

Characterisation

Newsletter

Number 05, January 2009

News from PFI

New PhD:

•Håkon Nordhagen will defend the thesis "Development of Fracture Mechanics to Study end Use of Paper Webs", on February 27 at PFI. The thesis work has been carried out as part of the "Reinforcement fibres in wood containing paper grades" project at PFI. The main topic of the research has been investigations of different strength reducing effects in paper webs containing a cut. The opponents are: Prof. Sören Östlund (KTH), Prof. Per Gradin (MIUN) and Størker More (NTNU).

New PhD student:

•Galina Rodionova has started as a PhD-student in the Sustainbarrier project. Her PhD will focus on the modification and barrier properties of nanofibrillar cellulose. Galina is from Arkhangelsk in Russia and completed her MSc in biotechnology at Arkhangelsk State technical University.

Microfibrillated cellulose

During the last three decades a new material concept has been introduced, microfibrillated cellulose (MFC). This novel material may be composed of a wide variety of fibril sizes, having diameters from the sub-micron to the nano-level. It is expected that these tiny structures may be utilized in e.g. food, painting, composites, paper and packaging applications. In this respect, fundamental understanding of the effects of cellulose fibrils on a given structure and the interaction of cellulose fibrils with other components such as plastic, fibres and fillers is necessary. A detailed characterisation will thus be required.

PFI has made major efforts to develop dedicated methods for assessing fibre, paper and composite structures at several scales. Proper quantification of multiscale structures is most essential for increasing our understanding of present materials and facilitate the creation of novel material concepts. Our objective is to aid the industry with the right characterisation tools, from the macro to the sub-nano level. A concrete example is field-emission SEM, which gives a detailed assessment of micro- and nanostructures.

Upcoming events

Pigment Coating and Calendering Technology course, Åbo Akademi, February 2-6 2009. [Read more...](#)

Packaging Diploma Course, STFI-Packforsk, March 9, 2009. [Read more...](#)

15th International Symposium on Wood, Fibre and Pulping Chemistry - ISWFPC 2009, Oslo June 15 - 18, 2009. [Read more...](#)

Recommended links

PFI services:

www.pfi.no/contract/contract.htm

STFI-Packforsk:

www.stfi.se

Next issue, August 2009

- 3D characterisation

Selected analysis method

Field-emission scanning electron microscopy (FE-SEM)

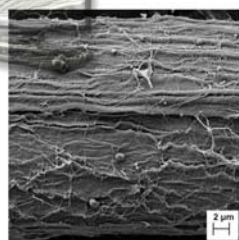
Characterisation of surface and bulk nanostructures

Versatile and high resolution device

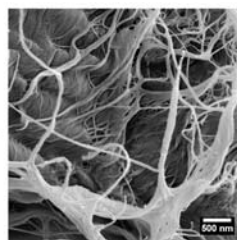
High-quality images



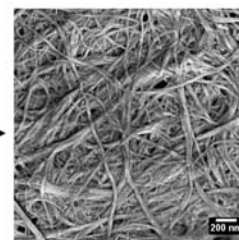
Field-emission SEM



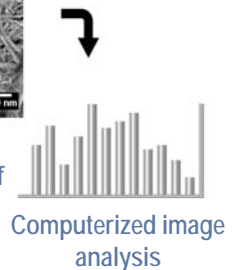
Surface structure of a kraft pulp fibre



Fibrils on a fibre wall surface



The surface of a model film made of cellulose fibrils



Editor

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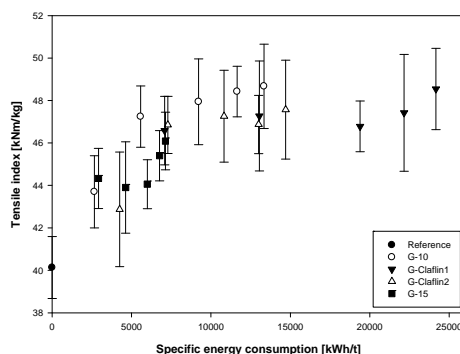
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MFC in paper

The use of microfibrillated cellulose produced from kraft pulp as strength enhancer in TMP paper

Abstract

The effect on the physical properties of TMP handsheets by adding microfibrillated cellulose (MFC) is investigated. 26 TMP handsheet series were made with 4 % addition of MFC produced by grinding or homogenization. Analysis of particle size distribution of the MFC showed that homogenization yields a bimodal distribution curve, while grinding gives a log normal distribution. The produced MFC had hydrodynamic particle sizes in the range 30 – 150 μm , and homogenization produced MFC with the largest particles. Addition of MFC to handsheets increased the tensile index and air resistance. MFC made by homogenization had a larger effect on the tensile index than MFC made by grinding (7 – 21 % and 11 – 34 % strength increase respectively), suggesting that the strengthening mechanisms of the two MFC qualities are different.



Reference: Eriksen, Ø., Syverud, K. and Gregersen, Ø.: "The use of Microfibrillated cellulose produced from Kraft pulp as strength enhancer in TMP paper". Nordic Pulp Paper Res. J. 23(3): 299-304 (2008).

The addition of MFC reduced the light scattering coefficient (a loss of 8 % for the worst case), opacity and brightness of the sheets. Theoretical consideration regarding addition of fillers to maintain the optical properties showed that one still may get a 10 % increase in tensile index. The use of MFC as strength enhancer in commercially produced paper is discussed.

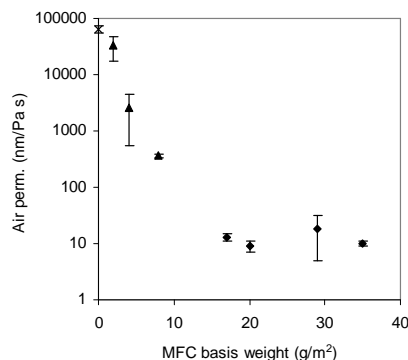
The figure shows the tensile index as a function of specific energy consumption for the MFC made with the ceramic grinder. The error bars show the 95 % confidence intervals. Reproduced from Eriksen et al. (2008).

MFC films

Strength and barrier properties of MFC films

Abstract

In this paper the use of microfibrillar cellulose (MFC) in films, oriented sheets and as coating on base paper is described. Strength and barrier properties have been assessed. Experimental evidence of the high tensile strength, density and elongation of films formed by MFC is given. Typical values for a MFC film with basis weight 35 g/m^2 were tensile index $146 \pm 18 \text{ Nm}/\text{g}$ and elongation $8.6 \pm 1.6 \%$. The E modulus ($17.5 \pm 1.0 \text{ GPa}$) of a film composed of randomly oriented fibrils, is comparable to values for cellulose fibres with fibril angle of 50 degrees. Low basis weight MFC sheets were manufactured using a dynamic sheet former.



Reference: Syverud, K and Stenius, P.: "Strength and barrier properties of MFC films. Cellulose 16(1): 75-85 (2009).

Their strength was comparable to the strength of the MFC films. The use of MFC as coating on base paper increased the strength significantly and reduced the air permeability dramatically. From FEG-SEM images it was observed how the porosity was reduced. The dense structure formed by the fibrils resulted in superior barrier properties. Oxygen transmission rates (OTR) as low as $17 \text{ ml m}^{-2}\text{day}^{-1}$ were obtained for films prepared from pure MFC. This result fulfils the requirements for oxygen transmission rate in modified atmosphere packaging.

The figure shows the air permeabilities of the base paper (reference) (x), MFC coated base paper, total grammage $90 \pm 1 \text{ g}/\text{m}^2$ (filled triangles) and MFC films (filled diamonds). Reproduced from Syverud and Stenius (2009).

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