

# PTSNEWS

01/2020

FIBRE based solutions for tomorrow's products

## Bioeconomy: Papermaking additives based on renewable resources



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# Editorial

*Dear readers,*

As members of the paper ecosystem, we naturally love books, newspapers, journals and magazines. Those among us who are no digital natives still like to print out documents and electronic mails to highlight passages or add editing notes.

During the past few weeks and months, however, a worldwide digitization programme started which could not be avoided by our institute. Business trips were cancelled, and video conferencing is suddenly a normal and indispensable tool of our standard work routines.

The same is true for education and training. Modern schools provide their pupils or students with learning videos or hold classes by web conferencing.

What was at best smiled at by our industry five months ago is now reality. Early March this year, we in PTS gave serious thought to the future of our Academy.

Less than two months later, we went through our baptism of fire with more than 300 persons taking part in the Network Day. The good feedback from numerous participants showed that our decision was a good one and its implementation was professional.

Now, we are looking forward to the next events. By the end of June, we were able to offer a live stream of our “adhesives” training session as our first major fee-based on-line event. The number of registrations exceeded our expectations by far. This was proof that there was no absolute need for physical attendance in advanced training programmes even in our industry.

After cancelling all in-person sessions of the second quarter, we are now planning a variety of on-line sessions and events for the second half of this year.

In the light of the current situation, we are confident that this option will be a

welcome opportunity for you although we do know that some aspects of what actual networking really means will be lost.

But, on the other hand, please bear in mind that the contents offered in on-line sessions are as valuable as the contents proposed in face-to-face presentations. As a matter of course we will pass on cost advantages (no room rents, no catering fees). Nevertheless, it is necessary to research and prepare the contents to match the on-line format. Also, we want to keep the number of participants deliberately small for certain sessions to answer all questions satisfactorily and have enough room for interaction. That is why we offer our webinars and online courses at fair market prices.

Even though we go very digital and on-line, it will always be my pleasure to welcome you in person to PTS in Heidenau.



*Clemens Zotlöterer, Director*

**PTS is a member of the  
“Bioeconomy” Cluster of  
the Zuse Association.**



member of

**ZUSE-GEMEINSCHAFT**



# Bioeconomy: Papermaking aids and paper processing additives based on renewables – a new subject area



Humanity's biggest challenge until the middle of the 21st century is to limit and contain man-made climate change to a necessary extent in the context of the existing infrastructures and in the light of a growing world population. To maintain our standard of living and preserve the living environment and thus the biodiversity on our planet, it will be necessary to effect a stringent transformation in our current way of life and economic activity. The key to achieving the Paris Climate Change Agreement long-term goal of limiting the global temperature increase to 1.5 °C by 2050 is to move away from fossil resources while increasing the use of renewable resources, i.e. to gradually build up a **bioeconomy**. As time is of essence with a view to the desired effects, it is important to take concrete implementation measures at an early stage, and so the decade that has just begun is in the focus of attention.

Germany is going to be a pioneer in this movement, not least because of its outstanding innovation infrastructure, and therefore the Science Year 2020 was dedicated precisely to this concept of bioeconomy. For this purpose, the German Federal Cabinet adopted the new "National Bioeconomy Strategy" (Fig. 1) as early as in January this year. This is a joint production between the German Ministry of Food and Agriculture (BMEL) and the German Ministry of Education and Research (BMBF) based on the "National Research Strategy on Bioeconomy 2030" and the "National Policy Strategy on Bioeconomy". So the policymakers have laid the foundation for ensuring that the necessary steps can be taken. It is now up to the various industries to accept the challenge and make meaningful contributions. Economic success in the markets of the future will be largely dependent on bioeconomic solutions.

But what is the place of the paper industry in all this? In the light of the current situation as outlined above, classical papermaking and paper processing has always been a largely bioeconomic activity that mainly uses wood as a regrowing raw material to extract cellulosic fibre for the manufacture of papers. This means that paper is already comparatively sustainable, because it is a value-adding product based on renewable resources of a lower quality and has for long been an outstanding example of material cascading by repeated recycling. However, as papers need to remain competitive with other materials—especially with regard to the ongoing developments in the manufacture, use and recycling of bioplastics –, it will be even more important in the future than today to succeed in the transformation of the energy-intensive paper industry into low-carbon bioeconomy.

A major approach across the whole industry in addition to closing circuits even further, increasing the efficiency of processes and raising the added value is to **broaden the resource base for developing 100% bio-based paper products**. In many cases, additives for the manufacture and processing of paper, such as barrier coatings, coating binders, glues and adhesives, retention or wet-strength agents, are composed of polymers synthesized from mineral oil and natural gas. In addition to the fossil carbon input related thereto, materials of such type often exhibit poor biodegradability thereby showing a general potential for the formation of microplastics.

Ideally, it would thus be possible to achieve a comparable performance with materials that are obtainable at low cost from regrowing resources, can be readily separated in the established recycling circuits and are fully degrada-



Fig. 1: Cover page: National Bioeconomy Strategy

ble in case of accidental release into the environment.

To meet this challenge in terms of research and knowledge transfer, „Bio-based papermaking additives“ are a central element of the PTS research work focused on the “Development of functional surfaces and converting properties for tomorrow’s fibrebased products”. The goal of the research work is to develop papers having a 100 % regrowing resource basis without jeopardizing the established processes and circuits. PTS is currently working on an accompanying study in collaboration with the paper technology research association FPT. As of today, numerous global players have already declared their intention to move entirely away from fossil resources for their products and their packagings by 2030. The paper industry must be able to offer forward-looking solutions especially for the latter growth market. Annually, 15 million tonnes of recovered paper, 5.2 million tonnes of fibre and 0.9 million tons of process and functional

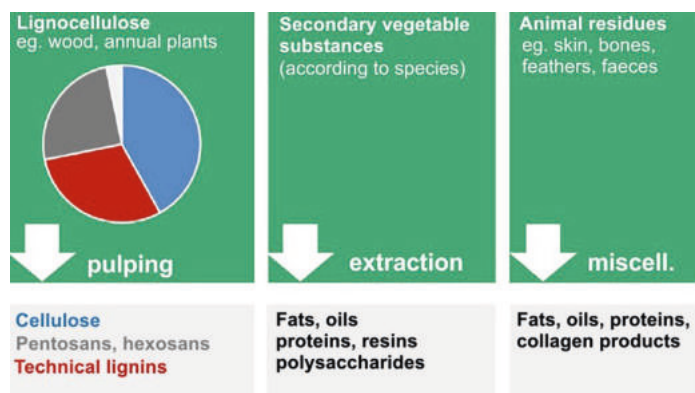


Fig. 2: Variability in the biogenic resource basis

chemicals are used in papermaking in Germany. The latter group is made up of about 40% of synthetic polymers, which are intended to be substituted by bio-based additives in the future. These figures do not include materials used in the converting and processing of paper.

The biogenic resource basis (Fig. 2) offers a broad range of usable materials that are suitable for substitution due to their polymer character and structural motifs. In some cases, they can be used as such (e.g. starches, waxes, gelatins...), in other cases, their molecular or superordinate structure can be used to generate promising characteristics profiles by simple chemical or mechanical transformations thereby giving competitive products such as nanocelluloses or charged polysaccharides. This is a clear advantage over fossil resources, which can be used almost exclusively via commodity chemicals and downstream polymerization. (Fig. 3) It will however be necessary to accept the broader range of variation in the characteristics and properties of the natural products and to integrate them reliably into existing processes. This is where digitization can make an important contribution.

For this purpose, PTS will conduct research along the whole innovation chain from the development of new substances via their application in papermaking or various converting or processing operations up to the assessment of the process and recycling capabilities. Also biodegradability plays a role here, depending on

the field of application.

In addition to the mere development of new solutions, it will be required to come up with new concepts enabling us to integrate the new solutions into existing processes while meeting the multitude of parallel requirements (drop-in solutions). For example, it may be necessary to rethink entirely the way how additives are applied by using, instead of a water-soluble process additive, e.g. chemically derived fibres that do not only produce a mechanical effect in the paper but generate additional performance without causing additional loads in the process water. This new research focus also means infrastructural changes for PTS. During the past few years, PTS has been increasing its investments in chemical reaction equipment and analytic tools in support of the chemical in-house skills in order to conduct its research activities at highest standards. For enhanced transfer and networking between industry and research in support of ongoing research, PTS was the organizer of the new international conference “Bio-based Solutions in Papermaking and Converting”, which will be held for the first time this year as a two day online conference.

So PTS will continue to make a meaningful contribution to the development of bioeconomy in Germany also in the future. ■

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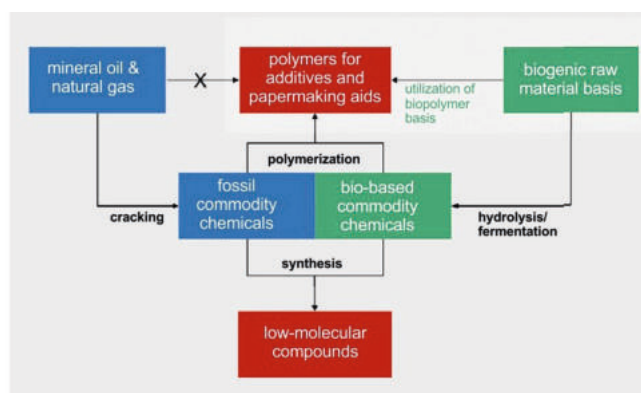


Fig. 3: Biogenic versus fossil routes for producing polymers for paper-making aids

### What is bioeconomy?

Bioeconomy is defined as the “production, exploitation and use of biological resources, processes and systems to provide products, processes and services across all economic sectors within the framework of a future-oriented economy. Innovations in the bioeconomy unite biological knowledge with technological solutions and utilise the inherent properties of biogenic raw materials in terms of their natural cycles, renewability and adaptability. The bioeconomy harbours the potential to provide new kinds of products and processes that protect natural resources and ensure our future prosperity.” These resources include plants, microorganisms, fungi, but also the knowledge of biological relationships. Bioeconomy pursues the goal to combine economy and ecology into a sustainable economic system.



# Bioeconomy: New value chains for contaminated sites by growing and utilizing Miscanthus – Cross-border research with our neighbours from the Czech Republic

The diversification of the raw material streams used in the paper and fibre industries and the increasing common use of non-wood materials is part of the set of requirements laid down in the Bioeconomy Strategy of the EU which supports the production of renewable biological resources and their conversion into vital products and bioenergy. An important approach is to find low-cost high-quality alternatives in substitution for the high-cost chemical pulp qualities made of primary fibre. In the light of this situation, the utilization of Miscanthus fibre has for several years become the focus of attention. The robustness and physiological properties of Miscanthus, such as its deep, dense and extensive root system, enable the plant to adjust to a variety of soils and environmental conditions. High yields with pronounced lignocellulose levels, low nutrient demands, and low vulnerability to pests and diseases make Miscanthus an excellent feedstock for the manufacture of fibre-based materials. For precisely the same reasons, Miscanthus can be planted for the decontamination of for-

mer mining or military sites as found both in Saxony and the Czech Republic.

Here, contaminants are trapped in the root system and allow all other parts of the plant to be used without any restrictions.

This behaviour is studied within the European CORNET project entitled “MiscanValue” which was launched on 1 July 2020 under the coordination by Technical University of Dresden. The aim of the project consortium (Fig. 1) is to develop a full-scale Miscanthus value chain from sustainable land management on various marginal soils via cultivation, harvesting, storage to the transformation of biomass into fibre, pulp, fibre-based materials and packaging papers. Another goal is to convert the Miscanthus residues obtained from the processing operations and the contaminated plant tissue from the field by way of pyrolysis into alternative energy and biochar. Various requirements must be met to achieve this goal, such as increase in yields, continuous supply of raw materials, providing reliable products, proper processing into fibre-based

## Project title:

» Creating value chains for utilization of Miscanthus fibres from sustainably managed marginal and post-mining areas (MiscanValue)

## Project period:

» 01/07/2020 – 30/06/2022

## Project type:

» IGF 283 EGB

## Research locations:

» Papiertechnische Stiftung (PTS)  
Manuela Fiedler, Dr. Martin Zahel  
» Technical University of Dresden  
» Chair for Wood and Fibre  
Material Technology  
» University of Chemistry and  
Technology Prague  
» Univerzita J. E. PURKYNE V  
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materials and papers, and efficient conversion of by-products. The value chain such developed will be a meaningful contribution to the circular economy and zero-waste approach.

The proposed project on a whole will strengthen the bioeconomy strategy of the EU and enhance cross-border cooperation between Saxony and the Czech Republic. ■

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Fig. 1: MiscanValue Project Consortium

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Mittelstand

Bundesministerium  
für Wirtschaft  
und Energie  
aufgrund eines Beschlusses  
des Deutschen Bundestages

## Lignin modification by reactive extrusion for bio-based paper coatings – “LignoREX”

This research project aims at low-cost chemical modification of lignin by reactive extrusion. Modified lignins are processed to form dispersions, then are applied onto paper surfaces and thus used as bio-based barrier materials. The solution approach comprises continuous solvent-free derivatization of lignin in a twin-screw extruder including scaling up to the industrial scale. The products are fully characterized, transformed into dispersions and coated onto paper.

Then the properties of the coatings are to be tested in terms of water vapour and oxygen permeability as well as grease-proofness. Transferring the lab-scale lignin modification to an economically viable full-scale process will increase the value of lignin as a tied product in non-thermal utilization. ■

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Bundesministerium  
für Wirtschaft  
und Energie

aufgrund eines Beschlusses  
des Deutschen Bundestages



### Project title:

» Lignin modification by reactive extrusion for bio-based paper coatings – „LignoREX“

### Project period:

» 01/09/2020 – 31/08/2022

### Project type:

» IGF

### Research locations:

» Papiertechnische Stiftung (PTS)  
» Johann Heinrich von Thünen-Institut

## PaperDocAnalytics: PTS Research Database becomes AI-based Cognitive Search

**Papiertechnische Stiftung is co-working with interface projects GmbH to develop a centralized information portal “PaperDocAnalytics” for results based on artificial intelligence**

Papiertechnische Stiftung and interface projects GmbH join forces to develop a centralized portal for rapid identification of material defects in papermaking on the basis of neural networks and deep learning. In a first step, the PTS research database will serve as a demonstrator to show on a text recognition basis how to interlink problems and solutions of paper manufacture. At a later stage, other modules for the recognition of image and material data will follow.

For almost 70 years, PTS has been supporting paper-processing companies and

researching new materials and instrumentation in specialist laboratories. The aim of the “PaperDocAnalytics” project is to set up a cognitive assistance system that provides quick and efficient recommendations for action in case of process deviations and quality non-compliances thereby increasing the effectiveness in the company.

In contrast with knowledge in the form of staff expertise or data in individual companies, PaperDocAnalytics is intended to become a sustainable solution that will combine the knowledge from manufacturers, suppliers and converters across the entire industry and network on an international scale

Digital questionnaires or interactive solution portals allow problem scenarios (e.g.

### intergator:

#### About interface projects GmbH

The limited-liability company interface projects GmbH is among the leading German suppliers for Enterprise Search and Knowledge Management solutions, headquartered in Dresden. With intergator we offer a modern enterprise search system that retrieves information in companies and public organizations of any size and provides the retrieved information in a well-structured form in a central point. interface projects GmbH has more than 25 years of market experience in the implementation of complex IT projects and is a renowned partner in the development of comprehensive solutions and concepts.

root cause analysis of paper defects) to be evaluated in a constructive manner via an artificial intelligence system.

“The paper industry has always attached great importance to quality. Increased customer demands, modern materials and new paper grades call for closely monitored production processes. We want to give companies the opportunity to have intelligent access to research results to benefit from machine learning today already and, with this system, we lay the foundation for accelerated root cause identification for papermaking problems”, said Dr Tiemo Arndt, Scientific Director at PTS. “Machine Learning offers tremendous advantages for a rapid and reliable understanding of complex data relationships and well-aimed production improvements. We are looking forward to another exciting industrial project on digital transformation”, says Frank Kuckelkorn, Head of Sales with interface projects GmbH.

The project is funded by several sponsors, such as the Association of German Paper Mills (VDP) headquartered in Bonn, within the scope of the INFOR project 215.■

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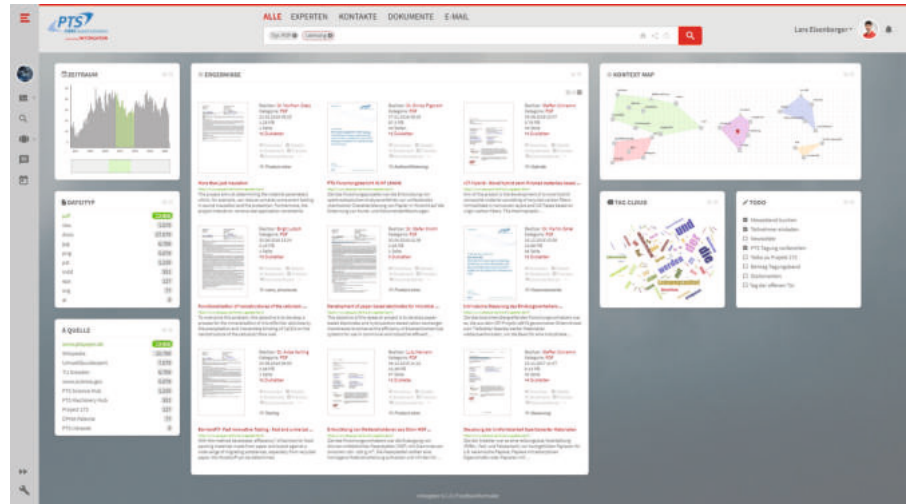


Fig. 1: User interface of PaperDocAnalytics

## A good estimate is half the calculation. Good estimates often are the basis for improved calculations

### THz-KOMPASS Research Project successfully completed

#### Basic situation

Terahertz applications, as typically used in safety engineering, are characterized by the fact that thin, dry and metal-free materials can be penetrated and measured with a still acceptable lateral resolution. Spectroscopic information is evaluated in very rare cases only. However, laboratory equipment in the THz domain uses electromagnetic waves (pulses) that are generated by so-called femtosecond lasers and lie in the terahertz wavelength range rather coincidentally. Such waves are subject to deceleration and attenuation in physical matter and to reflection and refraction at interfaces.

In summary, this technology can be used in the same way as a ground radar system is used to prospect underground resources or cavities, but the depth resolution is entirely different. Figure 1 shows such a generated image of an approximately 1 mm thick plastic part in which the upper and lower surfaces appear as interfaces, but inner interfaces are visible as well.

The problem of this approach is that it is not possible to obtain exact quantitative information about individual layer thicknesses of deeper-lying layers depending on the rich variety of diverging material characteristics and optical properties.

#### Short title:

» KOMPASS (Development of a method for non-destructive and non-contact measurement of layer thicknesses, refractive indexes, penetration depths and scattering parameters of multilayer systems by means of Terahertz pulses)

#### Project period:

» 01/09/2017 – 31/12/2019

#### Project number:

» IK-MF 170017

#### Research location:

» Papiertechnische Stiftung (PTS)  
Dr. Patrick Plew, Project Leader



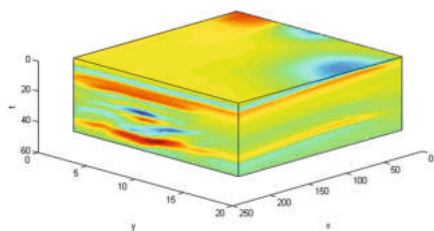


Fig. 1: 3-d detail (20 x 20 x 1 mm) of a plastic chip card

### Project goal

KOMPASS aimed at the development of a method for non-destructive and non-contact measurement of multilayered structures by means of terahertz waves. The focus was laid on the determination of inner layers, especially of three and four-layered structures. The method is designed for composites having fibre-based material components. It was intended to measure planar samples with a total thickness of up to several millimetres. Each of the layers was to have a thickness of at least 100  $\mu\text{m}$ . The authorized measuring definition should be 10  $\mu\text{m}$  at an accuracy of  $\pm 1 \mu\text{m}$ . In addition, the method was tested for its usability on lower layer thicknesses. Especially, a transceiver antenna should be used in which the transmitter and the receiver are directed to the sample in a zero-degree geometry.

### Solution approach

THz pulses are delivered in reflection to the multilayered sample to cause a sufficient number of simple and multiple reflections that can be measured independently of one another, as shown in Figure 2. A typical example of a multilayered sample would be an adhesive label comprising a top layer, adhesive and release paper.

Since the signals result from a limited number of layers and material properties, a complex equation system can be established in which many – but not all – of the unknown quantities can be removed along the way to the target figures ( $d_1$ ,  $d_2$ ,  $d_3$ ).

KOMPASS, an approach for the multidimensional estimation of unknown parameters, was mainly processed by a

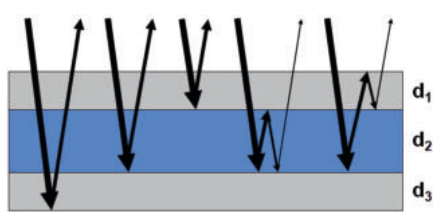


Fig. 2: Potential inner reflections in a three-layer sample (selection)

studied logician with the final aim to determine all layer thicknesses of complex samples on the basis of reasonable assumptions, physical laws and eventually measurements, but also with precision.

### Parameter estimation algorithm

A routine was developed for the application-specific pre-processing of the measured raw data of the THz pulse. The applied pre-processing steps were filtering, de-trending and noise reduction. The heart of the estimation algorithms is the selection and adjustment of the best-suited combination of an information criterion and an optimization method. During the further course,

- several combinations of information criteria and optimization methods were implemented in a high-level language and subjected to quantitative validation, and
- promising combinations were adjusted in the first line such that parameters of the measured samples in greatest possible agreement with the reference method (scanning electron microscope) are estimated.

Since the estimation of parameters in a mathematically high-dimensional space requires many millions of iteration steps, the number and adjustment of the combination was optimized in the second line to give short calculation times. A plausibility check was developed to deliver a warning for samples not meeting the predetermined boundary conditions (e.g. total thickness, basis weight, number of layers).

In a nutshell, it is attempted to bring the real reflected pulse pattern in line with an image generated on the basis of estimates, models and calculations. Once

this is achieved, the target values (layer thicknesses) can be output as well as all other influencing quantities. However, it has to be noted at this point that the intended transceiver antenna could not be delivered in time during the project period and was replaced by an 8-degree geometry as an undesired additional parameter that had to be included in the estimation algorithm.

### Implementation

The above-described algorithm was tested on planar samples with a structure of up to five layers using an x-y table and the PTS software platform DOMAS. The system remains largely open to ensure that interfaces with a variety of different x-y tables and pulsed THz devices, also of external users, are authorized. ■

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Gefördert durch:



aufgrund eines Beschlusses  
des Deutschen Bundestages

# Development of an analytical method for the dating of paper

## New ways to determine the absolute age of documents and art objects

Paper is an important substrate for documents and works of art. Therefore, the forensic examination of paper can be of great importance in solving criminal cases of document and art forgeries and fraud associated therewith. Determining the age of paper has always been an issue of particular interest in this context [1]. In many cases, the differences to be established between the actual age of the paper and the date on the document are just 1 to 5 years. Until now, there had been no method for dating of paper with the necessary accuracy for such cases.

The chemical composition and the paper structure are approximate indicators of a production period of a paper [2,3]. However, this allows the year of production of a paper to narrow down to an interval of some decades only.

A much higher accuracy in determining the age of paper is possible with the radiocarbon dating method (carbon-14 method). The basic feasibility of such an approach was proven by PTS already in 2014 [1,4]. On the basis of these results, a follow-on research project (IK-MF 170102) was conducted by PTS in collaboration with the Leibniz Laboratory for Radiometric Dating and Isotope Research in Kiel to develop an analysis method to determine the absolute age of paper.

The analysis is based on the carbon-14 dating method. The goal was to obtain a dating accuracy of at least  $\pm 2$  years for papers made after 1955.

The way to achieve this was to analyze the starch extracted from the paper, based on the assumption that the starch obtained from annual plants would enter the paper no later than within the year following the harvest of the plants. Another basis is

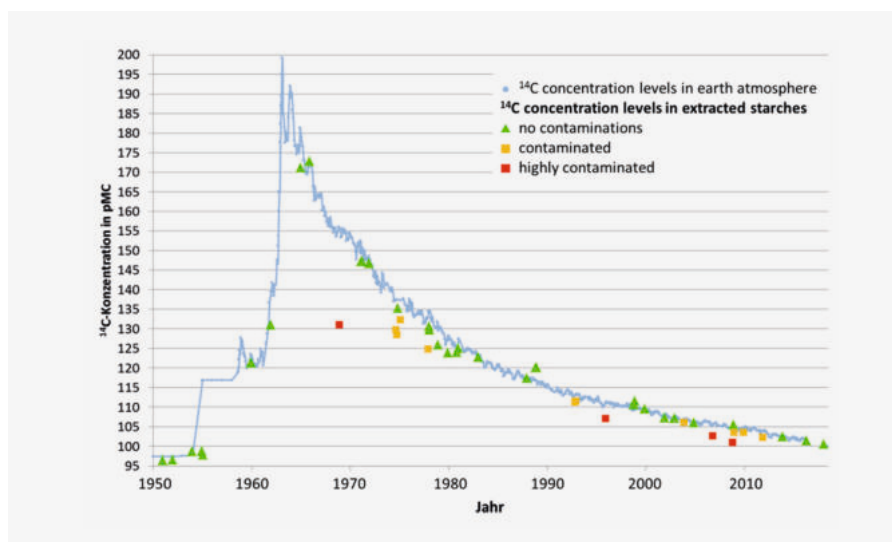


Fig. 1: Chart of  $^{14}\text{C}$  concentration levels in the Earth's atmosphere and  $^{14}\text{C}$  concentration levels determined in extracted starches

the so-called nuclear weapon effect which caused a high increase in carbon-14 concentrations in the atmosphere after 1955 and a gradual decrease in carbon-14 levels beginning in 1963 with the ban of overground nuclear tests (refer to Fig. 1).

The findings of the research project show that in most cases it is possible to determine the year of manufacture of writing, printing, copy and art papers at an accuracy between of at least  $\pm 4$  years [5,6]. The chart of Fig. 1 shows the dating results for extracted starches from 47 tested papers. For 33 extracts, the age of the starch was determined with a maximum deviation of 3 years. For 10 papers, the dating deviation was 4 to 5 years. For 4 papers, the age of the starch was determined to be far too low.

The only explanation of the higher deviations between the determined and expected carbon-14 levels is that the starch extracts were contaminated with so-called fossil carbon (i.e. material that does not contain  $^{14}\text{C}$ , e.g. mineral oil

products) from other paper constituents. IR and Raman spectroscopic measurements found the compounds of the rosin size to be the major cause. In the more recent synthetically sized papers, such contaminations are mainly optical brighteners, which are present at relatively high levels in some papers and also contain fossil carbon that may cause a strong reduction of the  $^{14}\text{C}$  value of the corresponding starch extract. Further investigations are necessary to prevent contaminations in the starch extracts also for the other papers or to allow cleaning of the starch extracts to minimize the impacts of contaminants.

It could be shown that determining the carbon-14 concentration in paper fibres is also largely indicative of the actual age of a paper [5,6].

The new analytical method makes it possible to determine the age of papers within an accuracy of just a few years. The method is applicable to writing, printing, copy and art papers made after 1955.

It is expected that the dating method can get established as a new and robust means of evidence in forensic examinations in cases of document and art forgery. ■

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## Optimal creasing in packaging boards with water-based barrier coatings

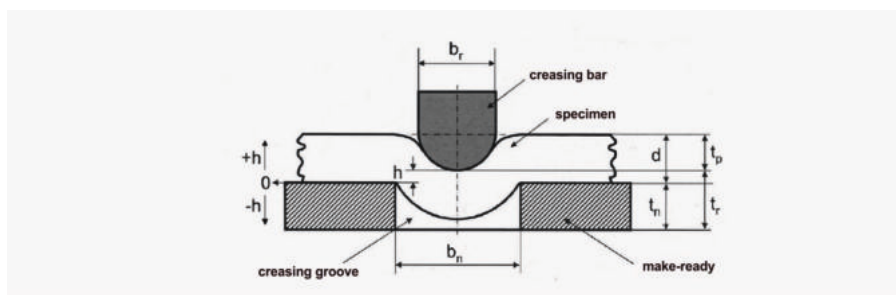


Fig. 1: Schematic view of the creasing process with the most important geometric variables

### Introduction / problem situation

Many food packaging applications require coated paperboard grades. Coated boards must have good creasability as a critical property for the converting processes. Creasing is done to prepare the material for folding and is performed simultaneously with die-cutting (creasing-cutting process). The board inclusive of its coating undergoes strong deformation during creasing, involving the risk that the barrier layer could be damaged or weakened. Although the creasing process is generally well-controlled for extrusion-coated and film-laminated boards, there are recurring problems with aqueously applied coatings. Especially, it is not clear which conditions are necessary for optimal creasing results.

### Project goals

The IGF project pursued two goals: One goal was to characterize in more detail the loads and strains of the material during the creasing process using a model based on the finite element method (FEM); the other goal was to develop recommendations on how to keep functional barrier losses as low as possible in the crease seam.

A number of specific measuring methods were envisaged in support of the first goal. They provided characteristic values for major input parameters. In order to achieve the second goal, systematic creasing tests were carried out on several board grades with different coatings in order to derive optimal creasing parameters.

### Short title:

» Water-based coatings / exact creasing

### Project type:

» IGF

### Project period:

» 01/02/2017 – 31/10/2019

### Research locations:

» Papiertechnische Stiftung (PTS), project leader:  
 Dr. Markus Kleebauer and  
 Benjamin Hiller

In practice, the thickness ( $b_r$ ) and immersion depth ( $h$ ) of the creasing rules, and the width and depth of the creasing channels ( $b_n$  and  $t_n$ ) at the make-ready are adjusted exclusively according to the board thickness ( $d$ ). This is also true for paperboards with top and bottom coatings. Usual standard conditions are illustrated in Fig. 1 and Fig. 2. A far-reaching insight into the creasing behaviour of paperboard can be obtained by means of a crease area chart, which covers a systematic variation of the immersion depth and the creasing channel width.

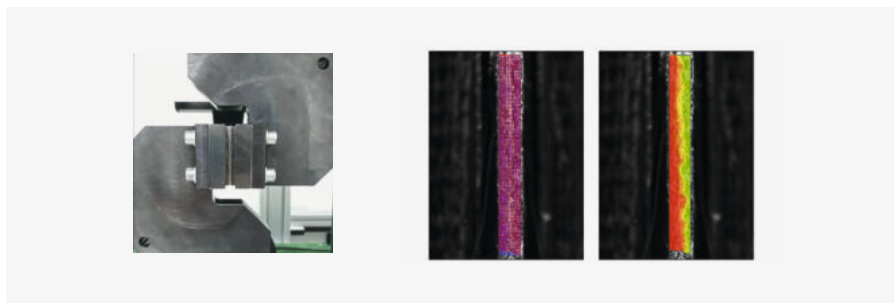


Fig. 2: Sample in place on the out-of-plane shear test stand (left) and shifts in the board material during testing: initial blue grid and shifted red grid (centre), as well as coloured identification of the separation level (right)

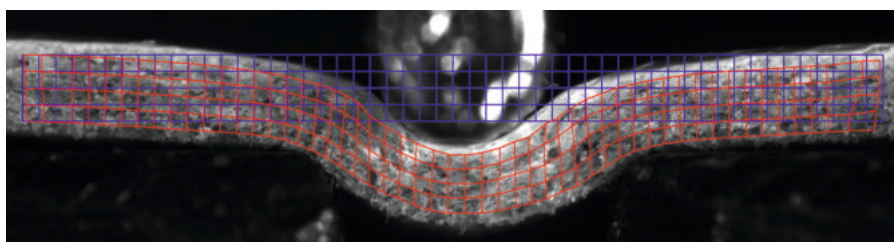


Fig. 3: Initial (blue) and deformed (red) measuring grids in a creasing operation for evaluation by means of optical strain field analysis

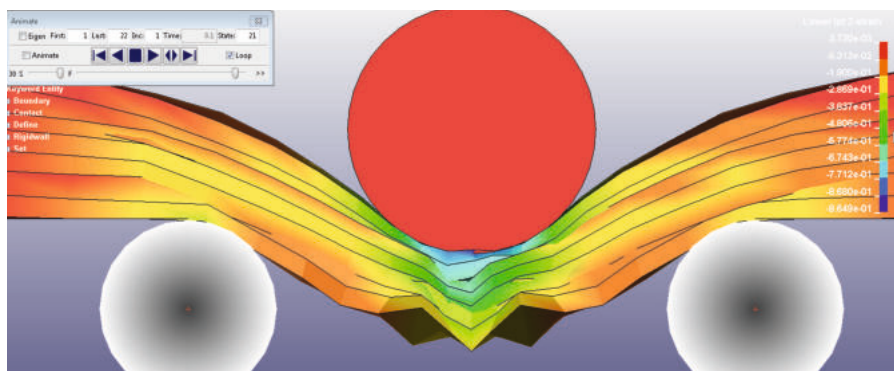


Fig. 4: Result of FE simulation: lateral strain (thickness compression) in each of the board plies as a result of the creasing process

### Development of the FE model

The model was developed with the FE software LS-DYNA, which is well suited for the simulation of complex deformation processes. The creasing bar (rule) and the edges of the creasing channel (groove) were simulated by cylinder-shaped geometries with radii that were each time adapted to given practical conditions (refer to Fig. 4).

In a first step, the paperboard was divided into seven individual layers, and later on an eighth layer was added, which represented the coating. So it was possible to generate accurate results in terms of the internal loads and to study the effects caused by layer displacements. Since the creasing operation was de-

finied by delamination between the layers, potential delamination levels were inserted between the outer layers of the material (layer 1, 2 as well as 6, 7) and the medium ply (layer 3-5). They had to be described with characteristic values regarding their maximum strength and stiffness both in plane and out of plane. The out-of shear test stand shown in Fig. 2 and the optical strain field analysis shown in Fig. 3 were used for this purpose. Also, the internal bonding strengths in a Z direction were determined.

The practical creasing tests on the universal testing machine were evaluated by means of an optical strain field analysis and showed the expectable compres-

sion and tensile areas in the thickness direction. The material located under the creasing bar during the operation is compressed whereas the material in the sidewalls of the creasing groove is drawn apart. The highest compression takes place exactly under the tip of the creasing bar.

The results of the simulation are an exact match of the material's behaviour in practice. Both the compressed areas under the creasing bar and the tensile areas at the top of the sidewalls can be seen in Fig. 4. Similarly, the picture shows the elongation results, which reflect different strain values in the various plies, or layers, of the paperboard in the creasing edges. The visual representation of the node shifts in the model is exaggerated and does not correspond to the real deformation. This is done to allow for easier detection and analysis of relevant deformation areas.

If an element exceeds the predefined strain or stress thresholds, local failure and elimination of the element will occur. The positions of such elements will then be indicated as defects leading to loss of function or the like in the coating.

### Systematic creasing testing on laboratory prototypes

The results obtained with the FE model were taken into account for the selection of folding boxboards and coatings. Three paperboard grades with substantially the same thickness but different compositions were selected: GZ = Coated SBB (445  $\mu\text{m}$ ), GC2 = Coated FBB, cream back (450  $\mu\text{m}$ ) and GD2 = Coated WLC, grey back (455  $\mu\text{m}$ ).

In the laboratory, the backs of the boards in the laboratory were coated with two different coatings, each of which was applied in three dosage amounts: 8, 15 and 25  $\text{g}/\text{m}^2$ . The coatings were an acrylate-copolymer coating and a polyvinyl alcohol coating. Comparative studies showed that the acrylate copolymer coating could be expanded to a larger extent and with lower effort than the PVOH coating.



The subsequent creasing tests were performed in a Marbach laboratory press with matching cutting-creasing tools delivering strip specimens of 25 x 60 mm in each stroke. The heights of the creasing lines were varied to implement different immersion depths (+0.10 mm, +0.05 mm, 0.00 mm, -0.05 mm, -0.10 mm) in the creasing channel. The make-ready consisted of a metal sheet containing milled creasing channels of different widths. The creasing channel width was varied in increments of 0.1 mm from 1.1 to 1.8 mm. The creasing channel depth of 0.5 mm was not varied during the tests.

The creases of the specimen strips then underwent visual examination for cracks inside and outside, and for poor delamination or for bulging. Additionally, an aqueous dye solution was applied to the crease seam region to check the coatings for pinholes. Also, the folding factor was determined, which describes the reduction of the folding moment by the crease.

#### Determination of the barrier effect of creased samples

The project included permeability tests against water vapours, fats & oils, and hexane fumes (as a model substance for mineral oil hydrocarbons and aromatic substances). This test series required circular specimens of 95 mm or 85 mm, respectively, for which additional cutting-creasing tools were fabricated with different channel widths and creasing bar lengths (refer to Fig. 5).

#### Recommendations for practice

The project allowed a big amount of permeability data to be collected with regard to different creasing conditions of the three coated board grades. The results from the evaluation of the data can be summarized in the following recommendations:

- (1) (The barrier effect is reduced along the crease seams in almost every case, whether or not visually de-

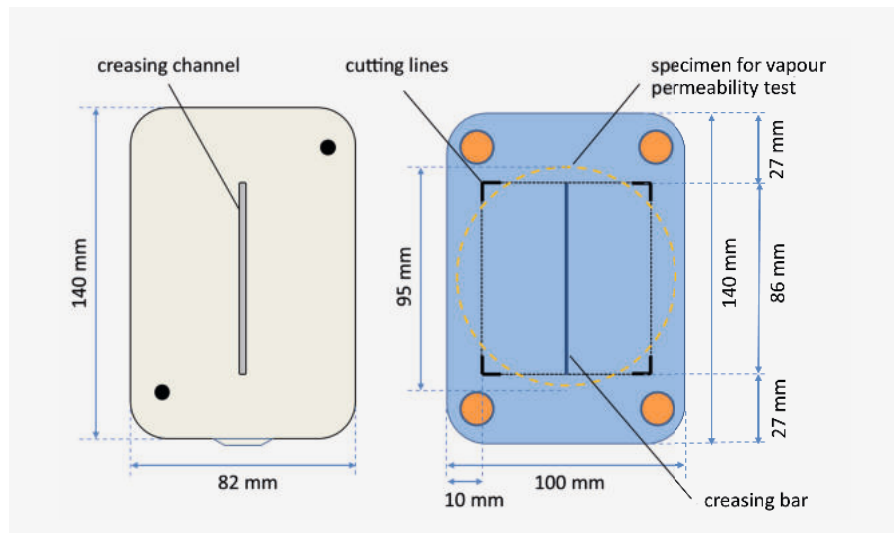


Fig. 5: Sketch of the cutting-creasing tools made for the testing of permeability to water vapours and hexane fumes

tectable. The rate of increase in permeability can range from just a few percent up to several powers of ten. The increase is higher for gaseous substances (water vapours, hexane) than for liquid substances (water, fat & oil).

- (2) The reduction of the barrier effect along the crease seams can be effectively minimized by applying a sufficiently high amount of coating compound ( $\geq 15 \text{ g/m}^2$ ), using a coating with high elasticoplastic deformability, using a base paperboard that has good creasability and a relatively smooth back.
- (3) For optimal results, i.e. for minimum barrier loss at acceptable to good folding factors, the creasing parameters should be slightly modified. The immersion depths of the creasing bar should be slightly higher than for the standard conditions (+0.05 to +0.10 mm) while the depth of the creasing channel should be the same

#### Credits

The research project IGF 19313 BG of the AiF Research Association was funded via the AiF within the framework of the Industrial Joint Research (IGF) programme

by the Federal Ministry for Economic Affairs and Energy under a resolution of the German Federal Parliament. We seize the opportunity to extend our gratitude for this support. ■

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Gefördert durch:



aufgrund eines Beschlusses  
des Deutschen Bundestages

1 H.-J. Tenzer: Leitfaden der Papierverarbeitungstechnik, 1. Auflage, VEB Fachbuchverlag Leipzig, 1989, ISBN 3-343-00448-0  
2 J. Blechschmidt (Hrsg): Papierverarbeitungstechnik, Fachbuchverlag Leipzig im Carl Hanser Verlag, 2013, ISBN 978-3-446-43071-6



# “Paper-Metal Composite II”: Lightweight potential and sustainability aspects in the automotive sector

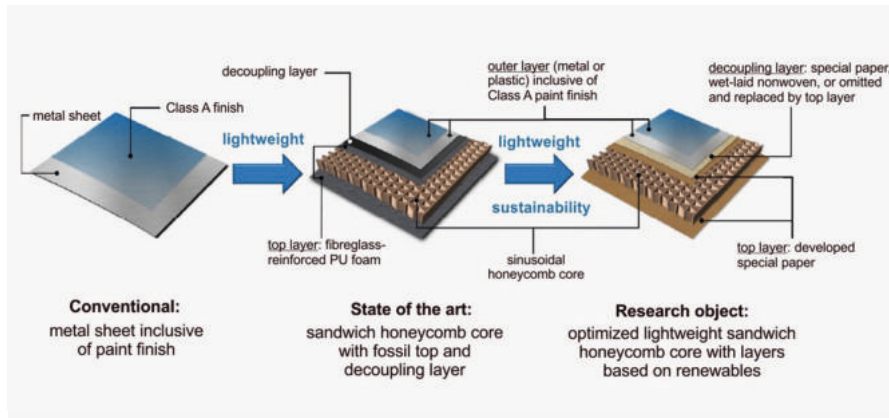


Fig. 1: Comparison between conventional, state-of-the-art and research project-based roof structures

As of 01/12/2019, a research project funded by the Federal German Ministry for Economic Affairs and Energy (BMWi) within the framework of the “Industrial Joint Research” (IGF) programme and conducted by PTS in collaboration with the Institute of Solid Mechanics (IFKM) of the Technical University of Dresden (TUD) was launched. The research project is based on the results obtained from the “Paper-Metal Composite” cooperation project IGF ZBR 362 of the research bodies PTS, DECHEMA and EFB in the period between 2010 and 2012.

## Technical background and project goal

Recent years have seen a trend towards lightweight structures in the automotive, ship-building and aeronautical industries – a trend that is going to continue in the years to come due to political rules and regulations. The further reduction in weight is in particular aimed at fuel savings for achieving lower CO<sub>2</sub> emissions and an improved standing in today’s heated climate debate. Therefore, the goal of the “Paper-Metal Composite II” is to raise, improve and demonstrate the lightweight potential and sustainability aspect in the automotive sector at the example of automobile roof structures. This approach is illustrated in Fig. 1.

The conventional method (Fig. 1, left) comprises the manufacture of final-

ly shaped body parts on the basis of metal sheets only. The disadvantage is that additional support structures need to be provided, especially for stability reasons, e.g. for the roof tops, which increase the weight of the components and result in higher fuel consumption of the vehicles. The current state of the art, which results from the findings of the predecessor project, uses composite panels made of sinusoidal honeycomb paper cores with fibreglass-reinforced PU foams in the top layers (Fig. 1, centre). Since the lined sandwich honeycomb core and the outer layers exhibit differences in hygroexpansivity and thermal expansivity ( $\Delta\alpha$  issue) that would cause the support structure geometry to be visible on the component surface (especially for surfaces with Class-A finishes), a viscoelastic decoupling layer made of plastic is inserted in an additional process step. Therefore, the resultant multi-material structure is not optimal in terms of its weight reduction potential and does not raise the full sustainability potential because of its poor recyclability and its use of fossil resources.

So the focus of the research project is to study how to substitute a special paper meeting the given requirements for the top layers of the sinusoidal honeycomb paper core and for the decoupling layer below the Class-A-finished outer-

## Short title:

» Paper-Metal Composite II

## Project period:

» 01/12/2019 – 31/05/2022

## Project type:

» Industrial Joint Research (IGF), IGF 20956

## Research locations:

» Institute of Solid Mechanics, TU Dresden (IFKM), project leader: Dietmar Süße  
 » Papiertechnische Stiftung (PTS), project leader: Birgit Lutsch

most layer (Fig. 1, right). Such it will be possible not only to improve the lightweight potential but also to enhance the sustainable and ecological character of lightweight car body elements of this type.

## Solution approach

The starting point for successful project implementation is to simulate each of the layers of the sandwich structure components (IFKM at TUD) while they are subjected to the loads of the forming process. This allows the necessary properties of each functional layer to be identified. Based on the quality requirements such formulated, commercially available papers in the market can be examined for their potential suitability for this purpose or suitable materials can be specifically developed (PTS). As can be anticipated already in the beginning of the project, it is necessary for the designated intermediate paper layers to act as a compensation material to reduce the parameter gradients in order to overcome the afore-said hygroexpansivity differences and the  $\Delta\alpha$  problem (refer to Fig. 2).

In principle, there are various conceivable ways how to manufacture the special papers that are required for this purpose:

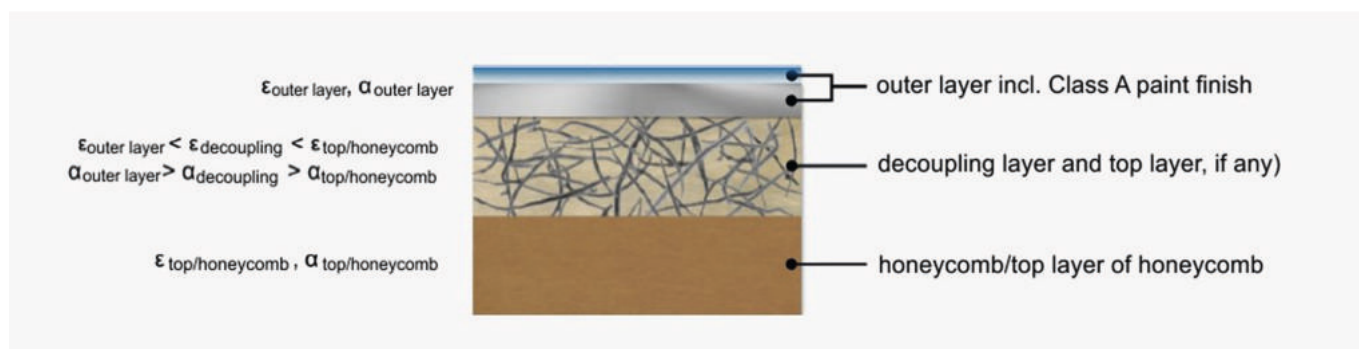


Fig. 2: Requirements to be met by paper as a decoupling material in sinusoidal honeycomb sandwich structure components

1. Manufacturing “compressible and shear-elastic” papers by providing higher porosities, weaker fibre-to-fibre bonds, and shear-elastic individual layers;
2. Manufacturing special papers by adding viscoelastic additives during production in stock, in the headbox or by spraying in a duplex process;
3. Maintaining high paper bulks during production, e.g. by through-air drying (TAD) and subsequent application of viscoelastic additives via a size press or a coating process.

In close cooperation with the research partners, the individual materials thus obtained will then be used to prepare sample specimens both for material testing and for simulation model validation. Final corrections or adjustments may be necessary before the materials will eventually be combined and processed to form sinusoidal honeycomb core sandwich structures.

### Benefits for papermakers and converters

The research results are manifold, last but not least they include the investigation and clarification of the question how the dimensional stability of paper and its impact on the characteristics of a composite structure can be controlled on all scales.

Manufacturers of special papers and paper converters in the field of honeycomb panels can be considered to benefit directly from the research project. Moreover, the project offers the possibility e.g. of sub-contracting the assembly of honeycomb core structures and their top and decoupling layers e.g. to SME. ■

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aufgrund eines Beschlusses  
des Deutschen Bundestages

## ASPEKTE – Asymmetric paper-derived composite materials with hydrothermally stable properties

The German paper industry has long been under considerable cost pressure, which was a key driver of innovation in recent years. Cost reductions alone are no longer sufficient for the companies to remain profitable in the longer term. The development of special papers offers an opportunity to create

or open up new, innovative and, most of all, profitable markets and industries. Within the ASPEKTE project, PTS is developing a new and promising way of using industrial paper machines. This prospective research project (IK-VF 190019), which is supported within the Innovation Competence funding programme of

the Federal German Ministry of Economic Affairs and Energy, is focused on the manufacture of hierarchically structured paper-derived ceramics.

PTS has long experience in the integration of ceramic fillers in paper (patents: DE10348798A1, WO2012062424A3), which

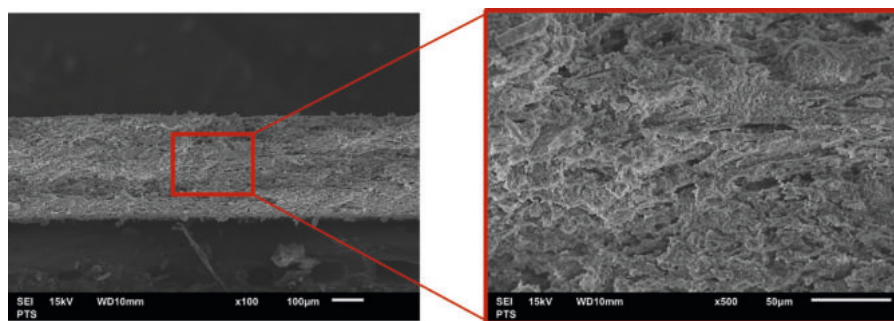


Fig. 1: SEM image of the cross-section of a paper-derived sintered ceramic having a homogeneous structure

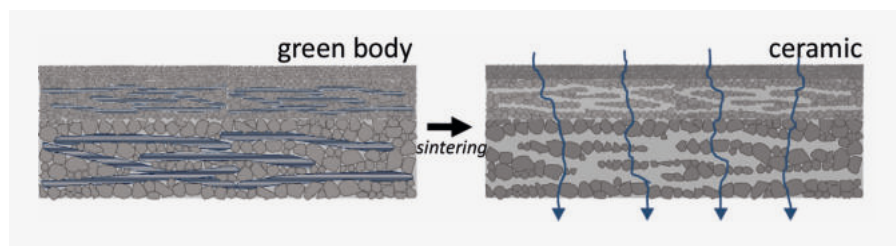


Fig. 2: Schematic view (not to scale) of the green body after sheet formation with the cellulosic fibres and the hierarchic structure (left), and of the high-porosity ceramic material, after sintering, with the desired microstructure from burning the cellulosic fibres with the pore size gradient allowing various fluids to flow through the material across the cross-section according to the given pore size (right).

is intended to be used and further extended in the current project. Technologically, it is envisaged to adjust a pore size gradient across the cross-section to create the desired microstructure. To do so, it is necessary to examine the structure-property relationships and the relations between material input and processing of the pre-ceramic paper in more detail. Using the papermaking technology for manufacturing sinterable, flexible pre-ceramic papers, instead of the common standard technology such as casting, pressing or extrusion methods, can give huge energy cost advantages.

Conventional low-cost papermaking processes are used to manufacture these new, innovative, pre-ceramic sinterable papers. Generally, there are a lot of papers containing a certain percentage of inorganic fillers in addition to cellulose-based fibre. The ASPEKTE project raises the filler content (e.g.  $\text{Al}_2\text{O}_3$ ) to at least 70 % by weight (approx. 40-60 % by volume).

The paper thus obtained is largely dominated by the properties of the filler. The ceramic particles are embedded into the

paper structure (the cellulose fibre network) and directly processed as a pulp slurry in the paper machine. The material is subjected to a well-adjusted accurate thermal treatment operation in which the fibre is burned while the individual filler particles are sintered. This thermal step creates cylindrical voids resulting in a ceramic material having high porosity. Fig. 1 shows a cross-section of an exemplary homogeneously structured ceramic material thus obtained.

In order to generate a pore size gradient across the cross-section, it is conceivable to bond distinct homogeneous layers of different porosities together or to apply additional layers using smaller particles. Ideally, the asymmetry (hierarchy) adjustment of the pore sizes can be done within one single process step. The structure of the green body and the structure of a ceramic with asymmetric pore size distribution are shown in Fig. 2.

In this method, the pore-forming task is directly performed by the cellulosic fibres and sintered particles actually used. The type, length and thickness of the fibres used and the size of the particles used

#### Project period:

» 01/10/2019 – 30/09/2021

#### Project type:

» Innovation Competence Funding  
Programme INNO-KOM IK-VF  
190019

#### Research locations:

» Papiertechnische Stiftung (PTS),  
project leader: Dr. Yvonne Jüttke  
Dr. Cornell Wüstner

are vital to the emerging microstructure and its utilization when sintered. Prior to sintering, the green body is flexible enough to be shaped into a complex geometry (e.g. wavy form) according to customer specification. Spiral and parallel winding can be used to create wound structures. The resultant ceramics have a high application potential as filter media.

Highly filled, flexible pre-ceramic special papers and the paper-derived sintered ceramics resulting therefrom are not the state of the art so far. However, current application-specific research projects, for instance in the field of fuel or electrolytic cells, do show that paper-derived high-performance materials can be used for performance enhancement and application-specific property adjustments and thus are of great interest for producers and end users. ■

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Gefördert durch:



Bundesministerium  
für Wirtschaft  
und Energie

aufgrund eines Beschlusses  
des Deutschen Bundestages



# KOMPAP – Energy-efficient construction by composite materials with paper

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Fig. 1: Tensile test unit for paper structures of different thicknesses and compositions

The use of paper in paper-based composite structures is offering manifold possibilities to enhance the role of regrowing, sustainable and recyclable materials in the building sector and to exploit the benefits, in particular cost-effective rapid production and exceptionally good specific strength properties, of paper structures.

The goal of the KOMPAP project was to develop energy-efficient concepts for the construction of, for instance, external building envelopes from composite materials made of paper, paper structures and mineral building materials. It was envisaged to optimize the composite of paper structure and mineral component by way of functionalization of the bonding interfaces.

PTS worked on the KOMPAP project “Energy-efficient construction by composite materials with paper” together with the coordinator PMV (Paper Manufacture and Mechanical Process Engineering) of TU Darmstadt and 7 other project partners (see [www.pmv.tu-darmstadt.de/forschung\\_pmv/forschungsschwerpunkte\\_2/kompap/index.en.jsp](http://www.pmv.tu-darmstadt.de/forschung_pmv/forschungsschwerpunkte_2/kompap/index.en.jsp))

Paper can be manufactured in large amounts at low cost and offers a broad range of properties, which can be adjusted in manifold ways by appropriate raw material selection, additives and modifications of the chemically reactive hydroxyl groups of cellulose. Good specific strength properties in combination with good heat insulation properties are just a few out of the many advantages of paper that have so far not been put to use in

construction and insulation material applications.

Within the project, a multitude of papers from the industrial partners were characterized under paper technology aspects and assessed with regard to their suitability for being subjected to further investigation. For formability classification purposes, a kraft liner, a greaseproof paper and a paperboard for plasterboard manufacture with different corrugation geometries, feed rates and adhesives were re-formed and their formability assessed.

For the production of paper structures on an industrial scale, sinusoidal honeycomb structures were manufactured at the premises of SWAP Sachsen GmbH using the most promising industrial paper combinations determined on the basis of the laboratory trials and were prepared for demonstrator production. The paper-based honeycomb structures were comprehensively tested and characterized in the premises of PTS.

Poisson’s ratios, elastic moduli (Fig. 1) and thermal conductivities (Fig. 2), among other, were determined. The thermal conductivities of the industrially manufactured

**Funded by the Federal Ministry for Economic Affairs and Energy within the “Building Energy Transformation” programme.**

**Project period:**

» 01/03/2017 – 29/02/2020

honeycomb structures were tested on layered structures having the same specimen thickness of 30 mm. A multilayered structure of thinner (6\*5 mm) laminated paper honeycombs was found to have a significantly better, i.e. lower thermal conductivity than a single-layered structure (1\*30 mm). Contrary to expectations, the structures with the larger sinusoidal core (1S) showed lowest heat conductivities. This may be due to the non-adhesive ultrasonic assembly method and thus due to the absence of adhesive.

The characteristic values determined for the material form the basis for the validation of the simulation models and for the design calculation of the demonstrator (refer to Fig. 3).

The figure shows a sandwich construction composed of 2 layers of laminated



Fig. 2: Real and schematic sandwich element demonstrator structure

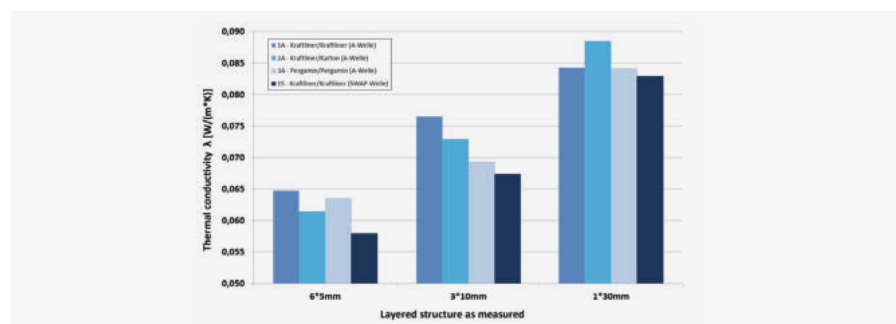


Fig. 3: Determined thermal conductivities of paper-based honeycomb structures of industrial papers having different numbers of layers

honeycomb structures manufactured within the scope of the project and comprising a layer of mineralized foam.

This modelled structure was generated at the end of the project (dimensions: 3000

x 750 x 360 mm). In the project, it was shown that the structure had the target properties in accordance with the preliminary investigations and simulations and that the project delivered a benchmark result for future research as well as for

the application of such structures. ■

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## Industry 4.0 and the paper industry – a relation with good potential

Almost 10 years have passed since the Industry 4.0 initiative was first announced at Hanover Fair. Nevertheless, there is a strong feeling that Industry 4.0 still has not really made it beyond science into industry. On the one hand, Industry 4.0 stands for many new possibilities and applications, but, on the other hand, there is the fear of wrong investments in a still rapidly changing environment. Whenever new solutions are presented, it is often unclear whether a solution is actually part of a fourth industrial revolution or just another episode of automation and digitisation. Without any doubt, there is huge demand for new technologies and solutions. Industry 4.0 promises to be of great assistance in handling large amounts of data and complex processes in the future (for applications such as machine learning, big data and intelligent algorithms). Especially in the paper industry with its complex circular economy and costly papermaking process, this will create new potentials for optimization. Since a “resource-efficient circular economy” gains more and more in importance, the stakeholders of the paper and board value chain of paper and cardboard are under the obligation to optimize their processes and make them traceable. This means, for example, consuming less energy and using less raw material. Measures of digital transformation can achieve a reduction by up to 25% in power consumption and material input, as shown in a study conducted by the VDI Centre for Resource Efficiency in the Manufacturing Sector. One focus of the research and development activities of PTS in recent years was to look into ways how to encourage digital transformation in the paper and

board value chain. Of course, this challenges us, as a part of a sector-wide added value network, to provide PTS products and services in the sense of Industry 4.0.

### INVITE4.0 project

Within the scope of the INNOKOM prospective research project INVITE4.0, PTS together with the Magdeburg Institute for Automation and Communication (ifak) is conducting research on the fundamentals and implementation of Industry 4.0 technologies in the paper industry.

The aim is to create a RAMI4.0 “Smart Service-Ready Platform Architecture” and to publish a guideline document on “Industry 4.0 in the Paper Industry”. Two university students are currently working on partial aspects of Industry 4.0 in our research institute.

### Sub-project: RCP monitor as an Industry 4.0 component

Richard Fankhänel from the Technical University of Dresden joined PTS for writing his thesis in mechanical engineering under the tutorship of Björn Zimmermann. The thesis is focused on the recovered paper (RCP) monitor. An in-line quality assessment of incoming recovered paper by measuring its material composition in the receiving area allows efficient measures to be taken in the processes. The quality assessment is based on near-infrared (NIR) technology. For the purpose of his thesis, Mr. Fankhänel has the task to build a device allowing the camera to be used above a conveyor belt. The particular challenge for Mr. Fankhänel in his thesis is not just to build a machine, but rather to identify the RAMI4.0 requirements

**Short title:** » INVITE 4.0

**Project period:** » 1/10/17 – 31/3/21

#### Projekttart:

» Innovation Competence funding programme INNO-KOM IK-VF 170001

#### Forschungsstellen:

- » Papiertechnische Stiftung (PTS), project leader: Björn Zimmermann
- » ifak, Institute for Communication and Automation, Magdeburg
- » SHD System-Haus-Dresden GmbH, Dresden
- » Stora Enso Sachsen GmbH, Eilenburg



PTS students Richard Fankhänel (left) & Justus Feron

for its development. The task is to subject the recovered paper monitor to a thorough life cycle analysis based on the Industry 4.0 concept with the aim to ensure the optimal use and application of the machine in all phases – from assembly via production to recycling. Also, it is to be ensured that the RCP monitor can be used both as a fixed unit for a long period in the same location and as a flexible unit that can be removed at short notice to be moved to and used in another paper mill.

### Sub-project: Development of an Industry 4.0 Guideline

The second university project was related to the digital description of physical technical objects (“assets”) in the context of Industry 4.0, based on DIN SPEC 91345 for the Reference Architecture Model for Industry4.0 (RAMI 4.0).



The project was performed by Mr. Justus Feron who is also a student in mechanical engineering at the Technical University of Dresden. For this purpose, he worked on the concrete implementation of an asset administration shell with an application programming interface (API). Asset administration shell (AAS) is the representation image of a physical asset with all of its descriptive information and functions in the digital world. The generation of data is no longer a problem in many industrial fields thanks to a high degree of digitization and automation. To be able to use the data for optimizations and for offering data-driven services in the future, it is vital to create new interfaces and standards. Data needs to be described in a clear and unambiguous manner and be available with its context information before it can be further processed (Fig. 2). For this purpose, it is desirable to collect both information about the entire life cycle and information about a maximum number of assets. Reloadable modules are supposed to make it possible in the future to provide, in addition to the description of paper as a product, data from sensors, software products or a plc in compliance with Industry 4.0. This work by Mr. Feron formed the basis for

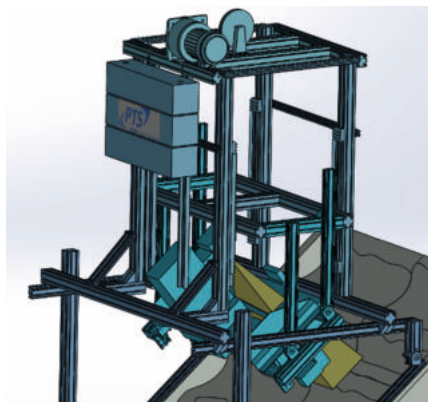


Fig. 1: RCP monitor concept for installation above a conveyor belt

the further development of data-driven services, so-called smart services. Now, Mr. Feron is working on a first concrete implementation of his concept at the example of the RCP monitor in connection with the above mentioned student project.

#### Outlook

PTS has repositioned itself internally and its new business line “Smart Services & Products” is clearly focused on a future with Industry 4.0. Cross-linking of assets and data will become increasingly important in the future. What tends to be overlooked quite often is that Industry 4.0 is supposed to make life easier for machine attendants and plant operators. It is en-

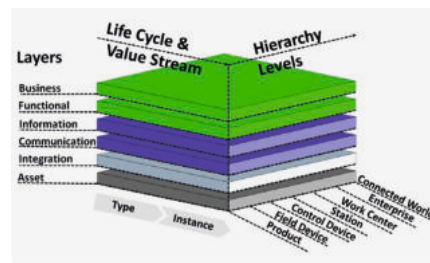


Fig. 2: Reference Architectural Model Industry 4.0 (RAMI 4.0)

visaged to make the user again the centre of attention. If this works out and if it can be shown that data is a key to optimization, then Industry 4.0 will eventually be accepted. This is exactly what PTS attempts to demonstrate by looking into a number of manageable use cases. In addition, recommendations for action and best practice documents are intended to help interested companies get going with first own projects in this field. In case of interest, webinars and training courses are also conceivable in this area to ensure that in the end the relationship between the paper industry and Industry 4.0 is not a difficult but a happy one. ■

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## Sustainable paper cycle – fact-checking



It is impossible to imagine people's daily lives without paper. Accordingly, the weight of the paper industry is high in Germany where paper is mainly based on regrowing raw materials. With its recycling rate of 75 %, paper is among the best recycled materials in Germany. So the German paper industry is one of the stakeholders and drivers of a modern circular economy. Nevertheless, the manufacture and use of paper also meets with criticism, especially because it involves the use of wood removed in thinnings, sawmill residues and wood from plantations.

Moreover, the paper production process is energy-intensive. As a result

of this ambivalent public perception of paper, the Board of Trustees for Research and Technology of the Pulp and Paper Industry in VDP e.V. requested the bifa environmental institute (bifa Umweltinstitut GmbH) to conduct a fact-checking study regarding the sustainability of paper. PTS supports bifa by employing its broad expertise in the use and recycling of raw materials over the entire life cycle of paper. The project was kicked off in December 2019. The study is expected to be finalized in autumn 2020. ■

**Dr. Gert Meinel,**  
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#### Project title:

» Sustainable paper cycle – fact checking

#### Project period:

» Dec 2019 until presumably autumn 2020

#### Project type:

» INFOR project

#### Research locations:

» Papiertechnische Stiftung (PTS), project leader: Dr. Gert Meinel  
» bifa Umweltinstitut GmbH project leader: Dr. Wolfram Dietz

# Paper for batteries, fuel cells and electronic applications

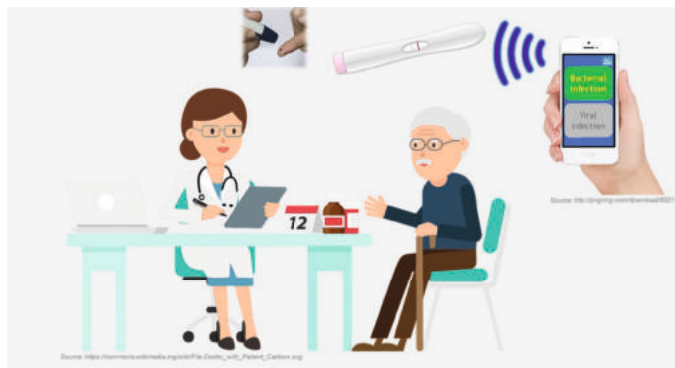


Fig. 1: Point-of-care test impetus



Fig. 2: Printed electronics

The original purpose of paper is archiving the information written on it. As early as 2000 years ago, plant fibres were used to produce hand-made writing substrates in ancient China. Especially during the course of industrialization and technological developments of the past two centuries, paper became a commodity product that was produced in ever increasing quantities and for specific purposes. As well as for printing, paper is widely used for packaging and hygiene products where it offers clear advantages over other materials in terms of the re-usability of the recovered materials.

Technological progress, once the key to success for the paper industry, has for several years become an increasing challenge. The original function of paper, which is transmission and storage of data, is nowadays ensured by digital media. Thanks to the remaining advantages of paper, i.e. reel-to-reel processibility, recyclability as a material and good formability of a porous substrate, paper and the related papermaking and converting processes qualify for the manufacture of functional up-market products in high volumes.

The paper production process allows for flexible use of a variety of fibres and fillers that impart highly specific functionalities to the paper. The paper surface provides an excellent support for functional coatings so that the base paper

sheet's fibre network can be considered to form a skeletal structure receiving the functional components internally or on its surface. Eventually, the material can optionally be compacted and shaped by known methods. If the plant fibres are not needed in the final workpiece and provided that the functional components have appropriate stability, the fibres can be thermally destructed at high temperatures to create a new material.

Apart from such material-dominated application, paper can still be used as a substrate, specifically for printed electronic structures, and thus as a support for e.g. sensor elements. Therefore, the combination of the well-established and fully developed papermaking process with the internal and surface application of fillers or functional components offers completely new possibilities far superior to other materials.

During recent years, PTS has already made visible progress thanks to numerous research activities.

So it was possible to produce highly filled special papers using both ceramic and metal fillers. The focus in research & development is currently placed on electrode materials for processes that ensure sustainable and economical power supply (fuel cell). The main goal is to increase the efficiency of conventional

technologies and to open up new ways and benefits for application-specific products of the paper industry.

The meanwhile completed "ElectroPaper" project (03XP0041E) covered the optimization and full-scale application of a bioelectrochemical system for the treatment of effluents. A major element of the system consists in paper-derived electrodes for enhancing the performance of microbial electrochemical technologies for use in municipal and industrial effluent treatment. The electric conductivity can be increased by well-aimed selection of a suitable graphite and embedding of the powder in the fibre network while maintaining the mechanical properties of the material. As a result, the paper-derived material shows the same performance at a lower manufacturing cost than in conventional material uses.

Within the scope of the projects IGLU (IGF 19957 BG) and Impetus (EU H2020 No 761167), PTS came up with a suitable paper substrate for inkjet printing of sinter-free UHF antennas and a point-of-care test with printed sensors and electronics. The aim was to obtain favourable microfluid properties by selecting and processing a suitable fibre material while at the same time designing a sufficiently smooth surface for the printing process. So it was possible to obtain a coating formulation having appropriate smooth-

ness and fixing the printing ink at close proximity to the surface and at low film resistance.

Corresponding UHF antennas and RFID tags can be flexibly printed, ensuring track-and-trace of packagings and advantages in logistics and inventories.

We support you in putting your idea to practice and advise you on the potential use of the papermaking process for your product, we conduct technological feasibility studies, market studies and state-of-the-art research and are able to produce

laboratory samples up to demonstrators in our modern laboratories and pilot plants.

For this purpose, we have a pilot paper machine for the manufacture of reeled paper allowing the integration of almost any fillers whatsoever, and various coating units in which the functional component can first be transferred into an applicable form and then applied onto the surface in a defined manner. Also, extensive analytical methods are available.

In the near future, we are going to further extend our capacity in the field of

the development of functional papers (pilot coaters) and to teach concepts for the use of papermaking processes within the scope of workshops. Please come forward. ■

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*This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 761167.*

## Voith and PTS set a new standard for measuring stickies and non-tacky contaminants using near-infrared measuring technology

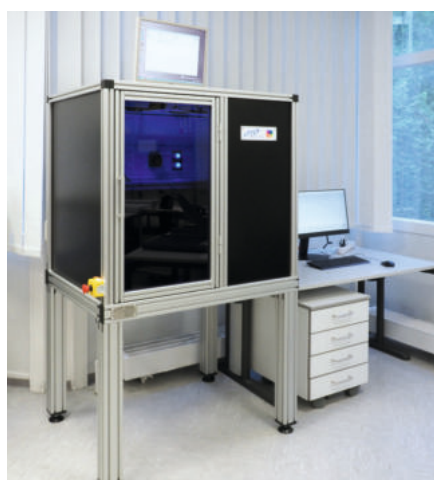


Fig. 1: Measuring workplace

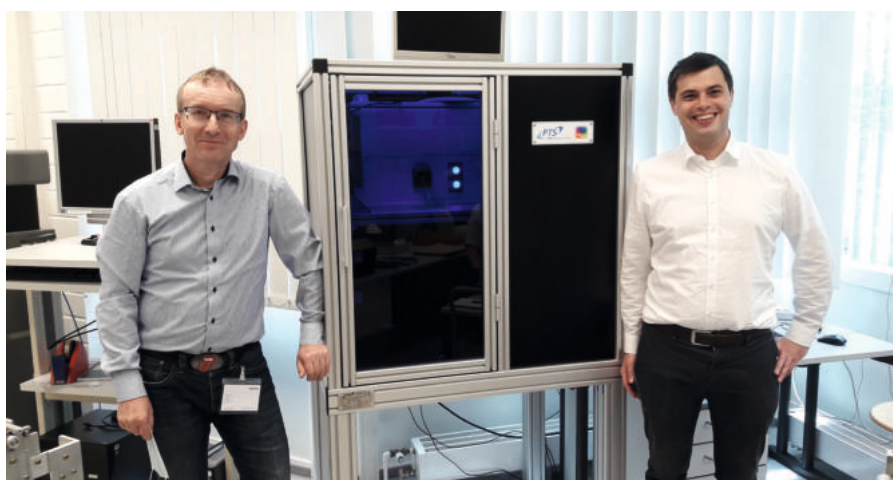


Fig. 2: Delivery Jörg Hempel (PTS) & Dr. Linus Friedrich (Voith Paper)

**H**eidenau, 09.07.2020. In collaboration with Voith Paper Papiertechnische Stiftung (PTS) is introducing a new measuring method to detect unwanted tacky contaminants known as stickies. The measuring method, which uses a near-infrared (NIR) camera, allows the reliable detection of contaminants along the papermaking process and offers higher measuring accuracy and a wider range of applications compared to conventional methods. The

associated technical rule was recently published as DIN SPEC 6745.

### Higher measuring accuracy and wider range of applications

Compared to established methods in the paper industry, the measuring technology uses NIR to determine more comprehensive information about the contaminants with a high measuring accuracy. The spectral measurements obtained are compared and assigned to values of

known contaminants. This allows further classification of the contaminants based on their chemical composition. In addition, both adhesive and non-tacky contaminants can be identified and classified using the NIR measuring technology.

### Reliable identification, reduced laboratory effort

The new measuring method enables much more reliable information to be obtained while reducing the amount of



**Advantages:**

- » New near-infrared measuring technology offers higher measuring accuracy and a wider range of applications compared to conventional measuring methods
- » Reliable detection of stickies and non-tacky contaminants

**DIN SPEC 6745**

- » Voith, PTS Heidenau and PROPAKMA publish technical rule for sticky measurements as DIN SPEC 6745

 [www.din.de](http://www.din.de)

 **DIN SPEC 6745**



Fig. 3: Workplace for sample measurement

laboratory work involved. “Using NIR technology to measure stickies allows the papermaker to determine sticky balances with reliable and sufficient accuracy based on single measurements,” says Dr. Linus Friedrich, Senior Manager R&D Fiber Systems at Voith Paper. “This demonstrates one of the benefits of the new measurement technology. With conventional methods, this was only possible to a limited extent due to the large variation in results,” Friedrich said.

Since the new measuring method uses laboratory sheets that can be produced by a laboratory sheet former and contain fibers, stickies and non-tacky contaminants, numerous intermediate steps in sample preparation are eliminated. For example, the sticky contaminants in a stock sample no longer need to be concentrated in order to be analyzed. The preparation time for laboratory sheet formation is significantly shorter and the

measurement is less prone to error than applying conventional methods. Moreover, the new NIR measuring method can be used to evaluate final paper samples in addition to stock samples.

#### Technical rule published as DIN SPEC 6745

The technical rule developed in cooperation with Papiertechnische Stiftung (PTS) Heidenau and PROPAKMA was recently published as DIN SPEC 6745. The DIN SPEC is a preliminary stage of the DIN standard and describes the measuring procedure based on NIR measuring technology. The DIN SPEC 6745 ([www.din.de/de/forschung-und-innovation/din-spec/](http://www.din.de/de/forschung-und-innovation/din-spec/)) is available to download free of charge from the Beuth Verlag website.

#### A new standard for the paper industry

Thanks to its technological advantages, the NIR measuring technology has the potential to replace established methods

for measuring stickies. The publication of a technical rule on sample preparation and the performance of measurements has created the underlying conditions for setting a new standard in the paper industry.

The new measuring technology is available at the Voith Paper Technology Center in Heidenheim for the technology group’s as well as at PTS for R&D activities and for customer trials. This innovation can also be used, e.g., in service operations and customer audits. Voith is the first company in the paper industry to make use of the measuring device developed by PTS and thus, as a fullline supplier to the paper industry, contributes significantly to an ever better understanding and analysis of the entire paper manufacturing process through intensive research and development activities. ■

#### Further information:

[www.ptspaper.com/products](http://www.ptspaper.com/products)

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# Stability and durability requirements for pharmaceutical packagings

In February 2019, the Delegated Regulation (EU) 2016/161 entered into effect [1]. The objective of the Regulation is to increase the anti-falsification security of pharmaceutical products and to reduce the entry of falsified medicinal products into the legal supply chain. The Regulation provides that the packaging must carry a unique identifier in addition to an anti-tampering device. The anti-tampering device can for instance comprise a safety label which can be checked to verify whether the packaging was opened before being supplied to the patient. Typically, codes are used as unique identifiers. The information contained therein must be present on the packaging both in plain text and in a data matrix code in order to ensure machine readability of the information. The identifier code, which is unique for each secondary packaging (or folding box), can be applied by different marking technologies such as inkjet printing methods (thermal inkjet – TIJ, continuous inkjet – CIJ), thermal transfer printing (TTP) or laser marking technologies (inverse codes by laser ablation or laser marking on thermochromic surfaces).

According to the Regulation, the applied codes must be unique and readable “for a minimum of one year after the expiry date of that medicinal product or five years after the pack has been released for sale or distribution” [1]. This provision implies requirements regarding the stability and durability of the data matrix codes or anti-tampering devices. Defined storage conditions for the medicinal products are not specified in the Regulation. Even in case of thoroughly monitored storage and transport conditions for pharmaceuticals (Good Distribution Practice), the safety features must withstand different climatic conditions (transport chain or e.g. refrigerated medicinal products) and ageing processes.

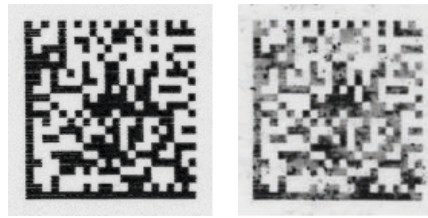


Fig. 1: Example of a code before and after rub-off testing

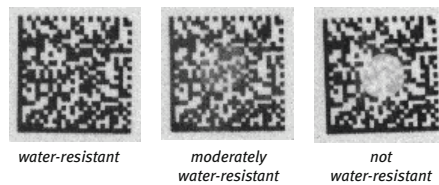


Fig. 2: Impairment of codes caused by water

The readability of the codes can be impaired by abrasion or vibration, e.g. between several folding boxes in a secondary packaging, during the transport of medicinal products. The codes' resistance to abrasive processes at a defined weight load can be determined by a rub-fastness test (refer to Fig. 1).

Further factors influencing the stability of the codes are water and moisture. They can be relevant in the supply chain because of different transport and storage conditions of the medicinal products. Water resistance is tested after ISO 18935 and classified in three categories: “water resistant”, “moderately water resistant” or “not water resistant” (refer to Fig. 2). The test can be carried out, as appropriate, either with a drop of water or by adjusting the ambient moisture. Another option is to load the codes such that they are subjected to a rub-off test

immediately after exposure to water or moisture.

Furthermore, the light-fastness of codes may be important. Here, the code is subjected to accelerated light ageing, and the change in readability is recorded. Depending on the ink and the substrate, there may be a reduction in contrast due to fading of the ink or yellowing of the paperboard (refer to Fig. 3). The minimum requirements may be different according to the specific application.

The Regulation (EU) 2016/161 [1] provides, as mentioned above, that the safety features must remain readable for a minimum storage time of 5 years. Without long-term testing, it is difficult for pharmaceutical companies to verify compliance with this legal obligation. The new PTS method PTS DF 109/2019 [2] demonstrates a concept for the testing of codes and packagings by accelerated ageing, except for exposure to light, according to DIN ISO 5630-3 or DIN 6738.

In this method, codes and folding boxes undergo accelerated ageing at 80°C and 65 % relative humidity for the evaluation of their (shelf) life. The methodology was transferred to the FFPI Specification for paperboard for pharmaceutical folding boxes FFPI-SP 08/2019 [3].

Testing the safety features for their resistance to various ambient conditions and for their ageing behaviour can furnish proof of legal compliance and facilitate the selection or optimi-



Fig. 3: Impairment of code gradings by different light exposure times (LE4 - LE6)



zation of the materials and processes. We would be glad to support you in this matter. ■

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- 1 Commission Delegated Regulation (EU) 2016/161 of 2 October 2015 ([https://ec.europa.eu/health/sites/health/files/files/eudralex/vol-1/reg\\_2016\\_161/reg\\_2016\\_161\\_en.pdf](https://ec.europa.eu/health/sites/health/files/files/eudralex/vol-1/reg_2016_161/reg_2016_161_en.pdf), 09/06/2020)
- 2 PTS method PTS-DF 109/2019 "Testing of the verifiability of data matrix codes on folding boxboard after accelerated ageing", Papiertechnische Stiftung (PTS)
- 3 FFPI Specification FFPI-SP 08/2019 "Paperboard for pharmaceutical folding boxes" ([https://www.ffpi.net/fileadmin/ffpi/Dokumente/Dokumentationen/FFPI-SP%2008-2019\\_Spezifikation%20Pharmakarton.pdf](https://www.ffpi.net/fileadmin/ffpi/Dokumente/Dokumentationen/FFPI-SP%2008-2019_Spezifikation%20Pharmakarton.pdf), 09/06/2020)

**Get in touch!**  
*codierung@ptspaper.de*



## PTS Fibre Packaging Concept: For your benefit in packaging development

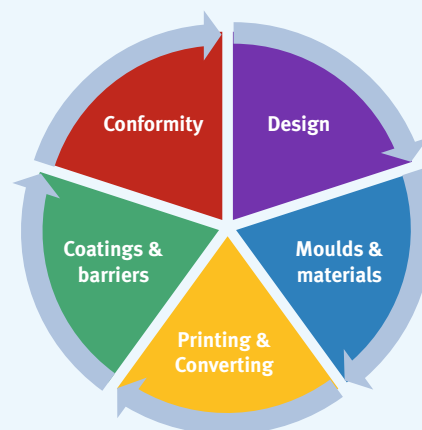
Motivated by the wish of our customers to develop sustainable packaging components as an alternative to oil-based products, PTS channelled its expertise in each of the different fields to come up with the Fibre Packaging Concept (Fig. 1). Thanks to our many years of expertise and modern infrastructure in material development, thanks to our knowledge in the evaluation of recyclability, food safety and conformity aspects, and thanks to our strong network of partners from industry and research, we are an innovative place to go whenever our customers need answers to their problems or questions in packaging development.

From packaging design via the application of barrier and functional layers up to the development of processing and printing processes, our experts are at your disposal to help you with words and deeds. Our working method is designed to ensure that the materials actually used will always meet current recyclability and food safety standards. ■

**We are looking forward to hearing from you.**

**Dr. Martin Zahel,**  
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**Dr. Marcel Haft,**  
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**Fibre Packaging @ PTS**



- Packaging design, end-of-life concepts, simulation/modelling
- Material selection, papermaking, moulded pulp
- Forming, printing, traceability
- Manifold dispersion coatings, modern applicator systems, barrier functionalities for optimal protection of articles
- Recyclability assessment, food safety, matching of specifications



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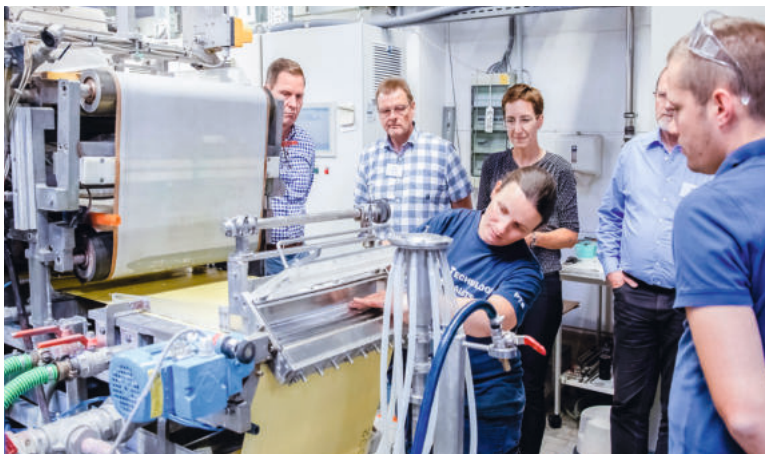


# PTS Academy

## Conferences · postgraduate training · Inhouse trainings · Online events



- » Conference for subject-specific knowledge expansion & intensive networking
- » Seminars and workshops on current topics in the fields of fibers and Composite materials, packaging, printing and surfaces, and analytics, Measurement and test engineering
- » Customized in-house training courses around the topics  
Paper production and paper processing
- » Online formats, from eLearning to conferences, offer a flexible and location-independent participation for high-quality knowledge transfer



### Early bird prices & participation

- » **10% discount** from the list price for a Booking 3 months before the event
- » **5% discount** from the list price for a Booking 1 month before the event
- » **member benefit:** Member companies of a PTS Stifterverband always receive 10% off the list price

## Further development and extension of surface coating capacities in the Technical Centre of PTS

Coatings must provide many functions and properties. For instance, they may serve as a barrier towards fats, water vapours, flavours, mineral oils or gases, or as a functional layer in highly specialized products such as electronic applications. PTS offers an excellent environment for developing such coatings and designing their complex properties thanks to an interdisciplinary team providing a 360-degree view of a problem and using modern measuring devices and plants in the laboratory and technical centre.

The equipment pool comprises not only required dispersion devices and classical film applicators but currently also includes a sheet-fed curtain coater for contactless coating of single sheets and a web-fed Jagenberg coating machine (see Fig. 1). The Jagenberg Coater is a modular construction thereby allowing various coating options such as a blade metering unit, cast coating cylinder and film press).

Due to the currently high demand for paper-based packaging materials from many industrial areas in anticipation over legal restrictions of plastic packagings, there is a need for suitable coatings with appropriate barrier functions towards water vapours, fats and gases. Since barriers

should ideally have a uniform layer thickness to provide a homogeneous performance over the entire surface, it is essential to apply an ideal contour coating. Contactless application methods such as curtain coating are especially suited for this purpose.

For development projects, it is often necessary to produce larger amounts of materials. The web-fed coating process allows the full potential of paper as a material to be used. The envisaged installation of a tensioned web slot coating unit on the Jagenberg Coater will allow contactless application of a coating compound and make it possible to provide an ideal contour coat with good coverage despite low running speeds. In connection therewith, it is also envisaged to install appropriate open and closed-control equipment to ensure the detailed acquisition of the process parameters thereby laying the basis for the interconnection of the coater with further existing plants.

As a result of this modification, it will be possible to use the Jagenberg Coater for contactless application of coating compounds, especially for the development of well-adjusted barriers and high-coverage coatings. In connection with the already existing applicator units, the ex-

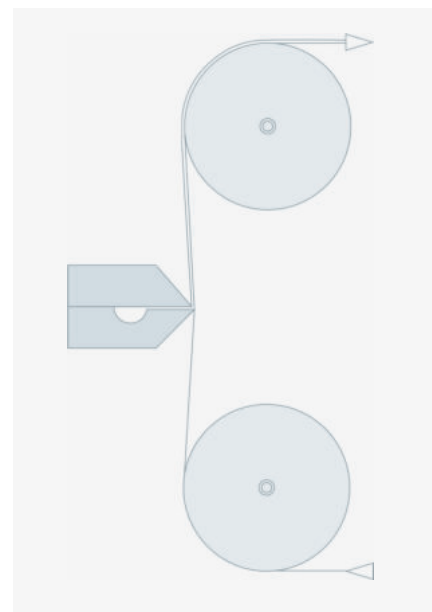


Fig. 1: Schematic sketch of tensioned web slot coating

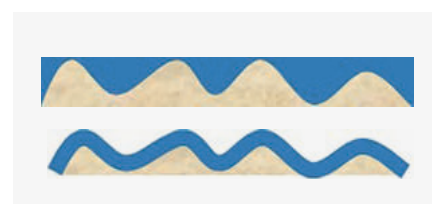


Fig. 2: Levelling coating (top) and ideal contour coating (bottom)

tended coater will be the central element in coating development and thus a vital component for future research & development projects in PTS. ■

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Picture 1: Jagenberg Coater



## Products based on recovered paper – be compliant, remain compliant



Fig. 1: Participants/Schulte Trebsen © PTS

Recovered paper-based products are widely used in food packaging food logistics. For sustainability reasons, they are in greater demand than ever before. However, recovered paper as a secondary fibre source may contain substances originating from primary production or recycling that could migrate into the packaged products. Some of those substances are subject to legal regulations or controversial debates regarding their impact on human health.

During the past few years, this situation led to recurrent public debate and product recall programmes as well as new legal regulations. Therefore, the issue of conformity is more relevant than ever before.

As early as in 2016, PTS launched the specialist platform “Food packaging made of paper” as a common pre-com-

petitive discussion and work platform in which the participants have the opportunity to identify research needs, generate knowledge and find technical solutions for the current problems of recovered paper-based packagings in a protected environment.

Apart from offering latest legislation and press news, this platform is used for the presentation or joint creation of research projects, new analytical methods and process developments. Members discuss current projects in the fields of inspection of incoming recovered-paper, allergens, fibre recycling and reject utilization, or new systems/innovations for the detection of noxious substances.

### The benefit for members?

They take an active part in designing the future of paper recycling with custom-tailored R&D projects geared to entrepreneurial needs. Moreover, they have direct access to the expertise and skills of PTS and its cooperation partners and get information and research results at first hand. The members join forces to come up with cooperative solutions on a win-win basis – from fund raising via expert knowledge and budgeting up to demonstrations on production plants.

You wish to know more and join the 11th session in November 2020?

Do not hesitate to contact our coordinators.



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Last but not least, the specialist platform “Food packaging made of paper” provides the opportunity and the non-public framework for participating companies to work on solutions to politically difficult issues. We seek a vivid exchange in biannual meetings at changing locations. ■

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## PTS Network Days 2020: 3 research forums – 3 on-line events

The on-line format of the PTS Network Days 2020 from 26/05 to 28/05/2020 proved to be successful, instructive and satisfactory for both the participants and the PTS research team.

With more than 300 participants within three days, the research projects,

reports and topics received a high level of attention on behalf of attendants from various industries from all over Germany.

The forums covered the following subjects:

- “Optimized use of fibres and additives”

- “Recycling, sustainability and digitization”
- “Paper converting”

The Network Days participants came from different spheres with a keen interest in the research subjects.



Fig. 1: Welcome

Both research institutions and SMEs were represented.

Switching from the traditional in-person format to the remote on-line format resulted in several work-flow changes, such as forwarding the questions, coordination between speaker and moderator, and technical support for participants during the event.

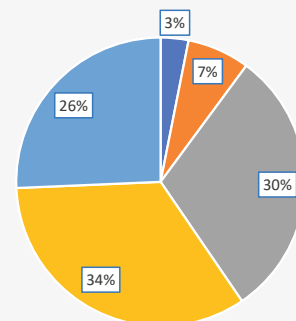


Fig. 2: Behind the scenes

The positive feedback from the participants after each research forum made the team very happy and encourages PTS to schedule on-line events also in the future in order to offer those interested a flexible participation scheme for seminars and training sessions. ■

**Armin Bieler,**  
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### Participating companies by types



- Members of the organizing research location(s)
- Research association/group
- no SME
- SME
- Other participants (e.g. public service)

## PTS is a member of the “Bioeconomy” Cluster of the Zuse Association

**B**ioeconomy is a prerequisite for solving central problems of society and business in the future. The institutes of the Zuse Association can rely on comprehensive expertise and experience in a broad range of bioeconomic research areas. In order to leverage said expertise and experience by enhanced networking, the Zuse Association launched the Bioeconomy Cluster with PTS being one of the 16 founding members.

The orientation towards a sustainable bioeconomy is a megatrend that is currently underway in various industries and will gain in importance. But this megatrend is not a matter of course. Rather, it is advised to purposely encourage and advance the trend towards sustainable bioeconomy. Here, the institutes of the Zuse Association make significant research and development contributions, especially to the transfer of scientific findings into concrete technologies, products and services. “In the Bioeconomy Cluster, the

institutes of the Zuse Association bring together their knowledge of biology and their ideas for bio-based technologies and products. This is how we create valuable synergies and present ourselves as a strong community in this field of the future”, says cluster coordinator Prof. Dr. Jens Schrader from the DECHEMA Research Institute.

### Research areas

- Energy efficiency
  - » Fuel cells
  - » Metal/air batteries and other systems
- Saving resources
  - » Innovative corrosion protection
  - » Water treatment, recovery of recyclables, photocatalysis
- Biologization of chemistry
  - » Biotechnological methods for chemical production
  - » Regrowing raw materials, Added value from single-carbon (C1) resources

















In its bioeconomy strategy early this year, the German government recognizes the great importance of a good management of natural resources. For instance, the strategy places emphasis on application-oriented transfer of research results. The Bioeconomy Cluster of the Zuse Association is well positioned to provide competent answers and solutions to the issues of application-oriented transfer. More than 15 out of the 75 research institutes of the Zuse Association are at present members of the Bioeconomy Cluster. ■

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[www.zuse-gemeinschaft.de](http://www.zuse-gemeinschaft.de)



# PTS Event program 2020 & 2021

Events		Format	Date	Venue
PTS Corrugated Board Symposium 2020		Online Conference	25. - 26.11.2020	Online
Introduction to compliance work and quality assurance for paper and board in contact with food (FCM)		Workshop	02. - 03.02.2021	Heidenau
Recyclability of paper & board based packaging		Workshop	03. - 04.02.2021	Heidenau
Surface functionalization of paper & board based packaging		Workshop	04. - 05.02.2021	Heidenau
Introduction to compliance work and quality assurance for paper and board in contact with food (FCM)		Workshop	02.03.2021	Online
Paper and cardboard in food contact		Online Conference	03. - 04.03.2021	Online
Introduction to paper manufacturing		Workshop	16. - 17.03.2021	Heidenau
Altpapier im Fokus – Recovered Paper conference	 	Conference	18. - 19.05.2021	Dresden
★ 30th PTS Coating Symposium 2021		Symposium	07. - 08.09.2021	München
Introduction to compliance work and quality assurance for paper and board in contact with food (FCM)		Workshop	05. - 06.10.2021	Dresden
Recyclability of paper & board based packaging		Workshop	06. - 07.10.2021	Dresden
Surface functionalization of paper & board based packaging		Workshop	07. - 08.10.2021	Dresden
★ PTS Fibre Symposium 2021		Symposium	23. - 24.11.2021	Radebeul/Dresden

## Registration, information & programme:

 [www.ptspaper.com/events](http://www.ptspaper.com/events)



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 +49 (0) 3529 551 618



# Highlight Events 2020 & Outlook 2021

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[www.ptspaper.com/events](http://www.ptspaper.com/events)

**PTS  
Network Day  
2021**

01/06/2021 in Dresden •  
Save the date!



📺 Online Conference

## PTS Conference – Biobased solutions in papermaking and converting 🇬🇧

📺 online 📅 06 - 07/10/2020

Paper is a comparatively sustainable material based on renewable resources. Nevertheless, there is a need for change in order to successfully transform the energy-intensive paper industry into a low-carbon bio-economy. Against this background, the participants of the 1st International Conference will be able to exchange views on the following topics:

### You can look forward to the following topics:

- » Biobased additives and auxiliaries and their production pathways
- » Performance Benchmarking
- » Future Developments
- » Effects on Paper Recycling
- » Interaction with Conventional Additives and Processes
- » Market Developments and Trends
- » Life Cycle Assessments



📺 Online Conference

## PTS Corrugated Board Symposium 2020 🇬🇧

📺 online 📅 25 - 26/11/2020 🖥️ [www.corrugated-board-symposium.com](http://www.corrugated-board-symposium.com)

The symposium represents a platform for the exchange of knowledge and experience in the production and processing of corrugated board for packaging, construction and special applications. The participants will be comprehensively informed about the state of the art and innovations across all industries, future trends and market-political aspects will be pointed out.

### You can look forward to the following topics:

- » Trends and Developments
- » Product Processes
- » Design for Recycling
- » Innovations

## PTS Coating Symposium 2021 🇬🇧

Symposium

📍 Munich


📅 07 - 08/09/2021

🖥️ [www.coating-symposium.com](http://www.coating-symposium.com)

The PTS Coating Symposium is the international meeting for experts from industry and research and development to learn and discuss about latest innovations in coating and surface treat-

ment of paper and board materials. Besides a well selected scientific program you will get the chance to broaden your network and enjoy the event.

## Online Offers

 **Registration at:**  
[www.ptspaper.com/events](http://www.ptspaper.com/events)



### Recyclability of paper & board based packaging



**Online Workshop**



First date: 30/11 - 01/12/2020



Second date: 03. - 04/02/2021

The participants will be familiarized with current framework conditions and the basics of paper-based recyclability.

- » Framework aspects of recycling
- » Technical aspects of recycling
- » Test methods for recycling
- » Packaging design

### PTS Insight: Chemical Modification of Lignocellulosic Fibres for Future Biomaterials



**Online Event**



01/12/2020 - 3 pm to 5 pm

The trend towards plastic avoidance causes an increased This Online Event is intended to give an insight into the combination of the above approaches showing chemical derivatization opportunities for lignocellulosic fibres. It will be discussed how surface modified fibres and modified cellulose nano-materials, respectively can be produced and implemented in many different promising applications.

#### Speaker

- » Dr. Martin Zahel,  
Head of Division Fibres & Composites (Moderation)
- » Dr.-Ing Alexander Feldner,  
Project Manager Composites & Modification
- » Dipl.-Ing. Birgit Lutsch,  
Project Manager Composites & Modification
- » Dipl. Chem. Stefan Möckel,  
Project Manager Composites & Modification

### Introduction to compliance work and quality assurance for paper and board in contact with food (FCM)



**Online Workshop**



02/03/2021

With the focus on paper, cardboard and tissue, the relevant food law is presented and tips for implementation in companies are given on the basis of exercises and practical examples.

- » Information on sources of migrating substances
- » basic analytical methods, sampling, information transfer along the supply chain
- » Evaluation and interpretation of test reports and certificates
- » Preparation of declarations of conformity

### Surface functionalization of paper & board packaging



**Online Workshop**



04 - 05/02/2021

Paper based packaging materials for food and consumer goods are highly demanded by end customers as well distributing companies. In many cases one or multiple coating layers enable the packaging to protect e.g. food via barrier

functionalities. In the workshop we explain what materials show good barrier properties, how they can be applied onto paper and how they act into the recycling process.

## Conference report: Paper and board in food contact – current trends

5 - 6 March 2020 – Penck Hotel –Dresden

This was the last educational event held by PTS before all big events were finally cancelled worldwide in mid-March. This is not the only reason why we keep this wonderful conference in good memory and high esteem.

The conference was already exposed to the increasing uncertainty caused by SARS-COV2. Attendants cancelled their visits at very short notice, speakers were unable to appear because their companies withheld their authorization. It was imperative to ensure an unprecedented degree of flexibility and organizational skills while establishing appropriate concepts of disinfection and hygiene. At that stage, the Federal German Institute for Risk Assessment had already published first FAQs regarding SARS-COV2 and its relevance for food contact materials. There was cautious optimism that food contact materials were not a particularly relevant source of virus transmission.

All of the approximately 70 participants from Germany, Austria and Switzerland considered the conference to be a complete success with top-class speakers and fascinating expert discussions.

It was the second food contact conference held in Dresden, this time in the Penck Hotel next to the Dresden Zwinger. Not only there was a new venue, but also a new form of interaction: the Slido® app was used to collect questions from the audience and refer them to the speakers. Also, we conducted small surveys among the attendants. So we asked the question: Which are the key topics you are dealing with at the moment? The answers of the 29 votes can be found in the tag cloud;

the size of a keyword is indicative of its weight (number of mentions). The participants' key topics still are mineral oil hydrocarbons (MOH) followed by microplastics, printing inks, and newly: al-



Audience and speakers during the panel discussion on Day 1

uminium. The then following papers and presentations explained the background for this.

Also, we asked: How often do you need to answer inquiries about food-grade materials? More than 75% of the participants answering the question have to deal with such an inquiry more than once a week. This shows that we had once more an expert audience of practitioners in Dresden, who know exactly where the problems lie.

An audience highly involved in an animated discussion. Voices:



Fig. 1: Which are the key topics you are dealing with at the moment? Result of the 29 votes. (SLIDO®, chart from [www.wortwolken.com](http://www.wortwolken.com))

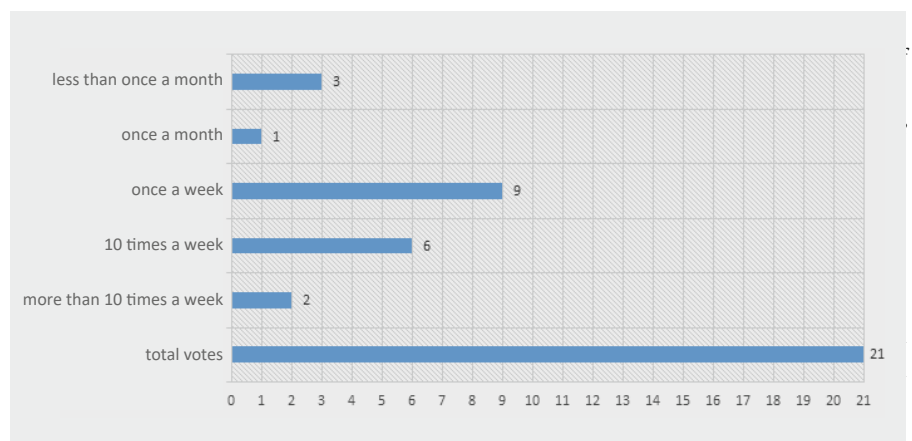
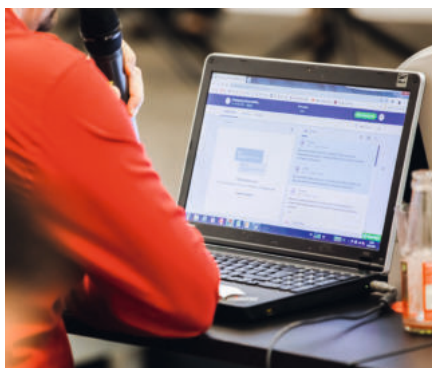


Fig. 2: How often do you need to answer inquiries about food-grade materials? (number of persons, 21 answers in total)





SLIDO® for surveys and submitting questions



Enjoying the panel discussion

investigate biodegradability, hygiene at the workplace, substances in discussion: aluminium and perfluorinated compounds.

**Katharina Adler** from the **Federal Ministry of Food and Agriculture (BMEL)** highlighted recent **Developments in the law of food contact materials**. She presented (preliminary) results of the **Evaluation of EU FCM legislation**, which show that the positive-list approach is basically effective, but limited because of the high amount of tied-up capacities within EFSA. Good Manufacturing Practice (GMP) is a key factor to ensuring general safety, but the specifications are not detailed enough. Declarations of conformity provide greater transparency and build more trust, but they are not mandatory for all material groups (such as paper and board). EU harmonization is more efficient than national or smaller-scale provisions. All in all, the results were not really surprising. Assessments by EFSA and those by ECHA are typically consistent, when the different regulatory goals are considered, but the exchange of data between the institutions is in need of improvement. As a consequence of the evaluation results, an impact assessment is about to begin; a report is expected to be available in 2022. Also, the Commission Recommendation (EU) 2017/84 on the **monitoring of mineral oil hydrocarbons** is to be extended to apply to new food groups. BMEL continues to cherish the project of a national **Printing Ink Regulation**, because there is no progress on the EU level; the project is in the phase of inter-ministerial coordination. Also, the ministry envisages the notification of the Mineral Oil Regulation, which is

also in the phase of inter-ministerial coordination. There still is no EU measure specific to paper and board. Activities of the Council of Europe have now resulted in an updated **Resolution/Guiding Principles for Food Contact Materials** and articles, and in a **Technical Guidance on Food Contact Materials and Articles Made of Paper and Board**. Both drafts were submitted for public consultation and are now put to final vote.

A diverting report regarding the practical experience gained in official FCM monitoring with focus on GMP was presented by **Saskia Both** from the **State Office for Consumer Protection in Saarbrücken**. She placed special emphasis on the importance of drafting specifications for product qualities in B2B agreements between suppliers and customers. This is the only way to provide a detailed description of the conformity requirements for paper and board-based food-contact materials for a specific purpose, in a manner that can be understood and verified by both parties. For supporting the flow of information within the supply chain, **Dr. Henrik Jungclas** from **Decernis corp.** highlights the experience gained with the **CEPI/EPCG Pulp & Paper Value Chain Information System** (PP VIS). This information exchange software system was developed with more than 20 companies to cover more than 90 % of all FCM FAQs.

One initiative for reducing mineral oil contents in recycled paper consists in generally avoiding their entry into the paper cycle. In collaboration with SID, the FOGRA research institute for media technologies worked on a project commis-

sioned by the Federal German Environment Agency, in which the **substitution of mineral-oil-containing newspaper printing inks** by other ink systems was tested in practice. Results were presented by **Dr. Phillipp Stolper (FOGRA)** and **Almut Reichart (UBA)**. Practical problems encountered in a full-scale print shop (FSD) were mineral oil carry-over from piping systems, residual contents of mineral oil of unknown origin, roller compatibilities and lack of rheological stability of the inks. Thus, mineral oil free printing inks for newspapers are not fully ready for the market.

The audience was invited to join **Sebastian Säger** from **Labor Lommatzsch & Säger** for a dip into the world of **MOSH, MOAH, POSH & Co.** Experts succeed in the **analytical differentiation of hydrocarbons** into hydrocarbons from recycled board, polyolefins, resins or hotmelts by using two-dimensional GCxGC-ToF-MS/FID. This allows the distinction of mixed contaminations in foodstuffs.

**Romy Fengler** from **Fraunhofer IVV Freising** presented project results regarding the prediction of the migration of mineral oil hydrocarbon components (MOH) from packagings. The generated data on the migration behaviour under various conditions was used to develop a numerical prediction model for MOH migration in cooperation with the Technical University of Munich (TUM). The model can be used to minimize the migration of mineral oil hydrocarbons and to make assessments of packagings.

Nowadays, all packaging solutions wish to be considered sustainable. A property relevant for sustainability is **biodegra-**

**dability** and **compostability**. **Dr. Ralph Derra** from **ISEGA** showed how to verify this property on a bench scale. Here, one should make a clear distinction whether this is about industrial composting, home composting, biodegradability in the environment – each of these properties is tested in a different way. Current test standards do not cover all topical subjects such as **microplastics**. Whoever wishes to look into composting must be patient: experiments in the institute's in-house composting plant last several months.

Then, **Franca Werhahn** from **Meyer-Rechtsanwalts GmbH** informed the audience which ecolabels are authorized for being printed on a packaging after successful testing – and which are not. In an entertaining manner, she explained the thin line between **permitted advertising and wrongful misrepresentation** – especially in terms of environment-related advertisements. The label must show very clearly which property of the product it refers to. The standards are strict.

After an exiting concluding panel discussion and a **guided city tour**, the lively conversations continued until late in the night in the medieval ambience of the Sophienkeller restaurant in Dresden.

The first presentation on the second day of the conference happened to well-chosen in the light of the corona pandemic and the widely discussed Wilke meat scandal, covering the important subject of **Hygiene at the workplace**. **Joelle Nussbaum** from **BAV Institut GmbH** provided valuable information and guidance on how to reduce germs and respond to microbial problems such as biofilm formation in everyday papermaking and processing practice.

Then, **Elisa Mayrhofer** from **OFI Vienna** showed that microbiology can be of assistance also in the conformity work by means of bioassays. In a lively manner, she presented the comet assay for genotoxicity testing and the Ames test for the detection of DNA-reactive substances in migrates. Since sensitivity of bioassays is an issue, they should always be used in addition to instrumental analyses of the products.

Latest news **from the analytical laboratories of the Food Control Authority** in Baden-Württemberg were related by **Lydia Richter** from the Chemical and Veterinary Investigation Office (CVUA Stuttgart). The current focus of the food chemists lies on **3-MCPD** and **1,3-DCP** in **drinking straws** and **cupcake liners** made of wet-strength finished paper. Anomalies were more often found especially in drinking straws. For 2020 the work of the scientists in Stuttgart is also focused on the **BPA substitutes** D8, TGSA, BPS-MAE, Pergafast 201 made of thermal and recycled papers.

**Dr. Sebastian Zellmer** from the **Federal Institute for Risk Assessment (BfR)** provided information about the current and upcoming regulation of **perfluoroalkyl substances (PFAS)**. There is a lot going on to regulate and control this substance group, which comprises more than 3,000 individual substances and is currently under critical review. The BfR Recommendation XXXVI on paper and board for food contact will not introduce new PFAS until final clarification of mobility, persistence, and contamination of air and drinking water. The BfR recommendations take account of assessments made by EFSA (and ECHA). According to the plans of various regulatory authorities, it is envisaged to limit the authorized use of PFAS to the absolutely essential minimum. The future will tell.

At present, there is another substance substance puzzling the minds of papermakers. The BfR Recommendation XXXVI has authorized the use of many aluminium compounds as fillers or additives without any restrictions so far. Since 2019, there is a new limit to the maximum amount of **aluminium released from paper and board**, which is 1 mg per kg of food. **Antje Kersten** from **PMV Darmstadt** related the results of an INFOR project of VDP. Both the method of aluminium determination in a water extract (EN 645) and the correlation between release amounts and stock formulations of paper articles are problematic. A VDP task force comprising PMV Darmstadt, TÜV Rheinland and PTS has been formed to systematically seek solutions before the end of this year, because the provisional target value of 2 mg

per litre of cold water extract will then cease to be applicable.

The appetizing smell of lunch was already filling the air in the halls of the Penck hotel, when the audience started listening to the final presentation held by **Jens Hannibal** from **Winopal corp.** on the subject of electronic noses. Electronic olfactory analyses showed promising results in quality assurance during production e.g. when checking for detergent or cleanser residues, for identifying the origin of off-odours and for comparing odour profiles between packagings.

In the end, it was time for the attendants and participants to get back to their own noses over a cosy lunch and a final cup of coffee.

„Such a nice time. I hope we meet again soon!“ This was the wish of the PTS organizers **Markus Kleebauer** and **Antje Harling** at the end of the two days in Dresden – not knowing that it would take some time, thanks to Corona, before this wish can come true. ■

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### Save the Date!

**Paper and board in food contact – current trends**

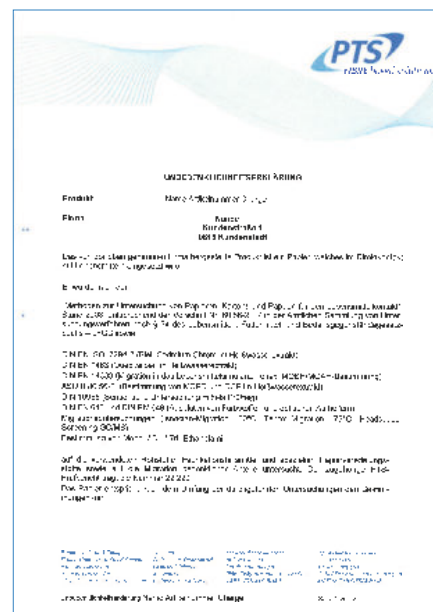
**03 to 04 March 2021 at Penck Hotel Dresden**

# Introduction to conformity work and quality assurance for paper and board for food contact

Since 2018, PTS has been offering “courses of introduction” into the complex world of **conformity work for food packagings made of paper, board and tissue**. Small groups of 10 to 15 persons work together on highlighting the legal requirements on a European and national level and the paper-specific elements contained in the Framework and GMP Regulations, EU Council Resolutions, Bfr Recommendations and Industrial Guidelines, as well as the accompanying requirements regarding plastic coatings, printing inks and adhesives. The participants learn which substances are authorized for use and how to handle substances that are not specifically regulated. Analytical testers provide first-hand information on which tests are required and how to establish a meaningful QA procedure in papermaking and paper processing operations. The participants can ask their practice-related questions, exchange experience and discuss with experts. These courses are intended for engineers, technical staff of papermakers and converters, quality management supervisors, product supervisors, as well as business development, marketing and legal affairs managers dealing with declarations of conformity in their everyday work. Prior knowledge is not required.

PTS conformity courses are very popular and are also held in English since 2019. Starting in September 2020, our in-person training offer will be extended by additional **ONLINE courses in German and in English**. Sign up now. [www.ptspaper.com](http://www.ptspaper.com) ■

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## Upcoming events:

**Introduction to compliance work and quality assurance for paper and board in contact with food (FCM)** 🇬🇧

ONLINE Seminare:  
03/09/2020 & 15/10/2020  
IN PERSON-Events:  
02 - 03/02/2021, 05 - 06/10/2021

**Einführung in die Konformitätsarbeit und Qualitätssicherung für Papier, Pappe, Karton und Tissue für den Lebensmittelkontakt** 🇩🇪

ONLINE Seminar: 27/10/2020  
IN PERSON-Event: 2/3/2021



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