

NORDIC PULP & PAPER RESEARCH JOURNAL

THE INTERNATIONAL RESEARCH JOURNAL
ON SUSTAINABLE UTILIZATION OF FOREST BIORESOURCES

EDITOR-IN-CHIEF

Gunnar Henriksson, KTH Royal Institute of Technology, Stockholm, Sweden

EDITOR

Josefin Illergård, KTH Royal Institute of Technology, Stockholm, Sweden

EDITORIAL BOARD

Geoffrey Daniel, Swedish University of Agricultural Sciences, Uppsala, Sweden

Per Engstrand, Mid Sweden University, Sundsvall, Sweden

Merima Hasani, Chalmers University of Technology, Göteborg, Sweden

Christer Korin, Örebro University, Örebro, Sweden

Magnus Lestelius, Karlstad University, Karlstad, Sweden

Tom Lindström, KTH Royal Institute of Technology, Stockholm, Sweden

Carlos Martín Medina, Inland Norway University of Applied Sciences, Hamar, Norway

Kristiina Oksman, Luleå University of Technology, Luleå, Sweden

Monika Österberg, Aalto University, Espoo, Finland

Anna Sundberg, Åbo Akademi University, Turku/Åbo, Finland

Kristin Syverud, RISE-PFI and Norwegian University of Science and Technology, Trondheim, Norway

Hans Theliander, Chalmers University of Technology, Göteborg, Sweden

INTERNATIONAL SCIENTIFIC ADVISORY BOARD

Angelés Blanco, University Complutense of Madrid, Madrid, Spain

Emily D. Cranston, University of British Columbia, Vancouver, Canada

Patrick Gane, Aalto University (Professor emeritus), Espoo, Finland

Gil Garnier, Monash University, Melbourne, Australia

Øyvind Weiþy Gregersen, Norwegian University of Science and Technology, Trondheim, Norway

Akira Isogai, University of Tokyo, Tokyo, Japan

Monika Österberg, Aalto University, Espoo, Finland

Herbert Sixta, Aalto University (Professor emeritus), Espoo, Finland

Per Stenius, Aalto University (Professor emeritus), Espoo, Finland

Hans Theliander, Chalmers University of Technology, Gothenburg, Sweden

DE GRUYTER

Please see the journal's homepage for Abstracting & Indexing Services information.

Published in cooperation with Royal Institute of Technology (KTH), Stockholm, Sweden and run as a project at KTH with Chalmers University of Technology, Karlstad University, Mid Sweden University, Swedish University of Agricultural Sciences, Norwegian University of Science and Technology, Aalto University, Åbo Akademi University, Luleå University of Technology and University of Oulu.

The publisher, together with the authors and editors, has taken great pains to ensure that all information presented in this work (programs, applications, amounts, dosages, etc.) reflects the standard of knowledge at the time of publication. Despite careful manuscript preparation and proof correction, errors can nevertheless occur. Authors, editors and publisher disclaim all responsibility for any errors or omissions of liability for the results obtained from use of the information, or parts thereof, contained in this work. The citation of registered names, trade names, trademarks, etc. in this work does not imply, even in the absence of a specific statement, that such names are exempt from laws and regulations protecting trademarks etc. and therefore free for general use.

ISSN 0283-2631 · e-ISSN 2000-0669

All information regarding notes for contributors, subscriptions, Open access, back volumes and orders is available online at <https://www.degruyter.com/npprj>

EDITOR-IN-CHIEF Prof. Gunnar Henriksson, KTH Royal Institute of Technology, Division of Wood Chemistry and Pulp Technology, Teknikringen 56, 100 44 Stockholm, Sweden, e-mail: ghenrik@kth.se

JOURNAL COORDINATOR Dr. Gunda Stöber, De Gruyter, Genthiner Straße 13, 10785 Berlin, Germany, Tel.: +49 (0)30 260 05-279, e-mail: npprj.editorial@degruyter.com

ADVERTISEMENTS e-mail: anzeigen@degruyter.com

© 2025 Walter de Gruyter GmbH, Berlin/Boston

TYPESETTING TNQ Tech Private Limited, Chennai, India

PRINTING Franz X. Stickle Druck und Verlag e.K., Ettenheim

COVER ILLUSTRATION Mountain spruce forest, Kyushu, Japan. © GA161076/iStock/Getty Images Plus

Questions about General Product Safety Regulation: productsafety@degruyterbrill.com



Contents

Bleaching

Feifei Song, Wenwen Guo, Yu Qu, Dayong Ding and Lanfeng Hui
The effect of xylanase on the fine structure of a bleached kraft softwood pulp — 261

Mechanical Pulping

Christer Sandberg, Stefan B. Lindström, Kateryna Liubytka and Fritjof Nilsson
Development of handsheet mechanical properties linked to fibre distributions in two-stage low consistency refining of high yield pulp — 275

Paper Technology

Gerrit Roosen, Tiemo Arndt and Frank Miletzky
Analysis of finger ridges in paper manufacturing and development of a qualitative model of their formation — 287

Paper Physics

Kayla Guyer, Michael Machold, Xiaoyan Tang, Nathan J. Bechle, Junyong Y. Zhu, Biljana M. Bujanovic, Nayomi Z. Plaza, Peter Kitin, Kevin T. Turner and John M. Considine
Microfibrillated cellulose coatings for biodegradable electronics — 317

Paper Chemistry

Jun Gao, Xiaoshuang Chen, Hua Li and Jiaxin Yan
Preparation of CMC- β -CD-sulfaguanidine and its application for protection of paper — 333

Yan Yan, WeiChao Wang, Zhao Pan, Zhen Yang, JiaXi Li, ZiYu Yao and YunHeng Qi
Drying characteristics and numerical simulation of tissue paper — 345

M. Mostafizur Rahman, Taslima Ferdous, Yangcan Jin and M. Sarwar Jahan
Hemicellulose as an additive in papermaking — 357

Coating

Yuxuan Li, Hua Li and Xiaoshuang Chen
Synthesis of carboxymethyl cellulose- β -cyclodextrin-coated sulfaguanidine and its enhanced antimicrobial efficacy for paper protection — 365

Nuray Acar, Celil Atik and Duygu Bağbakar Orhan
Integrating barrier chemicals into coating systems for optimized white top testliner performance — 375

Printing

Katarina Itrić Ivanda, Marko Morić, Antun Lovro Brkić and Damir Modrić
Quantifying optical and mechanical contributions to dot gain — 385

Packaging

Caroline Lachance, Simon Barnabé, Dominic Deshaies and Benoit Bideau
The impact of cellulosic pulps on thermoforming process: effects on formation time and drainage efficiency — 395

Environmental Impact

Vijayan Selvam, Tholkapiyan Muniyandi, Abiraami Ramakrishnan, Shantha Kumar Kandasamy, Hemalatha Alagar and Hemalatha Balasubramanian
Assessing the impact of substituting hypo sludge (paper pulp) in cement and introducing natural fiber in the form of human hair to enhance compressive strength in concrete — 407

Recycling

Yiwei Wang, Yongjian Xu, Kangkang Guo and Xuefeng Yin
Atomization numerical simulation of high solids content bamboo pulping black liquor based on VOF model — 419

Zhongbo Sun, Jialong Xu, Shaoyu Wang, Yuxiang Li, Liping Tan and Tongjun Liu
A review of the fractionation and properties of lignin derived from pulping black liquor and lignocellulose pretreatment — 427

Lignin

Ting Wang, Haitang Liu, Shaoze Wang and Xiaoyuan Liao

In-situ construct dynamic bonds between lignin and PBAT by epoxidized soybean oil to improve interfacial compatibility: processing, characterization, and antibacterial activity for food packaging — 445

Yinglong Wu, Renyuan Song, Yanfang Tai, Wei Wang and Liu Zhong

Separation of high-yield and high-purity lignin from *Elm wood* using ternary deep eutectic solvents — 455