cost

FORESTRY & FORESTRY PRODUCTS (FFP)

COST Action E35
Fracture mechanics and micromechanics of wood and wood composites with regard to wood machining

2004 - 2008
Chair: Professor Stefanie Tschegg

http://www.boku.ac.at/physik/coste35/

Surface of spruce, cut by a tool superimposed with ultrasonic vibrations.
(Anaglyph-Image courtesy by G. Sinn, BOKU-University, Vienna 2003)

The main objective of the Action is to achieve a better understanding of the relationship between wood structure at the cellular level or the structure of wood composites respectively and the mechanical as well as the fracture performance of wood machining at the macroscopic scale through an intensive European network. This COST Action is providing new cooperations and research on the fracture mechanical properties of wood and the correlating structural features. The results will be of importance for a better understanding and an optimisation of wood machining processes. The COST Action E35 combines and continues the objectives of the already concluded COST Actions E8 "Mechanical performance of wood and wood products" and the COST Action E20 "Wood fibre cell wall structure" and extends the aims to an optimisation of the wood machining processes.

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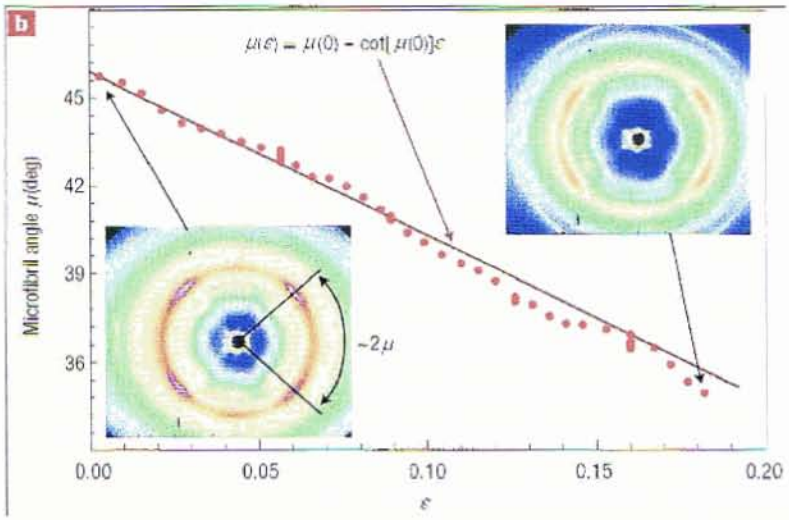
COST Action E8 provided many insights into the mechanical performance of wood, especially at a macroscopic scale. Several phenomena of wood behaviour have been described. However, each of these phenomena also needs to be understood at the cellular and ultra-structural levels to achieve a comprehensive protocol for machining wood.
COST Action E20 worked out new aspects on the distribution of cell wall components and on the structure of wood cell walls. A transfer of these anatomical and chemical fundamentals to mechanical and fracture mechanical interrelations will offer the possibility of a more precise understanding of the response of wood to machining processes.

Working Group 1: Microstructure and micromechanics

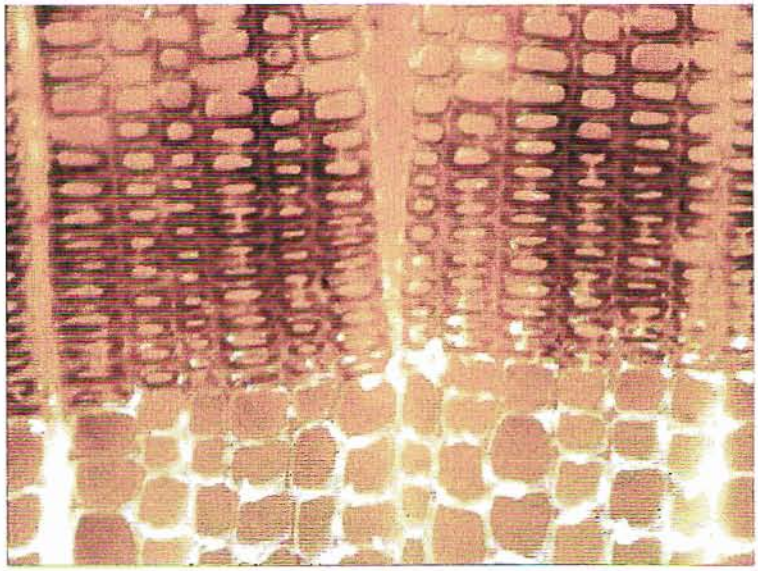


Keckes, J., et al., Cell-wall recovery after irreversible deformation of wood. Nature Materials, 2003. 2(12): p. 810-813.

This Working Group is directing its efforts to study aspects of wood micromechanics on the levels of tissue and cellular structure. For better explaining the material performance in cutting processes it is essentially important to understand the influence of microstructural features and the fracture behaviour of wood. Micromechanical tests on wood species with different structural characteristics can produce information on the specific mechanical relevance of the tissue features. Here, the goal is to provide new information on failure mechanisms and how they are influenced by wood anatomy at the cellular level or the composite of wood products respectively. In order to gain a comprehensive appreciation of the mechanical heterogeneity of wood and wood composites and how this heterogeneity is affected by wood anatomy at the tissue and cell levels, the micromechanical investigations on individual tissue types and *in-situ* tests under optical control (light microscopy, REM, ESEM) will be applied.

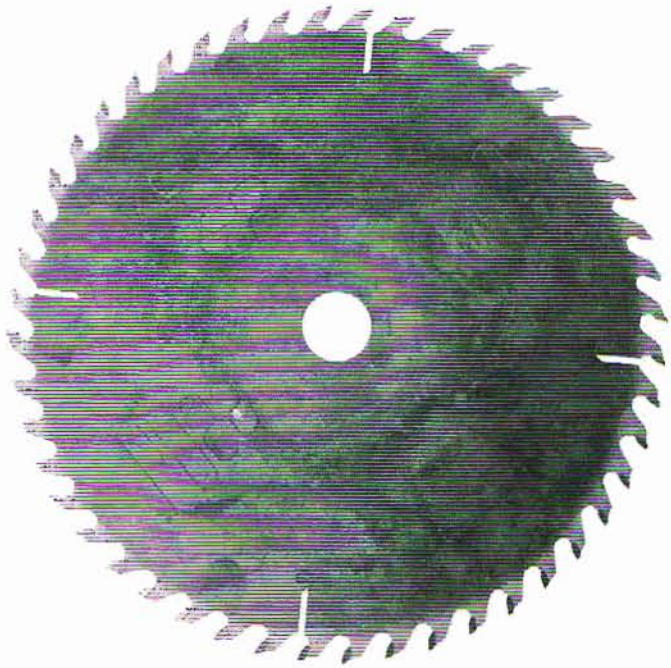
Working Group 2: Fracture and Surface Characterisation

In WG 2 the aspects of wood fracture mechanics are examined with special emphasis on how cellular organisation affects this important wood property. Since crack propagation is in particular influenced by density and density variation, wood demands a detail examination of fracture properties with regard to its grown structure. Different fracture modes have to be considered as well as the influence of different loading and environmental conditions. In addition, for the determination of fracture energy advanced non-linear fracture mechanical concepts will be used. Machining treatment of a wood surface entails significant changes in morphology, wetting behaviour, and in chemical composition of the wood surface.The machined wood surfaces are deformed to a considerable depth and this destroyed layer (chemically - on the molecular level or mechanically - on the particle level, weak boundary layers) can hinder adhesives and coatings from penetration and anchoring to intact wood material.



Tochigi, T., et al. Studies on Veneer Cutting at the Cellular Level. In COST Action E35 Rosenheim Workshop. 2005, Germany.

Working Group 3: Wood Machining



Orlowski, K. and J. Sandak. Measurement of the critical rota-tional speed of circular saw. In COST Action E35 Rosenheim Workshop. 2005, Germany.

A better appreciation is aimed of how the results can be transferred practically to improving the cost effectiveness of wood machining for the solid wood and for wood composites. Therefore WG 1 and WG 2 provide fundamental data for WG 3 for modelling wood and for a better understanding and optimising of wood machining processes. Basing on the knowledge achieved the interaction of tool and material will be studied in order to optimise material quality and service life of the tools. By carrying out examinations under different moisture contents and under several load conditions and load directions, specific data can be obtained with regard to the conditions of treatment for several wood machining processes (e.g. sawing, veneer production). Studying micro-crack initialisation and growth in cause of cutting processes by optical control with light microscopy and Environmental Scanning Electron Microscopy will help to optimise tool shape, in order to create high quality surfaces in cutting processes. The overriding objective of WG 3 is a better utilisation in wood machining. The specific goals on the material side are increasing surface quality, reducing wood wastage, unnecessary fractures and other imperfections resulting from the handling of wood and wood composites. The specific goals on the tool side are achieving higher cost effectiveness, optimising tool shape and increasing their service life.

The Management Committee (MC) of Cost Action E35 has overall responsibility for the coordination of the Action on "Fracture mechanics and micromechanics of wood and wood composites with regard to wood machining". The action is made up of 3 Working Groups.

Chairman

Stefanie TSCHEGG
BOKU – University of Natural Resources and Applied Life Sciences
Institute of Physics and Materials Science
Peter-Jordan-Str. 82
A-1190 Vienna
Austria
Tel: +43 1 47654 5160
Fax: +43 1 47654 5159
stefanie.tschegg@boku.ac.at

Vice-Chair

George JERONIMIDIS
Reading University
School of Construction Management & Engineering
Whiteknights
Reading RG6 2AY
UK
Tel: +44 118 931 8582
Fax: +44 118 931 3327
g.jeronimidis@reading.ac.uk

COST Office

Günter SIEGEL
Science Officer
COST Office
149, avenue Louise
1050 Brussels
Belgium
Tel: +32 2 533 3824
Fax: +32 2 533 3890
gsiegel@cost.esf.org

Nic STANDAERT
Administrative Officer
COST Office
149, avenue Louise
1050 Brussels
Belgium
Tel: +32 2 533 3844
Fax: +32 2 533 3890
nstandaert@cost.esf.org

Leader WG1

Lennart SALMEN
STFI - Packforsk
PO Box 5604
114 86 Stockholm
Sweden
Tel. +46 8 676 73 40
Fax. +46 8 411 55 18
lennart.salmen@stfi.se

Leader WG2

Simo KOPONEN
Laboratory of Wood Technology
Helsinki University of Technology
P O Box 6500
02015 Helsinki
Finland
Tel. +358 9 451 37 25
Fax. +358 9 451 37 76
simo.koponen@hut.fi

Leader WG3

Tony ATKINS
School of Construction Management and Engineering
University of Reading
Engineering Building
Reading
United Kingdom
Tel. +44 118 931 8562
Fax. +44 118 931 3327
a.g.atkins@reading.ac.uk

Deputy WG1

Ingo BURGERT (D)
ingo.burgert@mpikg-golm.mpg.de

Deputy WG2

Lars BERGLUND (S)
blund@kth.se

Deputy WG3

Rémy MARCHAL (F)
remy.marchal@cluny.ensam.fr

Management Committee Members

Austria: Gerhard Sinn, Stefanie Tschegg; **Croatia:** Vlado Goglia, Ruzica Beljo Lucic; **Finland:** Simo Koponen, Pekka Saranpää; **France:** Rémy Marchal, Patrick Perre; **Germany:** Joerg Ressel, Ingo Burgert; **Greece:** Sotirios Karastergiou; **Hungary:** Jozsef Szalai, Zsolt Kovacs; **Italy:** Marco Fioravanti, Martino Negri; **Norway:** Knut Sandland, Peder Gjerdrum; **Poland:** Bartosz Pałubicki, Grzegorz Kowaluk; **Portugal:** José Lopes Morais; **Romania:** Mihai Ispas, Budau Gavril; **Sweden:** Lennart Salmén, Hans Petersson; **Switzerland:** Peter Niemz, Parviz Navi; **United Kingdom:** Tony Atkins, George Jeronimidis

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