Fraunhofer
WKI

FRAUNHOFER INSTITUTE FOR WOOD RESEARCH, WILHELM-KLAUDITZ-INSTITUT WKI

ANNUAL REPORT 2020

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Figure
Aerial photograph of the Fraunhofer campus in Braunschweig with the IST and WKI institutes.

FOREWORD

Figure
Portrait photo of Professor Bohumil Kasal, Director of the Fraunhofer WKI.

Foreword

2020 was a year full of challenges. Like many other businesses and institutions, we had to adjust our processes and work schedules in response to the COVID-19 pandemic. We reorganized our operations, implemented strict hygienic protocols, and were able to continue our work in full scope. Thanks to the flexibility and creativity of our staff, we were able to meet all expectations of our customers. We have used the temporary dampening in research projects to strengthen our research portfolio and develop new ideas. Our departments that work directly with industry were able to deliver their services uninterrupted and with the highest possible quality. Our industry customers continued to work with us and we were able to maintain full operations. Thanks to all of the implemented measures, we finished the year with a balanced budget, no losses, and no interruptions.

We have finished construction of a new laboratory building on our campus and construction of the Center for Light and Environmentally-Friendly Structures (ZELUBA®) on the TU Braunschweig campus continued despite the difficult situation. The ZELUBA® construction process, however, was slow to begin with and the delays were not a result of the pandemic. We hope to be able to move into the new building in the summer of 2021. This will open new research and development opportunities in the area of sustainable building materials and components.

Our scientists worked intensively on innovative ideas during the height of the pandemic and developed a number of proposals to compete for public funding. We were successful in securing grants to continue to develop and strengthen our expertise and position ourselves for years to come.

I would like to use this opportunity to thank all our customers and supporters for their continuous loyalty and lasting confidence in our expertise. Last but not least, my thanks go to all our employees for the dedication and service.

Sincerely Yours,

Bo Kasal

Braunschweig, in March 2021

INSTITUTE WITH PROFILE

Figure *Tree population in Germany.*

Sustainability has formed the focus of the Fraunhofer WKI since its foundation in 1946. The founder and eponym, Dr. Wilhelm Klauditz, sought solutions for the optimal exploitation of raw wood - a commodity which had become scarce as a result of the war - as well as for the technical utilization of waste wood and small-dimensioned wood. He is regarded as a co-founder of the modern wood-based materials industry.

Today, at the Fraunhofer WKI, we examine a wide range of renewable raw materials and their holistic utilization from production through to recycling. One particular focus is thereby directed at sustainable lightweight construction solutions. Our holistic research approach also encompasses the development of material recycling processes, life cycle analyses and indoor air analysis.

Virtually all the procedures and materials resulting from the research activities are applied industrially. Customers of the Fraunhofer WKI include companies from the wood and furniture industries, the construction industry, the chemical industry, the packaging industry and the automotive industry.

With its research and development activities, the Fraunhofer WKI makes an important contribution towards the development of a bio-based recycling economy (bioeconomy).

As an accredited testing body, the Fraunhofer WKI performs material-testing and quality monitoring tasks. It assesses cases of damage and provides advice on questions of damage remediation. The quality assurance of wood products and other materials by means of non-destructive procedures such as thermography, ultrasound or computer tomography enhance the institute's spectrum.

With the HOFZET® Application Center and the integration into the Open Hybrid LabFactory, the important and promising new field of fiber composites is currently being systematically augmented and expanded. In collaboration with the Technische Universität Braunschweig, the ZELUBA® Center for Light and Environmentally-Friendly Structures is reinforcing the subject areas of building construction and lignocellulose-containing materials.

Since October 2010, the Fraunhofer WKI has been headed by Professor Dr.-Ing. Bohumil Kasal. Professor Dr. Tunga Salthammer acts as his deputy. The institute was incorporated into the Fraunhofer-Gesellschaft in 1972 and, with currently around 160 permanent employees and an operating budget of 15.3 million euros, is one of the largest institutions for applied wood research in Europe. Around 9,000 m^2 of offices, laboratories, technical center and workshops are available for the processing of the research contracts.

The Fraunhofer WKI is a member of the Fraunhofer Group for Materials and Components - MATERIALS, the Fraunhofer Alliances Vision, Building Innovation, Lightweight Design, and Technical Textiles, and the Fraunhofer Networks for Sustainability and Science, Art and Design as well as the Research Alliance for Cultural Heritage. Within the Fraunhofer-Gesellschaft, the Fraunhofer WKI occupies a unique position as regards its holistic research approach to the material usage of wood and lignocellulosic materials.

VISION

Our vision is a world class research institute focused on current and future issues related to the environment, renewable natural lignocellulosic materials and technologies.

MISSION

We develop technologies and products and provide services for the responsible use of renewable resources, respecting the environment and a sustainable quality of life.

SUSTAINABILITY

Since its foundation in 1946, the institute has conducted applied research and, together with the industry, has used the knowledge to develop new materials, products and technologies including a wide range of services.

These are focused on renewable resources and their sustainable use with the objective of improving product quality and safety as well as increasing the competitiveness of industrial partners, thereby striving to ensure a long-term co-operative partnership.

In addition to the most important renewable resource wood, we focus on all other lignocellulosic materials. In all aspects of our research portfolio, from chemicals to industrial use and recycling, we develop solutions that contribute to sustainable development and help meet social and economic challenges of today's world.

To be able to master complex natural materials, a wide range of special knowledge ranging from natural science to engineering is required.

The Fraunhofer WKI is the research facility in which the complexity of renewable materials is systematically investigated and transformed into usable products and technologies. This is the basis of our success as one of the world-leading institutions in research focused on renewable resources.

ORGANIZATION CHART

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BOARD OF TRUSTEES

The Board of Trustees of the WKI, which consists of qualified scientists and experts from industry, science and research, authorities and institutions, examines the research activities and advises the institute's management as well as the Board of Directors of the Fraunhofer-Gesellschaft.

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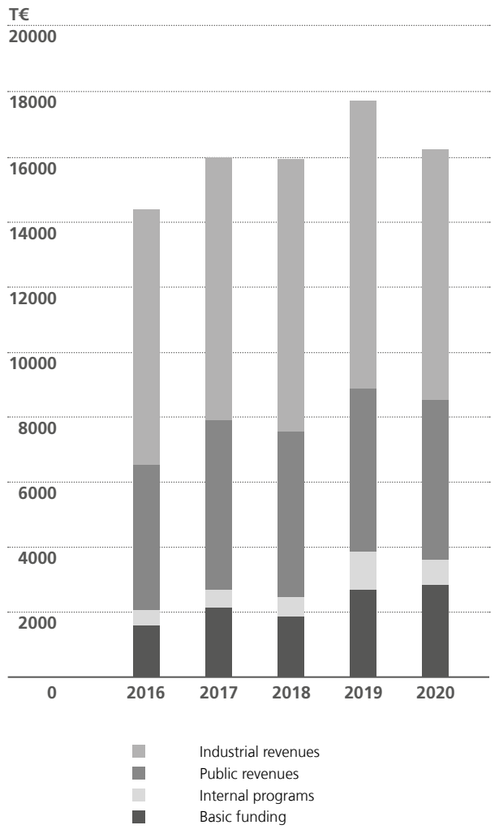
Rhenocoll-Werk e. K., Konken, Germany

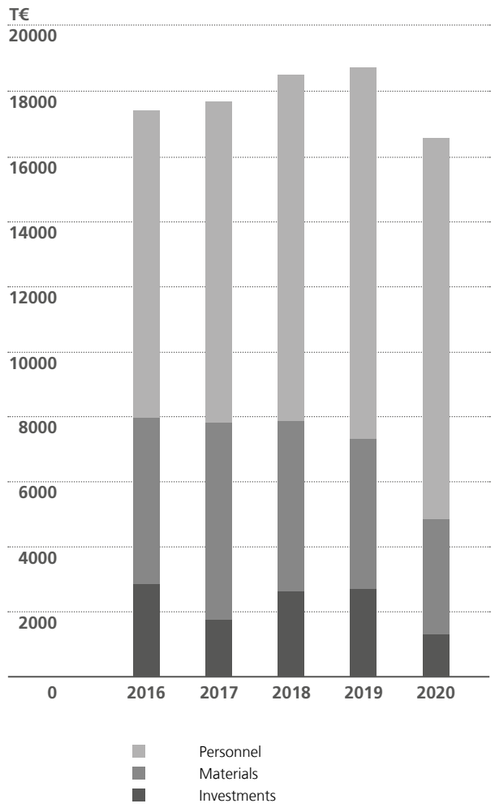
Status: March 2021

FIGURES | DATA | FACTS

REVENUE STRUCTURE



BUDGET & INVESTMENTS



In 2020, a total of 12.7 million euros in external revenues was realized. This enables the Fraunhofer WKI to once again build on the above-average results of previous years. More than 60 % of the revenues were financed by industrial partners. Public sponsors supported our research projects with almost 5.0 million euros.

The operating budget amounted to 15.3 million euros in the year under review. Personnel expenses amounted to 11.8 million euros and material costs totaled 3.5 million euros.
The investment budget had a volume of 1.3 million euros. The share of normal investments amounted to 700 thousand euros. A further 340 thousand euros were financed through projects.

LOCATIONS

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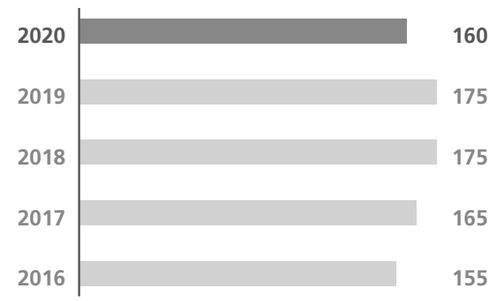
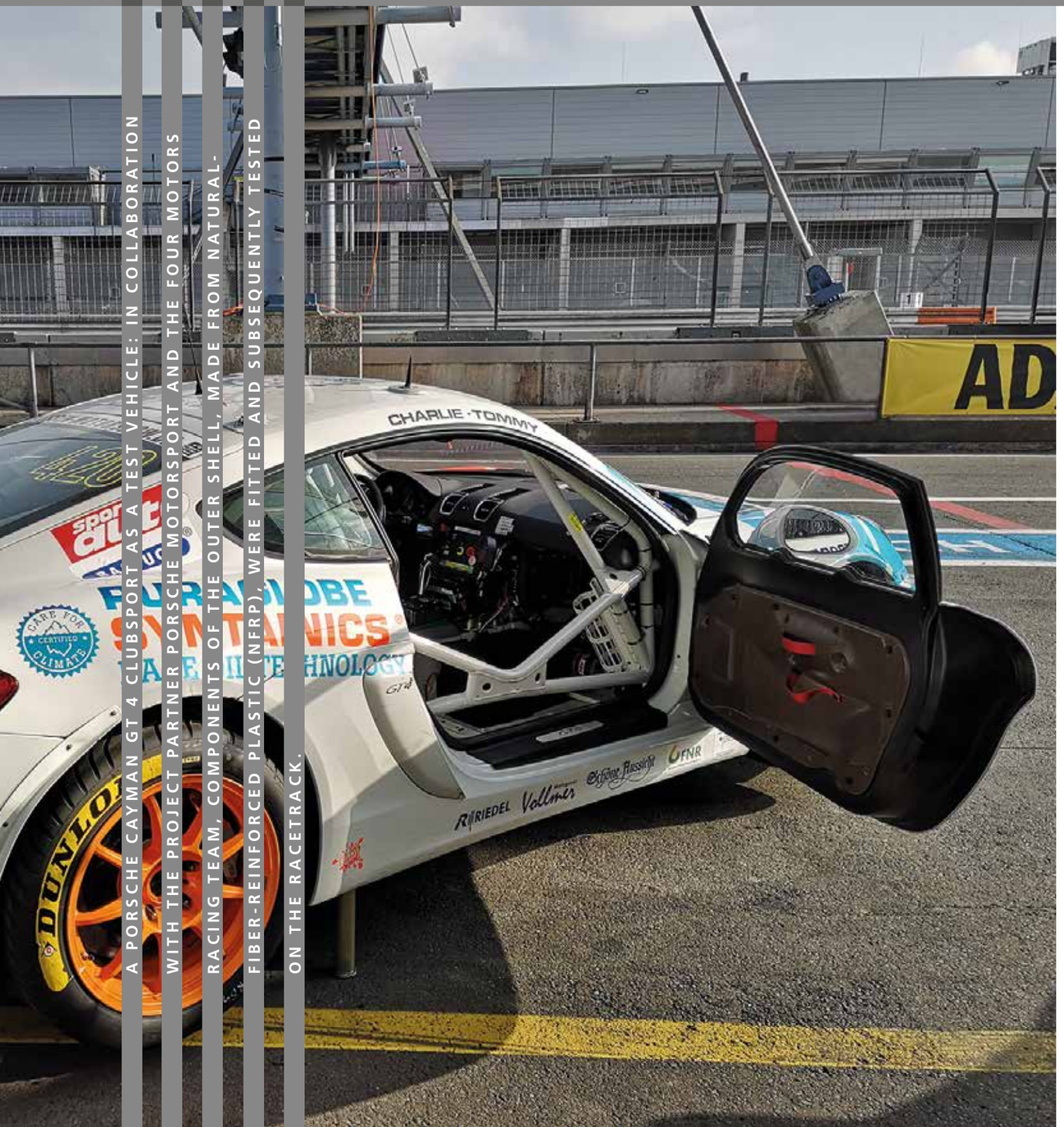
STAFF

In the reporting period, the Fraunhofer WKI employed around 160 staff, 40 % of whom were scientific personnel, engineers and doctoral students. Technical staff, administrative personnel and IT specialists as well as master's/bachelor's students and student assistants supported the research work.
The institute enabled nine trainees to embark upon their careers in the fields of information technology, office communication, industrial and wood mechanics, and media and information services.



INNOVATIVE RESEARCH FIELDS



A PORSCHE CAYMAN GT 4 CLUBSPORT AS A TEST VEHICLE: IN COLLABORATION WITH THE PROJECT PARTNER PORSCHE MOTORSPORT AND THE FOUR MOTORS RACING TEAM, COMPONENTS OF THE OUTER SHELL, MADE FROM NATURAL-FIBER-REINFORCED PLASTIC (NFRP), WERE FITTED AND SUBSEQUENTLY TESTED ON THE RACETRACK.

Fig. *Hot press for 2D and 3D molded parts in the WKI Technical Center.*

Fig. *Test chambers with a volume of six cubic meters.*

TECHNOLOGY FOR WOOD AND NATURAL FIBER-BASED MATERIALS

Composites made from wood and other lignocellulosic raw materials have a unique character: They are environmentally friendly, degradable and exceptionally functional. In the "Technology for Wood and Natural Fiber-Based Materials" department, we address the development of composite materials, the recycling of waste wood and biocomposites (WPC), and image-processing methods for process and quality control. The spectrum of our material developments ranges from classic wood-based materials (particle board, fiberboard, insulation board, OSB, plywood, LVL) through hybrid materials and on to biocomposites, 3D molded parts and material composites.
For the preparation and production of the materials and for the application of the binders, technical facilities are available which offer a direct industrial orientation. This allows us to map the complete process chains from raw commodity through to material.
In addition to the further development and optimization of existing process technologies and the combination of positive properties in the material production, we also perform testing on formaldehyde-free binders, bonding and modification processes. Our portfolio is completed through new sorting processes and utilization methods for an efficient recycling of waste wood, WPC and their coatings and constituents as well as non-destructive measuring and testing methods.

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MATERIAL ANALYSIS AND INDOOR CHEMISTRY

In the department "Material Analysis and Indoor Chemistry", we comprehensively address the measurement and evaluation of indoor air contaminants and consumer-related products. The spectrum of materials investigated ranges from classic wood-based materials, through plastics and building products, and on to products from the automotive, consumer goods, electronics, aircraft and food industries.
The development of new analysis and sampling techniques, olfactory examination methods and the construction of emission test chambers and cells are further important fields of work. We investigate questions of indoor hygiene and indoor climate with regard to the environment, health and consumer protection. For this purpose, we analyze real interiors, such as residential buildings and means of transportation, as well as the air quality in showcases, exhibition rooms and storage rooms of museums. In collaboration with other Fraunhofer institutes, we work on solutions for improving air quality by means of (photo)catalytically equipped materials and devices for air purification.
A current priority topic concerns the influences of short- and long-term climatic changes on indoor air quality for the region of Central Europe. We are thereby contributing our expertise on the relevant committees. Furthermore, we cooperate with numerous research institutions in Germany and abroad within the framework of scientific exchange programs.

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Fig. *In the laboratory of the "Binders and Coatings" department.*

Fig. *High-frequency laboratory press in the Technical Center.*

Fig. *Test specimen made from a wood-concrete hybrid material.*

Fig. *Vehicle door made from natural-fiber-reinforced plastic (NFRP).*

BINDERS AND COATINGS

With a commitment to the environment, in our "Binders and Coatings" department - formerly "Surface Technology" - we develop bio-based coatings, adhesives, printing inks and 3D-printing materials derived from vegetable oils, sugars, lignin and other vegetable residues. From binder synthesis, through formulation and on to processing, we are at your side as a competent research partner. Standardization tests, damage analyses and the development of methods for the assessment and optimization of the weathering stability of materials complete our profile.
Wood hereby also forms the focal point for us. In addition to the development of wood coatings that protect wood from environmental influences, abrasion and fire, we also develop binders for adhesives for the production and bonding of wood, wood-based materials and other materials. Connected to this is damage analysis, which involves rapid and unequivocal clarification of damage cases in coated woods, wood adhesives, wood-based materials and solid woods.
Our bio-based binders are also deployed in the field of printing inks and additive-manufacturing processes. In the printing-ink sector, we primarily substitute health-endangering ink constituents for diverse printing processes. For additive manufacturing, we develop novel polymeric materials for UV-curing and thermoplastic processes.

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QUALITY ASSESSMENT

The focus of the research projects in the department "Quality Assessment" is directed at the assessment of bondings, evaluation of bonding processes, forestry-relevant issues for products made from wood, and the further development of test methods for measuring the formaldehyde emission of products with and from renewable raw materials.
In an interdisciplinary team, we elaborate and develop solutions for and with customers from, among others, the forestry and timber industry, the construction industry, the furniture industry and the chemical industry. The expertise we have gained through contact with manufacturers and from our research work is made available in certified advanced training courses at our **WKI | AKADEMIE®**.
We are furthermore internationally recognized as a testing, monitoring and certification body and are consequently a competent partner for all issues relating to testing, monitoring and certification.

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CENTER FOR LIGHT AND ENVIRONMENTALLY-FRIENDLY STRUCTURES

At the "Center for Light and Environmentally-Friendly Structures ZELUBA®", we develop sustainable solutions for the construction industry.
We support industrial partners from the wood-based materials and prefabricated-house industries, as well as companies from the manual-skills trades, in the development of new systems.
One of our major competences is the transmission of fundamental research via applied research through to the finished product within the construction industry. With the addition of building physics and mechanical-constructive investigation methods as well as the consideration of the comprehensive life cycle of a product, our spectrum ranges from the development of innovative materials, through the complex issues of individual details, and on to complete building-material systems and their recycling.
A further research focus is the development of reactive fire-protection systems for improving the behavior of building materials and the fire resistance of building elements, as well as the development of hybrid building-material systems.

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APPLICATION CENTER HOFZET®

The aim of the "Application Center HOFZET®" is, in collaboration with industrial partners, the identification of new applications for sustainable composites and the development of future-oriented products and technologies. The research fields range from simple material developments through to complex complete solutions for products, components and semi-finished products. We develop sustainable solutions from raw-material selection, material production and processing, through material-appropriate design and simulation, and on to the ecological evaluation and production maturity.
The material focus is directed at the development of thermoplastic extrusion-produced short-fiber-reinforced compounds as well as the production of textile semi-finished products and their processing into thermoset and thermoplastic composites. The focus in the material development is on the utilization of cellulose-based fibers, yarns and fabrics as well as the use of biopolymers and recycled materials.
Our developments always take place under consideration of the corresponding impact categories of a life-cycle assessment; as a result, the topic of sustainability is addressed from the selection of raw materials, through component production and the life cycle, and on to recycling. The topic of recycling does not come last in the list of importance for us, but instead accompanies every development from the very beginning. Recycling strategies are therefore an intrinsic element in the preparation of the specification sheet.

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RESEARCH HIGHLIGHTS

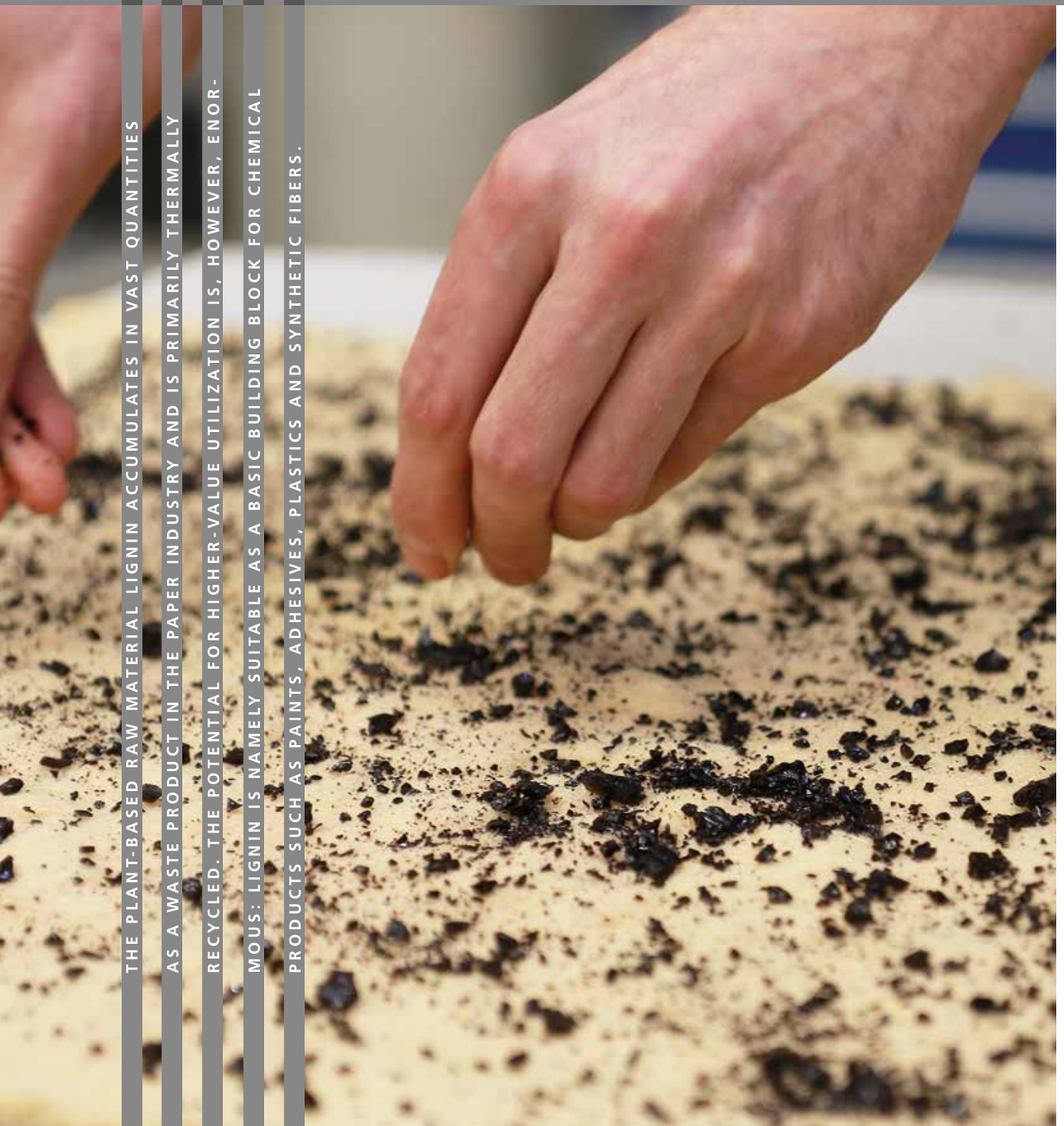

Fig. *Researchers and designers discover application possibilities for lignin.*

Fig. *Medium-density wood-fiber boards with a proportion of beet pellets.*

SCIENCE MEETS DESIGN: STRONG AND FLEXIBLE COMPOSITE MATERIALS MADE FROM LIGNIN

Researchers from the Fraunhofer WKI and designers from the weißensee academy of art berlin cooperated within the framework research program of the Fraunhofer Network "Science, Art and Design" in order to develop application possibilities for the raw material lignin. This resulted in a variety of panel materials for furniture construction and a flexible leather alternative for the fashion industry. The path leading towards the aim of replacing petrochemical raw materials in the processing industry with the renewable raw material lignin has thereby been shortened.
Many chemical products such as paints, adhesives, plastics and synthetic fibers are based on aromatic carbon compounds. Currently, the majority of these originate from fossil raw materials such as crude oil, natural gas and coal. The plant-based raw material lignin is a promising alternative, as it already contains aromatic structures and is generated on a massive scale as a waste product in the paper industry. The petrochemical starting materials cannot, however, simply be replaced by lignin, as lignin exhibits a special structure. The idea behind the cooperation between the researchers from the Fraunhofer WKI and the designers from greenlab - Lab for Sustainable Design Strategies at the weißensee academy of art berlin within the project "Thinking Lignin Design" was to implement the utilization of creative and experimental methods in order to find new perspectives for the practical application of the renewable raw material lignin.

Funded by: Fraunhofer Network "Science, Art and Design".

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BEET PULP FOR NEW MATERIALS

During German sugar production, large quantities of sugar beet pulp are produced as a by-product. Can composite materials be created from this? This question was examined by the Fraunhofer Institutes WKI and UMSICHT in a joint research project with partners from industry and agriculture.
In the project, the researchers pursued the goal of introducing beet pulp into higher-value applications beyond the energy and animal-fodder markets. During the beet harvest and processing, the major German sugar manufacturers alone produce beet pulp in the seven-digit tonne range. This so-called pressed pulp is currently marketed regionally as dairy-cattle feed or biogas substrate.
Sugar beet pulp has a different composition from common plant fibers or agricultural products such as wood. The scientists from the Fraunhofer WKI were therefore faced with the challenge of testing a new processing method. They nevertheless succeeded in producing medium and high-density wood-fiber boards (MDF and HDF), with a mixing ratio of 15 percent beet pellets and 85 percent spruce chips and with one adhesive. Due to the adhesive strength of the beet-pulp proportion, glue could be saved and wood could also be substituted.

Funded by: State of North Rhine-Westphalia with funds from the European Regional Development Fund (ERDF) 2014-2020 "Investments in Growth and Employment" via Project Management Jülich (PtJ).

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Fig. *Load-bearing timber-concrete composite elements with long span ranges (here: 6.15 m).*

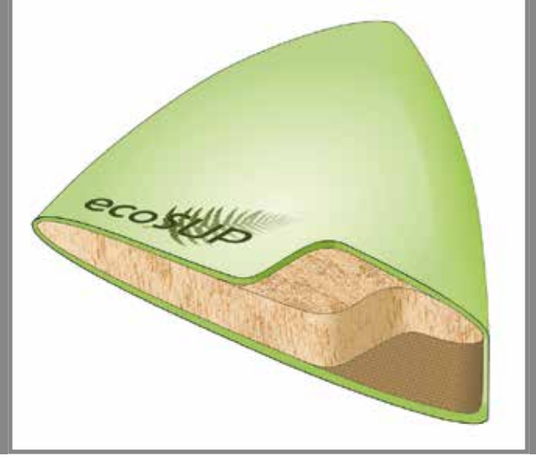

Fig. *The cross-section of the paddleboard shows the sandwich construction: core made from recycled balsa wood with an outer shell of natural-fiber-reinforced bioplastics.*

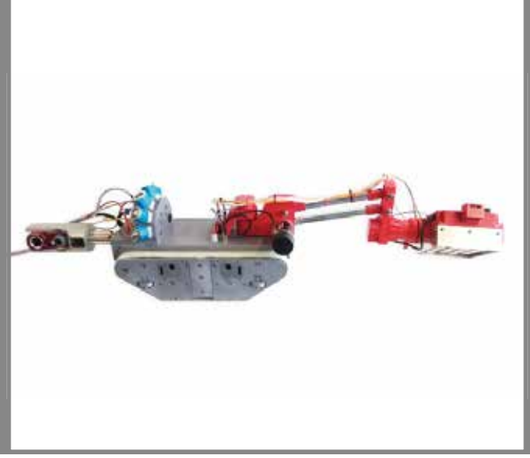

Fig. *Thermography robot: With a concept from the Fraunhofer WKI developed by IAI GmbH.*

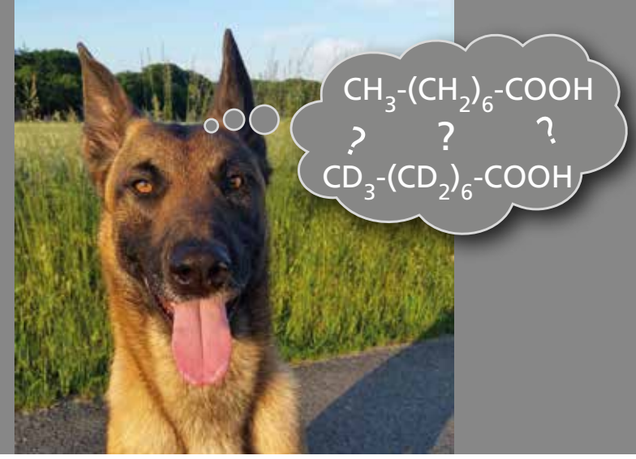

Fig. *Sniffer dog "Champ" from the Polizeidirektion Braunschweig.*

INNOVATIVE BONDING TECHNOLOGY FACILITATES USE OF TIMBER-CONCRETE COMPOSITE ELEMENTS IN THE CONSTRUCTION INDUSTRY

By means of an innovative bonding technology, high-performance wood-concrete composite elements (WCC) can be produced faster and more easily. As a result of the new joining technology, which was developed by researchers in a cooperative project involving the Fraunhofer WKI, the composite elements become more competitive in comparison to pure concrete elements. The utilization of the renewable raw material wood can therefore be increased in the construction industry.
Up until now, WCC elements have been connected to one another via, for example, screws or through the casting of fresh concrete onto wooden components. Both methods have disadvantages. In comparison to the pure concrete construction method, WCC elements are therefore not competitive in many locations. In order to amend this, researchers from the Fraunhofer WKI, in collaboration with the Institute of Joining and Welding at the TU Braunschweig and the specialist field of "Timber Structures and Building Rehabilitation" at the University of Kassel, have developed a new rapid-bonding technology.
The researchers discovered that not only two-component epoxies (2C-EP) but also heat-curing single-component polyurethanes (1C-PU) are suitable for bonding on smooth concrete surfaces. It had been previously assumed that solely sand-blasted concrete surfaces were suitable for bonding. It was possible to refute this assumption during the project.

Funded by: German Federal Ministry for Economic Affairs and Energy (BMWi) via AiF e. V.

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STAND-UP PADDLEBOARD MADE FROM BIOPLASTICS AND BALSA WOOD

In the project "ecoSUP", researchers at the Fraunhofer WKI developed a stand-up paddleboard with a lightweight sandwich element made from renewable raw materials. For the core, balsa wood from disused wind-energy rotor blades is being used - a sustainable solution for their high-quality recycling. The outer shell consists of bioplastics which are reinforced with regionally available flax fibers.

Currently, watersports equipment such as surfboards is produced using petroleum-based materials in combination with glass and carbon-fiber fabrics. For the core of the new bio lightweight-construction material, the scientists used recycled balsa wood and modified it accordingly. Balsa wood is used in large quantities in the rotor blades of wind turbines. At the end of the life cycle of the rotor blades, it accumulates as waste. This balsa wood is now being given a longer useful life. In addition, the researchers also developed an outer shell made from natural-fiber-reinforced bioplastics on the basis of itaconic acid. They thereby concentrated on the application of flax fibers, as these have advantageous mechanical properties and are cultivated in Europe. With the project, the Fraunhofer WKI provided a contribution towards the development of a bio-based economy and, at the same time, broke new ground through the utilization of a crowdfunding campaign.

Funded by: German Federal Ministry of Education and Research (BMBF) via Project Management Jülich (PtJ).

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NEW THERMOGRAPHY ROBOT ENABLES INTERNAL INSPECTION OF ROTOR BLADES

In order to increase the safety and economic efficiency of wind turbines, researchers at the Fraunhofer WKI, in collaboration with project partners, have developed a thermography robot for the internal inspection of rotor blades. The Fraunhofer WKI heat-flow thermography methods are already being successfully utilized for quality control of the external surface of rotor blades. Production defects close to the surface can thereby be determined. Now, imperfections on the inside of the rotor blade can also be detected.
The rotor blades of wind turbines are generally manufactured by gluing together two half-shells, i.e. they are hollow inside. During operation, they are subjected to high mechanical loads. Material defects such as faulty bonding and cracks can have serious consequences - and can even result in the total loss of the entire turbine. They must therefore be meticulously inspected from both the inside and the outside. Inspection from the inside was previously only possible to a limited extent, as not all blade areas are accessible and not all defects are optically visible. Further application possibilities for the new procedure include tubular objects such as drainage/sewage pipes. In such cases, the thermography robot could detect damaged areas in the glass-fiber-reinforced plastic cladding, which is often used to renovate old drainage pipes.

Funded by: German Federal Ministry for Economic Affairs and Energy (BMWi) via Project Management Jülich (PtJ).

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SENSORY PERCEPTION OF NON-DEUTERATED AND DEUTERATED ORGANIC COMPOUNDS

The olfactory perception of deuterated and non-deuterated organic compounds was investigated experimentally and theoretically in a collaborative effort by the Fraunhofer WKI, the University of Bonn, the University of Lüneburg and the Technische Universität Braunschweig. Using subject panels, it was determined that the isotope effect was weak for acetone. In contrast, clear sensory differences were observed with octanoic acid.
A sniffer dog from the Braunschweig police, trained with octanoic acid, was initially unable to identify the deuterated octanoic acid. The interaction with a non-polar liquid phase is less pronounced for the respective deuterated molecule. Quantum chemical calculations show that deuterated octanoic acid binds more strongly to a model receptor than non-deuterated octanoic acid. This is reversed for acetone.
The binding between molecule and receptor results from the interplay of different thermostatistical contributions to the free binding energies and is molecule-specific. The vibrational terms play approximately the same role as rotational and translational contributions and are larger than the binding-length effects for the differential isotopic perception of odors, with the result that general rules for odor perception cannot be derived from experiments with isotopologues (see also https://doi.org/10.1002/chem.202003754).

Funded by: Own research

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PUBLIC FUNDING SOURCES

Number of public funded projects 2020

51

AiF	German Federation of Industrial Research Associations »Otto von Guericke«
BLE	Federal Office for Agriculture and Food
BMBF	Federal Ministry of Education and Research
BMEL	Federal Ministry of Food and Agriculture
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BMVI	Federal Ministry of Transport and Digital Infrastructure
BMWi	Federal Ministry for Economic Affairs and Energy
DBU	German Federal Environmental Foundation
DFG	German Research Foundation
DLR	German Aerospace Center
EBA	Federal Railway Authority
EU	European Union
FNR	Agency of Renewable Resources
FZJ	Forschungszentrum Jülich GmbH
iVTH	International Association for Technical Issues related to Wood
KIT	Karlsruher Institute of Technology
Land NRW	State Government of North Rhine-Westphalia
UBA	German Environment Agency
VDI/VDE	VDI/VDE Innovation + Technik GmbH
WKF	Waldklimafonds

SCIENTIFIC EXCELLENCE

58	**Publications**
1338	**Citations (Source: Scopus)**
20	**Presentations**
8	**Inhouse seminars**
6	**Webinars**
5	**Lecturers**
25	**Lectures**
2	**Training events by the WKI | AKADEMIE®**
3	**Guest scientists**
4	**Doctoral theses**
13	**Master / Diploma theses**
12	**Collaborations with expert committees and working groups**
46	**Involvements in standardization committees**
8	**Patent applications**
2	**Evaluated excellence research**

EVENTS

Building-committee meeting 2017

Room-requirement planning 2018

Submission of building documentation 2021

Technical construction statement 2021

Approval and start of building 2022

Completion 2024

Fig. *Architectural sketch of the planned Hall B, the new building for the WKI Technical Center.*

Webinars

- Eschig, S.: Baking cycle – Basic chemicals and carbon from old bakery products (D)
- Winkelmann, J.: Further training to become a Composite Engineer (D)
- Salthammer, T.: The influence of coatings on the emission behavior of wood-based materials (D)
- Sydow, S.: (New) processes for wood modification (D)
- Yan, L.; Bachtiar, E.; Fu, Q. (TU Braunschweig): Long-term behaviour of adhesively bonded wood hybrid systems for built sustainability
- Vellguth, N.: Surface modification of natural-fiber fabrics for application in engineering thermoplastics (D)

Inhouse seminars

- Haller, F. (TU Braunschweig | iBMB): Standardization of a dynamic test method for pressure-pipe systems and pressure-hose liners for the rehabilitation of pressure lines (DruSaNo) (D)
- Schwarzkopf, M. (University of Primorska): Introduction of the study areas and infrastructure of the InnoRenew CoE
- Sandberg, D.; Myronycheva, O. (LTU Sweden): Mould fungi characterization on the wooden surface
- Schirp, A.: Halogen-free flame retardancy for 3D-printed biocomposites (D)
- Aßhoff, C.: Additive manufacturing of load-bearing wooden components through individual layer fabrication (ILF) (D)
- Presentation of the results of the preliminary research 2019
- Krenn, T.: Forest damage and opportunities - Risks and challenges for the wood industry (D)
- Sterr, V.: Glued laminated timber in the high-frequency press - An introduction (D)

(D): in German language

"Automobil Industrie" Leichtbau-Gipfel

Originally scheduled for March 2020, the event, which focused primarily on the key technology of lightweight construction for the mobility of the future, was held in Würzburg on 13th and 14th October 2020. Virtual participation via livestream was also possible. The HOFZET® presented lightweight-construction materials from current research.

BAU China

BAU China took place in Beijing from the 29th of October to the 1st of November 2020. Due to the worldwide COVID-19 pandemic, the Fraunhofer WKI participated exclusively in digital form.

Plastic Free World Conference & Expo

From 9th to 10th November 2020, the "Plastic Free World Conference & Expo" took place as a virtual presentation event. The event was aimed at companies that would like to reduce their plastic consumption, use more bio-based materials and create a true circular economy along their supply chain.

BMBF technology discussion "Material innovations for additive manufacturing"

In collaboration with industrial partners, researchers from the Fraunhofer WKI developed UV-curing materials for additive manufacturing with improved properties. The team thereby utilized itaconic acid that had been biotechnologically extracted from renewable raw materials. The results of the project up until then were presented in a free virtual technology discussion hosted by the German Federal Ministry of Education and Research (BMBF) on 11th November 2020 within the framework of the "Formnext Connect" trade fair.

2020/2021 university award to ecoSUP team

The ecoSUP team (see page 16) was one of ten winning teams in the university competition "Zeigt eure Forschung!" (Show your research!) in the Science Year 2020|2021 "Bioeconomy". The winning teams each received 10,000 euros and have until December 2021 to implement their ideas and enter into dialog with the public on their topics. In addition, they will receive training and participate in workshops on scientific communication.
In the university competition "Show your research!", students, doctoral candidates and young researchers from all disciplines submit concepts and communication ideas with which they want to provide impetus for the social challenges of tomorrow. The theme of the university competition is the current Science Year, which is proclaimed by the German Federal Ministry of Education and Research.

New building Hall P

At the end of March 2019, work began on a new research hall on the grounds of the main campus. It was possible to complete the construction in December 2020. As a result, the Fraunhofer WKI now has an additional 317 m² of research space at its disposal.

Planning status for the new Hall B building

In 2020, the planning for a new Wood-based Materials Technology Center on the main campus in Braunschweig began with the selected architects. Initial designs were sketched. At the beginning of 2021, the building engineers were able to obtain an initial overview of the spatial conditions and the research equipment. Further external planners, e.g. structural engineers and fire-protection technicians, are currently being selected and are to join in the planning as soon as possible.

New ZELUBA® building – current status

The new ZELUBA® building on the TU Braunschweig campus was completed at the end of 2020. In summer 2021, the employees of the department "Center for Light and Environmentally-Friendly Structures" will be able to move in. An official inauguration ceremony is planned for a later date due to the pandemic.

Announcement: 75th anniversary of the Wilhelm-Klauditz-Institut

On 7th June 2021, the Fraunhofer WKI, Wilhelm-Klauditz-Institut, will be 75 years old. A fitting occasion on which to reflect upon the institute's roots, its long history of development, and its future. The highlights will be summarized in a chronicle, which will be available in time for the anniversary.
Interested parties may place orders via our website at www.wki.fraunhofer.de.

Announcement: 12th European Wood-based Panel Symposium 2022

The 12th European Wood-based Panel Symposium will take place in Hamburg from 12th to 14th October 2022.
The new date became necessary due to the fact that the event could not be held in the customary manner in 2020. Registrations for participation as well as presentation proposals will be accepted by the organizers EPF and WKI directly via the conference website www.european-wood-based-panel-symposium.org from autumn 2021 onwards. Free registration for the event newsletter is possible with immediate effect.

GROUPS, ALLIANCES AND NETWORKS

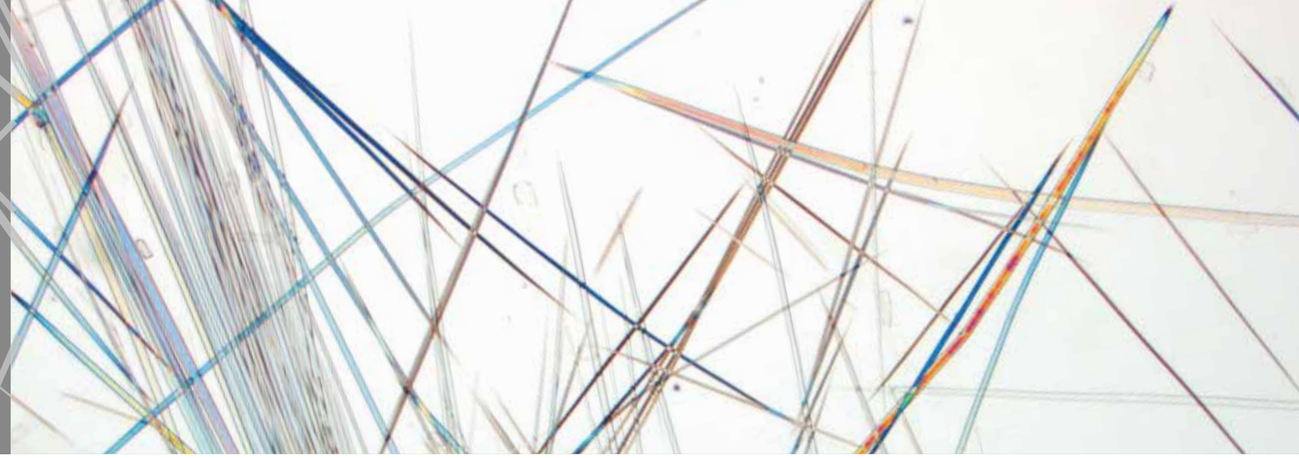

Fig. *Microscopy image of bamboo fibers.*

Institutions with differing competences collaborate within the Fraunhofer Groups, Alliances and Networks in order to mutually manage and promote a business segment.

The WKI is a member of the Group MATERIALS, of the Alliances Building Innovation, Vision, Lightweight Design and Technical Textiles as well as in the Fraunhofer Networks Sustainibility and Science, Art and Design. Additionally, the Fraunhofer WKI is a member of the Cultural Heritage Research Alliance.

Fraunhofer Group MATERIALS

Fraunhofer materials research covers the entire value chain, from new material development and improvement of existing materials through manufacturing technology on a quasi-industrial scale, to the characterization of properties and assessment of service behavior. The same research scope applies to the components made from these materials and the way they function in systems. In all these fields, experimental studies in laboratories and technical institutes are supplemented by equally important numerical simulation and modelling techniques – across all scales, from individual molecules up to components and process simulation. As far as materials are concerned, the Fraunhofer MATERIALS group covers the full spectrum of metals, inorganic non-metals, polymers and materials made from renewable resources, as well as semiconductor materials.

www.materials.fraunhofer.de

Fraunhofer Network »Science, Art and Design«

How can science be inspired by art - and vice versa? What parallels exist in the work of researchers and creative minds? How can they benefit from mutual dialogue? The Network for Science, Art and Design, founded within the Fraunhofer-Gesellschaft in 2018, is addressing these questions.

www.art-design.fraunhofer.de

Fraunhofer Building Innovation Alliance

The objective of the Fraunhofer Building Innovation Alliance is to represent and process all scientific and research-relevant questions on the topic of construction from a single source within Fraunhofer. This will provide the construction industry with a central contact point for integral system solutions.

www.bau.fraunhofer.de

Fraunhofer Lightweight Design Alliance

Lightweight construction means the realization of a weight reduction with sufficient rigidity, dynamic stability and strength. Hereby must be ensured that the developed components and structures can safely fulfill their task throughout their service life. The material properties, the constructive design, the construction method and the manufacturing process significantly determine the quality of a lightweight structure. The entire development chain, from material and product development through series production to approval and product application, must therefore be considered.

www.leichtbau.fraunhofer.de

Fraunhofer Technical Textiles Alliance

In order to fully exploit the potential of high-performance fibers for textile-reinforced lightweight structures, innovations must be created through application-oriented and product-specific developments of textile-based technologies and systems with direct linkage to preform and component manufacturing. The entire textile manufacturing chain is covered by the Fraunhofer Textiles Alliance, starting from fiber production and functionalization.

www.textil.fraunhofer.de

Fraunhofer Vision Alliance

The Fraunhofer Vision Alliance combines the expertise of institutes in the field of image processing. The allianced institutes offer services relating to applications of innovative sensors, from infrared to x-ray, plus the associated handling apparatus. Their work focuses particularly on optical sensing and automated inspection processes for quality assurance.

www.vision.fraunhofer.de

Cultural Heritage Research Alliance

The highest priority of this interdisciplinary alliance is the preservation of our cultural heritage through research and innovation in materials science. Documents, paintings, sculptures and historic buildings are not only invaluably precious idealistically for society; they also represent an enormous economic factor.

www.forschungsallianz-kulturerbe.de

Fraunhofer Sustainability Network

The Fraunhofer Sustainability Network seeks to orient research and technical developments at the Fraunhofer-Gesellschaft more strongly towards the principle of sustainability and to develop a distinct image profile for this which is clearly recognizable both internally and externally. The Network is thus supporting the Fraunhofer-Gesellschaft's current strategy process involving twelve future-related topics under the title of "People need a future - the future needs research".

www.fraunhofer.de

IVTH

The shortage of wood as a raw material and the obligation to use the available timber economically provided the impulse for the founding of the Association for Technical Issues related to Wood in Braunschweig in 1946. Through its activities, the Association, renamed as iVTH - International Association for Technical Issues Related to Wood e. V., continues to contribute towards the deepening and sharing of knowledge concerning wood as a material as well as its utilization.

The Association is one of 100 sector-orientated research associations which are members of the AiF (German Federation of Industrial Research Associations). We would like to transfer the knowledge from research projects practice-oriented into the timber industry, in order for procedures and products to be newly-developed or enhanced. The competitiveness of SMEs should thereby be strengthened. The focus of our activities is, after all, placed mainly upon small and medium-sized companies in the timber industry and their suppliers. Nationally and internationally, we maintain close contact with research bodies and businesses with practical involvement.

Our services at a glance:

The iVTH:

- promotes research and development work in the forestry and wood industries and associated fields, both nationally via cooperative industrial research (IGF) and internationally via CORNET (in each case BMWi via AiF),
- allocates research projects with currently-relevant objectives,
- organizes scientific events,
- awards the Wilhelm Klauditz Prize for wood research and environmental protection,
- contributes to advisory committees,
- is member of the German Federation of Industrial Research Associations AiF, the Austrian Society for Wood Research ÖGH, the Joint Committee on Adhesive Technology GAK, the Hardwood Research Interest Group IGLHF and
- is a cooperation partner for initiatives concerning wood as a resource.

If you have project ideas, are seeking a contact partner or would like to support our work, please do not hesitate to contact us.

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FRAUNHOFER-GESELLSCHAFT

The Fraunhofer-Gesellschaft is the world's leading applied research organization. With its focus on developing key technologies that are vital for the future and enabling the commercial exploitation of this work by business and industry, Fraunhofer plays a central role in the innovation process. Based in Germany, Fraunhofer is an innovator and catalyst for groundbreaking developments and a model of scientific excellence.

By generating inspirational ideas and spearheading sustainable scientific and technological solutions, Fraunhofer provides science and industry with a vital base and helps shape society now and in the future.

At the Fraunhofer-Gesellschaft, interdisciplinary research teams work together with partners from industry and government in order to transform novel ideas into innovative technologies, to coordinate and realize key research projects with a systematic relevance, and to strengthen the German and the European economy with a commitment to creating value that is based on human values. International collaboration with outstanding research partners and companies from around the world brings Fraunhofer into direct contact with the key regions that drive scientific progress and economic development.

Founded in 1949, the Fraunhofer-Gesellschaft currently operates 75 institutes and research institutions. The majority of our 29,000 staff are qualified scientists and engineers who work with an annual research budget of 2.8 billion euros. Of this sum, 2.4 billion euros are generated through contract research. Around two thirds of Fraunhofer's contract research revenue is derived from contracts with industry and publicly funded research projects. The remaining third comes from the German federal and state governments in the form of base funding. This enables the institutes to work on solutions to problems that are likely to become crucial for industry and society within the not-too-distant future.

Applied research also has a knock-on effect that is felt way beyond the direct benefits experienced by the customer: Our institutes boost industry's performance and efficiency, promote the acceptance of new technologies within society and help train the future generation of scientists and engineers that the economy so urgently requires.

Our highly motivated staff, working at the cutting edge of research, are the key factor in our success as a scientific organization. Fraunhofer offers researchers the opportunity for independent, creative and, at the same time, targeted work. We therefore provide our employees with the chance to develop the professional and personal skills that will enable them to take up positions of responsibility at Fraunhofer, at universities, in industry and within society. Students who work on projects at Fraunhofer Institutes have excellent career prospects in industry by virtue of the practical training they enjoy and the early experience they acquire of dealing with contract partners.

The Fraunhofer-Gesellschaft is a recognized non-profit organization that takes its name from Joseph von Fraunhofer (1787–1826), the illustrious Munich researcher, inventor and entrepreneur.

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IMPRINT

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Lignin derivate is spread onto a wood-fiber mat.
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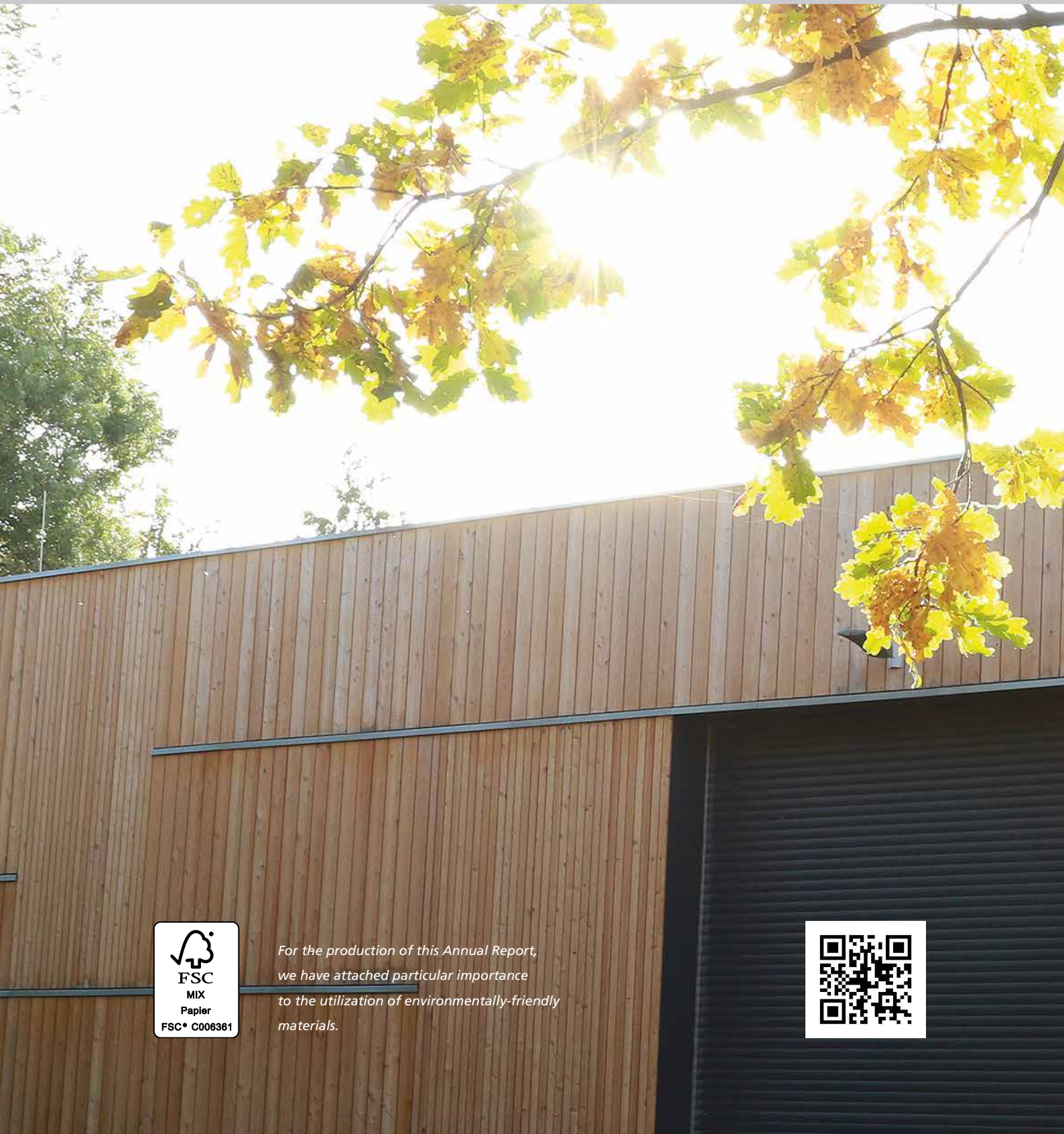
IN THE PURSUIT OF SUSTAINABILITY

SINCE

1946



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For the production of this Annual Report, we have attached particular importance to the utilization of environmentally-friendly materials.