. 1989). Modelling studies have established that the two crystalline arrangements correspond to two low-energy structures that could arise from parallel associations of cellulose chains (Vietor et al. 2000).
Cellobiose has been crystallized in native form, as well as in the form of derivatives and salts (Perez et al. 2000). In all crystals, the packing arrangement corresponds to low energy molecular arrangement of small molecules and do not provide clues about the polymorphism of the polysaccharide. Only crystal structures of methyl β-cellotrioside (Raymond et al. 1995a) and β-cellotetraose (Gessler et al. 1995, Raymond et al. 1995b) mimic chain-like arrangement. In these two cases, an antiparallel arrangement of molecules is observed, since this represents the lowest energy packing, and the resulting structure is similar to cellulose II polymorph.

Influence of storage conditions on the carbohydrate composition of beech wood hemicellulose fractions

Ursula Mais[1], Herbert Sixta[2]

[1]Competence Centre Wood, Werkstrasse 1, 4860 Lenzing, Austria
[2]Lenzing AG, R&D, Werkstrasse 1, 4860 Lenzing, Austria

Abstract

Approximately one third of the beech wood components belong to hemicellulose fractions which are still not sufficiently exploited for further utilization. In the viscose process the main fraction of hemicelluloses accumulates in the press lye and is mostly separated from the system.

Better knowledge of the chemical nature of the hemicellulosic material is necessary before a new membrane separation system can be established. As the press lye remains in the system for approximately 8 hours, it can be assumed that the hemicellulose composition varies over time due to the severe reaction conditions. In the present work, the ageing process of the hemicellulose fractions has been studied under different storage conditions. For this, a standard pulp test which is used for the determination of the alkaline resistance of pulp, was adapted for a novel "pulper" test. The alkali-soluble hemicellulose fractions were separated into acid-soluble and acid-insoluble fractions, gamma- and beta-fraction, respectively.

A decrease of total carbohydrates in the alkali-soluble fraction took place at higher reaction temperatures and longer storage, and as a consequence thereof a formation of undefined degradation products became the predominant part. A clear shift towards the low molecular gamma-fraction at these conditions was also observed. The amount of xylan in the beta-cellulose-fractions increased, simultaneously the percentage of glucan decreased indicating a lower stability. The molecular weight distribution for the beta-cellulose remained relatively stable throughout the tests. FT-IR-spectroscopy, solid state NMR-spectroscopy and MALDI/MS were employed for structural characterization. The results indicated the presence of side chains in the form of 4-O-methylglucuronic acid residues. The best modelling of the press lye fractions was obtained when the samples were stored at 50 °C for 6 h.

Actual state of pulping and need for further improvements

Rudolf Patt [1], Othar Kordsachia [2]

[1] Ordinariat für Holztechnologie (Holzchemie) an der Universität Hamburg,
Leuschnerstraße 91, D-21031 Hamburg, Germany
[2] Bundesforschungsanstalt für Forst- und Holzwirtschaft, Leuschnerstraße 91, D-21031 Hamburg, Germany

Summary

The Kraft process is the leading pulping process and has made great progress by modifying the cooking conditions. But not all principles of modified Kraft cooking can be applied in practice and it seems that future targets of pulping , i.e. the closure of a mill, are difficult to attain. Acid sulfite pulping is of minor importance because of the poor strength of resulting pulps and the limited raw materials suited for this process. But bleachability of sulfite pulps is excellent and production cost is low. Bisulfite pulping for the production of high yield pulps can overcome the deficiencies of this process at least partly. The utilization of organic solvents for lignin dissolution has failed and it is not very probable that organic solvents will play any major role in pulping in future. AS/AQ pulping yields excellent pulps. The process works selectively and the resulting pulps are easily bleachable. The bottleneck of sodium based pulping processes is the complicated chemical recovery. Black liquor gasification processes which are under development offer a chance for a breakthrough of this pulping process.

Reactions of cello- and xylooligosaccharides in alkaline media

Jürgen Sartori,[1] Antje Potthast[1], Thomas Rosenau[1], Herbert Sixta[2], Paul Kosma[1]

[1] Christian-Doppler-Laboratory, University of Agricultural Sciences, Vienna, Austria
[2] Research & Development, Lenzing AG, Lenzing, Austria

Abstract

The degradation of cellooligomers and xylooligomers under alkaline conditions has been investigated. A convenient method for the separation of cellooligomers from DP 1 to 8, based on capillary electrophoresis (CE) with pre-column derivatization, has been established and optimized. The optimized conditions use *p*-aminobenzonitrile as UV-label and 550 mM borate buffer as electrolyte, which allows precisely quantifying starting compounds and main degradation products within acceptable run times. A comprehensive kinetic description of the degradation reaction is presented, including the determination of activation parameters. In addition, the formation of stable radicals in steeping solutions in dependence on the temperature is studied.

More Information:

www.boku.ac.at/holzforschung
www.kplus-wood.at
www.cost.cordis.lu